STANDBY PAPER 2

NELSON MANDELA BAY MUNICIPALITY NON REVENUE WATER PROGRAMME – "PROVIDING SUSTAINABLE WATER SUPPLY SERVICES TO NELSON MANDELA BAY"

***David Raymer, **Dugald Ross and ***Pieter Joubert**
*Uhambiso Consult
**Re-Solve Consulting
***Engineering Advice & Services

ABSTRACT

This paper is an update of a paper delivered to the IMESA Conference in 2013.

Ten years ago, Nelson Mandela Bay Municipality (NMBM) was faced with the dual challenge of Non-Revenue Water (NRW) levels of over 40% and the onset of a severe drought. After receiving an ultimatum from the then Department of Water Affairs (DWA) to significantly reduce NRW levels, the Municipality embarked on a programme that would radically change the way in which its water supply system was managed.

From the outset, a water management system was required to integrate the GIS, billing and customer information, infrastructure development and asset management as well as operations and maintenance. The Edams Management System has successfully fulfilled this role.

A Master Plan for the provision of water services in the short, medium and long term was then developed. Following this, and as a result of a Water Research Commission Study on water loss in municipalities (commissioned by the then DWA), an Integrated Water Resource Management Strategy was developed. This strategy provided the necessary impetus for the Municipality to begin implementing a comprehensive water demand management and water conservation initiative. In order to significantly reduce the NRW, the Municipality then embarked upon various internal programmes and appointed professional service providers to implement.

NMBM's multifaceted and dynamic programme provides an important case study for municipalities wishing to turn around service delivery through the implementation of a sustainable NRW programme.

1. BACKGROUND TO NON-REVENUE WATER

The International Water Association (IWA) water balance and its various elements provide standard, internationally accepted terminology for water loss. By adopting a comprehensive auditing procedure to regularly update the water balance for NMBM, progress in reducing non-revenue water can be monitored and priority areas for intervention can be identified. The three components of Non-Revenue Water are apparent losses, real losses and unbilled authorised consumption.

1.1 Apparent Losses

Unauthorised consumption – illegal or unauthorised connections to the water supply network results in water theft. Early identification, removal and prosecution, through the application of the by-law, should be prioritised to minimise apparent losses.

Customer meter inaccuracies – factors contributing to meter inaccuracy include age, consumption, water quality and correct installation. Quality control for new installations, meter audits and meter replacement programmes can significantly reduce apparent losses attributed to meter inaccuracies.

1.2 Real Losses

Leakage on transmission and distribution mains, overflows at storage tanks and on service connections up to point of the customer meter – establishing and monitoring water supply zones within the supply network, active leak detection, customers reporting leaks through a call centre combined with repairs being carried out timeously will minimise real losses.

1.3 Unbilled Authorised Consumption

Unbilled metered consumption and unbilled unmetered consumption – a customer meter audit and subsequent update of the billing system should ensure that all customers are being metered, the meters are being read and that meter readings are being correctly captured and consumption accurately billed.

2. DEVELOPING A WATER MANAGEMENT "ROAD MAP"

Providing sustainable water supply services to Nelson Mandela Bay requires an integrated management approach that takes the various elements including source, supply and demand into consideration. A dynamic strategic approach is required as these elements are subject to change. The following key components provide direction in terms of the water management road map for Nelson Mandela Bay.

2.1 Water Management System

The Engineering Design and Management System for the water and sanitation services of the municipality has been in operation for a number of years. This system has successfully integrated many of the management and information components including, GIS, complaints database, flow networks, billing information, asset management and operations and maintenance. The system also provides management information and reports that monitor water demand trends.

2.2 Water Master Plan

To analyse and evaluate historical, present and estimated future water usage by the NMBM for the period 2010 to 2030, taking into account the water needs and the impacts on water supply that may follow from various reports and plans. The Water Master Plan was compiled for the complete water service operating system by preparing supply side analysis demand side analysis.

2.3 Algoa Reconciliation Strategy Study

The Algoa Reconciliation Strategy Study developed operating rules for the NMBM in 2008 to assist in decision making. The operating rules examine water availability, current water use and trends, projected use and a water balance. Different scenarios are presented. The operating rules were used as a guideline to NMBM, Gamtoos Irrigation Board (GIB) and the Department of Water and Sanitation (DWS, previously DWA) to make important decisions and the model was revised every three months. Regular meetings and consultation take place between the four institutions.

2.4 Integrated Water Resource Management

An Integrated Water Resource Management Strategy was prepared for the municipality in 2009 followed by a business plan. This document became the guideline for all the interventions that followed.

The strategy was developed into the following categories:

- Technical interventions;
- Financial measures;
- Legislative/regulatory measures;
- Social interventions;
- Institutional interventions.

2.4.1 Drought Strategy

Owing to the declining levels in the water storage dams since 2016 and the subsequent two-year severe drought, a drought strategy was included in the IWRM Strategy. The strategy included:

- Establishment of a Water Monitoring Committee;
- Regular meetings with DWS, Lower Sundays River Water User Association and GIB to consider the operating rules of the Algoa Water Supply System and water restrictions;
- Vigorous awareness campaign through publicity and marketing, including media and print;
- Applying three sets of stepped tariffs for different phases of the drought;
- Engaging industry, such as wet industries, nurseries, swimming pool and hotel industries;
- Engaging the Department of Education on water wastage at schools;
- Preparation of an Drought Mitigation Action Plan;
- Implementation of Water Conservation section of the Water and Sanitation Services By-law.

2.4.2 Drought Mitigation Action Plan

The Drought Mitigation Action Plan was prepared by the municipality in conjunction with DWS and included:

- Drought Campaign and water restrictions for the reduction of water consumption;
- Maximisation of supply of water from Gariep Dam via Nooitgedagt/Coega Low Level Scheme;
- Desalination of Sea Water at Schoenmakerskop;
- Investigating local groundwater schemes;
- Drilling of boreholes in catchments and close to water infrastructure;
- Water Conservation and Water Demand Management;
- Addressing School High Consumption;
- Low Income Housing Water Loss Programme;
- Rezoning Nooitgedagt water into zones traditionally supplied from western resources;
- Accessing low level storage in Impofu Dam;
- Promoting the use of rainwater tanks.
- Leak detection and repairs

The main schemes are the Nooitgedagt/Coega Low Level Scheme. Phase 2 of the Nooitgedagt/Coega Low Level Scheme was completed in July 2017, increasing capacity from 80 to 140 Mℓ/day. Phase 3 of the upgrade is under construction and due for completion in 2020 and will add an additional 70Mℓ/day increasing the schemes capacity to 210 Mℓ/day.

The graph below indicates the current combined system yield versus the total demand required by the NMBM, as well as how the interventions have reduced the total demand since 2015.

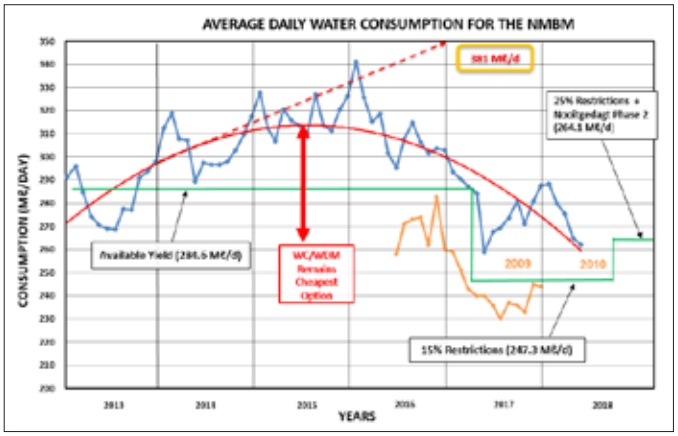

Figure 1: Current combined system yield versus total NMBM demand

2.5 Water Conservation and Water Demand Management (WC/WDM)

To implement WC/WDM interventions requires participation of many role-players such as different municipal directorates and sub-directorates, certain state departments, service providers and professional service providers which all needs to be managed collectively. Regular meetings are held to coordinate activities, monitor progress and deal with issues that hinder progress.

3. THE NON-REVENUE WATER PROGRAMME

3.1 Identifying and prioritising interventions

The priority areas identified for intervention as part of the Non-Revenue Water Programme were developed into 11 main work streams as follows:

1. Bulk metering and bulk pipeline water balance
2. District Metering;
3. Remote meter reading;
4. Non-revenue water
5. Water tariffs;
6. Leak repairs
7. Water loss audits;
8. Water meter management;
9. Industrial, Commercial and Institutional (ICI) users;
10. Pressure management;
11. Marketing and Publicity.

The present drought and subsequent constraint on the water supply system (2016 to the present) provided the impetus for the Municipality to implement these interventions.

3.2 Bulk Metering

A Bulk Water Task Team was set up to expedite the installation of bulk meters to establish losses on the bulk supply system in order to develop a water balance.

Work has been ongoing and the number of meters in operation has increased from 60 to 76, out of 105. Initial water balances indicate losses of 5. 5% and the target is to reduce to 3%.

3.3 District Metering

Greater Metered Area (GMA), District Metered Area (DMA) and Pressure Management Areas (PMAs) are needed to determine where the most water losses occur. This is done by comparing the inflow through the DMA meter with the total consumption of the district. The comparison is only possible if the district is discrete which means that the boundary valves separating districts are shut.

Extensive field work is required to check all boundary valves. Meters need to be installed in constructed chambers with sophisticated fittings and equipment. DMAs need to be made discrete by auditing the boundary valves.

There are 12 GMAs (29 meters), 93 DMAs (118 meters) and 58 PMAs (65 meters). A priority list was prepared and designs of the chambers undertaken. Designs have been approved by NMBM, work packages have been issued to the Cluster Contractors to construct.

The districts are essential to manage water losses in the reticulation system. Thirty new district meter stations have recently been installed. District metering will result in water balances being undertaken per district and assist in prioritising areas for intervention.

Progress with the installation of GMA and DMA meters is as follows:

Table 1: Progress with GMA, DMA and PMA meters

	Total	Discrete
GMA	12	3
DMA	93	73
PMA	58	55

Meters - 13 March 2018				
Total	Working	Not Working	Proposed	Bulk Supply
29	14	1	5	9
118	79	12	27	
65	45	5	15	
212	138	18	47	9

3.4 Remote Meter Reading

The municipality decided that AMI (Advanced Metering Infrastructure) must be introduced to enhance revenue collection.

The AMI Contract commenced in November 2017 for 1 500 meters, for industrial, commercial, DMA and bulk meters. AMI will enhance meter reading for billing purposes. It is anticipated that 450 meters will be completed in the current financial year. A service provider has installed GPRS loggers at 74 DMA's and real time flow monitoring is done. This has proven invaluable in alerting the repair teams of possible large leaks in the system. DMA water balances provide information used to priorities areas for potential leak detection.

3.5 Non-Revenue Water

The progress made with the reduction in NRW over several years is indicated in Figure 2 and includes quarterly figures.

The current Infrastructure Leakage Index (ILI) for the NMBM is 8.4. Although the NRW % is similar to the national average the high ILI indicates that interventions such as pressure management, leak detection and repairs should be continued. The reduction of non-revenue water is an ongoing process and should be seen as a long-term intervention.

3.6 ICI Consumers

ICI consumers account for approximately 10 000 of the 225 000 metered connections in the NMBM (4. 5% of the total consumers). However, they consume nearly 50 Mℓ/day or 30% of the Revenue Water in the city. It is therefore essential that billing of these consumers is correct, to ensure maximum revenue collection.

Work on meter readings, meter details and anomalies found from desktop studies and meter field audits have been forwarded to Budget & Treasury (B&T) to increase billing volumes and improve the customers' database.

3.7 Water Tariffs

An investigation was undertaken to compare water tariffs of the nine metropoles in South Africa. The outcome indicated that:

- NMBM domestic tariffs were high at low usage and low at high usage;
- Additional steps were required at low category;
- NMBM commercial tariffs were low compared to other Metro's

Some improvements have been made for the tariffs for 2018/19 financial year.

3.8 Leak Repairs

3.8.1 Assistance to the Poor Programme (ATTP)

Internal leaks of ATTP houses are passed to a team of consultants who arranges training of unemployed persons to undertake the repairs and the Municipality to supply the material. These repairs are only undertaken at households registered as ATTP. Material is supplied via the municipal stores. This is most cost effective and ensures the correct standard being applied. Although this intervention does not reduce NRW it does reduce wastage and non-payment levels.

Leak repair projects require that they be tackled with a degree of trepidation, careful planning and stringent management and supervision.

3.8.2 Schools with High Consumptions

The Municipality have been aware of high leakages at schools for a long time. Inspections of all the listed schools within the NMBM boundaries were conducted and assessments completed. Flow limiting devices were installed at 35 schools that had the highest consumption per learner to reduce water wastage and leaks. The devices close water supply after school hours and over weekends thereby reducing water wastage.

Training of care takers were provided in the operation of the devices and provision was made for fire flow along the perimeter of the schools. Pre- and post-logging were done to establish the feasibility and estimated savings.

The Algoa Reconciliation Strategy Study stated that water wastage at schools contribute to approximately 10 to 15 Mℓ/day. Preliminary results from a pilot study of 35 schools indicate that this figure is more likely to be in the region of 3. 5 to 5 Mℓ/day.

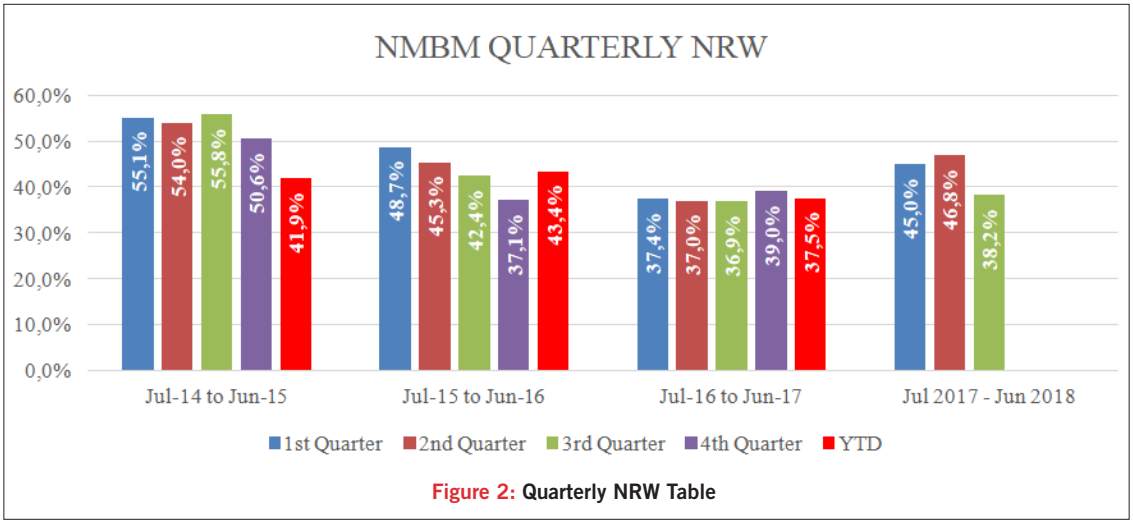

Figure 2: Quarterly NRW Table

3.8.3 Cluster Contractors

The NMBM has 60 wards which are divided into 6 clusters of approximately 10 wards each. Six Cluster Contractors were appointed to undertake various work items for water and sanitation services. For the water service this has included:

Table 3: **Summary of progress: Cluster Contractors**

Intervention	Number
Reduce backlog of unmetered consumers	5 740
Install meters to communal standpipes	343
Replace faulty ICI meters	459
Install flow limiting devices at schools	35

Other work packages to commence are:

- Installation and replacement of large meters (>250 mm in diameter)
- Boundary valve modifications for continued discreteness
- Bulk meter chamber covers

3.9 Water Loss Audits

3.9.1 Domestic Meter Audit

Audits are performed to identify and address the following:

- Meter related problems (i.e. leaks, unreadable, wrong erf position, etc.)
- No meter found at consumer property
- Field verification of billing data
- Identification of on-site leaks

Typical audit results are indicated in the table below.

Table 4: **Typical Audit Results**

Date of Audit Report:		1 June 2018	
AUDITS COMPLETED			
No.	**Details**	**Total Audited**	**%**
1	Connections	216 415	96%
2	Valves & Hydrants	29 438	98%
3	No Access	33 811	16%
FAULTS IDENTIFIED			
No.	**Details**	**Total Identified**	**% Faults identified**
4	Stop-cocks	4 374	2%
5	Meters	71 247	33%
6	Connection Leaks	766	0.4%
7	Internal Leaks	16 932	8%
8	Valve, Hydrant & Reticulation	19 221	65%

3.9.2 Valve and Hydrant Audit

The importance of valve and hydrant audits is listed below and was undertaken in this project:

- Many valves and fire hydrants that are reflected on record drawings are not found in the field, making it extremely difficult for field teams to control water wastage during pipe bursts.
- Accurate valve records simplifies the process of discretisation when creating and monitoring DMA's
- Numerous valves and fire hydrants have faults and the audits highlight these faults for maintenance activities to be undertaken.

The table below indicates the typical faults identified during the valve and hydrant audits, as well as the occurrence percentage for each fault.

3.9.3 Flow and Pressure Logging

Flow and pressure logging was carried out throughout the programme for the following initiatives:

- Monitoring of district/ zone inlet meters for:
  - zoning exercises/ drop tests
  - Leakage monitoring/ step testing/ Minimum Night Flow (MNF) Analysis
- Pressure investigations (zoning, low/ high pressure complaints and pressure management investigations, PRV sizing and condition assessments);
- Consumption profile monitoring of industrial, commercial and institutional consumers (including meter sizing verification);
- Sewer flow monitoring (outfall sewers for zones).

A very important part of the Waterloss Services was data logging in order to establish pre- and post-intervention flows/pressures. Data logging was usually carried out for a minimum of seven days or in some cases with permanent loggers installed. This was done to ensure that a representative sample of data is obtained (including pressure or flows over weekends) for analysis purposes.

3.10 Water Meter Management

The water service keeps its own database of over 230 000 water meters and the Water Management System is used to manage the meter information, meter maintenance and meter replacement programme.

A realistic period to replace water meters is between 7 and 10 years. The accuracy and quality of water meters has improved due to advancements in technology. Planned meter replacement is however normally recommended every 10 years and thus 10% of the meters need replacement per annum. Regular meter audits and sample testing to determine accuracy compliance in terms of legislation is however the preferable method of informing the meter replacement programme.

Unfortunately, budget constraints have resulted in a significant increase in the backlog of maintenance and the number of meters older than 10 years has increased from 19 000 to 70 000 in a period of 4 years.

3.11 Pressure Management

Pressure management as a means of managing real losses forms a critical component of the NRW programme. The benefits of optimising the pressure within the water supply system through pressure

Table 5: **Summary of Valve and Hydrant Audit**

Date of Audit Report:								1 June 2018	
No. of Valves Audited	**FAULTY VALVES**								
	Leak found	No Marker	Not Found	Not on Record	Not Working	Cover Damaged/ Missing	Inoperable	Head Covered	TOTAL FAULTS VALVES
16 554	2. 2%	44. 7%	22. 3%	22. 3%	0. 8%	0. 9%	6. 9%	9. 3%	18 091
No. of Fire Hydrants Audited	**FAULTY FIRE HYDRANTS**								
	Leak found	No Marker	Not Found	Not on Record	Not Working	Cover Damaged/ Missing	Inoperable	Valve Head Covered	TOTAL FAULTS FIRE HYDRANTS
12 884	0. 9%	12. 6%	20. 3%	10. 0%	0. 6%	0. 7%	5. 9%	2. 0%	6 783

management include:

- Reduce excess pressure/ pressure surges;
- A reduction in existing water loss/ leakage rates (and the natural rise of leakage);
- A reduction in pipe failures/ bursts;
- Extending the lifespan of existing infrastructure.

Pressure management includes re-visiting the existing PRV stations, ensuring zones are discrete, making PRV zones from DMA's or sections of DMA's.

Advanced pressure management entailed the installation of 2-Step pilot controllers which further reduces the pressure during predetermined off peak periods.

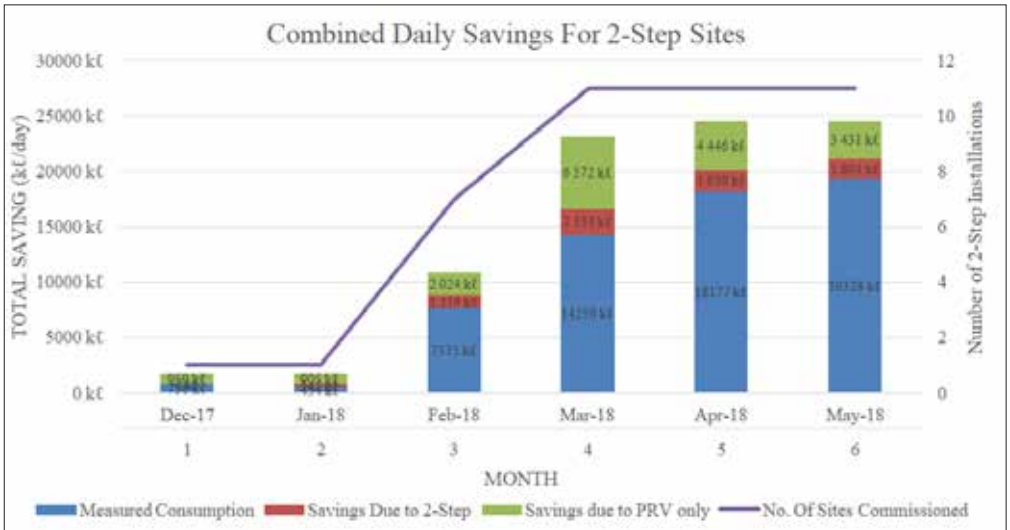

Figure 3: Savings achieved due to the installation of 2-Step Controllers

3.12 Social Intervention

3.12.1 Marketing and Publicity

The most important strategy in WC/WDM is the awareness through publicity. The publicity campaign has three components, namely publicity through the media and radio, secondly, the erection of display boards, preparation and distribution of leaflets, brochures, decals and posters and thirdly the social media. This campaign was initiated with a media launch in September 2016 by the Executive Mayor.

3.12.2 Social Facilitation

A social facilitator was appointed to visit various consumer groups such as carwashes (formal and informal), B&B's and guesthouses, high consumers, businesses, hair salons, public swimming pools and clinics. This is important as it creates water awareness and demonstrates that the municipality is serious about its water savings.

3.12.3 Schools Campaign

The schools awareness campaign commenced in March 2017. A social consultant was appointed and primary and secondary schools were visited. This is an important intervention as learners can influence the behaviour of their parents and they themselves become future water wise consumers. A total of 230 schools have been visited. The focal point of the school campaign was the development of water drop mascot named *Thontsi* and the sanitation mascot *Ngasese*, which appeared in many advertisements, display boards and literature, and the theme for the campaign, "*Play your part, be water smart*".

4. CASE STUDIES

4.1 Pressure Management

The NMBM has invested a significant amount in pressure management across the NMBM. The status of the pressure management is summarised as follows:

- 2018: 58 existing PRV stations in operation
- 21 stations have been identified as additional stations to implement pressure management
- 10 existing PRV stations will be upgraded to include the latest technology
- Total distribution network length – 4 700 km
- Total distribution network length under pressure management – 950 km (20% of total network)

By increasing the 47 PRV stations that existed in 2014 to a total of 58 in 2018, the NMBM succeeded to reduce the real losses to the extent that the total demand decreased by approximately 10Mℓ/day. Eleven (11) 2-Step controllers were also installed as advanced pressure management interventions at selected stations and this contributed to a saving of approximately 5 Mℓ/day.

4.2 Awareness and Education Programme – "Changing the Communities' Attitude towards Water"

Awareness and Education requires good communication with stakeholders which includes consumers who are the municipality's customers. A campaign needs a theme and clear messages. Initially consumers were distrustful of the municipality when the drought campaign started but changed once the media became involved. Social media has become a powerful medium for disseminating information. Consumers have become more aware of usage and the value of water as a resource.

4.3 Schools with High Consumptions: Installation of Water Restriction Devices

Lack of maintenance and vandalism of plumbing at state schools has been identified as a source of water wastage. There are 384 schools in the NMBM area of jurisdiction. During a pilot study 35 schools were selected for the installation of water restricting devices. The selection was based on pre-logging results from the school's metered consumption. Post logging was done after installation of the devices and the savings are shown in the table below:

	Saving with flow restrictors (kl/month)	Savings (kl/day)
Pilot study of 35 schools	9 012	300
Potential savings for all schools - 384	98 874	3 295

Field assessments showed that the state of the plumbing and ablution facilities at the most schools require urgent repairs.

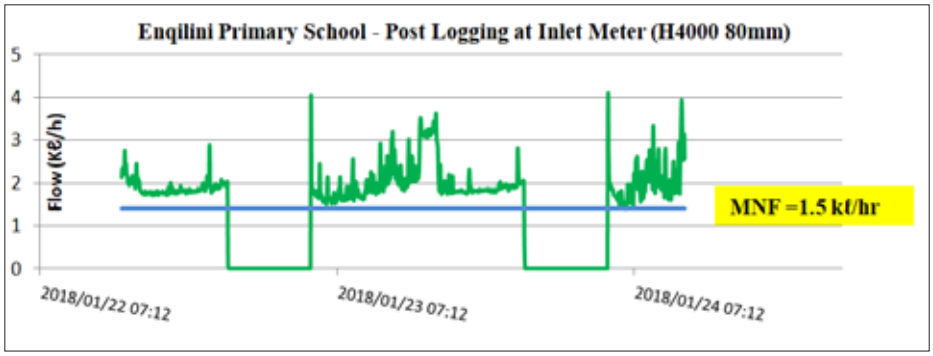

Figure 4: Typical flow logging after installation of the flow restricting device

4.4 District Metered Areas: Benefit of Remote Flow Monitoring

There are 151 DMA's (which includes 58 PMA's) in the NMBM. A total of 101 remote flow monitoring devices have been installed at 75 DMA's to monitor various parameters including MNF, total daily supply and average consumption trends. Remote flow monitoring provides the ability to observe a DMA's behaviour in real time. This enables the NMBM to react immediate or even anticipate pipe failures when it occurs. Areas can be identified and prioritised for leak detection based on MNF analysis on historic and current trends.

Kini Bay, a predominantly medium to high income residential zone, was identified as a typical case where the above-mentioned methods were applied.

As indicated above this area had a very high MNF of some 20 kℓ/hr in February 2018 which was exceptionally high given the fact the Kini Bay comprises of only 95 properties. Once the high MNF was identified leak detection teams were deployed in the area. Noise logging and correlation results showed possible leak locations for further investigation. Further field work indicated seepage near the bulk supply pipeline. The pipeline was exposed, and a large leak repaired resulting in the drastic reduction in the supply to this area.

The above is an example of the benefits of remote monitoring and how it can assist in proactively managing networks and leakage.

4.5 Bulk supply pipeline water balance

The Churchill and Elandsjagt pipelines convey treated water from the Churchill and Impofu dams over 120 km to the major supply reservoirs of the NMBM. The two parallel pipelines, a 1 200 mm diameter prestressed concrete and 760 mm steel line also supply bulk water to the Kouga Municipality as well as several residential suburbs and some 230 farmers along the route. Water can also be supplied in the reverse direction from Summit reservoir into the Churchill system. At the Seaview and Schoenmakerskop pump station water is pumped to major supply reservoirs.

Water meter were installed at critical locations to measure the volume of water entering and leaving the system.

A water balance was carried by comparing the Treated Volume leaving the two treatment works with the inflows and outflows measured along the pipeline. The diagram above shows the draw-offs and a loss of 5.8 % from Churchill Water Treatment Works to the Driftsands reservoir.

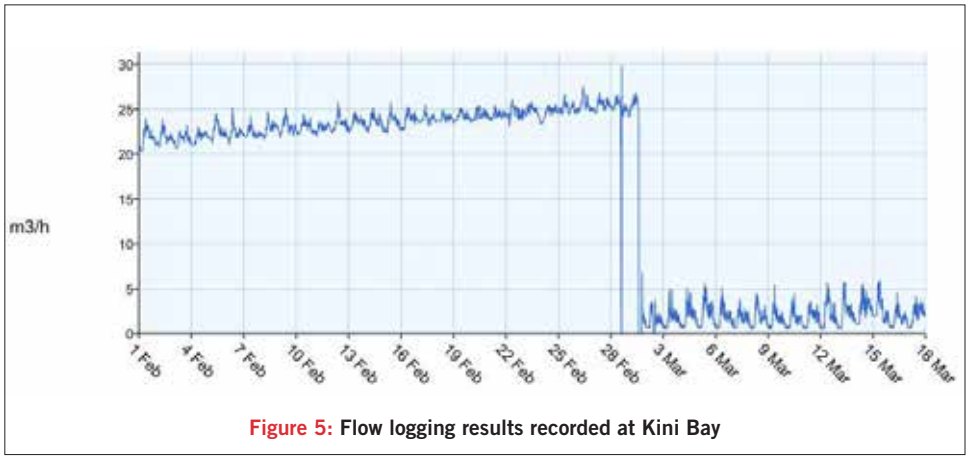

Figure 5: Flow logging results recorded at Kini Bay

5. LESSONS LEARNT

Valuable lessons that were learnt through the ongoing implementation of the NRW programme included the following:

- Field simulation of the reduced pressure conditions prior to the installation of the PRV station ensured the successful commissioning;
- Pressure management must go hand in hand with leak detection and repairs as well as infrastructure replacement programmes;
- Savings from 2-Step controller installations resulted in quick returns on investments;
- PRV sizing should consider actual consumption data as well as theoretical data.
- Quick awareness, location and repair times of leaks contribute to significantly reducing the volume of water lost.
- Ensure approved high standards in material, workmanship and quality control in leak repairs, as well as new housing developments. Experience has shown that most internal leaks occur on RDP housing projects, and in particular, on toilet cisterns;
- Where roads are constructed as a later phase to services and houses, there is a big risk that services will be damaged or affected. Higher specification and site supervision in these cases needs to be considered, such as installing road crossings in pipe ducts and increased pipe cover;
- Experience indicates that water districts need to be investigated at least three times for leak detection. As leaks are repaired pressure increases and new leaks develop, hence the necessity of a 2nd sweep of the area for leaks. Should that leakage still be unacceptably high, a 3rd sweep of the area for leaks is recommended;
- Proper awareness and education on services must be provided to recipients prior to houses being handed over and to the public. Consumers are the municipality's customers and good communication with your customer is essential for the success of any business;
- The importance of planning for large capital projects, such as pipe replacement programmes, meter replacement and refurbishment and upgrading of infrastructure is of utmost importance to avoid large scale leakage of networks in future. A number of areas had a high number of leaks repaired only to find that three months later a similar amount of leaks had appeared. This is an indication of aging infrastructure;

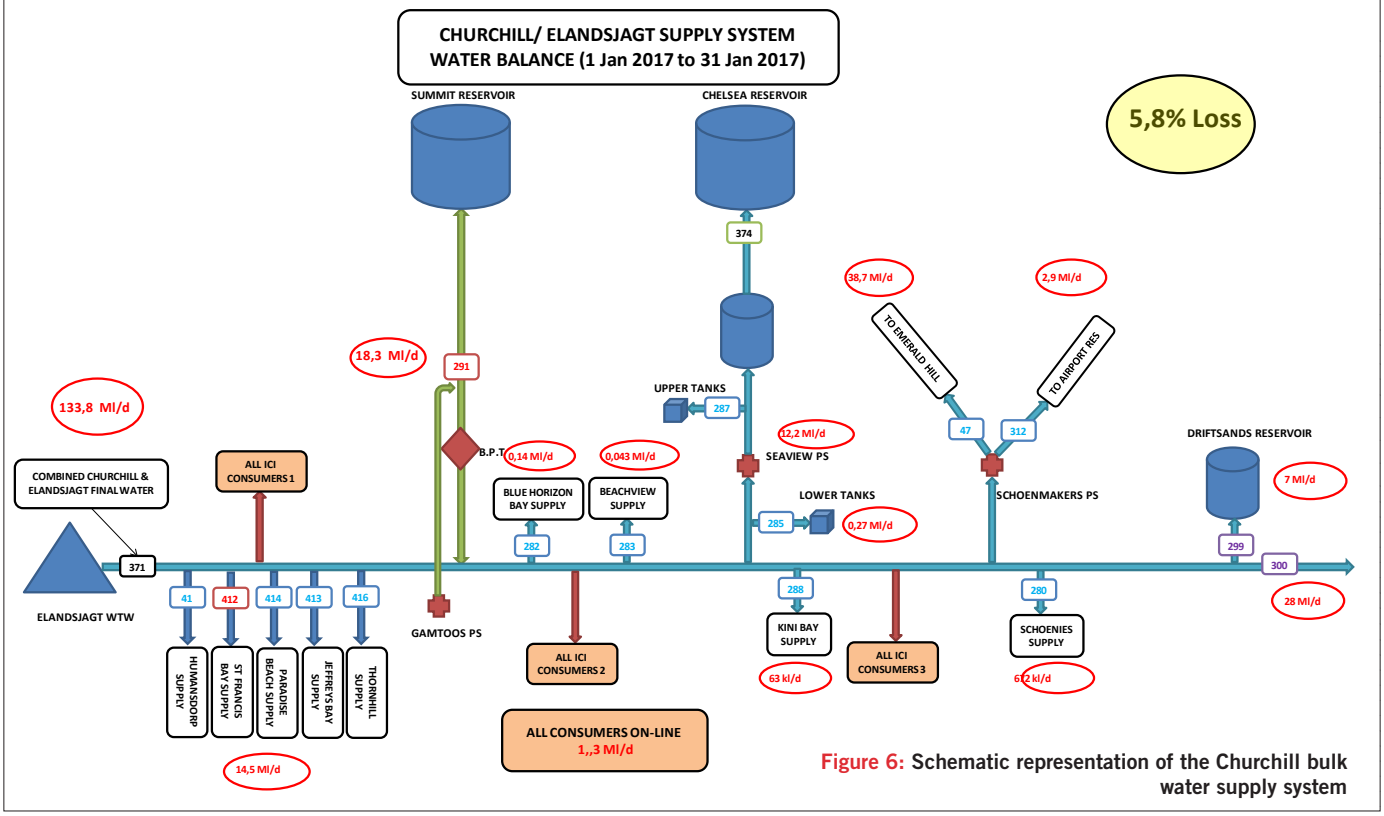

Figure 6: Schematic representation of the Churchill bulk water supply system

- Significant effort and resources are required to establish water supply zones which form the foundation of managing NRW within the context of the water supply system. A formal procedure for the operation of zone boundary valves must be established and adopted by relevant stakeholders in the municipality to maintain zone integrity;
- An effective non-revenue water programme provides an excellent return on investment.

6. WAY FORWARD – "MAINTAINING THE MOMENTUM"

NMBM has successfully implemented various initiatives including a Water Management System, development of the Water Master Plan and a multi-faceted Non-Revenue Water Programme. The significant improvement in the management of the water supply system cannot be attributed to one initiative alone but the comprehensive strategic approach taken by the utility. It must be emphasised that undertaking WC/WDM is not a once off project but rather a continuous programme. The programme needs to be funded through adequate budgets and requires a water management section, dedicated to best practice, maintaining momentum and moving towards attaining and ultimately overtaking benchmark standards.

While real losses has decreased appreciably over the last three years (by at least 8. 3%), a number of initiatives are still in progress for which the full impact has not yet been achieved. Other initiatives (including those targeting apparent losses), through continued effort, will see on-going benefit to both NMBM and its consumers.

Existing initiatives to be prioritised going forward include:

- Education and awareness relating to water conservation and water use efficiency
- An accelerated roll-out of the zoning programme and the active management and monitoring of these zones (to establish discrete district metered areas for the entire water supply system)
- Pressure Management programme for maintenance
- Optimising the current meter reading and billing system (to reduce reading errors, estimates and zero consumptions)

New initiatives include:

- Implementation of flow limiters for ATTP consumers who use excessive volumes without payment. Prior to introducing this measure Council needs to approve and awareness undertaken to gain acceptance.
- Consideration of installation of rainwater tanks for new dwellings and households that have swimming pools
- An on-going maintenance programme for Schools to be established in partnership with the Department of Education
- Availability of funds to maintain and operate the system while providing new services to a growing constituent is fundamental to the success of the utility in terms of service delivery. The benefit of reducing Non-Revenue Water and thereby increasing revenue remains critical to the success of the utility in providing a sustainable water supply service to Nelson Mandela Bay.

7. REFERENCES

Africoast, Nelson Mandela Bay Municipality: Water Master Plan Review 2011-2035, November 2012.

DWS, June 2013, National Water Resource Strategy, 2nd Edition.

DWS, Guideline for the preparation of an IWA Water balance and Water losses, August 2014.

R McKenzie et al, 2012, The State of Non-Revenue Water in South Africa (2012), TT522/12, WRC.

Uhambiso Consult, Integrated Water Resources Management Strategy (IWRMS), January 2015.

Van den Berg et al, April 2011, Department of Water Affairs, South Africa. 2011. Reconciliation Strategy for the Algoa Water Supply System.