

Nelson Mandela Bay Municipality Water Loss Programme

INTRODUCTION

The Nelson Mandela Bay Municipality (NMBM) embarked on a large-scale water conservation and water demand management (WC/WDM) programme in 2009. The objective is to reduce non-revenue water (NRW) by 15% within ten years (non-revenue water is the difference between 'system input volume' and 'billed authorised consumption'). The severity of the recent 2009 to 2011 drought in the Eastern Cape resulted in the municipality intensifying many of the WC/WDM interventions, all with the view to reducing NRW and water wastage and improving the sustainability of water services. Since the drought broke and the NMBM lifted their emergency water restrictions, the focus of the Water Loss Programme has shifted, putting more emphasis on initiatives that reduce unbilled authorised consumption and apparent losses.

BACKGROUND

The NMBM abstracts its water from regional water sources and the Lower Sundays River Government Water Scheme. For a number of years the municipality has abstracted its full allocation for water from the Gariep Dam, and demand is presently matching capacity of the various

water sources. Figure 1 shows the significant fluctuation in the supply dam levels over the last 37 months, highlighting the importance of water resource and demand management for the municipality.

The NMBM realised the need to implement a comprehensive WC/WDM programme, but has been hampered in its efforts by a lack of capacity. In recent years the Auditor General has queried the increase in non-revenue water. Benchmarking exercises between cities over the last few years have confirmed this. The Department of Water Affairs (DWA) asked the NMBM to put the necessary WC/WDM measures in place to reverse this trend.

The NRW has increased annually since the formation of the NMBM, and was standing at 40.2% of usage at the beginning of the programme. This can be attributed to a number of factors, including:

- Lack of education and awareness regarding water conservation amongst consumers, including the youth
- A high increase in water demand without a corresponding increase in water revenue
- Water losses on water supply networks attributed to ageing infrastructure, as

well as newer infrastructure that has been poorly installed

- Poorly maintained plumbing infrastructure in households in low-income areas
- High numbers of leaking water meters
- The NMBM being unable to capacitate and successfully deploy a WC/WDM section
- No active leak detection programme
- Un-metered connections and water meters not on the billing system

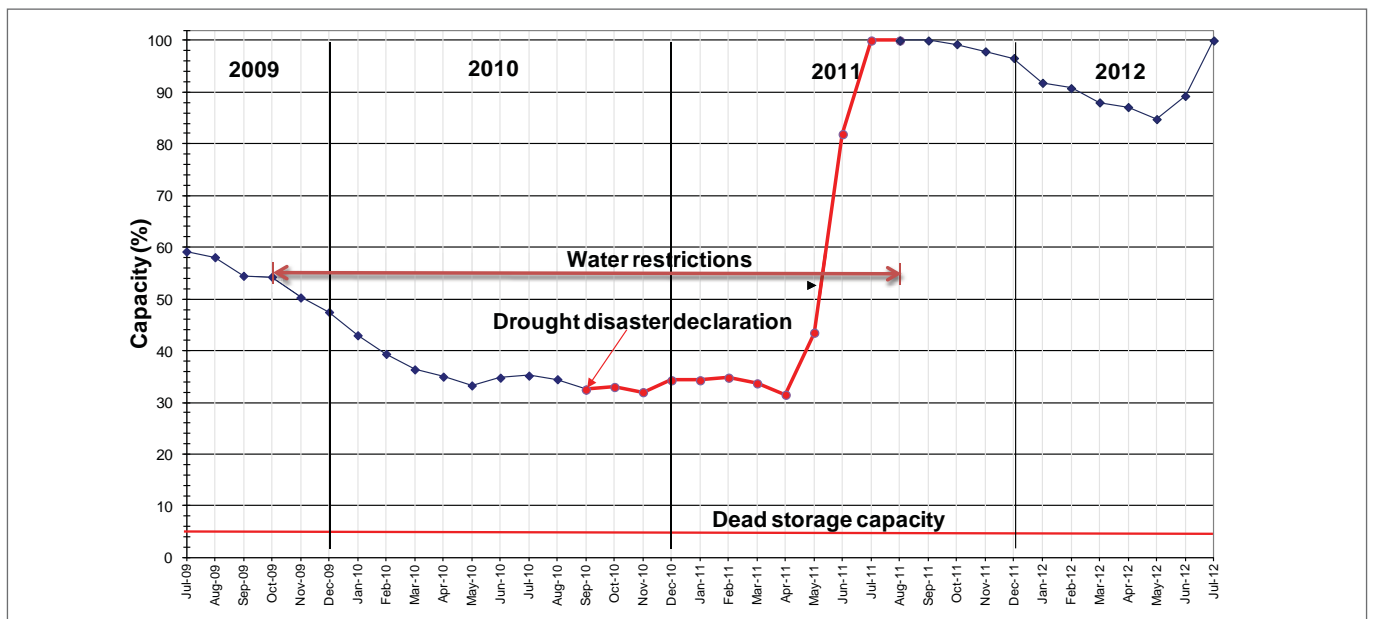


Figure 1: Storage capacity of the Nelson Mandela Bay Municipality dams (2009 to 2012)

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■ High water losses at many state schools. The need for a dedicated WC/WDM section was identified during the formation of the NMBM, and the organisation's organogram, which was created at the time, reflects this. However, due to the shortage of technical skills and despite numerous advertisements, no suitable posts could be filled. The NMBM have subsequently looked into employing suitable professional service providers (including management) to assist in implementing WC/WDM programmes.

The NMBM therefore appointed Uhambiso Consult (Pty) Ltd to assist in the development and implementation of an

Domestic area	Number of connections audited
Motherwell	30 864
Wells Estate	3 956
Khayamnandi	2 257
Kamvelihle (2nd sweep)	3 186
iBhayi	37 492
Aspen Heights	408
North End (Domestic)	374
Kabah	4 896
Jacksonville	1 121
De Mist	98
Bethalsdorp	3 234
Total	87 886

Figure 2 Summary of the domestic areas of Nelson Mandela Bay Municipality targeted to date by the programme

integrated WC/WDM strategy. This has led to the NMBM accepting an integrated water resource management approach to be implemented over the next ten years.

METHODOLOGY FOR LEAKAGE MANAGEMENT

The methodology for leakage management, as provided by Hydro-Comp Enterprises, is currently being implemented by the NMBM. This entails the following steps:

1. Zone prioritisation and identification
2. Preliminary water balance
3. Analysis of maintenance work
4. Recommendations for pressure management
5. Evaluation of minimum night flow results
6. Network analysis/zone calibration
7. Completion phase and zone commissioning.

As a starting point, the NMBM water supply system has been sectorised into approximately 203 zones using the EDAMS water and sanitation management system, which is a GIS-based engineering management information system.

In conjunction with this initiative, the NMBM identified the need for water loss services to be carried out.

WATER LOSS SERVICES

The NMBM appointed a service provider, Re-Solve Consulting (Pty) Ltd, in April 2010 to provide water loss services, as part of the Water Loss Programme over a three year period. This work is carried out, zone by zone by dedicated teams assessing all components of the water supply system.

Domestic consumers

The fieldwork comprises detailed investigation of the water supply infrastructure in domestic areas. This includes:

- Valve and fire hydrant audit (including update of as-built drawings)
- Meter audit
- Meter flow test for on-site leakage
- Leak detection (visual and sounding)
 - Mains
 - Valves and fire hydrants
 - House connections
 - Meters
 - Plumbing installation on properties.

Out of a total of 210 000 properties, 87 886 have been audited to date (24 months into the programme as at the end of June 2012) as part of the Water Loss Services Programme. A summary of the residential areas targeted to date by the programme is shown in Figure 2.

The results shown in Figure 3 and 4 provide a summary of leaks and faults actioned as a result of the Water Loss Services Programme in the domestic supply areas targeted to date.

The results of the investigations were then submitted in the form of a report per supply zone to the lead consultant, Uhambiso Consult. Work instructions are issued to various contractors appointed by the NMBM to undertake repairs as follows:

- Leak repairs (municipal infrastructure)
 - Valves and fire hydrants
 - Water mains
 - House connections
 - Meters
- Leak repairs (internal leaks)
 - Leaks on plumbing pipes
 - Replacement of toilet cisterns

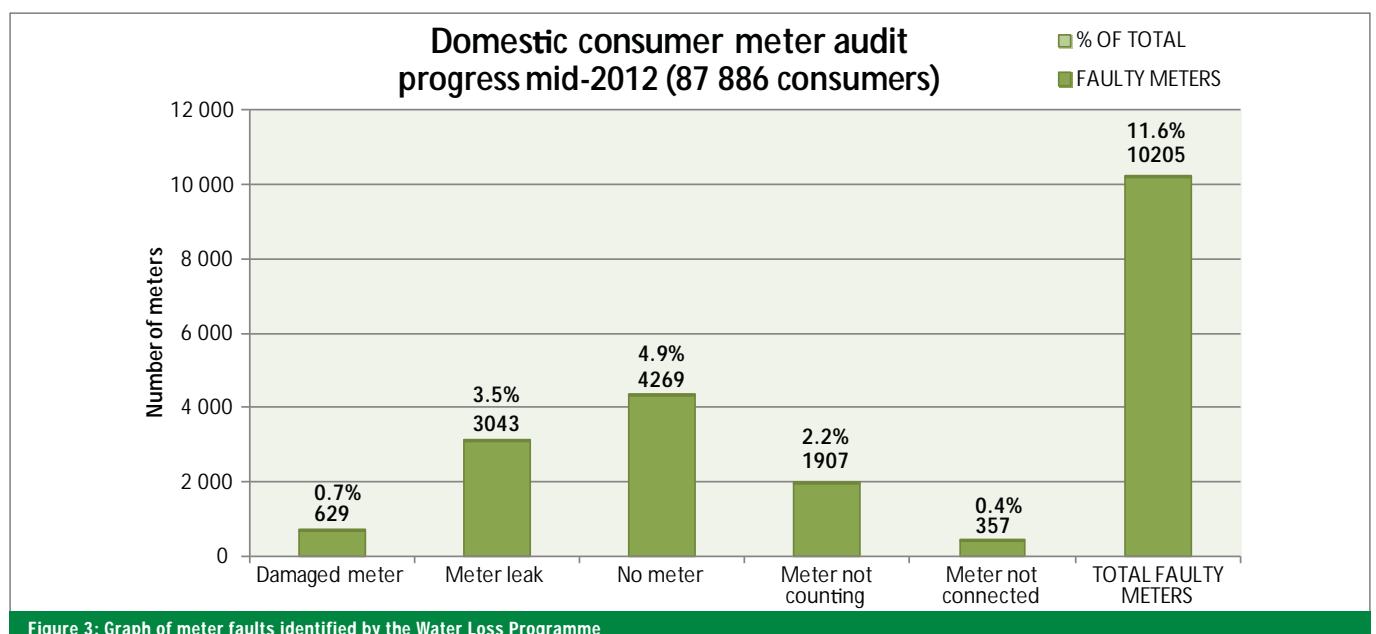


Figure 3: Graph of meter faults identified by the Water Loss Programme

- Meters
 - Repair/replacement
 - Installation (un-metered connections)
- Valve and fire hydrants
 - Repair/replacement
 - Chamber and marker repair/installation.

Urgent repairs such as large pipe bursts are prioritised in order to minimise water loss.

To date the following remedial work has been completed for the residential areas investigated by Re-Solve Consulting:

- Community-based semi-skilled plumbers have been appointed and trained to carry out leak repairs and install volume-control meters for registered indigent consumers with leaking plumbing

infrastructure (pipework, fittings, taps and toilet cisterns). For toilet leaks, the cistern is replaced with a siphonic action mechanism.

- Leaking and faulty meters (most severe in more recently developed low-income areas) are repaired or replaced by contractors working under the NMBM Water Installation Workshop.

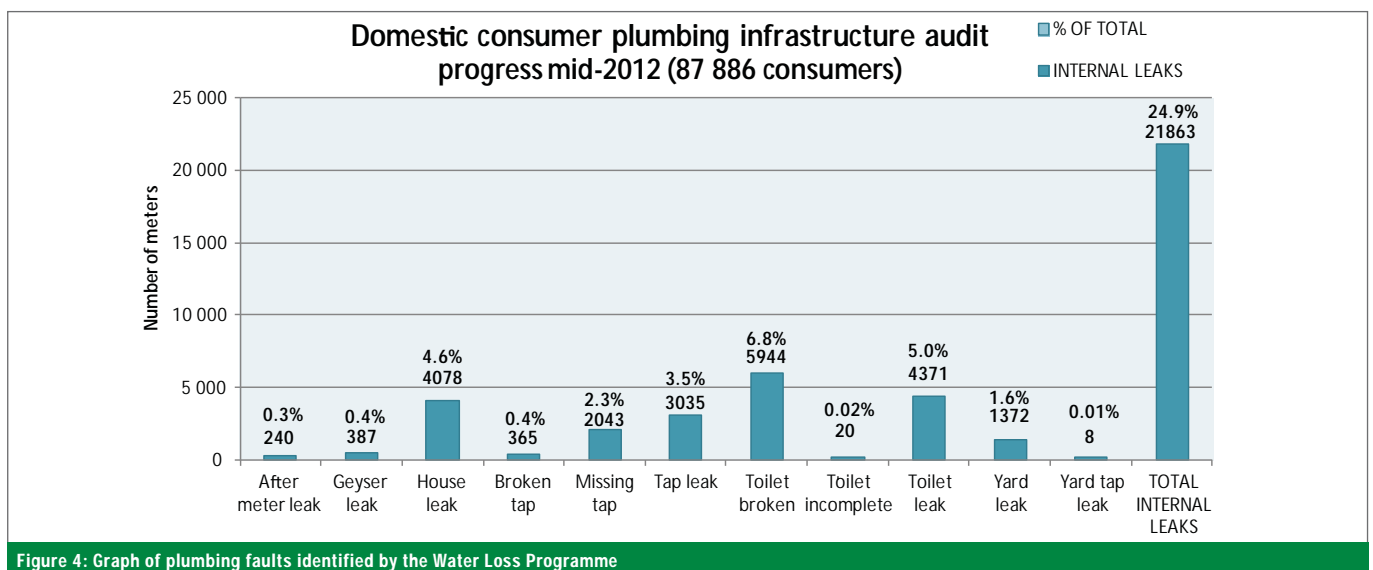


Figure 4: Graph of plumbing faults identified by the Water Loss Programme

- Un-metered properties and community standpipes have been metered and the necessary updates to the billing system carried out.
- Valve and fire hydrant faults (not shown on drawing, incorrectly shown on drawing, no cover/manhole, missing marker, not working) have been corrected by contractors and updated on as-built drawings where applicable.
- Large leaks/pipe bursts are repaired by the NMBM (typically within 24 hours). Once all visible leaks have been repaired and the zone made discrete, certain hydrants in the zone are level-surveyed and accurate pressure readings taken. These readings are used for network analysis/zone calibration, undertaken by Hydro-Comp Enterprises (Step 4



Burst pipe located during investigation in Wells Estate

above of the Methodology for Leakage Management), to identify areas with hidden/ underground leaks. These leaks are then located (using advanced leak detection equipment where necessary) and repaired, and a further flow analysis undertaken until the water losses have reduced to an acceptable range.

A comprehensive education and awareness campaign which made extensive use of the media, including newspapers, billboard advertisements and radio, was carried out by the municipality during the drought period to complement the technical interventions.

The NMBM is currently investigating the feasibility of implementing a combined debt management and active domestic leak repair programme. This will target residential consumers with high leakage on plumbing infrastructure coupled with a poor payment history for water services.

Water loss interventions: Motherwell, Kamvelihle

The flow logging results provided in Figure 6 for Motherwell, Kamvelihle, show excessively high minimum night flows (lowest consumption usually between midnight and 4 am) measured in August 2010 prior to the water loss investigations and follow-up interventions. This is compared with a reduced minimum night flow measured in May 2012.



Reticulation leak entering stormwater pipe through pipe joint

Interim logging results (taken in July 2011) showed that the leakage actually increased in the area following a first phase of interventions. The cause of the increase in water loss can be attributed to a number of factors, such as:

- An increase in pressure in the network (as a result of the first round of leak repairs) resulting in an increase in on-site leakage (failure of or leaking plumbing fittings on properties).
- Poor quality control of contractors installing on-property pipework and network connections (too shallow).
- On-going road construction in the area undermining the water supply infrastructure (damaging pipes).

The second phase interventions of all properties were then carried out by water loss teams (second sweep). This included:

- Stormwater investigation
 - Advanced leak detection (J Moorcroft – Underground Leak Detection).
- Targeted interventions following the second sweep included:
- Leak repair (municipal infrastructure)
 - Meter replacements
 - ATTP repairs (indigent household repairs).

It is noted that the excess night flow for the zone has been reduced by 19.1 kl/hr (22%) as a result of the interventions (excess minimum night flow calculated using the WRC SANFLOW Software). Sewer logging results taken pre- and post-interventions show a reduction in the minimum night flow of 5.1 kl/hr. The minimum night flow (MNF)/average flow ratio was reduced from 83.5% to 67.9%. The logging results also show, however, that there is still significant scope to further reduce leakage in the supply area. The results of the sewer

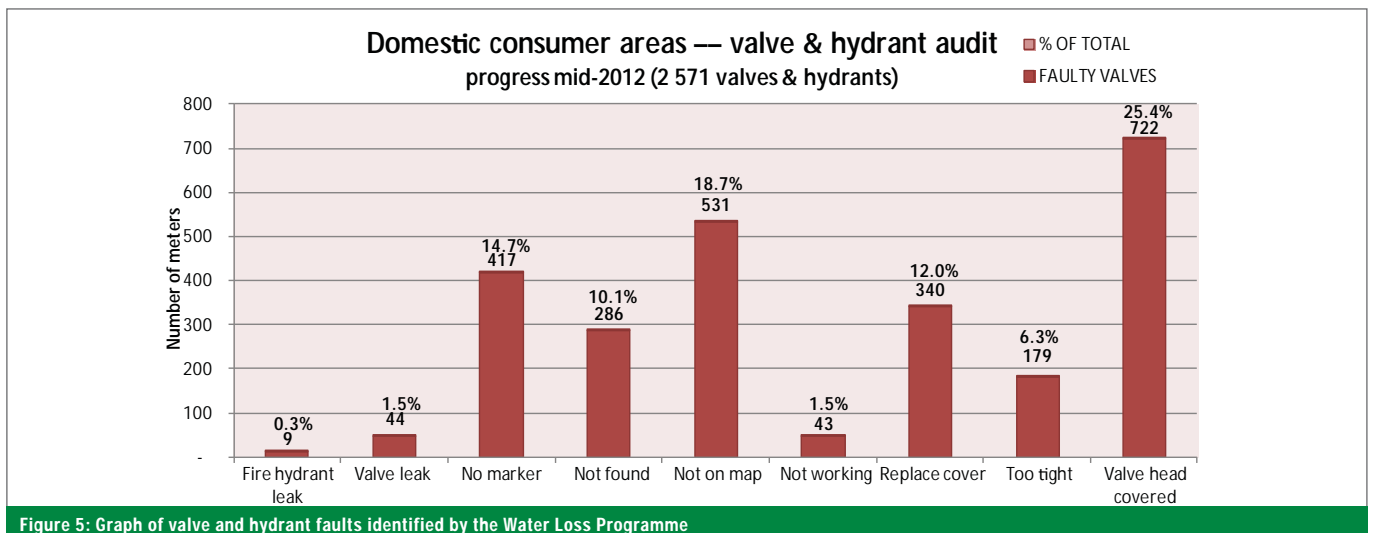


Figure 5: Graph of valve and hydrant faults identified by the Water Loss Programme

logging show a reduction in the minimum night flow of 5.1 kl/hr. The contributing factors to this reduction include the ATTP repairs (indigent household repairs). The revenue comparison in Figure 7 shows the combined impact of the Water Loss Programme in decreasing water losses. Non-revenue water has decreased through the various interventions targeting leakage while revenue water has increased through improved metering, meter-reading and billing. The return on investment has been calculated to be 16 months after the reduction of the MNF.

Water Loss Interventions: Bluewater Bay

An example of a middle-income area targeted during the Water Loss Programme is Bluewater Bay. Interventions undertaken in this supply zone include:

- Step testing (to apportion water loss per area within the supply zone)
- Active leak detection
- Valve and hydrant repairs/replacement
- Consumer meter audit
- Advanced pressure management

Following the completion of various remedial interventions, including the repair/replacement of valves and hydrants and the

repair of network leaks, a data logging exercise (pressure and flows) was repeated to assess the potential for advanced pressure management. Following positive analysis of the results, a new zone inlet meter and pressure reducing valve with advanced control (time and flow modulation) supplied by Dynamic Fluid Control (DFC) was designed. Camdekon Engineers, supported by the NMBM, arranged the installation.

The combined impact of the water loss interventions, most notably the installation of a correctly sized pressure reducing valve with time-based and flow modulation

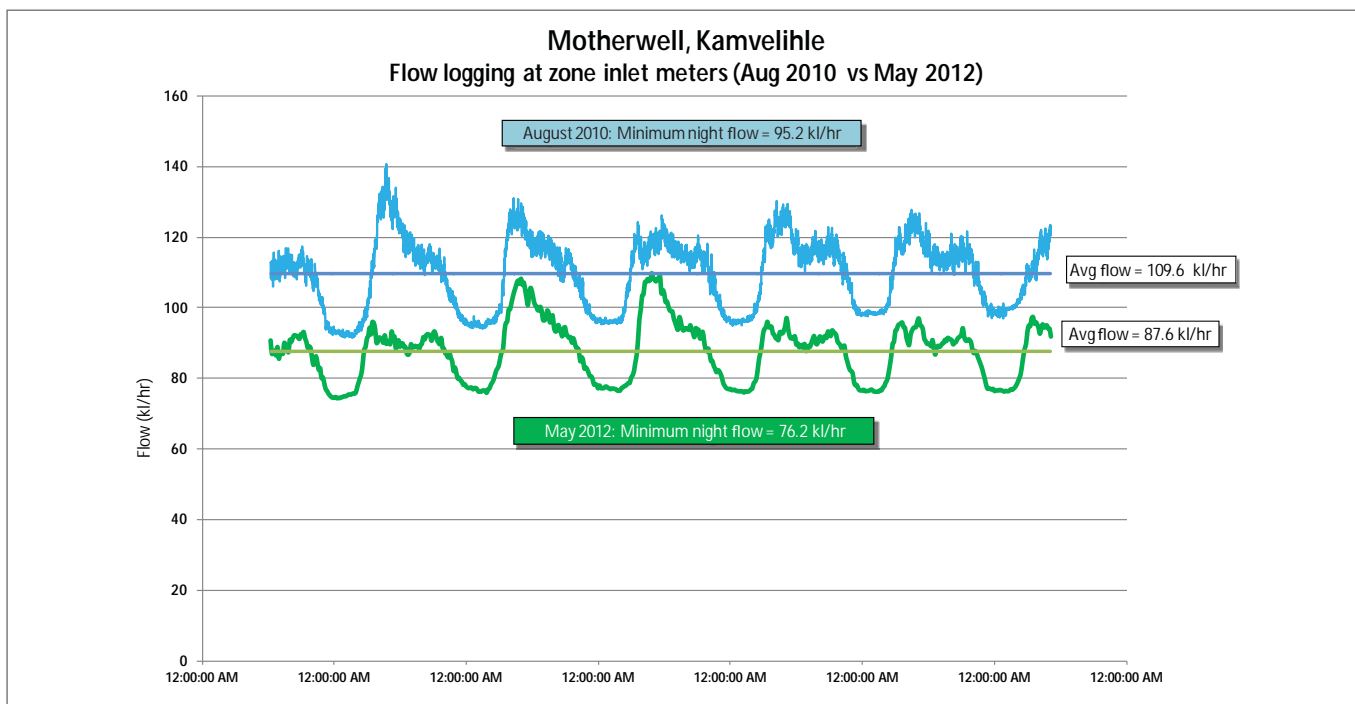


Figure 6: Flow logging results for Motherwell, Kamvelihle (August 2010 & May 2012)

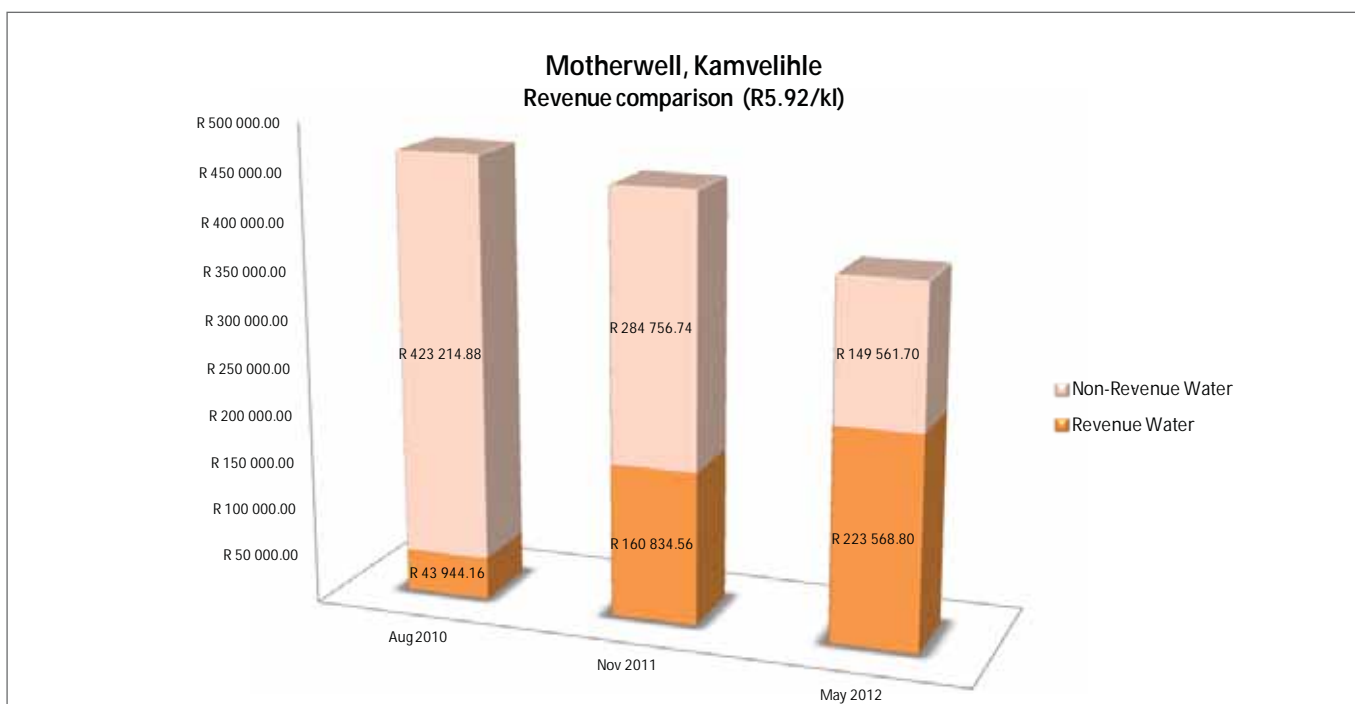


Figure 7: Revenue comparison for Motherwell (August 2010 – May 2012)

(activated in the event of a fire within the zone), has resulted in a significant reduction in night flows in Bluewater Bay. The MNF/average flow ratio was reduced from 65.8% to 28.5% (MNF reduced from 57.6 kl/hr to 14.1kl/hr), while the excess MNF has been reduced by over 80%.

The return on investment for the interventions undertaken in Bluewater Bay as part of the Water Loss Programme has been calculated to be less than six months.

Industrial, Commercial and Institutional Consumers

Included in the water loss services undertaken by Re-Solve Consulting, is an audit of industrial, commercial and in-

stitutional (ICI) consumers. This process includes the following:

- Valve and fire hydrant audit of industrial and commercial zones
- Meter audit
- Leak detection (visual and sounding)
 - Mains
 - Valves and fire hydrants
 - Meters.

The NMBM has identified schools as a priority component of the ICI audit due to significant potential to reduce water loss in schools. This is mostly due to dilapidated plumbing infrastructure, inefficient water use practices and low levels of payment for services.

The following industrial and commercial areas have also been targeted by the programme:

- Neave Industrial
- Perseverance
- Markman
- Struandale
- Deal Party

The results for all the Industrial areas audited to date (Figure 9) indicate the type of meter issues that are actioned as a result of the Water Loss Services Programme. Significant potential for improved revenue collection has been realised by the municipality by implementing this comprehensive ICI audit. This audit also included targeting

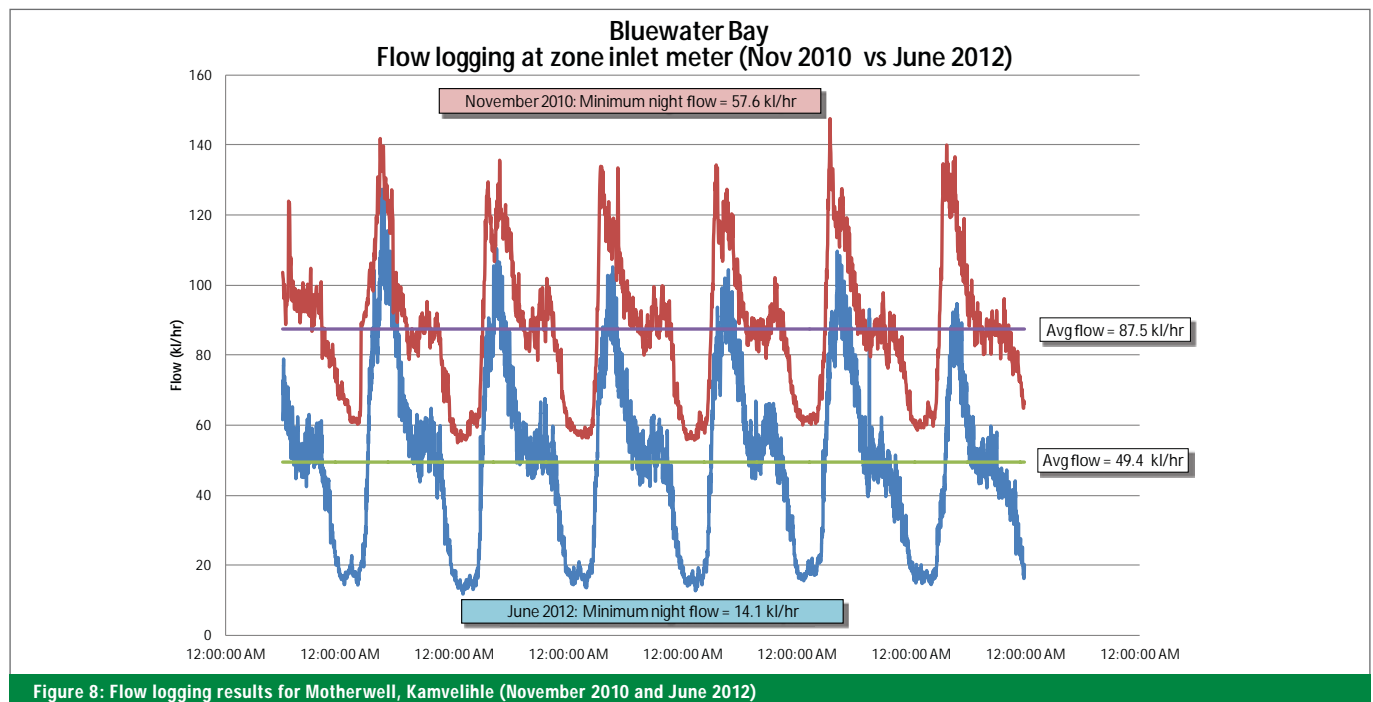


Figure 8: Flow logging results for Motherwell, Kamvelihle (November 2010 and June 2012)

Area Industrial		Audit		Faults			
		Connections	Valves & hydrants	Unmetered fire connections	Unmetered properties	Meters not working	Valve, hydrant & reticulation
Neave Industrial	No Off	136	106	8	2	9	60
	%			6%	1%	7%	57%
Motherwell ICI	No Off	52	0	2	0	8	0
	%			1%	0%	6%	0%
Markman Industrial	No Off	66	111	0	0	8	43
	%			0%	0%	12%	39%
Perseverance Industrial	No Off	50	43	2	0	2	16
	%			4%	0%	4%	37%
Struandale Industrial	No Off	26	76	0	1	6	37
	%			0%	4%	23%	49%
Uitenhage	No Off	284	0	5	5	89	27
	%			2%	2%	31%	
Deal Party	No Off	152	140	14	0	24	0
	%			9%	0%	16%	0%
New Brighton ICI	No Off	217	0	0	11	32	0
	%			0%	7%	21%	0%
North End Industrial	No Off	619	0	4	17	60	0
	%			3%	11%	39%	0%
TOTAL ALL INDUSTRIES	No Off	1602	476	30	20	117	156
	%			2%	1%	7%	33%

Figure 9 Industrial, commercial and institutional consumer meter audit – summary of findings

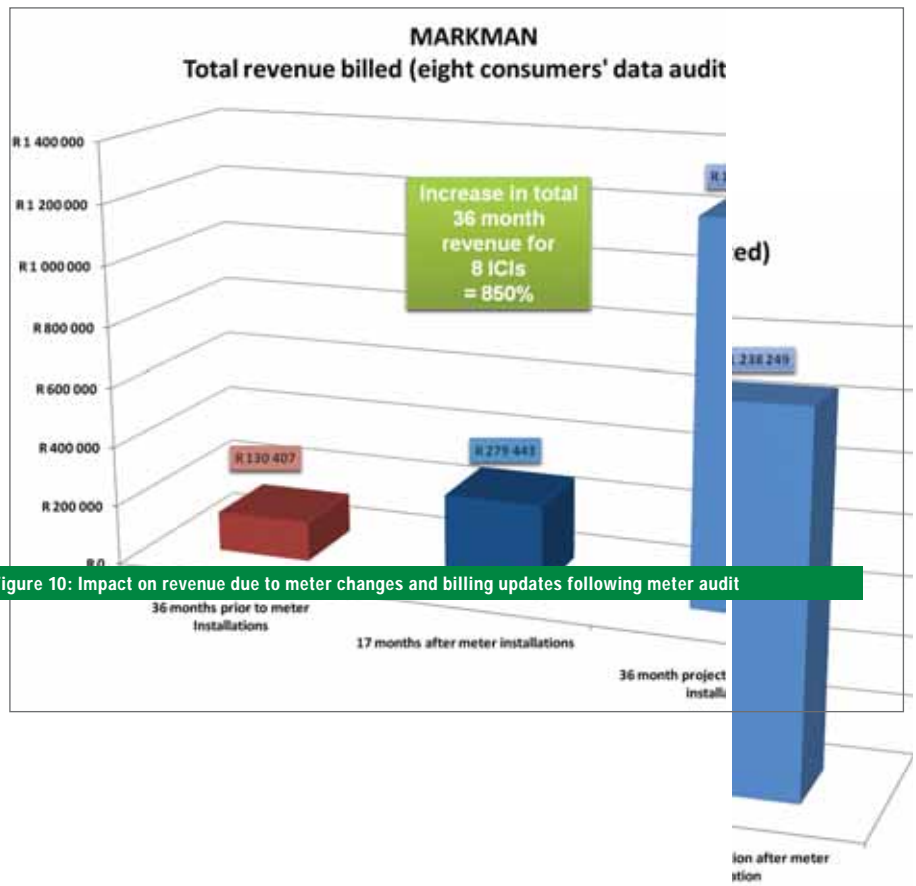


Figure 10: Impact on revenue due to meter changes and billing updates following meter audit

- Water supply zones that cannot be isolated (made discrete) due to faulty zone boundary valves. Certain zones cannot operate according to design, due to low pressures resulting from the excessive head loss in the supply network associated with the abnormally high water loss in the system.
- Leaking plumbing infrastructure on houses recently installed with solar geysers.
- Water wastage as a result of damage to the water supply network by contractors responsible for the installation of bulk services (roads and stormwater).
- No access to certain residential areas due to political interference/infighting.
- Delays in completing repairs due to material shortages and contractual disputes with the municipality (repair contractor).
- Low-income houses (excluding indigent) with high levels of on-site leakage.
- Additional leaks discovered after initial leaks repaired (as a result of an overall increase in system pressure as visible leaks are repaired).

WAY FORWARD

The NMBM Water Loss Programme has to date achieved significant success through the implementation of the various interventions discussed, including reducing physical losses from 29.3% (27 560 584 kl/yr) to 21.0% (19 272 764 kl/yr). NRW has been reduced from the 40.2% at the start of the programme to 36%. Combined savings as a result of the programme are estimated to be in the region of R16.2 million for the 2011/12 year. The goal to reduce NRW by 15% in ten years is obtainable, given the success of the Water Loss Programme to date and the intent to continue to roll-out sustainable, targeted interventions going forward.

CONCLUSIONS DRAWN FROM WATER LOSS PROGRAMME

- Ensure good standards in material, workmanship and quality control in 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 need to be considered, such as installing road crossings in pipe ducts and increased pipe cover.

- Experience indicates that an area needs to be investigated at least three times. As leaks are repaired, pressure increases and new leaks develop.
- Proper awareness and education about services must be provided to recipients prior to houses being handed over.
- Pressure management must go hand in hand with leak repair programmes.
- Delivery of a sustainable service requires an on-going Water Loss Programme, not once-off exercises, but continual monitoring and analysis as a basis for targeted interventions.
- An effective Water Loss Programme will provide an excellent return on investment.

ACKNOWLEDGEMENT

The Nelson Mandela Bay Municipality is thanked for their support and for the use of their data. □

Source:

http://www.saice.org.za/downloads/monthly_publications/2012/2012-Civil-Engineering-October/#/0