Alliance to Save Energy
WATERGY CASE STUDY
Emfuleni Municipality, South Africa

BACKGROUND

Sebokeng and Evaton are two previously disadvantaged, sprawling residential areas located in the Emfuleni Local Municipality, which is serviced by Metsi-a-Lekoa, the water and sanitation business unit of named municipality. These areas support a population of 420,000 and consist of approximately 65,000 freestanding housing units.

Key Results

- Performance contracting applied to water supply
- Payback period less than 3 months
- Annual cost savings: US$ 3.8 million
- Annual energy savings: 14 million kWh
- Annual water savings: 8 million kL
- Annual GHG emissions avoided: 12,000 tonnes
- Innovative application of pressure management technology has reduced water losses by over 30%

As a result of relatively high pressures in the water network, many on-property plumbing fixtures fail prematurely resulting in leakage and water wastage. Due to various socio-political and socio-economic factors, most failed fixtures remain in a state of disrepair and continue to waste water over lengthy periods of time, sometimes even years.

The overall effect is high levels of water wastage as measured in terms of Minimum Night Flow (or MNF, the best indicator of the level of water leakage and wastage for a particular area). For Sebokeng/Evaton, MNF amounted to 2800 m^3/hour, enough water to fill two Olympic sized swimming pools every hour! This is the highest recorded night flow on record for almost a dozen countries. Of all water flowing into these homes, 80% was lost through leaking plumbing fixtures.

Figure 1 at right shows the logging results of the MNF for Sebokeng/Evaton, as logged on the two dedicated bulk water supply lines into the area. From the graph it can be seen that the MNF is 70% of the average peak daily demand flow rate! By comparison, **Figure 2** on the next page illustrates what the MNF should be for an area where leaks are managed both on properties and within the network.

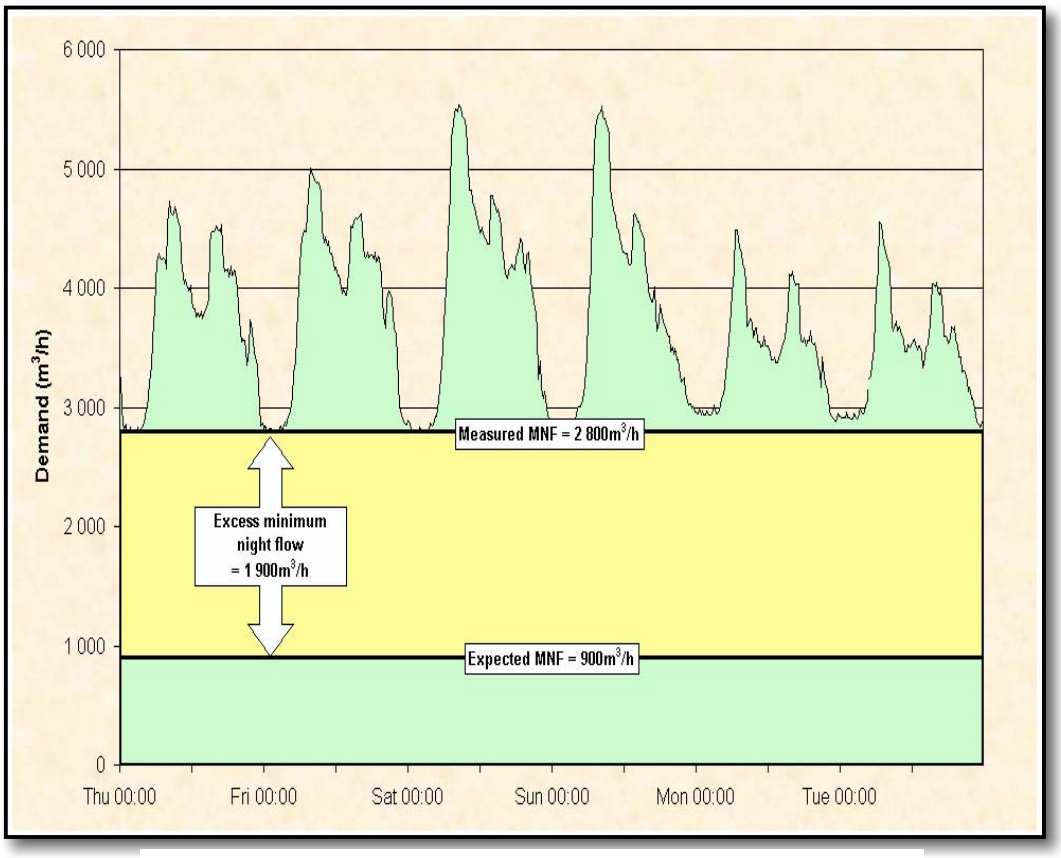

Figure 1: Minimum night flow for Sebokeng/Evaton

Furthermore, it has been established that the bulk of the leakage in Sebokeng and Evaton is occurring within homes, based on night time sewer flows of 2500m³/h entering the wastewater system, representing 80% of the volume of water flowing into these same areas.

THE TECHNICAL SOLUTION

Although theoretically it is possible to reduce wastage by repairing leaks on properties, it makes more technical and economic sense to first reduce higher operating pressures to prevent further damage to existing fixtures and potential damage to repaired and/or replaced plumbing equipment. This can be achieved through *advanced pressure management* which not only reduces and controls high pressures, but also allows pressures to be reduced even further at nighttimes when full operating pressures are unnecessary due to low demand and minimal usage.

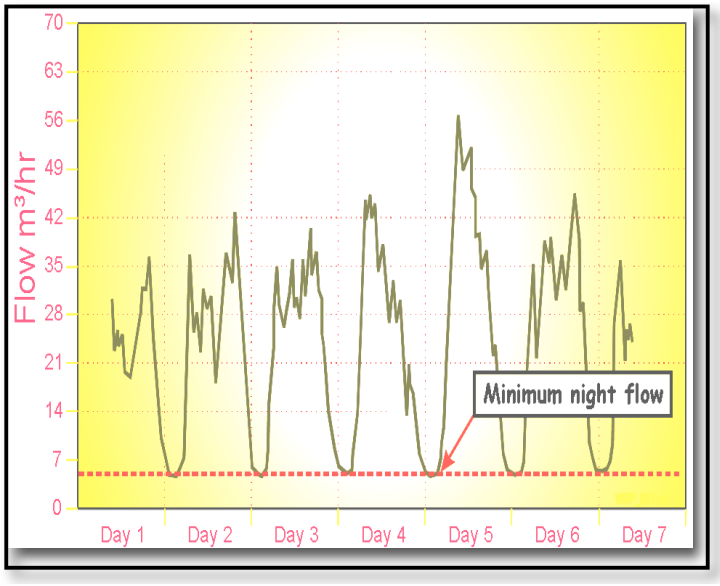

Figure 2: Minimum night flow for an area where leaks are managed and repaired, both on properties and within the municipal water network.

In theoretical and empirical terms, leakage is driven by pressure. When pressure is lowered, the water lost through a hole or leak is reduced. This holds true for all leaks, whether the leak is a typical burst pipe or simply a leaking tap, tap washer or toilet. The two photographs below in **Figure 3** graphically illustrate the difference in volumes of water lost under high pressure and under low pressure for the same burst pipe. It is also noted that over time higher pressures tend to exacerbate the damaged pipe or fixture, having a 'cutting' effect on the 'hole' and causing the 'hole' to increase in size over time.

Advanced pressure management is also very cost effective. This is especially true in the case of Sebokeng/Evaton where municipal water is supplied from a single point through two co-located and parallel spur-feed pipelines. The

Figure 3: Typical burst water main at high and low pressure

construction consists of a single large above-and-below ground chamber to house all of the required equipment. The installation of inlet and outlet manifolds allows for possible cross-over and hence greater flexibility in supply, as shown in **Figure 4**. Construction of the chamber (shown on the next page) was completed in September 2005. The total estimated capital cost of the pressure management installation is R5 million ($800,000) with anticipated savings in water supplied of R25 million per annum.

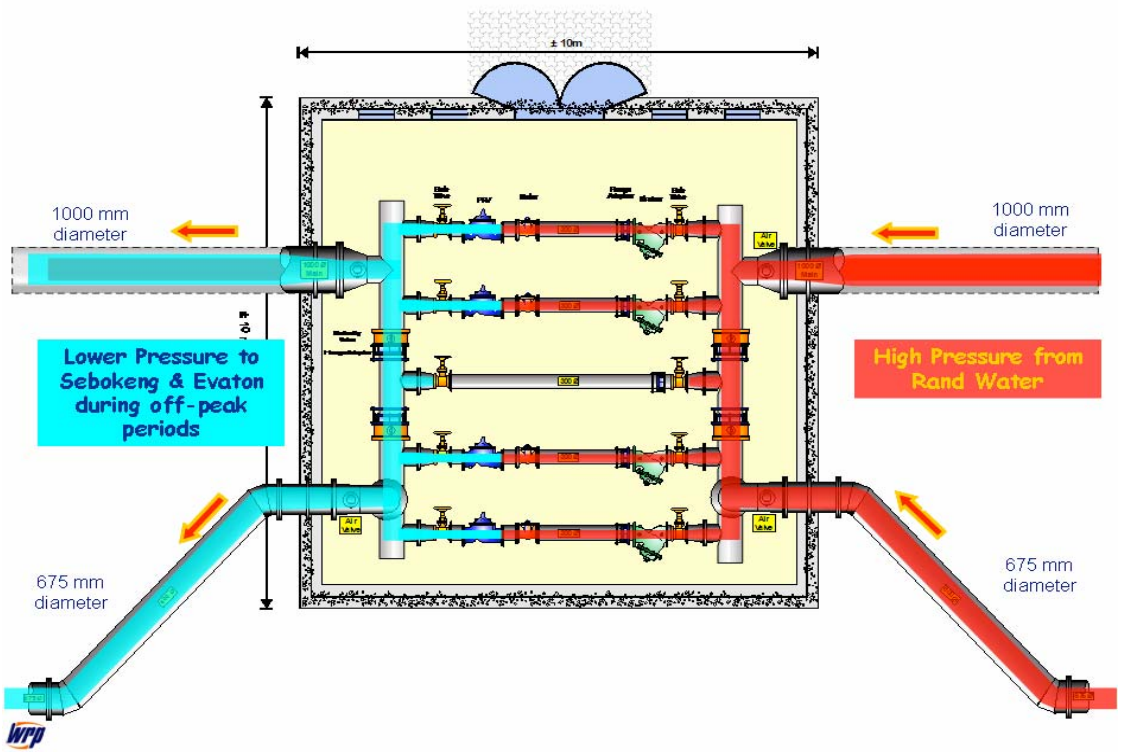

Figure 4. Schematic representation of the Sebokeng/Evaton pressure management installation

EFFICIENCY GAINS

This project has reduced water losses by over 30%, saving about 8 million kL per year with an equivalent financial value of around $3.5 million. Because of the water-energy nexus and the energy required to pump water, these water savings also translate into energy savings of around 14,250,000 kWh per annum. This corresponds to a reduction of about 12,000 metric tonnes of greenhouse gas emissions every year.

CONTRACTING MECHANISM

This project lends itself to performance contracting and the application of a BOOT (Build-Own-Operate-Transfer) type arrangement. This contracting mechanism was deemed to be the best approach in light of the municipality's limited ability to access capital and its lack of technical capacity with regard to pressure management. The original Request For Proposals therefore called upon bidders to not only implement efficiency measures but to also provide funding for the project, with remuneration paid through the resulting savings in water purchases from the bulk supplier of water to the municipality. This shared savings approach is common in the electricity industry.

The savings in water are so significant that both the municipality and contractor gain, with 80% of the savings accruing to the municipality and the remaining 20% used as remuneration to the contractor for services provided over a five year period. The contractor is required to provide a basket of services including financing of capital, design, implementation, commissioning, operation and maintenance over the contract period as well as training of municipal staff in operations prior to handover. As the installed infrastructure is permanent in nature and has a design life of at least 20 years, the municipality will continue to achieve savings well beyond the initial five year period.

VALUE ADDED BY THE ALLIANCE TO SAVE ENERGY

The Alliance to Save Energy has played a crucial role in making this unique project happen. This includes assistance in conceptualization, planning, procurement, contracting and legal arrangements, negotiations, contract management and the statistical determination of future water supply projections (the baseline). Currently the Alliance is providing macro-level site supervision. Once construction is complete the Alliance will play the role of independent Technical Auditor for the verification of monthly savings and related payment to the contractor.

CONCLUSION

The Sebokeng/Evaton pressure management project will reportedly be the biggest installation of its type in the world when complete. It represents innovation in many respects and although the project may not necessarily be replicable as a whole, many of its technical, financial and contractual components will find application elsewhere, not only in South Africa but around the world.

All photos and figures courtesy of Ronnie McKenzie of WRP (Pty), Ltd.

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