



Improvement of water supply management through a Geographical Information System (GIS) based monitoring and control system for water loss reduction in Grenada

Project Closure Webinar - 16th July 2020
Neil Thurston and Michael Clark - Wood
Sudesh Botha and Keyon Santlal - GISCAD
Ramiro Salinas Revollo - CTCN
Damani Bruno and Whyme Cox - NAWASA



Welcome

Please can you:

- mute your microphone to minimise noise 
- use the raise hand icon if you have a question 

Alternatively please type your question in the meeting chat 

Please can you also type your name, organisation, location, email address and ideally reason/ interest for attending the webinar into the meeting chat.

This will serve as the introduction part of the call.

We will also send out a feedback form to registered attendees after the event.



Improvement of water supply management through a Geographical Information System (GIS) based monitoring and control system for water loss reduction in Grenada

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Webinar Overview

- Safety Moment – Neil Thurston (Wood)
- CTCN Introduction – Ramiro Salinas Revollo
- NAWASA Introduction - Damani Bruno
- Project discussion
 - Data review and GIS system capability development (Neil Thurston - Wood)
 - Mobile data capture (Sudesh/Keyon - GISCAD)
 - Collaboration trip with WASA - Trinidad
 - Creation of the non-revenue water audit for two pilot areas of Grenada (Michael Clark - Wood)
 - Recommendations
- Number of short Q&A slots along the way



Safety Moment



CLIMATE TECHNOLOGY CENTRE & NETWORK



CTCN

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

16 July 2020





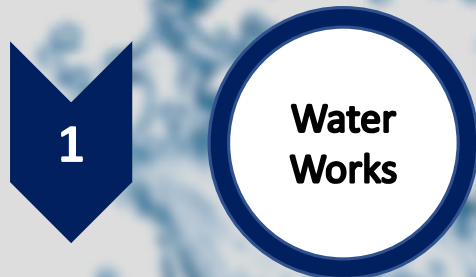
Introduction and Starting point

COMMITTED TO MEETING CUSTOMERS' NEEDS

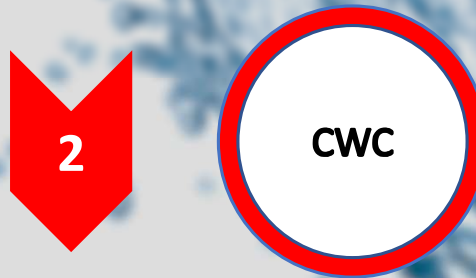


We can't change the direction
of the wind, but we can adjust
the sails

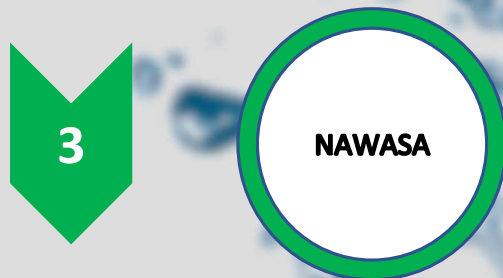
OUR HISTORY...



A unit developed under the Public Works Department within the Government



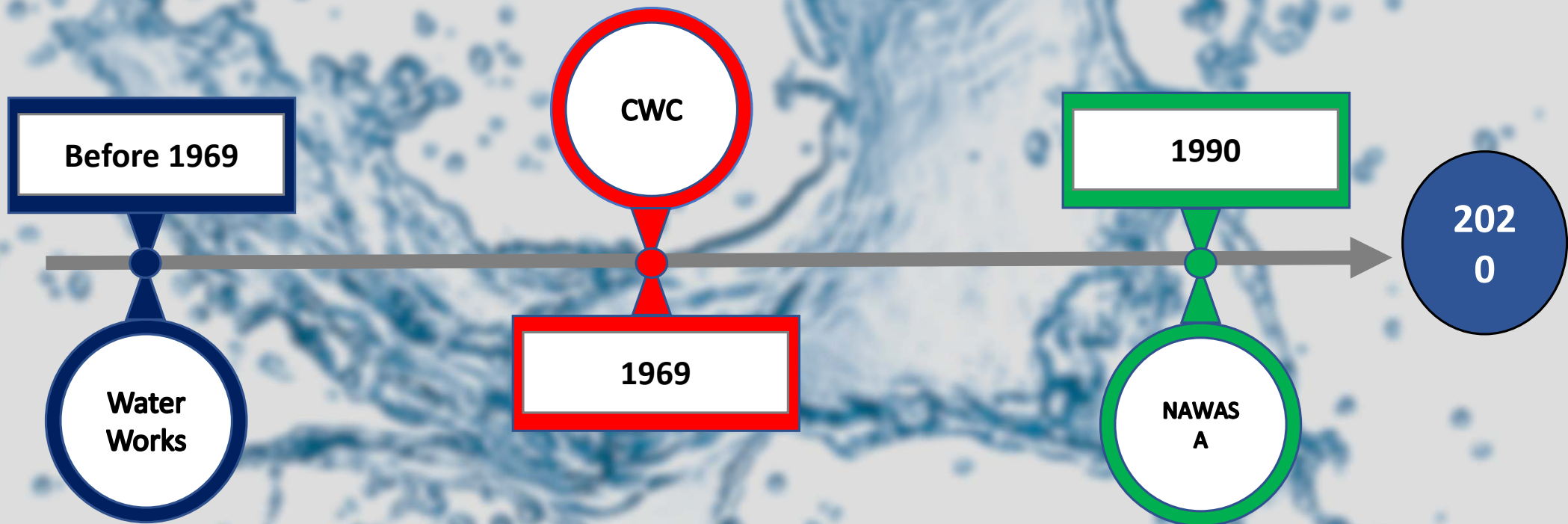
In 1969, Water Works was formalized into the Central Water Commission – Seated within the Ministry of Health



Through an Act of Parliament, The National Water & Sewerage Authority was formed in 1990 with responsibility for the production and distribution of potable water and the collection and disposal of Sewerage



NATIONAL OUR HISTORY...





30 water supply facilities



Over 43,031 customers

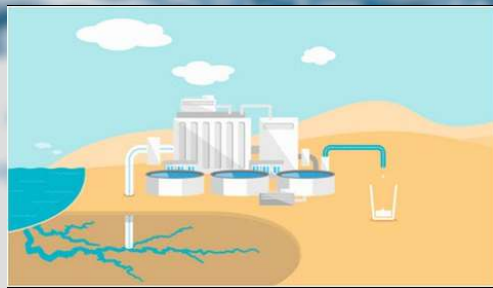
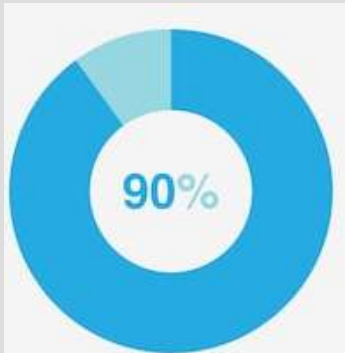
5 million gallons of water produced in Dry season



7 million gallons of water produced in Rainy

NAWASA

Approximately 90% public water supply coverage



Two (2) Desalination plants in Carriacou & Petit Martinique



NATIONAL WATER & SEWERAGE AUTHORITY

Over the past recent years NAWASA has integrated more telemetry devices to enhance the efficiencies of our operations.

- **GPRS data loggers that measure both flow and pressures;**
- **Automated climatic stations and rain gauges;**
- **Smart metering incorporated within DMZs**



Where were we in the context of GIS?

- **Change over from ESRI ARCGIS to QGIS**
- **Majority of the GIS work & processing tasks were done on a single standalone workstation**
- **No formal processes for automated back up of our data**
- **No centralized database for proper management of the data**
- **No data register which records standard metadata detail for the different datasets**



Where were we in the context of GIS?

- Despite all our challenges and lack of resources over 70% of our customer meters, over 60% of our pipe lines are mapped.
- However, they were held in a series of over 200 individual shapefiles.
- Additionally mapped are water supply zones, meter route areas, water storage facilities, boreholes, and infrastructure details including water valves, hydrants etc.



Thank you!

Eng. Damani Bruno

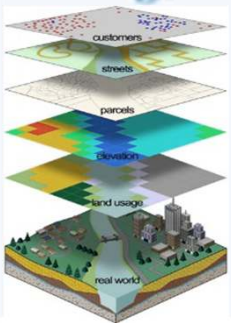
Planning and Development Department

National Water & Sewerage Authority

dbruno@nawasa.gd



INNOVATION IN OUR OPERATIONS AND SERVICE



Q & A



Project Objectives

Undertake a 13-month project to support the operational work of NAWASA by providing a structure for the future assessment of Non-Revenue Water using GIS techniques

Output 1

- CTCN project management documentation

Output 2

- Review the existing digital and Geographical Information Systems (GIS) used to monitor and manage clean water resources
- Develop an implementation plan to enhance the structure and connectivity of digital monitoring systems used by NAWASA
- Build the capacity of NAWASA staff to create and update an enhanced internal GIS system



Project Objectives

Output 3

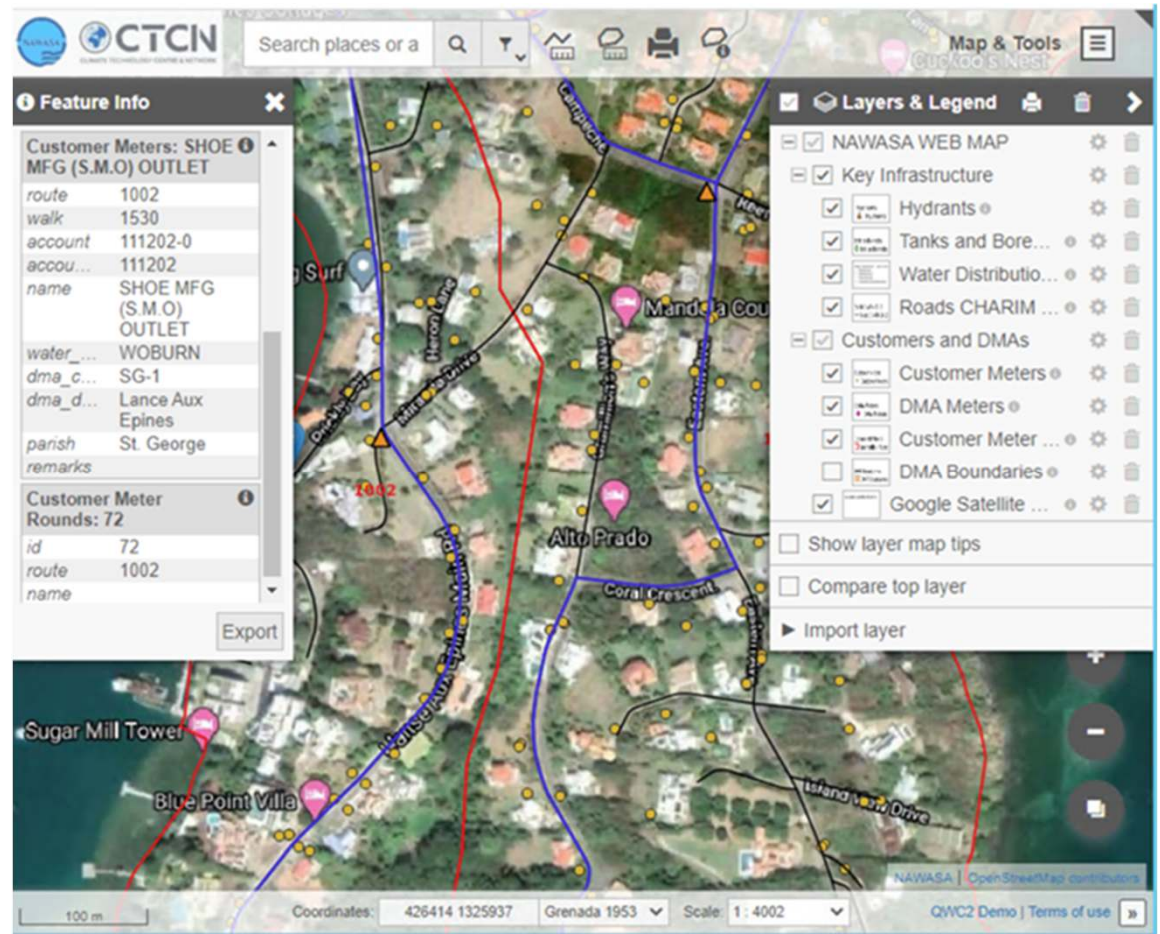
- Undertake a two-day learning visit to a neighboring Caribbean water agency (WASA Trinidad) during autumn of 2019

Output 4

- Pilot the updated structure in two District Metered Areas (DMAs) for identifying Non-Revenue Water

Output 5

- Deliver a final exchange webinar attended by representatives of Caribbean water agencies and wider CTCN network



NAWASA – Project Objectives

Objectives

- Provide structures and tools to aid the future collection, management and use of digital data
- Increase the accessibility and use of digital data in NAWASA's work
- Develop workable solutions which are scalable and not cost prohibitive – ideally free!
- Demonstrate that targeted actions are leading to the reduction of Non-Revenue Water over time

A graphic with a blue background and water bubbles. It features the NAWASA logo in the top corners. The text is centered and reads:

VISION STATEMENT
A premier water utility, providing excellent service to all customers, fostering a healthy and productive nation.

MISSION STATEMENT
To provide customers with a safe, adequate and reliable water supply and safe disposal of waste water, in a viable and efficient manner, that meets and exceeds customer expectations, and ensures the development of our organization, communities and our nation.



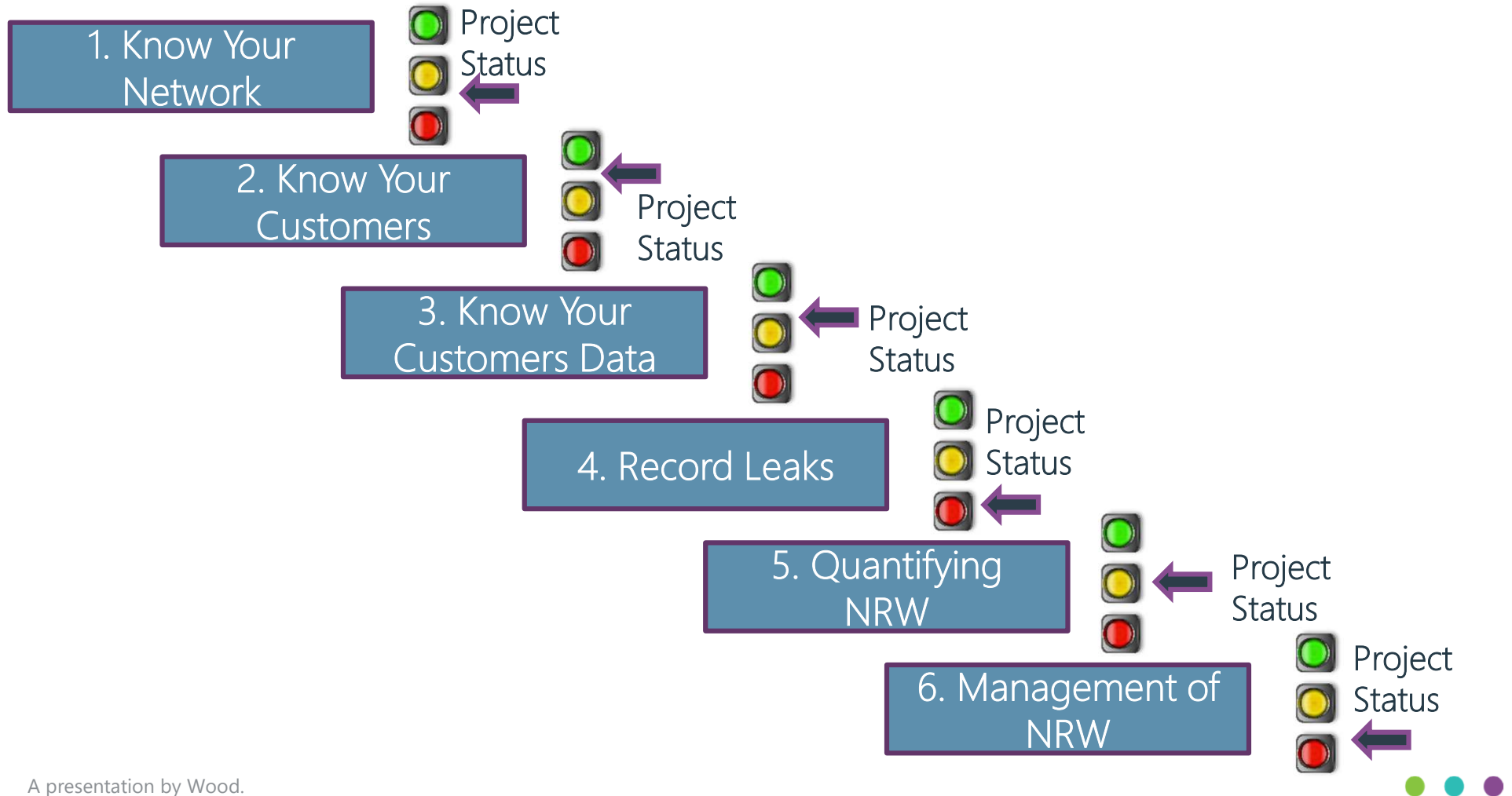
NAWASA – Project Benefits

Benefits

- Reduce the reliance on manual forms and data entry – time savings and enhanced data quality
- Develop a digital record which can be used to help inform and justify investment decisions
- Provide a structured and repeatable method for the future assessment of Non-Revenue Water



Background - Evaluating Non Revenue Water (NRW)



Q & A



Project Approach - Output 2

Activity 2.1 Development of the GIS data model

Activity and progress

- First in-country visit by Wood and GISCAD staff in early May 2019
- Initial meetings and data review – including meetings with NAWASA GIS, IT, finance, customer services (Northstar) teams and Ministry of Agriculture and Planning departments
- Production of data review report – issued to NAWASA/CTCN in second week of May and then revised and reissued as formal deliverable on 5th July 2019 (**Report 2A**)



Report:

Climate Technology Centre & Network (CTCN): National Water and Sewerage Authority, Grenada (NAWASA) – Improvement of water supply management through a GIS based monitoring and control system for water loss reduction in Grenada

Project Output 2: Review of GIS systems and recommendations for future development

Deliverable 2A: Report presenting the evaluation of type and quality of all available spatial data

1. Introduction

The following report updated and issued on the 5th July 2019 was developed by the Wood/GISCAD team as a core deliverable of UNIDO/CTCN project entitled "Improvement of water supply management through a GIS based monitoring and control system for water loss reduction in Grenada". This project was delivered in collaboration with technical staff within the National Water and Sewerage Authority of Grenada (NAWASA).

The scope of the technical note relates to the following objectives of Output 2 of the project:

- Evaluation of the type and quality of all available spatial data.

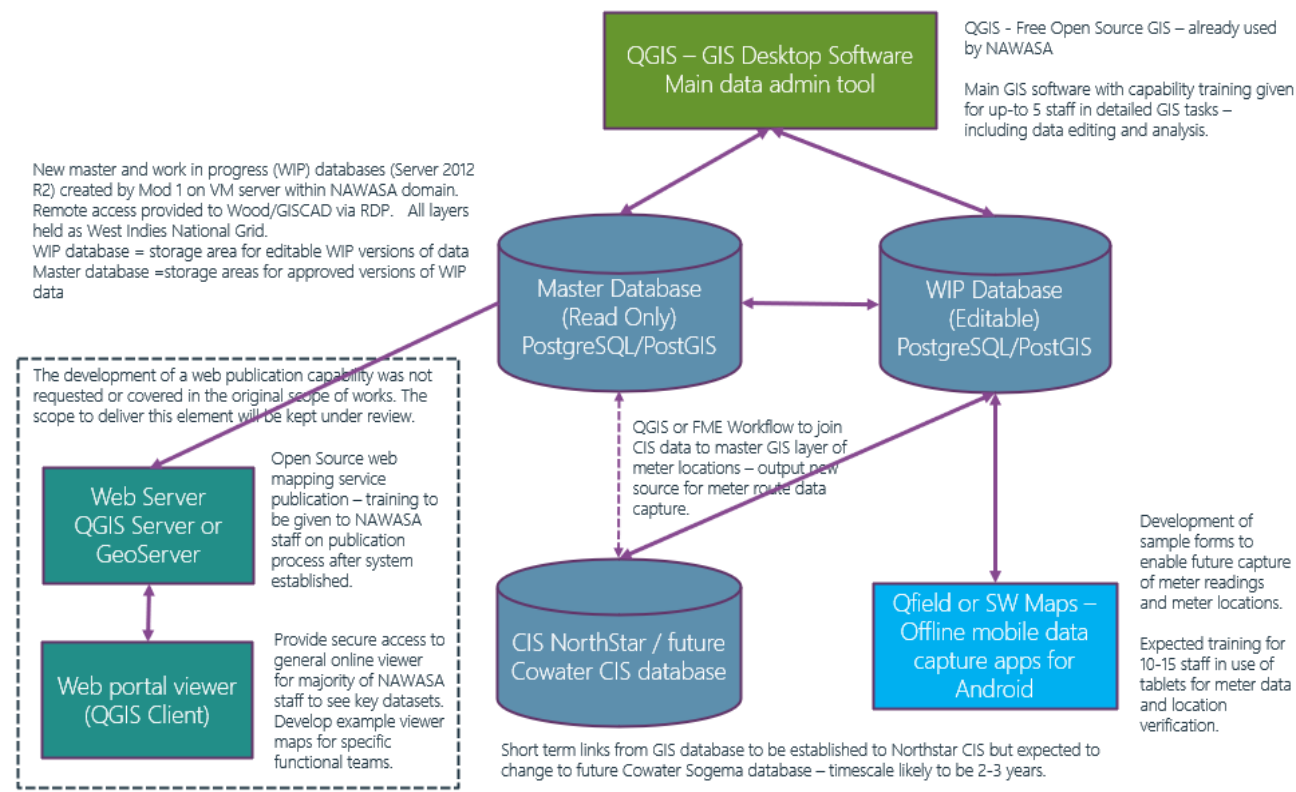


Project Approach - Output 2

Activity 2.1 Development of the GIS data model

Activity and progress

- System recommendations
 - New virtual server for centralised data storage
 - PostgreSQL/PostGIS database for future data management
 - QGIS as main desktop GIS
- Reasons
 - Existing skills with NAWASA
 - Developing use in Grenada and the wider Caribbean
 - Low deployment costs

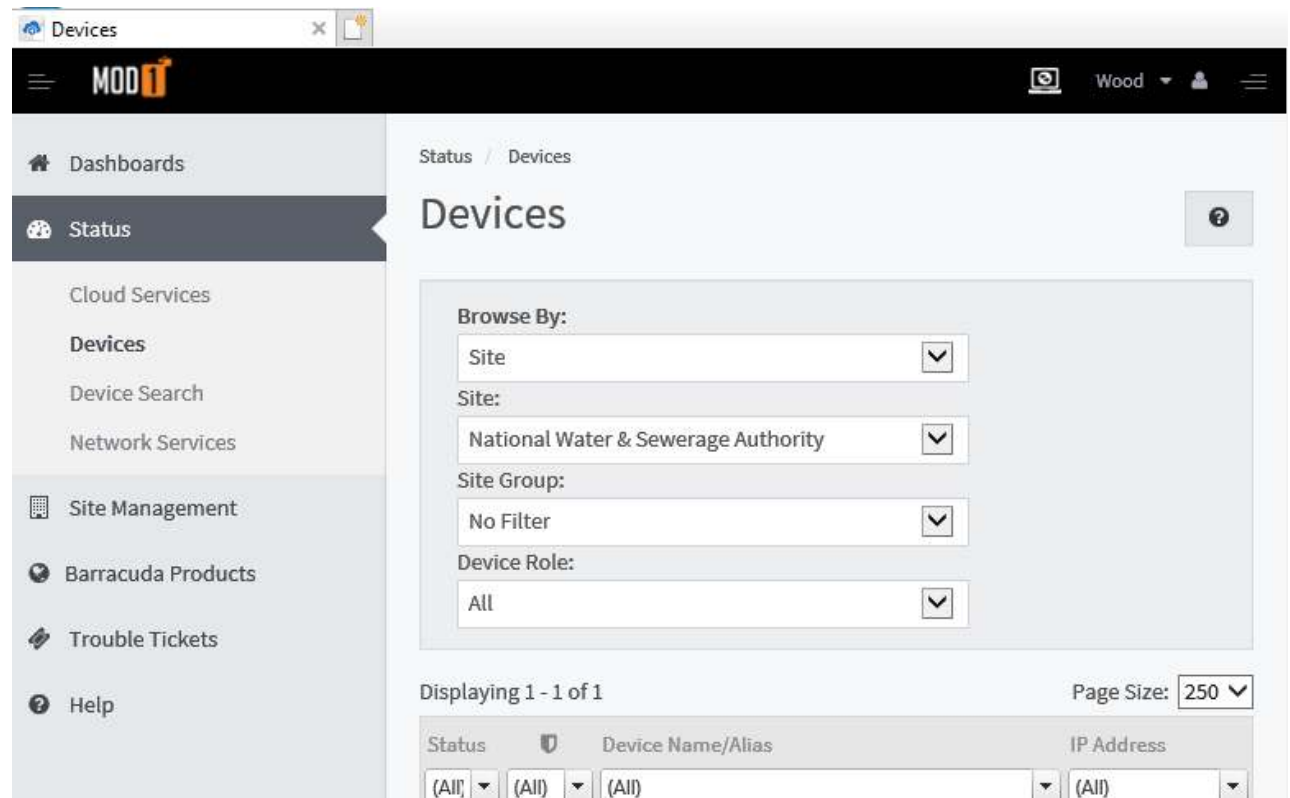


Project Approach - Output 2

Activity 2.1 Development of the GIS data model

Activity and progress

- Creation of new virtual server for the development of centralised open source PostgreSQL/PostGIS database for spatial data
- Project server made available to the project team in June 2019
- Home for the core project database accessible by NAWASA staff

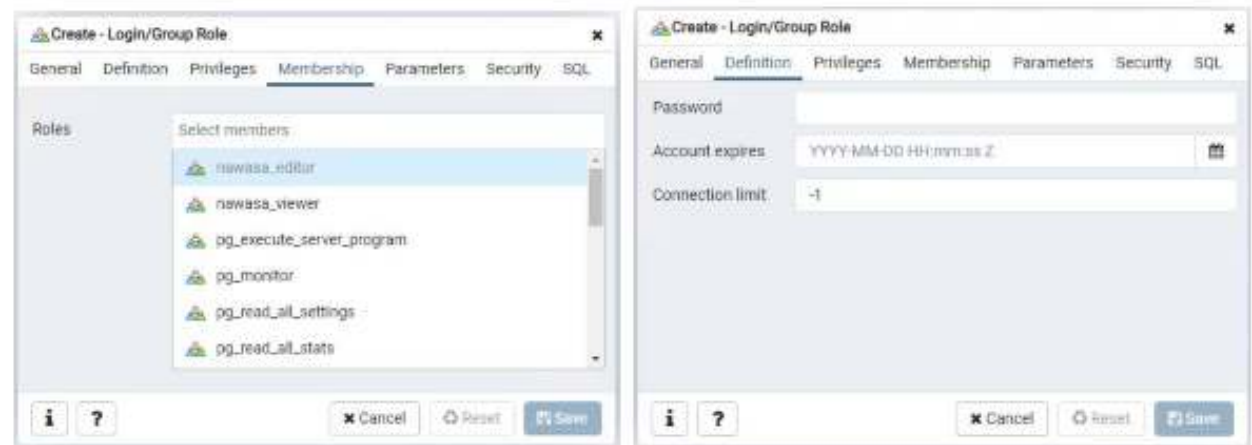
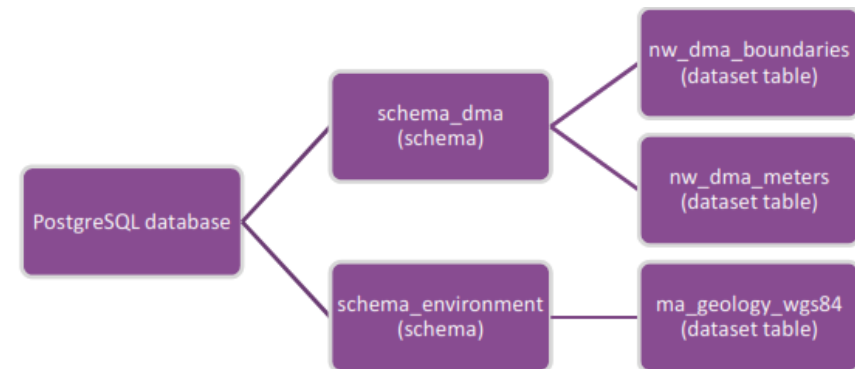


Project Approach - Output 2

Activity 2.1 Development of the GIS data model

Activity and progress

- GIS and database review **report 2B** and GIS data model **report 2C** produced in May/June 2019 - final version issued on 26th July 2019
- Creation of new GIS database during June 2019 structure on the new NAWASA server
- Structure includes database schemas, user groups and roles to determine access level and capability

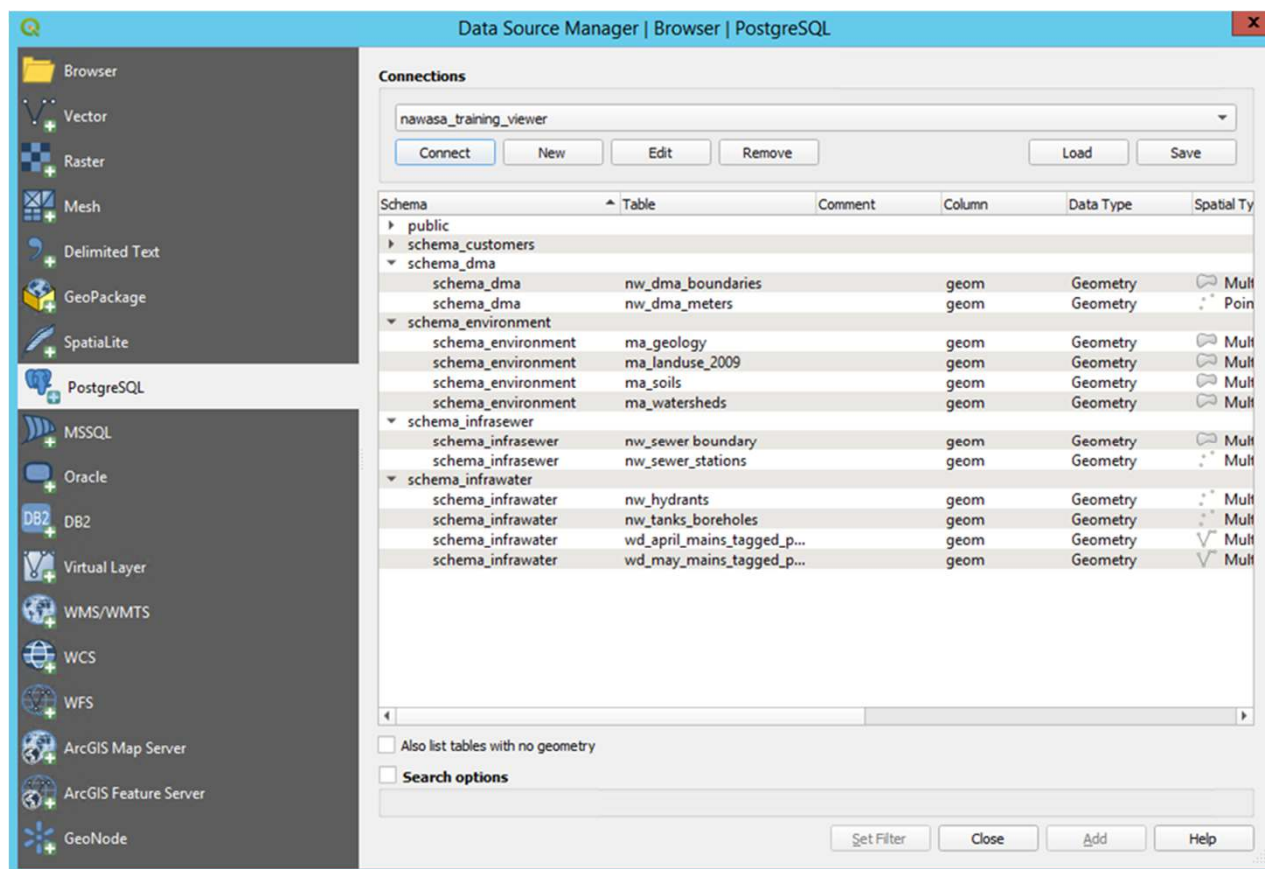


Project Approach - Output 2

Activity 2.1 Development of the GIS data model

Activity and progress

- Existing NAWASA data layers loaded to database in June and July 2019
- Training on structure provided to NAWASA staff during in-country visit by Wood and GISCAD staff in September 2019
- Additional layers added during 2019 and refresh training undertaken March 2020

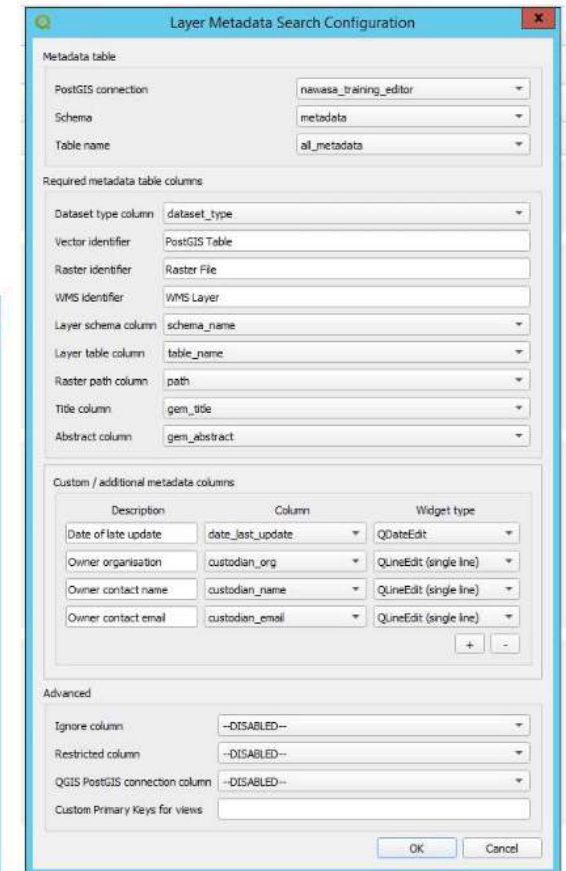
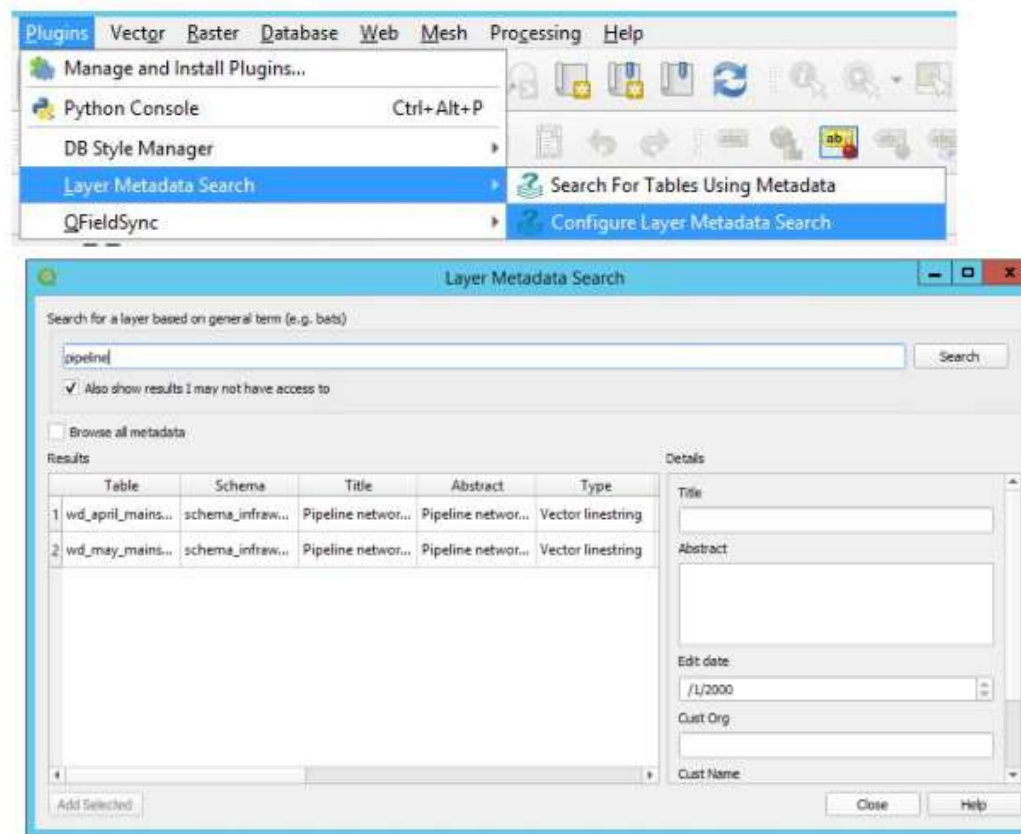


Project Approach - Output 2

Activity 2.1 Development of the GIS data model

Activity and progress

- Creation of additional metadata table
- Use of QGIS plugin to allow users to search for data and add to QGIS projects

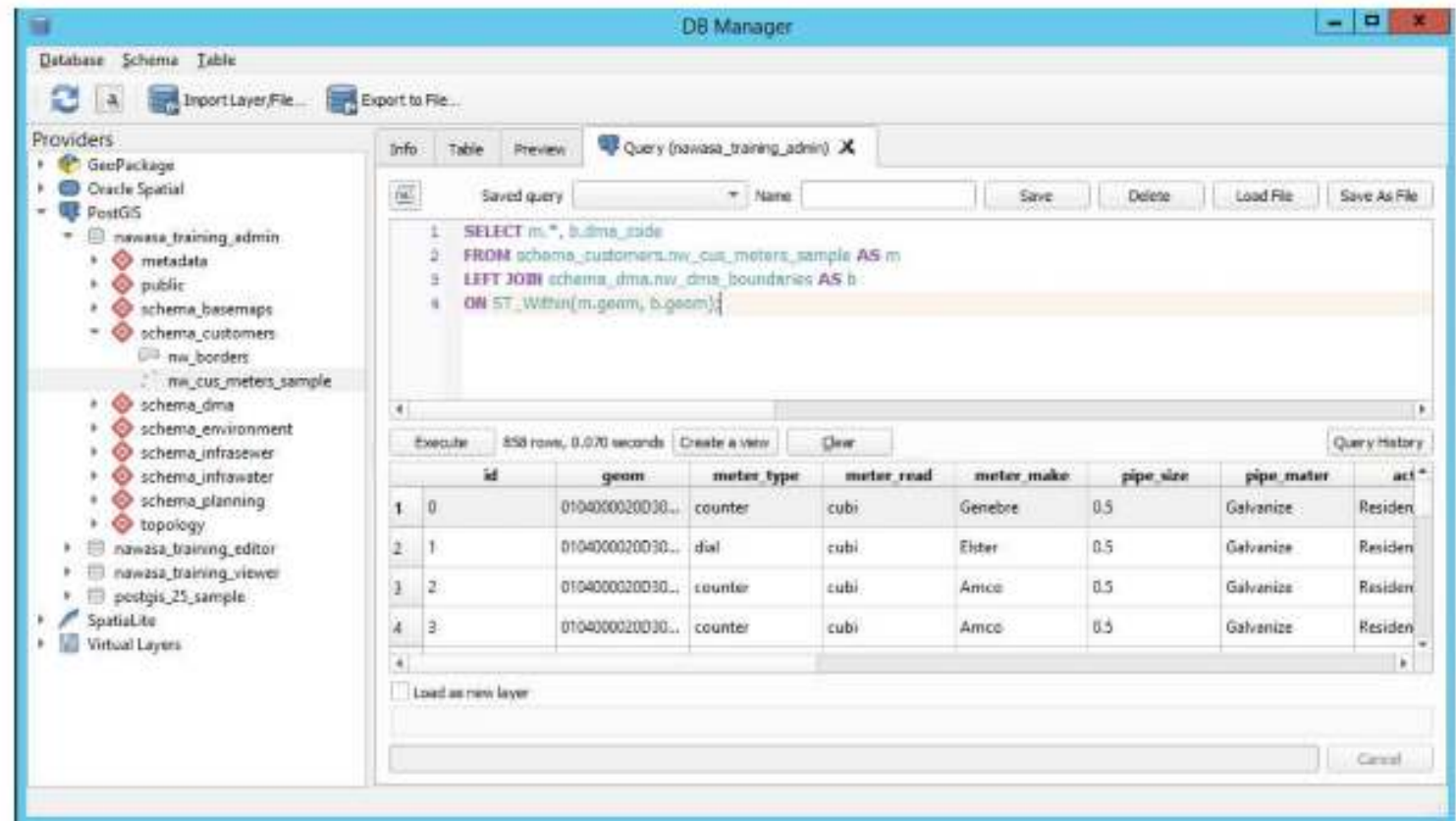


Project Approach - Output 2

Activity 2.1 Development of the GIS data model

Activity and progress

- Access to test version of Northstar Customer database provided to Wood in June 2019
- Information used to develop data interface and exchange report (**Report 2D**) - July 2019

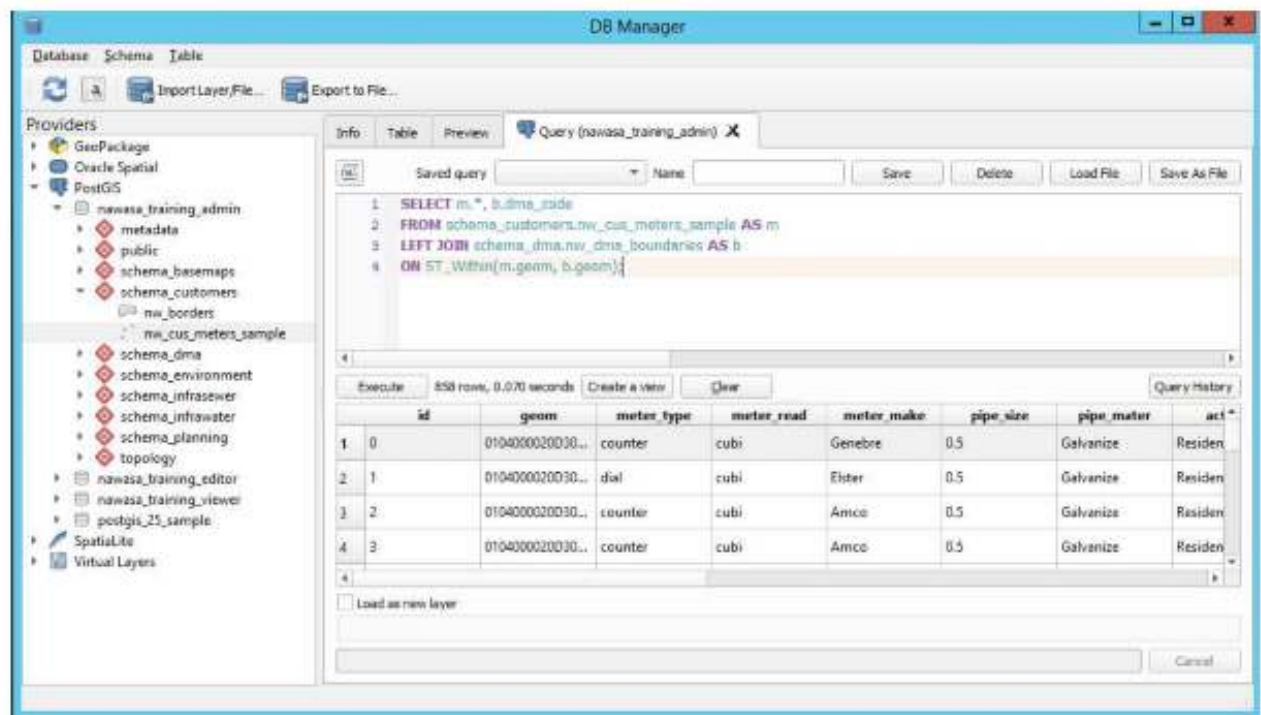


Project Approach - Output 2

Activity 2.1 Development of the GIS data model

Activity and progress

- New database created to provide secure access to a copy of the live Northstar account, meter and meter history data - September 2019.
- Database refreshed with duplicated Northstar data in January 2020 – used for Output 4 – Non Revenue Water data analysis



Q & A



Project Approach - Output 2

Activity 2.2 Review of data management procedures

Activity and progress

- Draft version of **Report 2E** produced at the end of August 2019
 - procedures for data sharing and storage; data capture workflows; and standards for customer identification in the GIS database
 - Key aim – remove handwritten and duplication of effort
- **Report 2F** - Job requirements description produced at the end of July 2019



Project Approach - Output 2

Activity 2.2 Review of data management procedures

Activity and progress

- Additional form development and fieldwork undertaken in late September/early October
- Updated report 2E produced in October 2019
- Additional work in March 2020 – focused on the capture of new meters and distribution leakage locations

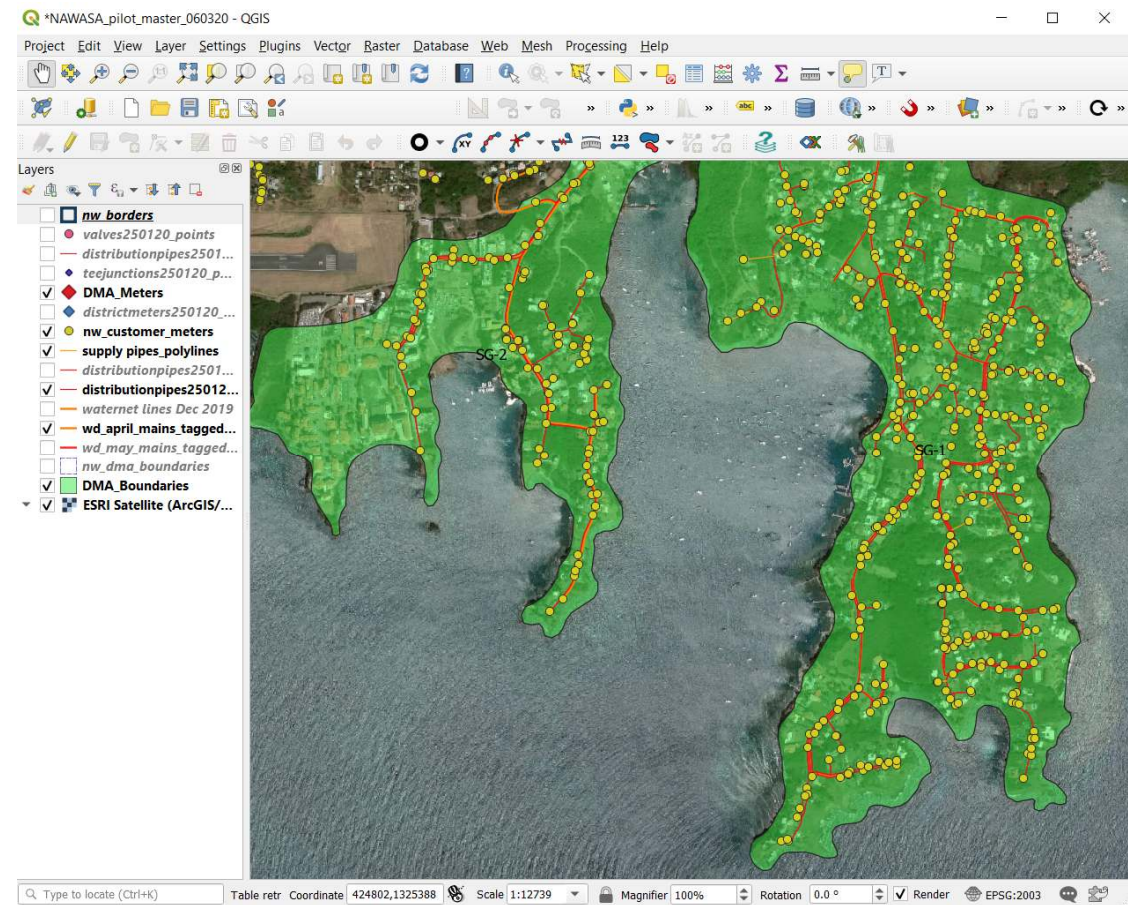


Project Approach - Output 2

Activity 2.3 Update the GIS

Activity and progress

- Activities included additional training on the collection and management of GIS data - using Qfield and SW Maps apps
- New processes used by NAWASA staff to create detailed pipeline distribution network across SG1 & SG2 in late 2019
- New data used in Output 4 - NRW assessment from January 2020





GIS Technician using older hardware and software



Meter Attributes captured were done using GPS handheld giving just coordinate output



Paper based forms were used to compile all other Meter information to create the GIS database

IN THE INITIAL
DESKTOP AND
FIELD ASSESSMENT
OF THE DATA
CAPTURE
PROCEDURES AND
METHODOLOGY
THE FOLLOWING
WAS OBSERVED

DESIGN AND DEVELOPMENT OF DIGITAL DATA-CAPTURE SOLUTION

✓ **MULTIPLE CONSULTATIONS WITH IN-OFFICE STAFF AND SENIOR MANAGEMENT – THIS EXERCISE WAS REQUIRED TO:**

- i. DEFINE THE WORKFLOWS AND INTER-DEPARTMENTAL DATA SHARING AND SUPPORT REQUIRED BY THE ORGANISATION
- ii. CREATE A DATA-CAPTURE SOLUTION THAT COULD BE EXPANDED TO ACCOMMODATE THE GROWING DATA NEEDS OF THE ORGANISATION FOR MONITORING AND CONTROL
- iii. ASSIST IN THE DETERMINATION OF THE DATA-PLATFORM CHOSE FOR SOLUTION BUILD OUT

✓ **FIELD VISITS TO THE METER CREW ON LOCATION – THIS EXERCISE WAS REQUIRED TO :**

- i. ASSESS THE FIELD PROCEDURES AND GET FEEDBACK ON THE USE OF THE PAPER-BASED FORMS THAT WERE PRESENTLY USED.
- ii. ASSIST IN THE DETERMINATION OF THE DATA-CAPTURE PLATFORM CHOSEN FOR SOLUTION BUILD OUT
- iii. DETERMINE THE LEVEL OF CAPABILITY OF THE FIELD CREWS FOR DIGITAL DATA CAPTURE
- iv. GAIN AN APPRECIATION FOR THE ADDITIONAL REQUIREMENTS REQUIRED FOR THE CURRENT PAPER-BASED FORMS

OTHER CONSIDERATIONS INCLUDED RECURRENT COST, EASE OF CUSTOMIZATION, SIMPLICITY AND SUPPORT



BASED ON THESE EVALUATIONS AND CONSULTATIONS, THE OPEN SOURCE GIS (QGIS/QFIELD) PLATFORM WAS ADOPTED AS OPPOSED TO SIMILAR COMMERCIAL GIS APPLICATIONS AVAILABLE

MOVING TO A DIGITAL DATA CAPTURE PLATFORM

*APPLICATIONS OF QFIELD
TO EXISTING
WORKFLOWS AND
ADDITIONAL QUICK
WINS...*



Data Capture can now be done by the GIS Department and the Field Teams to accurately record data into one platform



Any damages, interference and issues can be directly logged into the application by the meter crew for investigation.



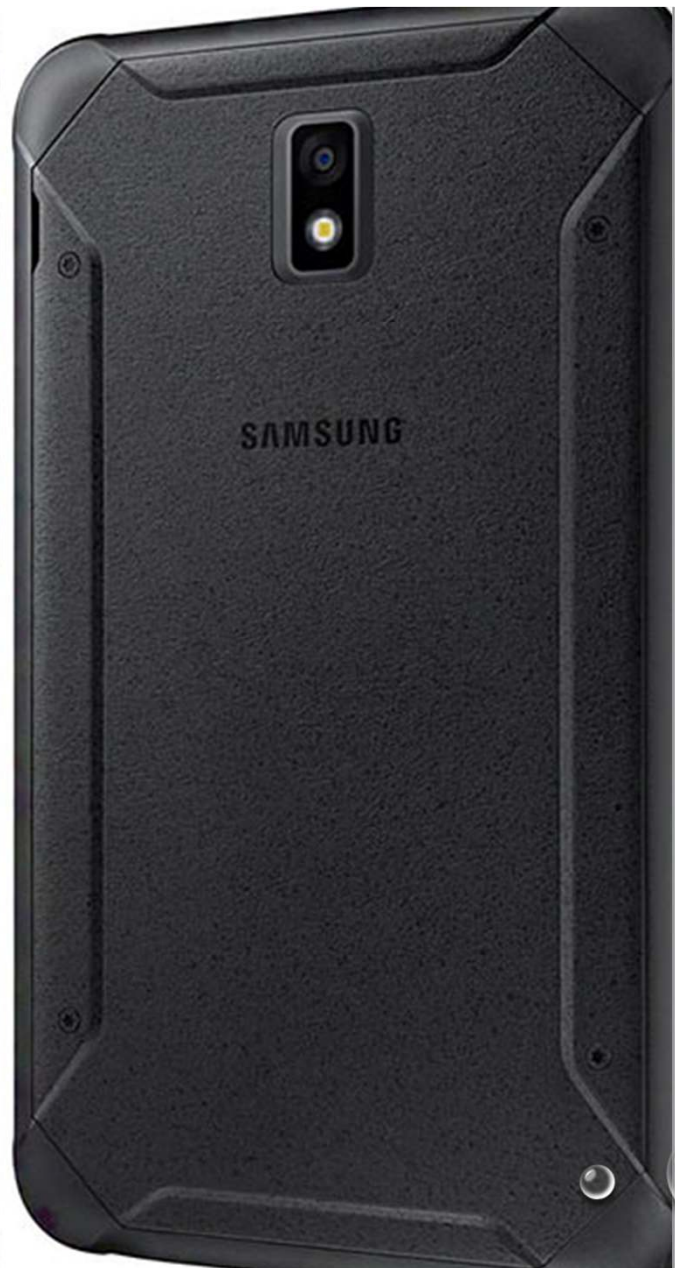
With the collected data leak detection crews can now accurately locate meters where leaks were reported, make the necessary hardware changes and update the customer's account with the new meter number.



Adaptation of Paper based forms allows for seamless integration of data captured in the field to be added to the GIS.



Materials used at each job will be digitally recorded to be transferred to the stores department to ensure proper inventory management



QFIELD CAPTURE

- PROPOSED SAMSUNG GALAXY ACTIVE TAB2

THE SAMSUNG GALAXY ACTIVE TAB2 IS A RUGGED TABLET WITH AN IP67 RATING FOR FIELD WORK.

SOFTWARE QFIELD V1.5.3

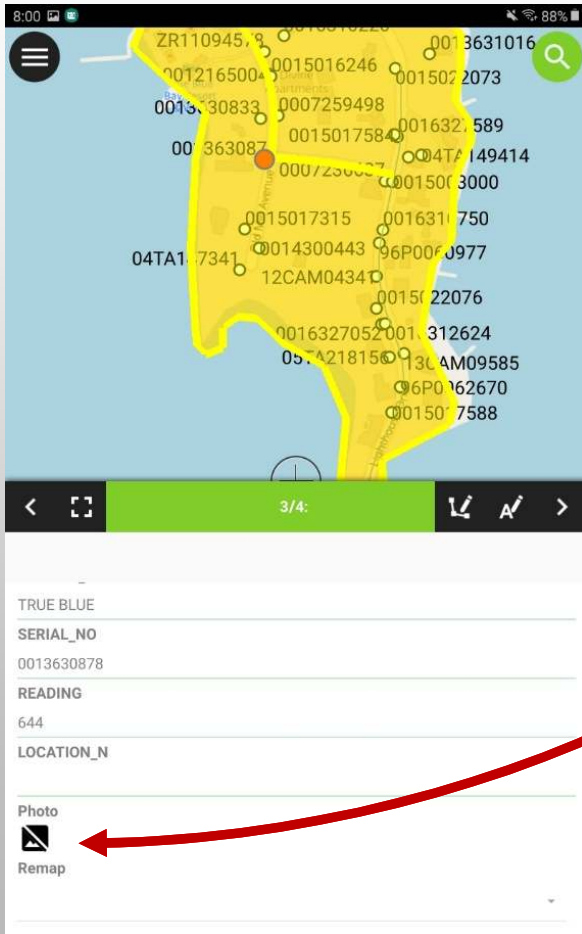


FORMS WERE CREATED FOR...

METER READERS

METER READERS WILL HAVE THE ABILITY TO

- UPDATE METER READINGS INTO THE APPLICATION.
- ADD ANY NEW METERS NOT YET CAPTURED DIRECTLY INTO THE APPLICATION.
- UPDATE METER LOCATIONS IF CHANGED.
- REPORT ANY METERING ISSUES ENCOUNTERED IN THE FIELD



FORMS WERE
CREATED FOR...

METER READERS WILL
ALSO HAVE THE ABILITY TO
ATTACH AN IMAGE TO THE
RECORDED ISSUE WHICH
WOULD BE PASSED ON TO THE
RELEVANT DEPARTMENT FOR
INVESTIGATION.

1021-0 144762-0 128955-0 102734-0
 117299-0 102963-0 101816-0 133363-0
 101050-0 138747-0 102014-0 146518-0
 115703-0 102441-0 140204-0 146518-0
 138205-0 33003-0 149053-0 101777-0
 132883-0 101254-0 102633-0 139084-0
 115613-0 100568-0 144749-0 131
 101327-0 100123-0 116344-0
 131606-0 131604-0 101181-0 101831-0
 39038-0 100066-0 102013-0 101537-0
 133126-0 102238-0 14061
 132867-0 120555-0
 128020-0 13

146346-0

✓ 1/1: ✕

Serial number
 13CAM30008727

Old/Existing Meter ID
 13CAM08727

New Meter ID

Action Taken
 IV- Install Valve

Cause
 LV- Leaking Valve

Remarks/Old Meter ID

1021-0 144762-0 128955-0 102734-0
 117299-0 102963-0 101816-0 133363-0
 101050-0 138747-0 102014-0 146518-0
 115703-0 102441-0 140204-0 146518-0
 138205-0 33003-0 149053-0 101777-0
 132883-0 101254-0 102633-0 139084-0
 115613-0 100568-0 144749-0 131
 101327-0 100123-0 116344-0
 131606-0 131604-0 101181-0 101831-0
 39038-0 100066-0 102013-0 101537-0
 133126-0 102238-0 14061
 132867-0 120555-0
 128020-0 13

146346-0

< 1/1: >

Service Work Order

Route
 3024

Name
 NORJAH.M SANDY

Account
 146346-0

Phone Number
 473-410-4693

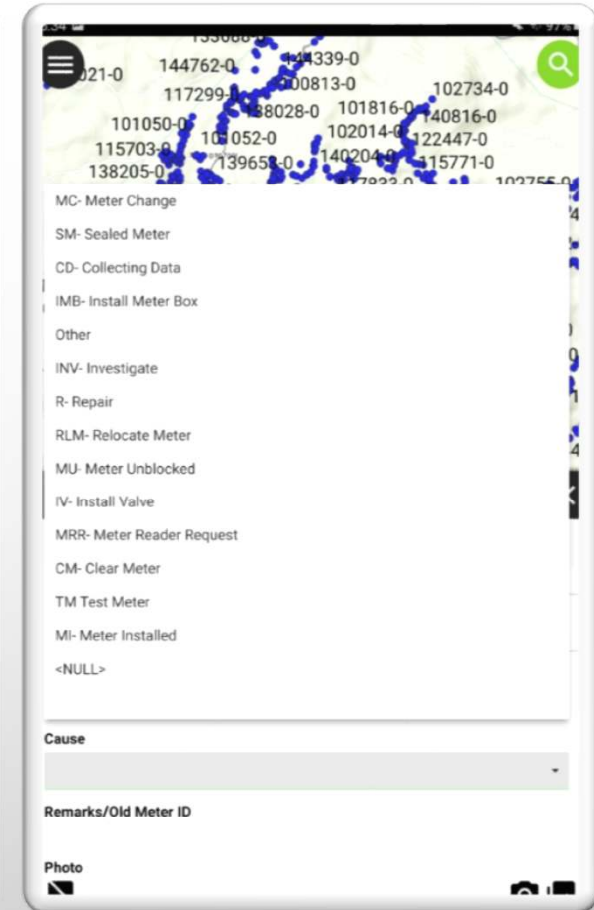
SERVICE LO
 IPPER CAPITOL

FORMS WERE
 CREATED
 FOR...

LEAK DETECTION CREWS

LEAK DETECTION CREWS

- ALL PAPER-BASED FORMS USED BY THE LEAK DETECTION CREW WAS DIGITIZED TO BE USED IN QFIELD
- TEAMS CAN NOW RECEIVE AND COMPLETE THEIR WORK ORDER USING QFIELD. RECORDING THE ACTION TAKEN AND THE CAUSE OF THE LEAK



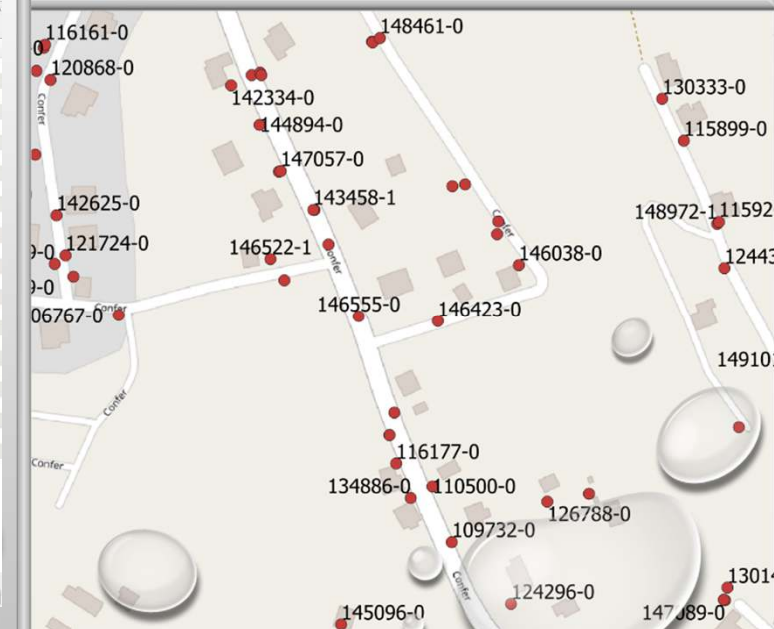
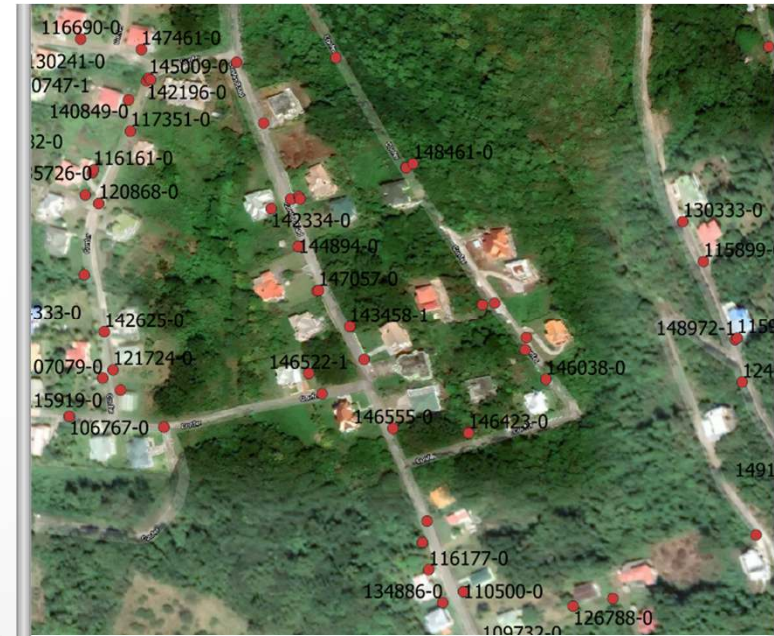
MATERIALS USED

- MATERIALS USED AT THE JOB CAN ALSO BE RECORDED WITHIN THE APPLICATION. THIS INFORMATION CAN THEN BE PASSED TO THE STORES DEPARTMENT FOR INVENTORY MANAGEMENT. AS WELL AS ASSIST OTHER DEPARTMENTS WITH A NEED TO ACCESS THIS DATA.

Meter
PVC Reducer
Thread Seal
Plug
Cap
Galv. Tee
Galv. Elbow
PVC Elbow
M.S. Cock
Connector
Union
Coupling
PVC Cement
PVC Celaner
Meter Seals
H/saw Blades
PVC Collar
Galv. Collar
Curb Stop
Washer
Galv. Pipe
PVC Pipe
Male Adaptor
Nipple
Galv. Reducer

FIELD TO OFFICE

- DATA COLLECTED CAN NOW BE SENT TO THE GIS TECHNICIAN TO UPDATE THE MAIN DATABASE



The screenshot displays a GIS application interface. On the left, the 'Layers' panel shows a list of layers including 'Meters_customers_all', 'borders', and 'OpenStreetMap'. The 'Meters_customers_all' layer is active, showing red circular markers on a map. The 'Identify Results' window on the right displays a table of data for a selected feature.



Feature	Value
Meters_customers_all	
NAME	MOUNT HARTMAN ESTATE LIMITED
NAME	JOHN E ALBANIE
NAME	ANTHONY & SU POTTER
NAME	ROH LTD
(Derived)	
(Actions)	
METER_TYPE	counter
METER_READ	cubi
METER_MAKE	Elster
PIPE_SIZE	0.50000
PIPE_MATER	Galvanize
ACTIVITY	Residential
METER_NO	0018000073
REMARKS	1000
WALK	780
ACCOUNT	116418-0
NAME	ROH LTD
SERVICE_IO	LANCE AUX EPINES
SERIAL_NO	0018000073
READING	339
LOCATION_N	
Photo	DCIM/20191001201619804.jpg
NAME	MUHAMMAD AHSAN UL-HAQ
NAME	MARTIN'S PROPERTY LTD
NAME	

Project Approach - Output 2

Activity 2.3 Update the GIS

Activity and progress

- NAWASA data catalogue and metadata information (**Deliverable 2G** produced in October 2019) which documented:
 - Metadata for the key QGIS data layers
 - Details of the QGIS Layer metadata tool used to search and access the data in QGIS
 - Details of sample SQL queries used for selected tables
 - Details of additional data used in the project

	
	
Technical note: UNIDO/CTCN: NAWASA Grenada Improvement of water supply management through a GIS based monitoring and control system for water loss reduction in Grenada	
Project Output 2: Review of GIS systems and recommendations for future development	
Deliverable 2G: NAWASA data catalogue and metadata information	
The following Excel workbook (issued on the 6 th December) was developed by the Wood/GISCAD team as a core deliverable of UNIDO/CTCN project entitled "Improvement of water supply management through a GIS based monitoring and control system for water loss reduction in Grenada". This project was delivered in collaboration with technical staff within the National Water and Sewerage Authority of Grenada (NAWASA).	
The information contain in the workbook relates to the following objectives of Output 2 of the project:	
<ul style="list-style-type: none"> • Excel document with a description of all available data • Excel document listing missing information and related data collection 	
The workbook includes the following information:	
QGIS/PostGIS - Metadata for the key QGIS data layers held in the master PostgreSQL/PostGIS database	Worksheet
QGIS/PostGIS - Description of fields used in QGIS metadata	QGIS spatial metadata
QGIS/PostGIS - Details of the QGIS Layer Metadata Search Plugin used to manage metadata in QGIS	QGIS metadata fields
QGIS/PostGIS - Configuration details for the QGIS Layer Metadata Search Plugin	QGIS Layer Metadata Search Plugin
QGIS/PostGIS - Viewing metadata in the PgAdmin management interface for PostgreSQL	QGIS Plugin Config
MS SQL Server - Metadata for additional SQL Server tables and queries	QGIS pgAdmin
MS SQL Server - SQL code used to create selected tables	MS SQL Server Tables
Additional data sources - identified but not loaded to main NAWASA GIS system	MS SQL Server SQL Codes
Data capture priorities	Additional data sources Data capture priorities

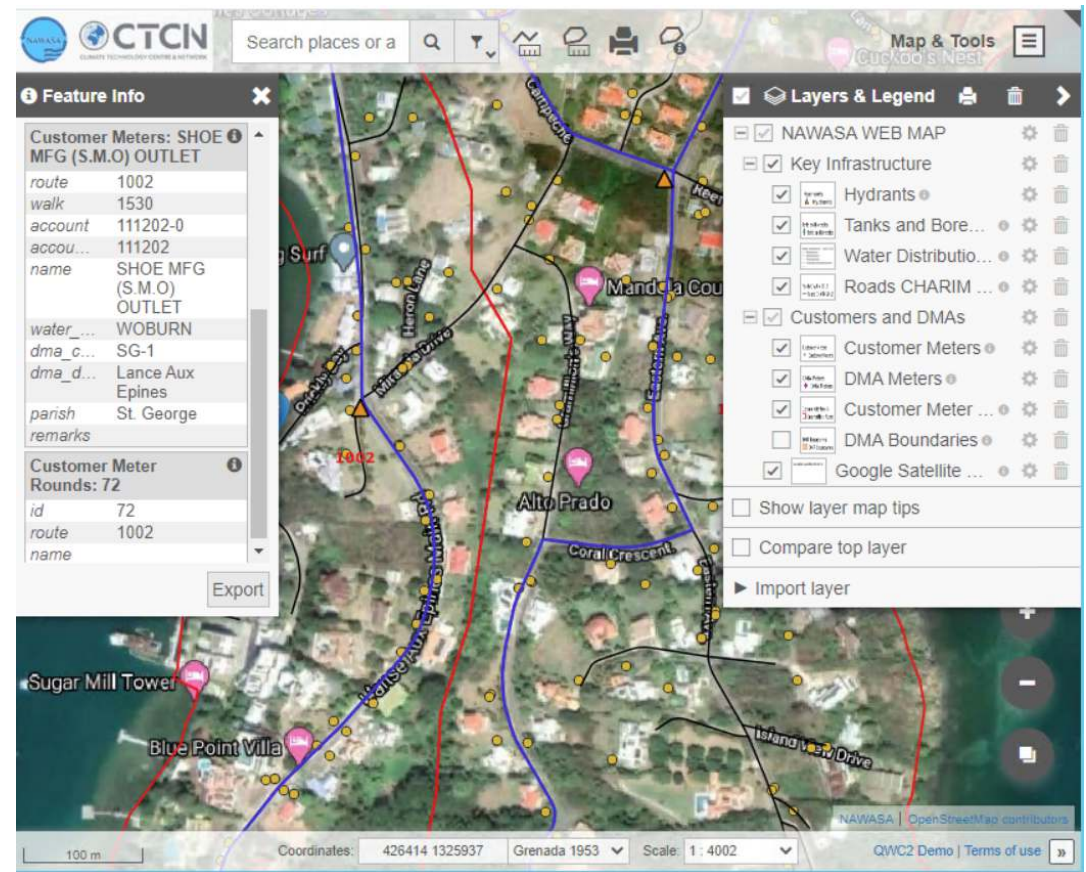


Project Approach - Output 2

Web mapping portal – Additional work beyond original scope

Activity and progress

- Creation of web mapping portal using XAMPP web mapping stack (including Apache Web server), QGIS server and the QWC2 web mapping client
- Manual configuration of components on project server
- Provide facility to publish QGIS mapping content stored in PostgreSQL as Web mapping services
- Initial site developed for potential development in the future



Q & A



Project Approach - Output 3

Activity 3.1 South-South Learning mission

- Three day visit to WASA Trinidad in early October 2019 – attended by two representatives of NAWASA and members of the Wood/GISCAD project team.
- Exchange of information regarding approaches to NRW assessment and contacts for future collaboration
- Mission report (**Report 3A**) produced by end of October 2019



Project Approach - Output 3

Activity 3.1 South-South Learning mission

- GIS capability within WASA started in 1990s
- Current system includes a wide range of geospatial datasets covering Trinidad
- Development of internal ESRI Portal web mapping system 2017-2019
- Provides WASA users access to comprehensive data for the organisation
- Requires continued investment in software licensing and staffing



Q & A



Project Approach - Output 4

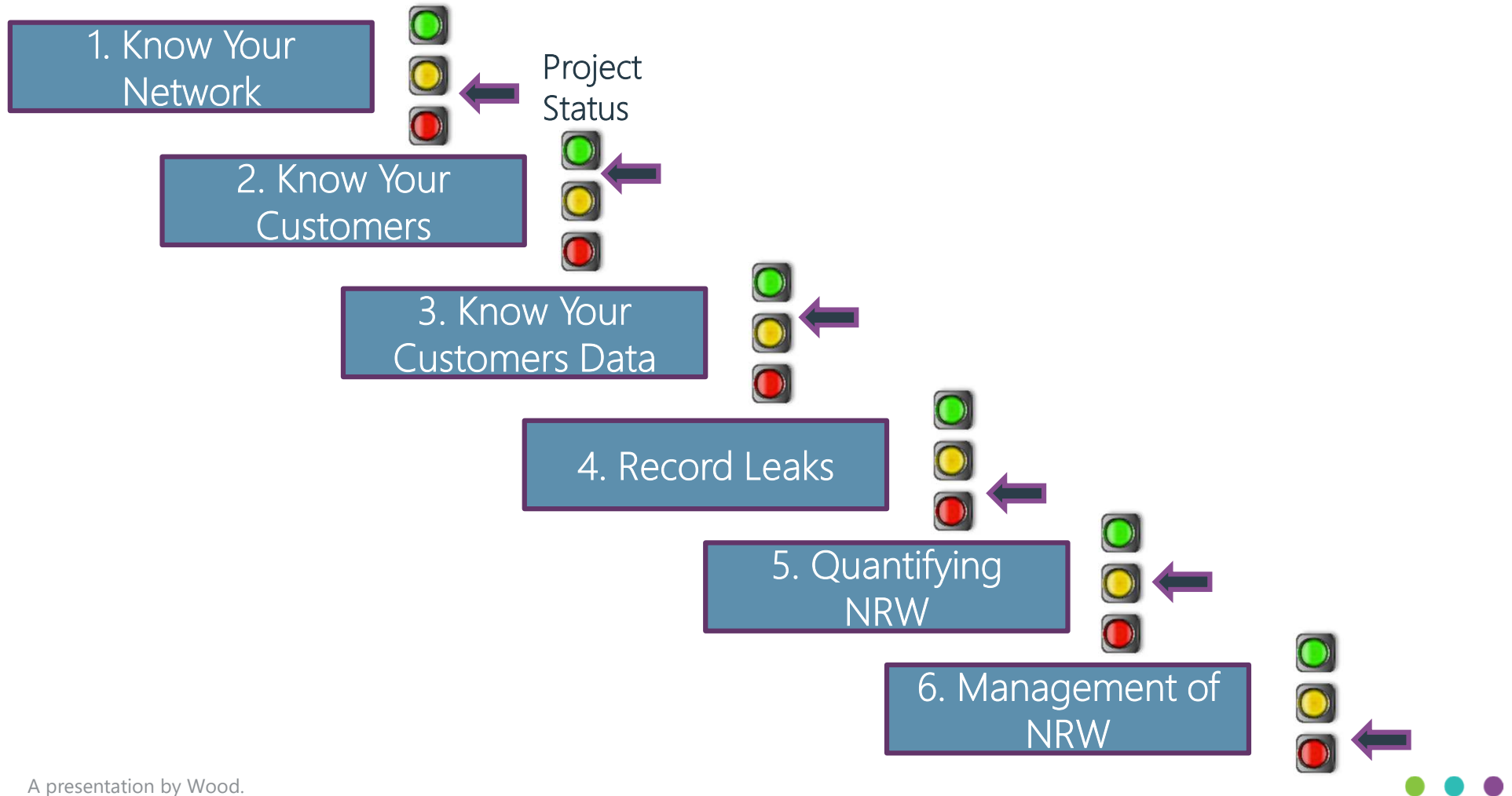
Activity 4.1 Evaluation of Non Revenue Water in the two pilot DMAs

Deliverable

- Spreadsheet based water audit for :
 - Pilot areas (SG1 and SG2)
 - Grenada (whole island)
- Report providing details of input, process and recommendations for future actions
- Inputs in process include:
 - Water production and DMA meter data
 - Northstar billing system data
 - GIS spatial mapping of customer locations (meters) and pipelines
 - Estimates for unknown elements – e.g. level of unauthorised consumption



Project Approach – Output 4



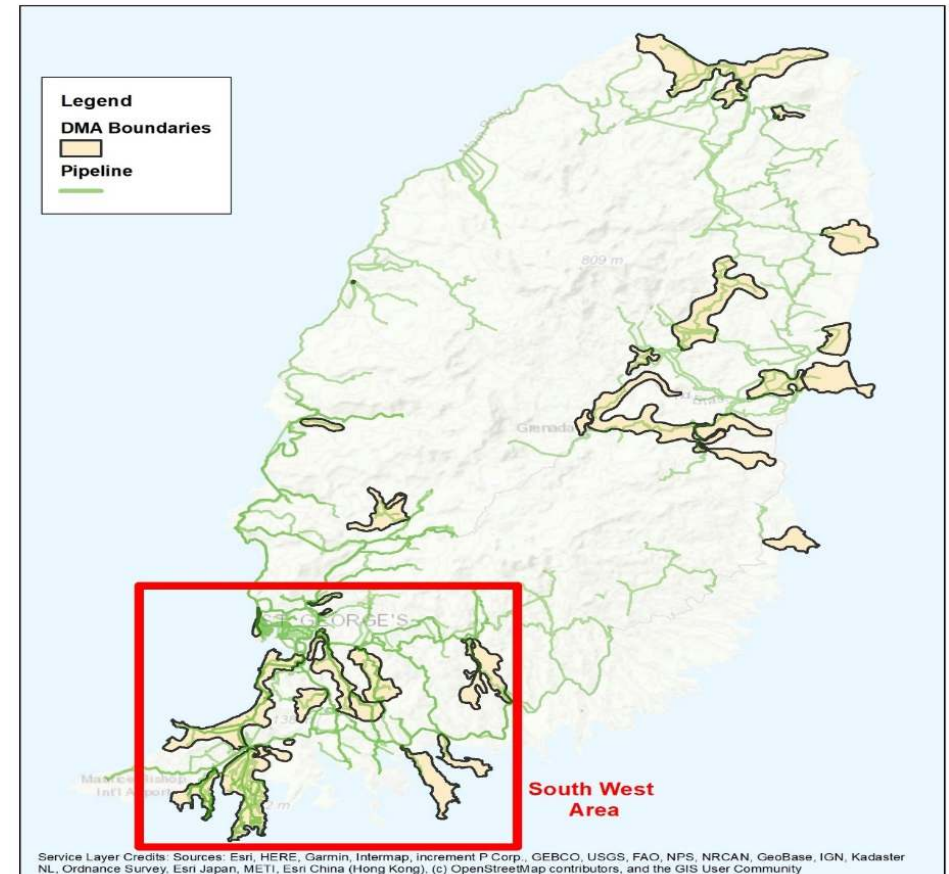
Project Approach - Output 4

Activity 4.1 Evaluation of Non Revenue Water in the two pilot DMAs

Stage 1 – Know your network

Project initiation:

- 36 notional DMA's within GIS
- Covering approx. 21% of customers
- 100's of miles of mains missing on GIS
- Some of the 29 production plants missing on GIS

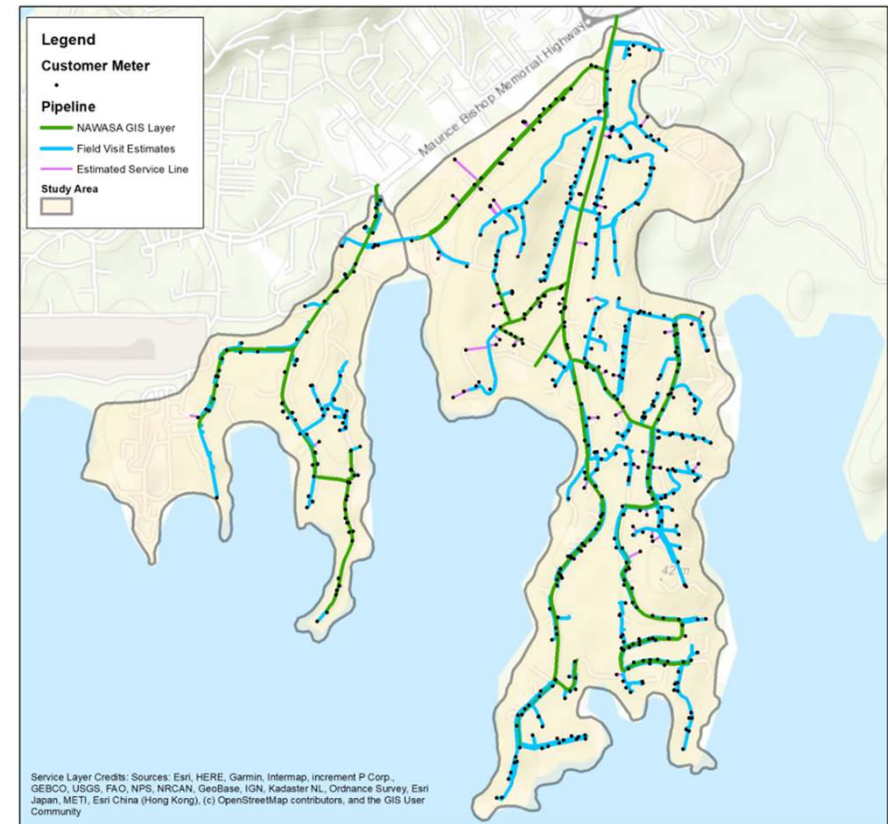


Project Approach - Output 4

Activity 4.1 Evaluation of Non Revenue Water in the two pilot DMAs

Stage 1 – Know your network

- Wood review of the pipeline datasets in May/June 2019
- Initial refinement of network data focused on DMA area SG-1 (Lance aux Epines) and SG-2 (True Blue)
- **Training in data collection apps in Sept/October with Wood / GISCAD team**
- **Detailed remapping of pipeline distribution network for SG1 and SG2 by Damani and Annel in Oct/Dec 2019**
- **Recorded network length increased by a by factor of 2.3**

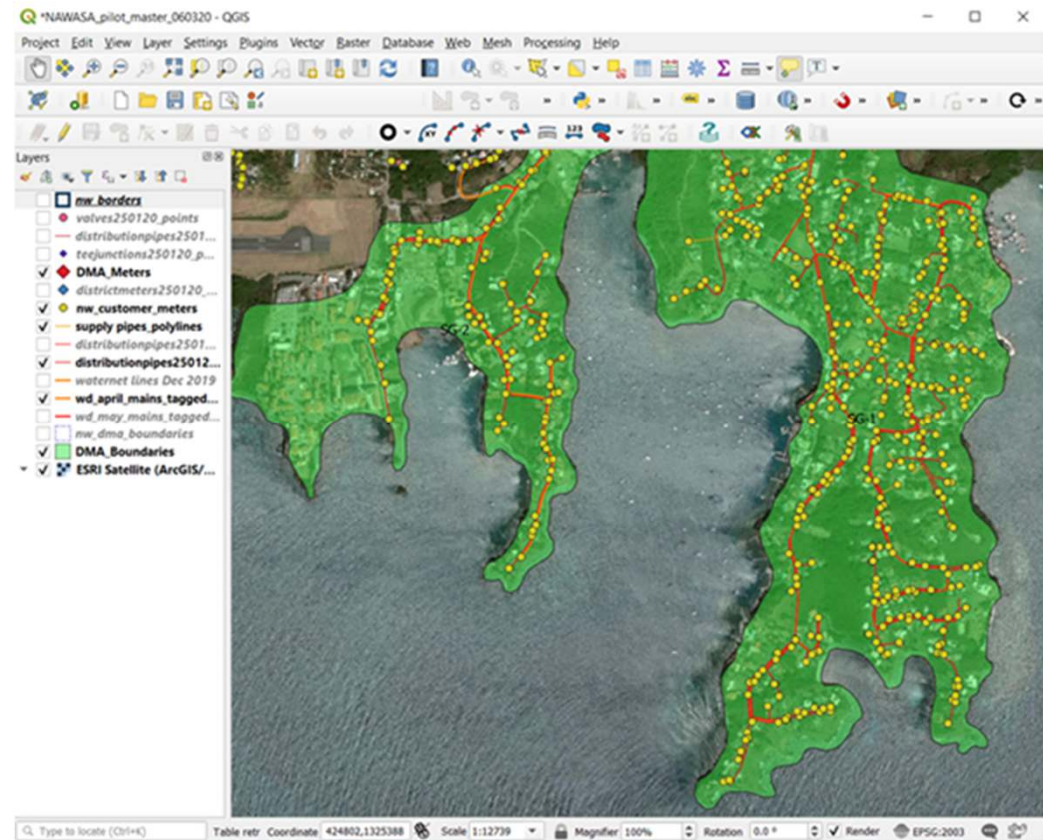


Project Approach - Output 4

Activity 4.1 Evaluation of Non Revenue Water in the two pilot DMAs

Stage 2 – Know your customers

- Merging of 200 individual GIS datasets into a single layer of available customer account/meter locations
- Combined dataset of around 35,500 locations – around 85% with account numbers which can be matched to 2019 billing data
- Need for ongoing work to add details for the remaining 15% and improve locational accuracy over time
- GIS used to add the DMA ID for each point – needed for the NRW Assessment



Project Approach - Output 4

Activity 4.1 Evaluation of Non Revenue Water in the two pilot DMAs

Stage 3 – Know your customers' data

- Microsoft Access database created database linking to the central GIS of customer/meter locations and copy of the Northstar billing data (2019)
- Workflow of queries and macros to create structured table for
 - Average consumption per account for 2019
 - Aggregated queries by DMA/billcode

The screenshot displays the Microsoft Access interface with a table named 'Account Average Daily Consumption OUTPUT'. The table contains the following columns: account_no, DMA_CODE, billcode, unique_ref, SumOfCons, MaxOfread, MinOfread, no_of_days, DaysInPeriod, BillingDays, ConsumptionPer, and Consumer. The data is sorted by account_no in ascending order.

account_no	DMA_CODE	billcode	unique_ref	SumOfCons	MaxOfread	MinOfread	no_of_days	DaysInPeriod	BillingDays	ConsumptionPer	Consumer	
100001	WNON2	100002_14/01/	92607.05	11/12/2019	14/01/2019	34	331	365	253.7179452054	#####	D	
100002	WDOM	100002_24/01/	21117	24/12/2019	24/01/2019	33	334	367	57.5385095367847	#####	B	
100003	WNON1	100003_14/01/	23976.85	11/12/2019	14/01/2019	34	331	365	65.6894520547945	#####	B	
100004	WDOM	100004_24/01/	48883.18	24/12/2019	24/01/2019	30	334	364	134.157087912088	#####	C	
100006	SA-8	WDOM	100006_08/01/	23096.74	09/12/2019	08/01/2019	32	335	367	62.9338964577657	#####	B
100008	SA-5	WDOM	100008_16/01/	58071.87	16/12/2019	16/01/2019	28	334	362	160.41953038671	#####	C
100012	SA-5	WDOM	100012_16/01/	19577.23	16/12/2019	16/01/2019	28	334	362	54.0807458563536	#####	B
100013	WNON1	100013_24/01/	23096.78	23/12/2019	24/01/2019	28	333	361	63.98	0.2904602	B	
100014	WDOM	100014_15/01/	4399.4	13/12/2019	15/01/2019	35	332	367	11.7819669400545	#####	A	
100015	WNON1	100015_14/01/	22436.86	11/12/2019	14/01/2019	34	331	365	61.4708493150685	#####	B	
100016	WDOM	100016_11/01/	11658.39	09/12/2019	11/01/2019	30	332	362	32.2054872375691	#####	A	
100017	WNON3	100017_14/01/	476893.34	11/12/2019	14/01/2019	34	331	365	1306.55709589041	#####	F	
100018	SA-5	WDOM	100018_16/01/	26616.26	16/12/2019	16/01/2019	28	334	362	73.5258401104972	#####	B
100019	WDOM	100019_16/01/	18917.34	16/12/2019	16/01/2019	28	334	362	52.2578453038674	#####	B	
100020	WDOM	100020_14/01/	5939.19	12/12/2019	14/01/2019	33	332	332	17.8891265060241	#####	A	
100021	WNON1	100021_14/01/	12656.8	11/12/2019	14/01/2019	34	331	365	62.0734246575342	#####	B	
100022	WDOM	100022_03/01/	4399.38	05/12/2019	03/01/2019	33	336	336	11.0613928571429	#####	A	
100023	WDOM	100023_10/01/	219.97	10/12/2019	10/01/2019	34	334	334	0.658592814371257	#####	A	
100024	WDOM	100024_14/01/	10338.58	12/12/2019	14/01/2019	32	332	364	28.4026923076923	#####	A	
100025	WDOM	100025_14/01/	1539.79	12/12/2019	14/01/2019	33	332	332	4.63792168674689	#####	A	
100027	WDOM	100027_14/01/	90627.33	11/12/2019	14/01/2019	34	331	365	248.294054794521	#####	D	
100028	WDOM	100028_22/01/	67750.52	26/12/2019	22/01/2019	30	338	368	184.104673913043	#####	C	
100029	WNON1	100029_14/01/	11218.46	11/12/2019	14/01/2019	34	331	365	30.7355068493151	#####	A	
100031	WDOM	100031_14/01/	23756.65	11/12/2019	14/01/2019	34	331	365	65.0867123287671	#####	B	
100032	WDOM	100032_21/01/		18/12/2019	21/01/2019	31	331	331			0 AZ	
100034	WDOM	100034_11/01/	18037.47	09/12/2019	11/01/2019	30	332	362	49.8272651933702	#####	B	
100035	WNON1	100035_14/01/	6379.13	11/12/2019	14/01/2019	34	331	365	17.4770684931507	#####	A	
100036	WDOM	100036_03/01/	21556.99	05/12/2019	03/01/2019	30	336	366	58.8988797814208	#####	B	
100038	WDOM	100038_18/01/	20897.07	18/12/2019	18/01/2019	32	334	366	57.0958196721311	#####	B	
100039	WDOM	100039_14/01/	5939.19	11/12/2019	14/01/2019	34	331	365	16.2717534246575	#####	A	

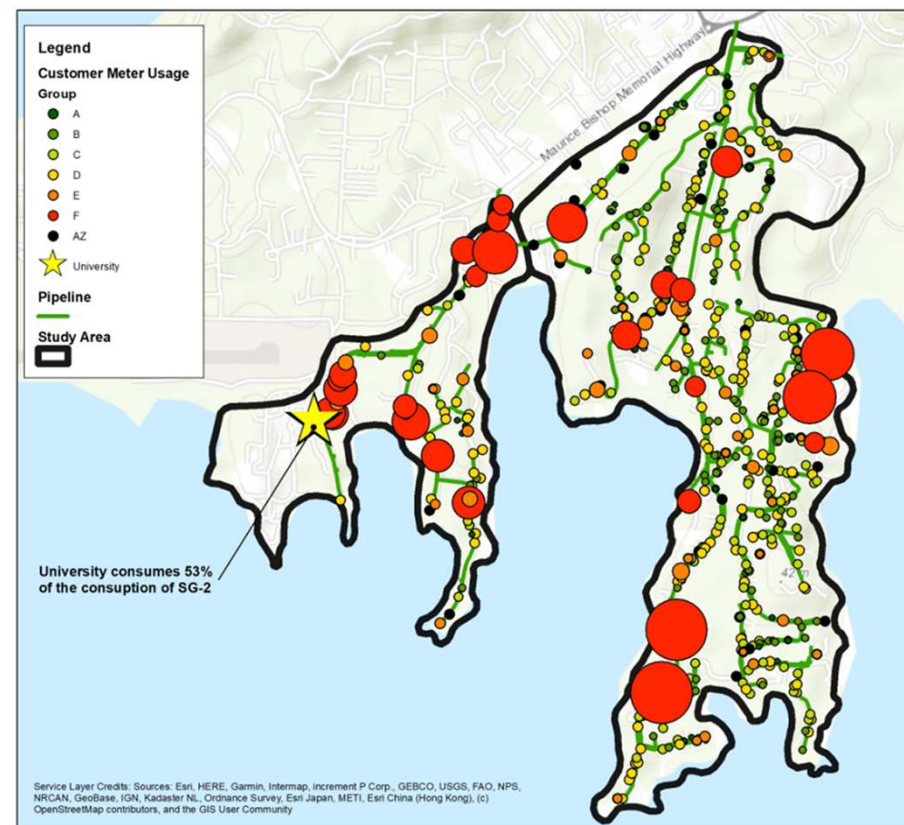


Project Approach - Output 4

Activity 4.1 Evaluation of Non Revenue Water in the two pilot DMAs

DMA SG1 - L'Anse Aux Epines - Monthly readings of consumption billed
Data produced from MS Access query

route	walk	account_n o	name	meter_no	unit_mea sure	read_date	Year	Month	usage_hi	cons_billed
1010	1230	107529	CABLE & WIRELESS G'DA LTD	0018002498	M	08-Aug-19	2019	8	95	20897.08
1010	1230	107529	CABLE & WIRELESS G'DA LTD	0018002498	M	09-Jul-19	2019	7	149	32775.42
1010	1230	107529	CABLE & WIRELESS G'DA LTD	0018002498	M	08-Jun-19	2019	6	177	38934.56
1010	1230	107529	CABLE & WIRELESS G'DA LTD	0018002498	M	04-May-19	2019	5	123	27056.22
1010	1230	107529	CABLE & WIRELESS G'DA LTD	0018002498	M	03-Apr-19	2019	4	115	25296.46
1010	1230	107529	CABLE & WIRELESS G'DA LTD	0018002498	M	06-Mar-19	2019	3	114	25076.49
1010	1230	107529	CABLE & WIRELESS G'DA LTD	0018002498	M	05-Feb-19	2019	2	159	34975.11
1010	1230	107529	CABLE & WIRELESS G'DA LTD	0018002498	M	03-Jan-19	2019	1	178	39154.53
1005	140	108020	CALABASH HOTEL	0010208607	M	02-Aug-19	2019	8	986	216889.68
1005	140	108020	CALABASH HOTEL	0010208607	M	04-Jul-19	2019	7	1241	272981.84
1005	140	108020	CALABASH HOTEL	0010208607	M	06-Jun-19	2019	6	1461	321375.07
1005	140	108020	CALABASH HOTEL	0010208607	M	07-May-19	2019	5	1643	361409.47
1005	140	108020	CALABASH HOTEL	0010208607	M	04-Apr-19	2019	4	1022	224808.57
1005	140	108020	CALABASH HOTEL	0010208607	M	07-Mar-19	2019	3	1261	277381.22
1005	140	108020	CALABASH HOTEL	0010208607	M	06-Feb-19	2019	2	1341	294978.76
1005	140	108020	CALABASH HOTEL	0010208607	M	07-Jan-19	2019	1	1155	254064.48
1005	400	126069	JUDITH C. LANGAIGNE	0014222854	M	02-Aug-19	2019	8	61	13418.12
1005	400	126069	JUDITH C. LANGAIGNE	0014222854	M	04-Jul-19	2019	7	41	9018.74
1005	400	126069	JUDITH C. LANGAIGNE	0014222854	M	06-Jun-19	2019	6	58	12758.22
1005	400	126069	JUDITH C. LANGAIGNE	0014222854	M	07-May-19	2019	5	66	14517.97
1005	400	126069	JUDITH C. LANGAIGNE	0014222854	M	04-Apr-19	2019	4	43	9458.68
1005	400	126069	JUDITH C. LANGAIGNE	0014222854	M	07-Mar-19	2019	3	45	9898.62
1005	400	126069	JUDITH C. LANGAIGNE	0014222854	M	06-Feb-19	2019	2	44	9678.65
1005	400	126069	JUDITH C. LANGAIGNE	0014222854	M	07-Jan-19	2019	1	48	10558.52

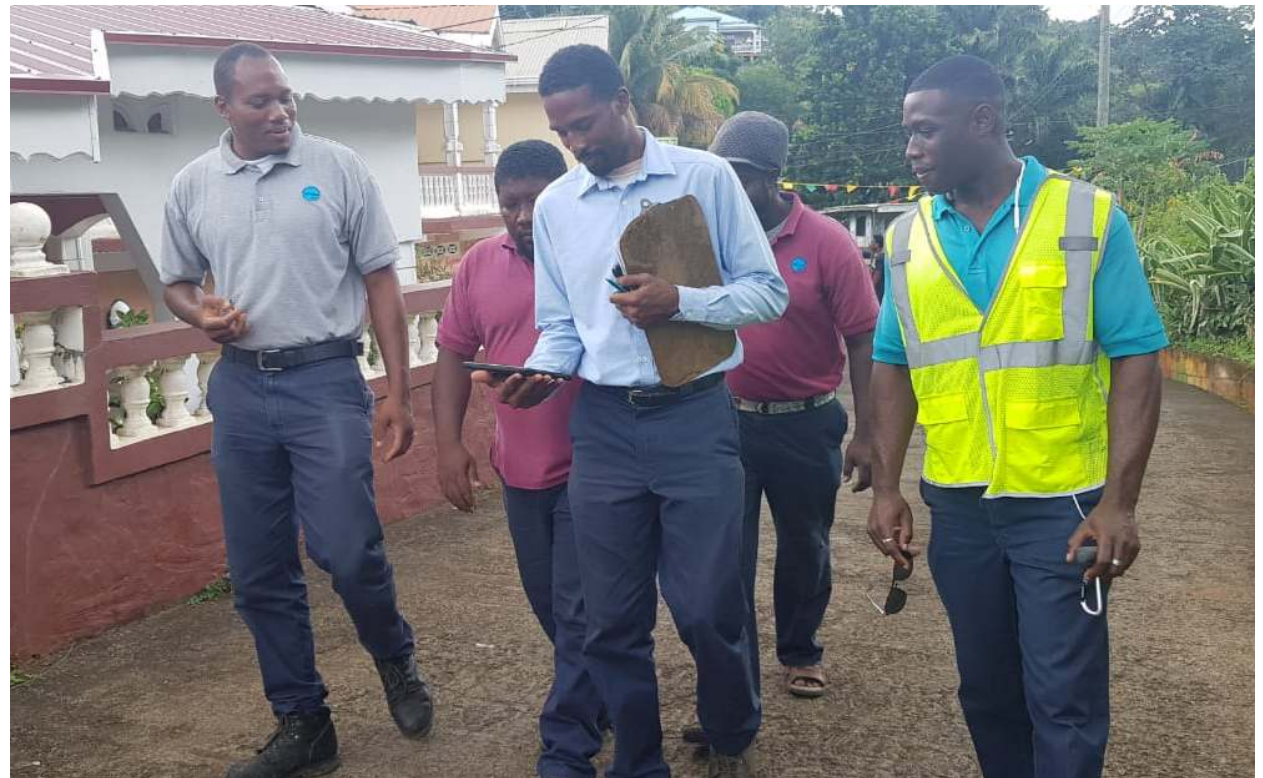


Project Approach - Output 4

Activity 4.1 Evaluation of Non Revenue Water in the two pilot DMAs

Stage 4 – Record leaks

- Ongoing development of tablet form for the future collection and management of leak information
- Information will help with future management and improved assessment and lowering of NRW across Grenada
- Ongoing trialling required by NAWASA staff in the field



Project Approach - Output 4

Activity 4.1 Evaluation of Non Revenue Water in the two pilot DMAs

Stage 5 – NRW assessment

- Use information from stages 1-4 to develop NRW water audit models for two pilot DMAs and a company-wide assessment
- Approach based on adapting an established AWWA method in MS Excel
- Audit includes a series of individual sheets storing values including:
 - Water volume supplied
 - Authorised and unauthorised consumption
 - Network length and pressures
 - Production cost data
 - Calculation of NRW losses

wood. National Water & Sewerage Authority

2019 NAWASA Water Audit - V2.0

Instructions Water Balance Input Water Loss Planning

Guidance Water Balance Report

Evidential Worksheets

A: WATER LOSSES	B: AUTHORISED CONSUMPTION	C: WATER LOSSES	D: SYSTEM DATA
A1 Source volume	B1 Billed metered	C1 Unauthorised consumption	D1 Mains length
A2 Source error	B2 Billed unmetered	C2 Customer meter error	D2 Number of services
	B3 Unbilled metered	C3 Data handling error	D3 Ave service length
	B4 Unbilled unmetered		D4 Ave pressure
E: COST DATA	E1 Total annual cost of operating	E2 Customer retail unit cost	E3 Variable production cost



Project Approach - Output 4

Activity 4.1 Evaluation of Non Revenue Water in the two pilot DMAs

Stage 5 – NRW assessment

SG1

- 31.2 miles of pipework
- 527 service connections
- 37% non-revenue water as percent by volume

SG2

- 7.8 miles of pipework
- 120 service connections
- 11% non-revenue water as percent by volume

NAWASA Company-wide

- 962 miles of pipework
- 45,500 service connections
- 27% non-revenue water as percent by volume

Key factors which affect the accuracy of the audits include:

- accounting for unbilled usage
- accuracy of mains lengths & service connection counts
- and availability of production and distribution metered data.



Project Approach - Output 4

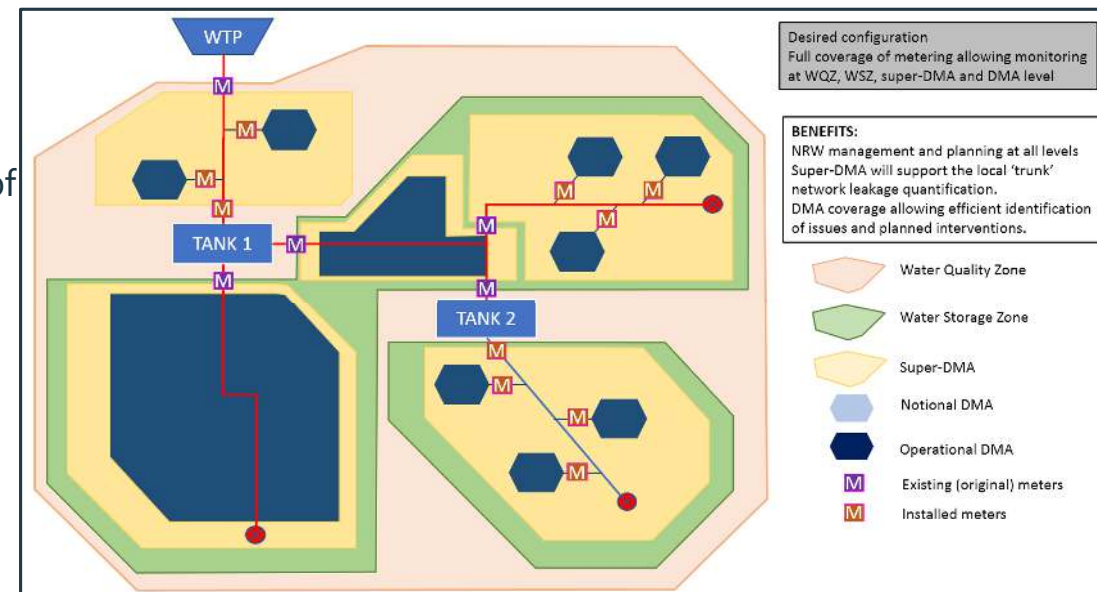
Activity 4.1 Evaluation of Non Revenue Water in the two pilot DMAs

Stage 6 – Management of NRW

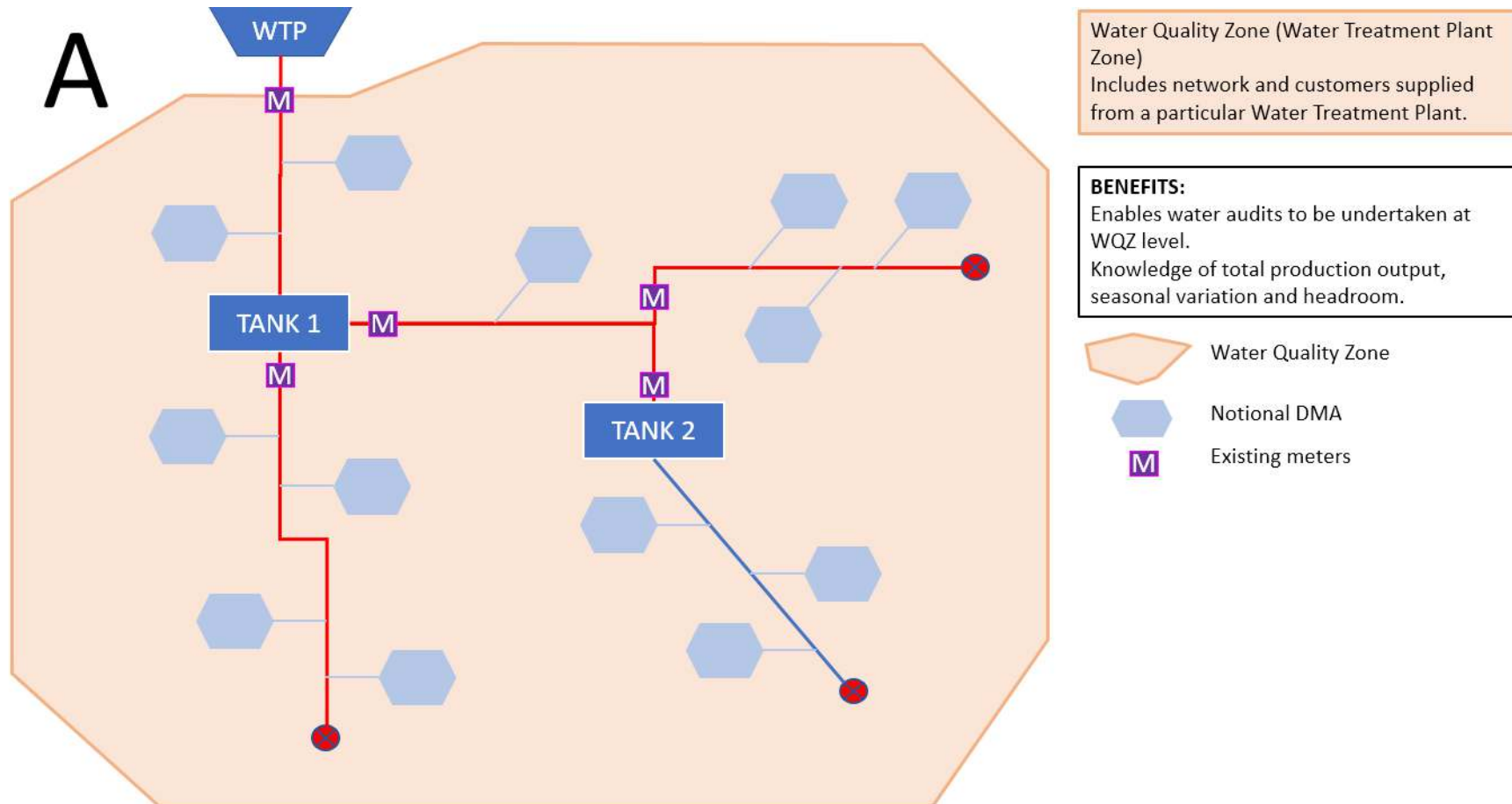
A more detailed understanding of NRW within the company is required before specific NRW management activities can be undertaken.

KEY ENABLERS & RECOMMENDATION:

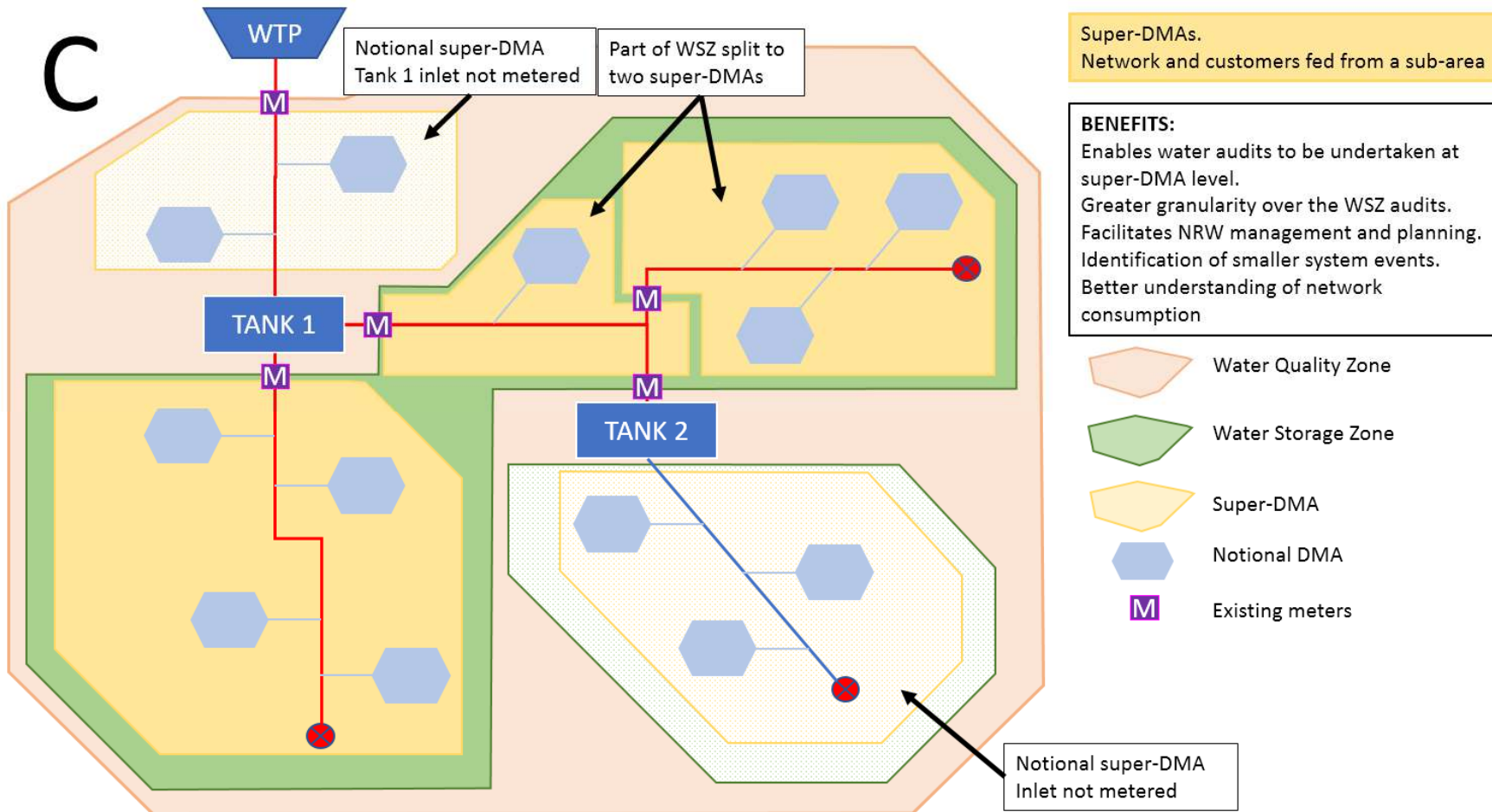
- Update GIS Coverage (Step 1 know your network)
- Establish Network Monitoring Zones based on 4 levels of network monitoring or 'zonal hierarchy'.
 - Level A - Water Quality Zones (Water Treatment Plants)
 - Level B - Water Storage / Supply Zones
 - Level C - Super DMAs
 - Level D – DMAs
- A lot of this can be done now with existing knowledge and metered data!



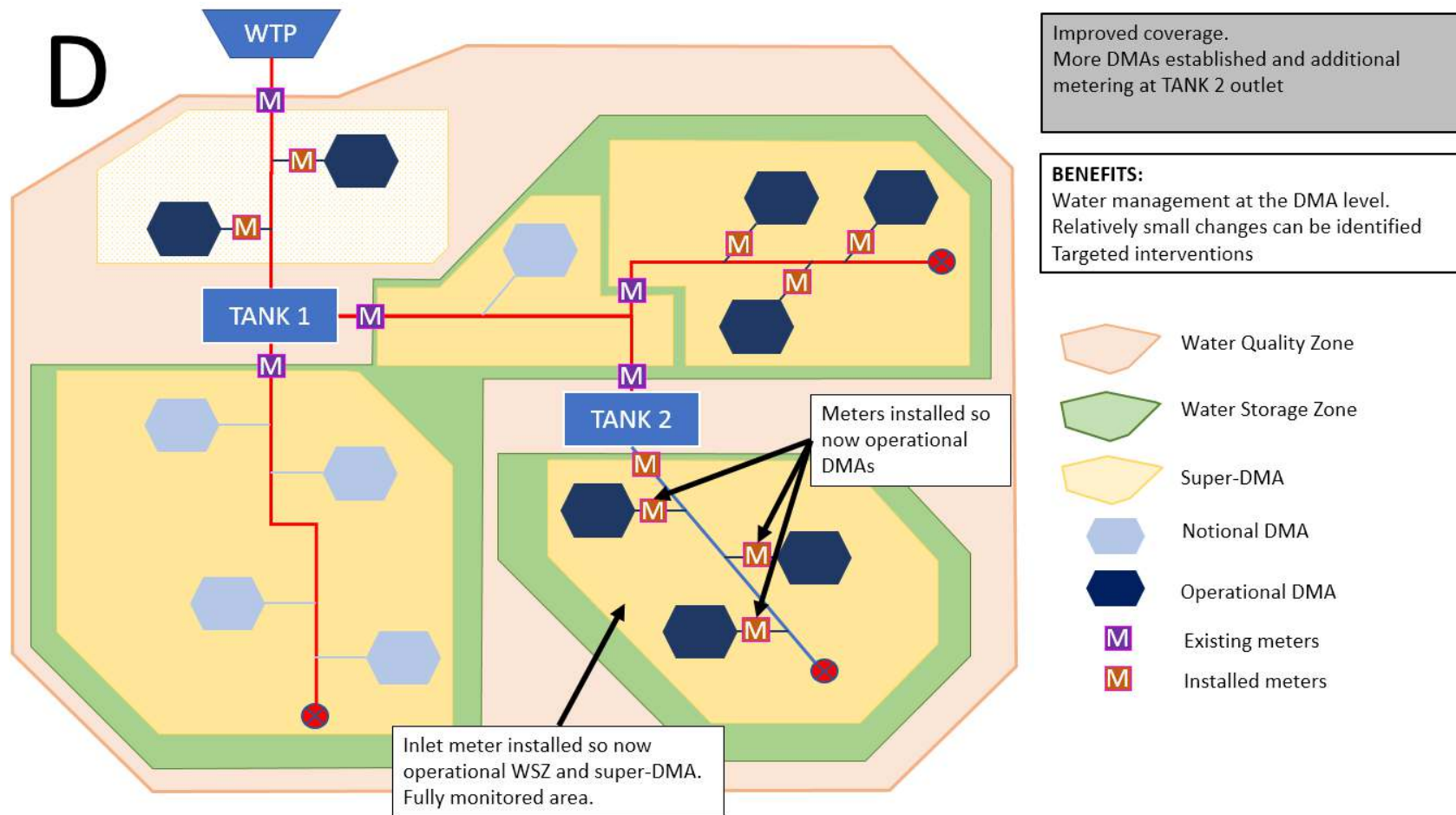
Project Approach - Output 4



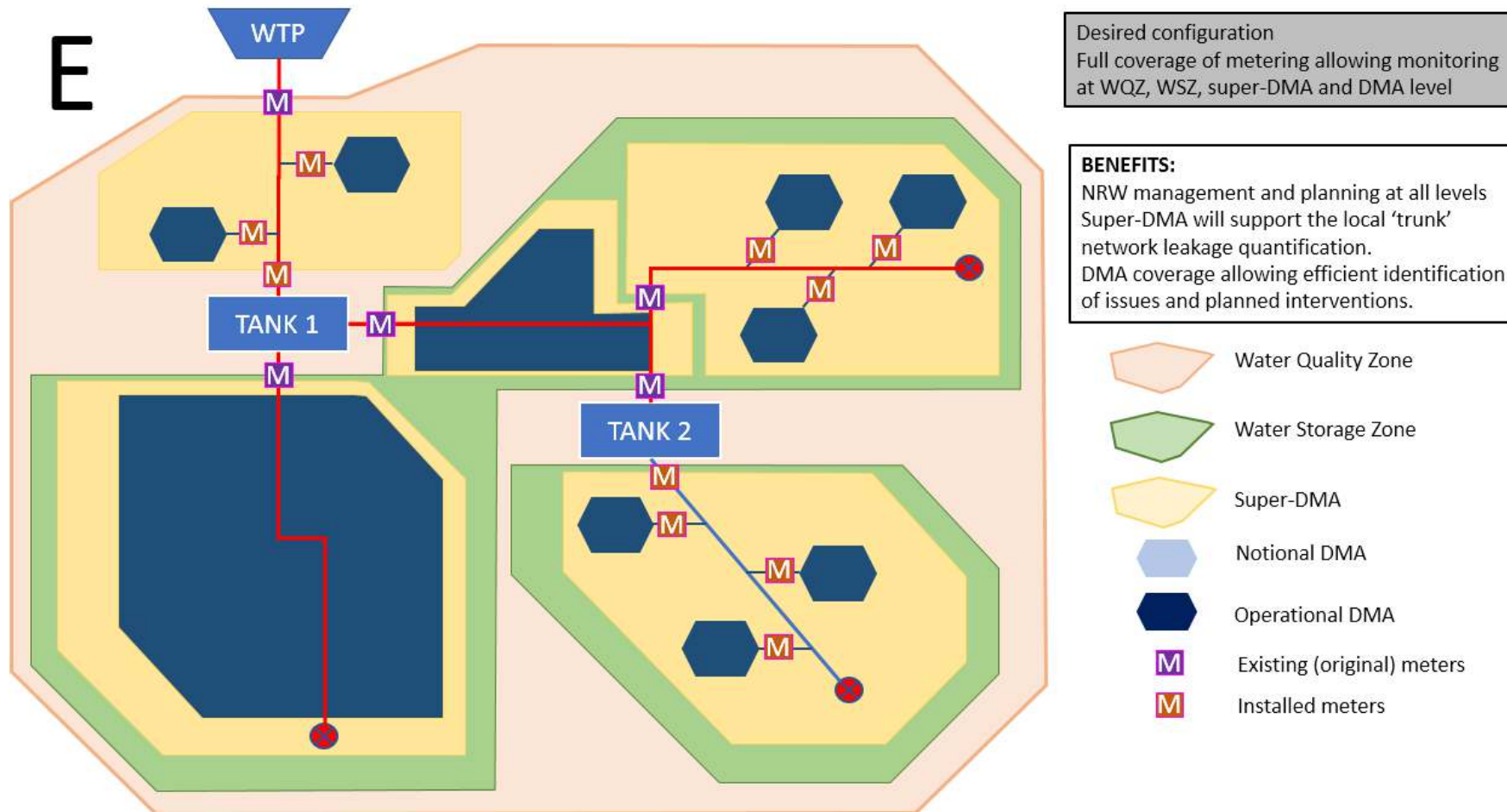
Project Approach - Output 4



Project Approach - Output 4



Project Approach - Output 4



Project Approach - Output 4

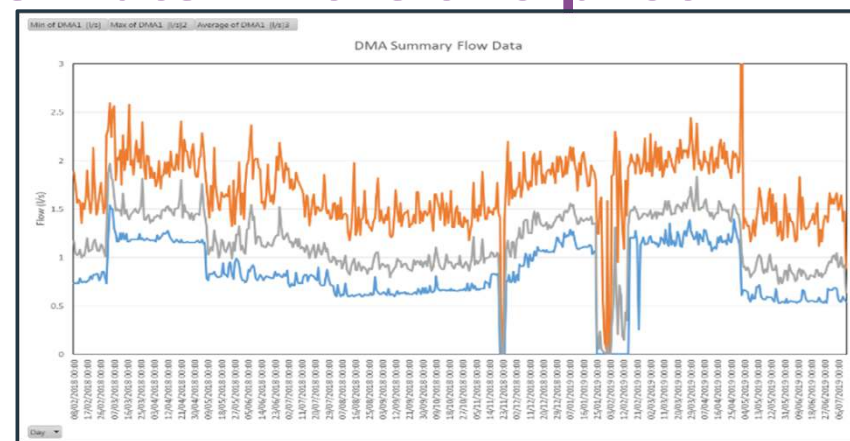
Activity 4.1 Evaluation of Non Revenue Water in the two pilot DMAs

Stage 6 – Management of NRW assessment

Provide advice and guidance on future measures to help manage NRW

- DMA flows should be continually monitored to enable minimum night flow (MNF) assessments of losses.
- Active leakage reduction activities should be focussed on DMA's with a high night flow and DMA's where MNF increases over time.
- Pressures should be monitored throughout the DMA network to assist with pressure related leakage assessments and to identify potential for pressure reduction.
- Transmission main meters should be tested for accuracy and replaced if necessary.
- Mains renewal should be considered for mains with a high failure history.
- Detailed flow data from bulk meters at SG1 and SG2 should be used to help identify trends in usage

Output 4 Report Issued May 2020



Example Leakage Reduction Measures

	Reduced Awareness Time	Location	Repair	Reduced Burst Frequency	Reduced Burst Flow Rate	Reduced Background Losses
Pressure Reduction				✓	✓	✓
District Metering	✓	✓				
Active Leakage Control	✓	✓		✓		
Selective Mains Replacement				✓		✓
Free Supply Pipe Repairs			✓			✓
Telemetry	✓					



Q & A



Project Approach - Output 5

Activity 5.1 Regional South-South exchange event

- Plan A - Originally planned as a one-day face-to-face engagement workshop with NAWASA staff and members of the Caribbean water management community in Grenada
- Planned Objectives
 - Communicate the outcomes of the study
 - Demo the technical approaches used
 - Promote wider discussion between attendees about their shared experiences
- Plan B - Deliver a 2 hour webinar with members of the Caribbean water management and wider CTCN community



Recommendations

Data collection

- Commence a 2-3 year programme to enhance the mapping of the pipeline distribution network
 - Aim to complete six DMAs in 2020 and 2021
 - Programme to complete remaining DMAs/priority areas by the end of 2022
 - Continue process across the whole island in the long term
- Continue to test and embed digital data collection in the work of the metering and T&D teams
 - Being supported by staged investment in data collection tablets
 - Test in the field- demonstrate benefits – buy more
 - Build up enhanced digital record of meter/customer locations and leakage events
 - Get regular feedback from crews using the forms – issues and benefits (time saved)



Recommendations

Data collection

- Install detailed flow loggers for as many DMAs meters as possible
 - Only on DMAs where the flows through the meter will be accurate across the full flow range.
 - Link installation to above mapping programme priorities
 - Use data to help identify spatial patterns and reasons for outages
 - Wood staff can help with future interpretation and training for this

GIS

- Long term investment in additional server capability to support continued development
 - Priority needed to ensure that data collected is protected – key risk issue for future success
- Continued development of GIS staff resources and capacity
 - Critical for future success and adoption of GIS within NAWASA



Recommendations

GIS

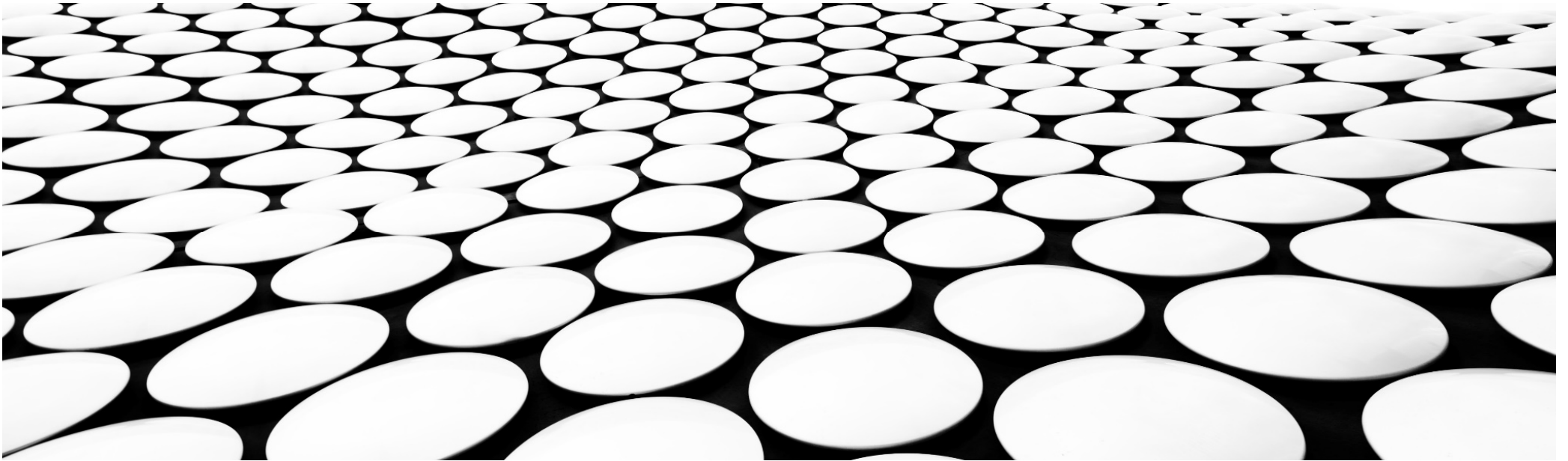
- Increase awareness of data collected across all functions in NAWASA
 - Initial web mapping portal start of this process

NRW assessment

- Carry out NRW assessments at zonal monitoring levels to inform decisions on which areas would benefit most from the implementation of a full DMA structure.
- Identify and investigate customers with unusual usage patterns – using a combination of Northstar and GIS
- Undertake regular repeat assessments of NRW to assess the impact of focused investment actions – over time benefits will be seen and can be quantified



NEXT STEPS FOR NAWASA



NEXT STEPS...

- Long term programme to capture updates and remap the primary distribution network
 - with the aim to complete minimum 15 DMAs per year
- Review of DMA Strategy
 - to be tailored to areas containing 300 or more properties for permanent monitoring



NEXT STEPS...

- Reduction of Non-Revenue Water (NRW)
 - Establishment of network monitoring zones
 - Increase DMA coverage
 - Continuous and increased data collection
 - NRW assessment through improved GIS analysis
 - Water Balance tools, Revised AWWA Water Audit.



NEXT STEPS...

- Enhance Data Capture & Management Procedures and Standards
 - Continue digitalization of NAWASA infrastructures (WTP, wells etc) and assets (meters, pipeline etc)
 - Capture the location of new / updated meter locations and over time build up an enhanced digital record of meter/customer locations
 - Increase use of smart meters, GPRS flow and pressure instruments, SCADA systems on our Treatment plants and water storage facilities



THANK YOU

Innovation in our operations and service



Q & A



wood.

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