

# The 101 of Smart Metering - Easier and harder than you think

Guenter Hauber-Davidson, Water Conservation Group

## Abstract

It is surprising to see how much confusion, misinformation and myth exists around 'smart water meters' when the reality is so simple. This paper attempts to demystify smart water metering by defining what a smart water meter is and how it works. It discusses the role of smart water meters in obtaining valuable water usage data. An overview is given of the technology which is utilised in smart metering and the set ups currently used. The paper emphasises the benefits and value of smart water meter data for large users through several case studies and examples.

## Introduction

Conserving water is becoming increasingly important all around the world as the globe faces a widening gap between ever reducing water supplies due to climate change and increased demand from population growth and lifestyle changes.

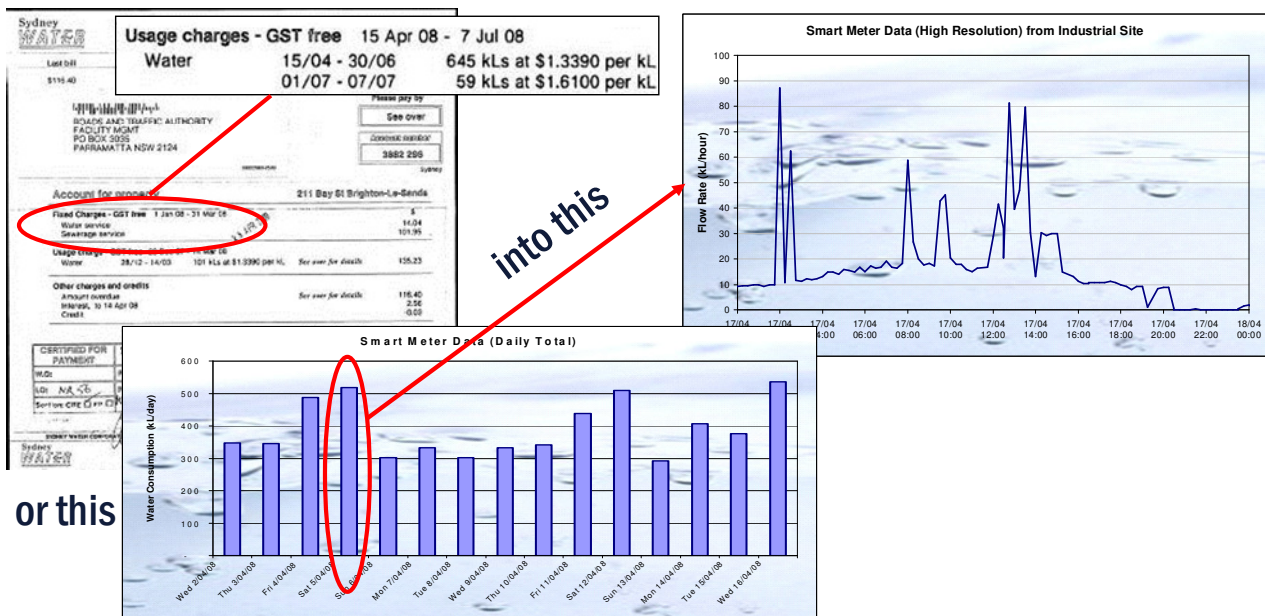
The first step in water conservation is to understand a site's water consumption and make it visible to either the resident or manager of the facility/factory. What you don't measure you can't manage. Smart metering plays a significant role in this. It brings water meter readings to a user's computer allowing continuous readings.

Large hope has been pinned on the impact this has on saving water for residential users. Numerous papers have been published on related studies. This paper however, focuses on the technology behind smart water metering what it can and cannot do and the unique challenges associated with it. It then focuses on what smart metering can do especially for large water users.

## What is Smart Metering?

Smart metering is the continuous reading of a water meter displayed on a computer. It turns simple monthly or quarterly billing data or individual readings into a continuous display. It permits to understand the underlying consumption patterns. This allows analysing abnormal water consumption, whether it was higher or lower in a particular period.

Frequently its greatest benefit is the identification of leaks, leakage that may have been gone unnoticed for years. Once a smart metering system is implemented it acts as an insurance against leaks with the system automatically providing an instantaneous alarm.



**Figure 1:** Smart metering turns a water bill or discrete readings into data showing how water can be saved

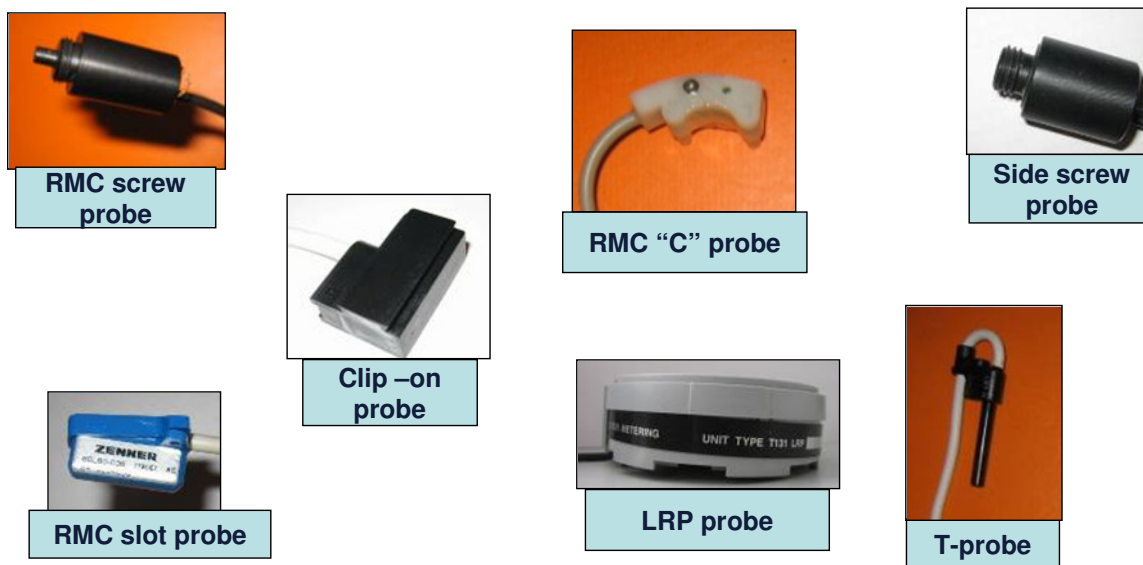
## Smart Metering or Automatic Meter Reading (AMR)?

Often the two terms are used synonymously. In theory, AMR should be considered a subset of smart metering. It denotes taking a single automatic reading of a water meter for billing purposes. Leak detection features may be included. AMR is often done for whole suburbs. It can involve thousands of metres. Much of the system intelligence and complexity centres around reliably picking up and processing metering data often gathered by simply walking or driving by the water meter.

In contrast, smart metering is the continuous monitoring, as opposed to taking discrete (automatic) readings, of a particular meter for improved water management. It can be for a single meter, a few in close proximity or many dozens at a site.

## How to Smarten up a Water Meter

A common misconception is that people believe a whole new water meter is required. Apart for some older models this is not the case. All that needs to be done, is to insert or attach a probe that records an electric signal (pulse) for a known volume of water that has flown through the meter. It is then just a matter of counting the pulses, just like Morse code, where each pulse represents x litres of water.



**Figure 2:** Turning a normal water meter into a smart meter is easy - as long as the right probe is found!

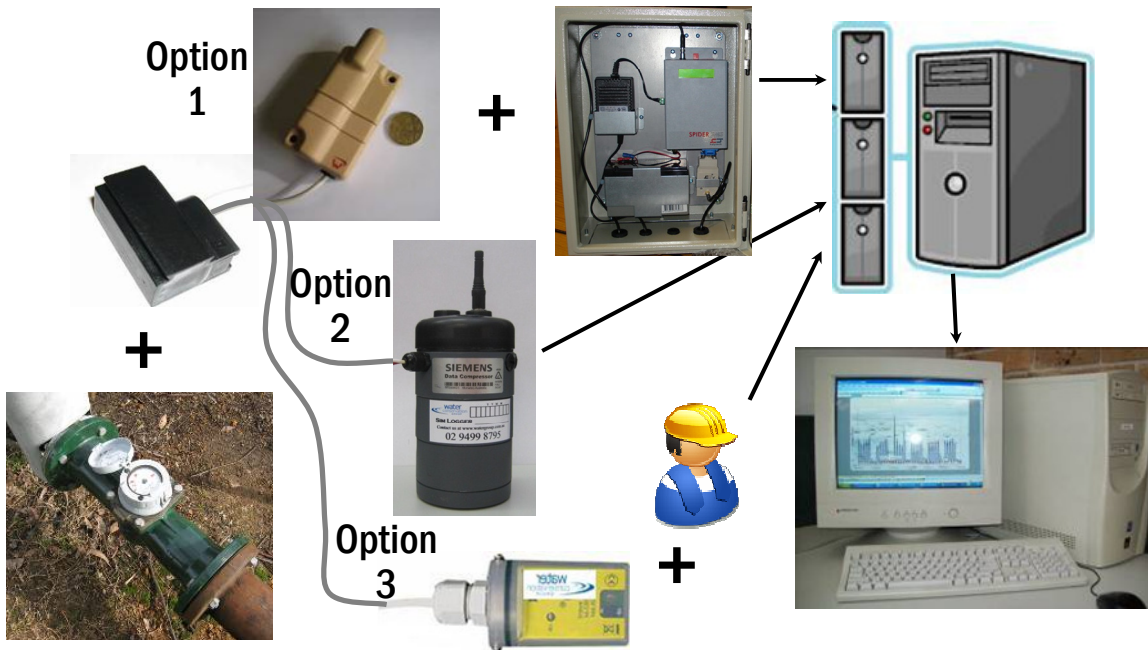
This signal can then be captured, logged and processed. Mobile phone technology, wireless modems, the internet and other data distribution technologies make it possible to bring this signal readily to a computer as water usage data.

## Special needs of smart water meters

By definition smart electricity meters are near power. Smart water meters often have to be completely standalone with no power nearby, exposed to weather and vandalism. Technology has been developed to have them battery-powered with low power consumption and independent communication in a rain and weather protected robust enclosure. They are vandal protected or cheap enough for easy replacement. Ideally, they should be plug and play for easy connection with the different probes available and other components. A smart meter should also be easy to troubleshoot.

## Different Connection Options

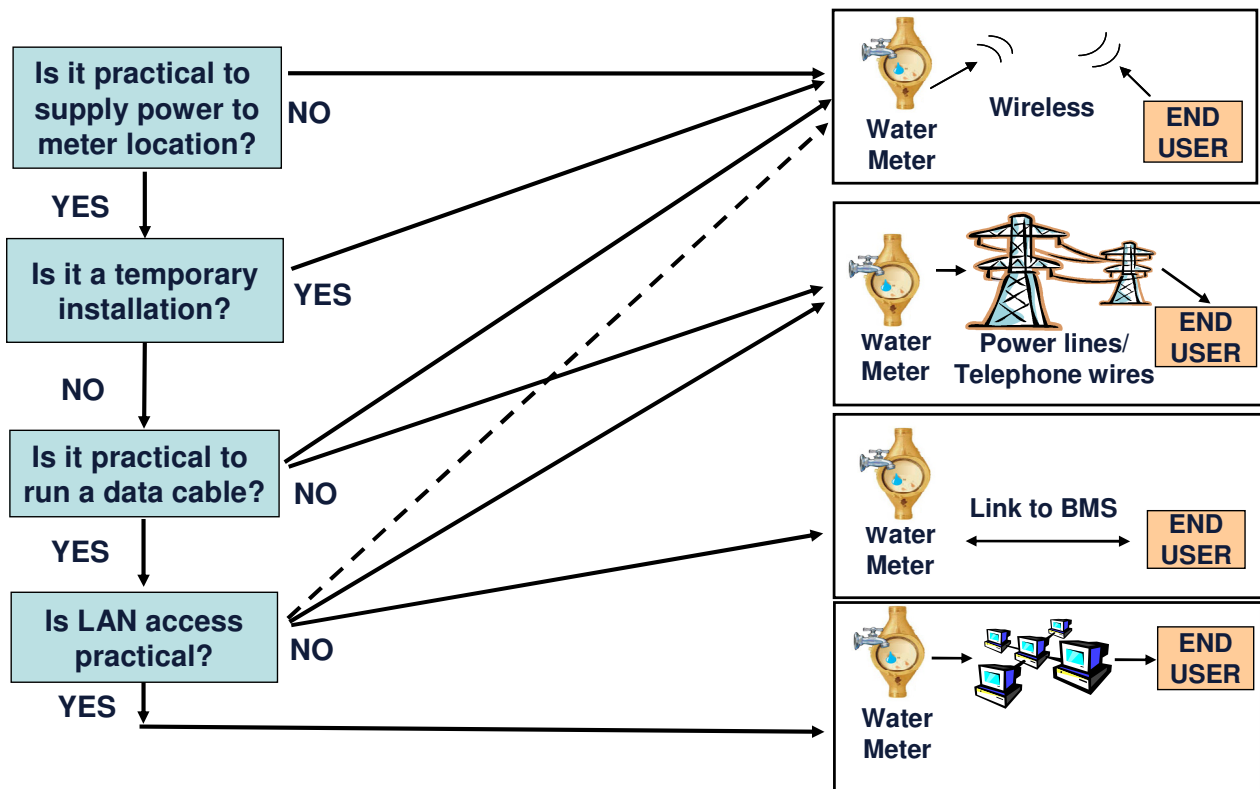
The probe can directly be connected to a data logger from where water consumption data can manually be downloaded (Option 3 in Fig. 3). Option 2 represents an independent standalone logger that can directly transmit data to a web server. These units may receive up to 4 hardwired meter inputs. In Option 1 a small transmitter is wired to the probe. It allows a wireless transmission of the pulse data from the water meter to a central receiving unit which then sends it to a web server. The receiving unit can capture as many wireless pulse transmitters as are within its reach (typically 100 to 300m).



**Figure 3.** Smart metering connection options

**Data Upload Options**

Data from the water meter can be uploaded to a connected computer in one of several ways (Figure 4). Modern smart metering technology uses all available communication options from mobile phone technology GPRS to using power cables, hard wiring to the existing building management system or using the corporate LAN. An individual assessment of each site's particular needs will identify the best practical option.



**Figure 4:** Decision tree to evaluate possible connection options

**Benefits of Smart Water Meters**

The six main benefits of smart metering can be summarised as follows:

- Distributed information of water consumption data
- Continuous water meter readings delivered to the user's PC
- Insurance policy against undetected leaks

- Cheapest way to pick up operational information
- Compliance with building requirements
- Automatic water meter reading

These six points are explained in detail below.

### ***Distributing water usage information***

Providing water usage data to all relevant people within an organisation is seen as one of the greatest benefit. Users can see their water consumption in near real time, adjust actions accordingly and get feedback the next day instead of waiting for the next water bill. Anybody who needs to know can view and report on the water consumption.

Across the organisation there is has a central depository for this data. No more fumbling for near impossible to find water bills. Data access for corporate reporting is greatly facilitated, which can even be incorporated into an automatic system. It creates significant efficiency gains offsetting a large part of the smart meter installation costs and sometimes even outweighing the water savings.

### ***Continuous water meter readings***

Seeing daily usage patters allows users to understand their water consumption. Abnormal usage patterns can be identified immediately and corrective action taken. Systems even allow an automatic alarming of such occurrences. It assists in establishing meaningful KPI's. It is the key reason why smart metering, embedded into a comprehensive water management program, typically saves at least 10% of the measured consumption.

### ***Leak insurance policy***

Smart metering allows to identify leaks as soon as they happen and not months after the event. Where 10 or more site meters are monitored for one organisation, it is almost guaranteed that the smart meter system pays for itself through the identification of a leak at at least one site. Hence, it can be considerate an insurance policy with the premium spread across a number of sites.

### ***Picking up operational information***

Experience has shown that monitoring the water consumption can be one of the most cost-effective methods to record other operational information. In the author's experience smart metering has provided socio demographic information regarding work, lifestyle and occupancy patterns. It has identified reduced productivity rates on a Friday as the work was carried over onto a Saturday for increased pay. In another example monitoring the water consumption was the simplest way to identify inefficient operation of a cooling room such as staff leaving doors open or inefficient cooling tower operation.

### ***Compliance with building requirements***

Frequently it is a requirement for a "green" building to have its consumption monitored via a smart meter and reported to achieve the desired level of certification.

### ***Automatic meter reading***

In special cases where reading the water meter is associated with high access costs this can be a significant benefit. For most other cases, despite common belief, it is only a marginal benefit. It comes as a side effect of smart metering.

### ***Who should get a Smart Water Meter?***

Anybody interested in their water consumption, really. However, smart metering is still relatively expensive. The cost of monitoring a water meter that measures \$100 worth of water consumption is exactly the same as for a meter that monitors tens of thousands of dollars worth of water. There are economies of scale, though. Generally, the more meters monitored on a site the smaller the cost per point becomes.

In Australia, true per point project costs, even for large residential smart metering projects, are still close to A\$1,000 per point. Until this price barrier is significantly lowered it is hard to see how smart metering can become mainstream while the cost of water is still low (<A\$2/m<sup>3</sup>) and individual meter readings for billing purposes can be taken at less than A\$1 per reading.

The equation changes completely for large water users especially with multiple sites. This is where smart water metering increasingly becomes the norm. For these entities, due to the benefits explained above, smart metering typically pays for itself within 2 to 3 years even if the cost of monitoring a single standalone location is as high as A\$2,500.

Nothing can provide a better argument for the business case of smart metering than some case studies. A few examples are listed below.

### Case Study 1: Water Consumption at a Market Site

As illustrated in Figure 5 the site showed quite a distinctive usage pattern including a significant base flow indicating leakage. Mid months this was addressed as the base flow dropped to zero. However, it was also noted that the consumption peaks were far higher than what they had previously been. Smart metering provided this information and allowed to investigate the reasons which were traced down to a different contractor providing washing down services. Once his work practices were corrected water use returned back to normal at the end of the month.

Without smart metering both the leak and the water inefficient work practices are likely to have gone unnoticed for months causing costs in the order of \$25,000/month.

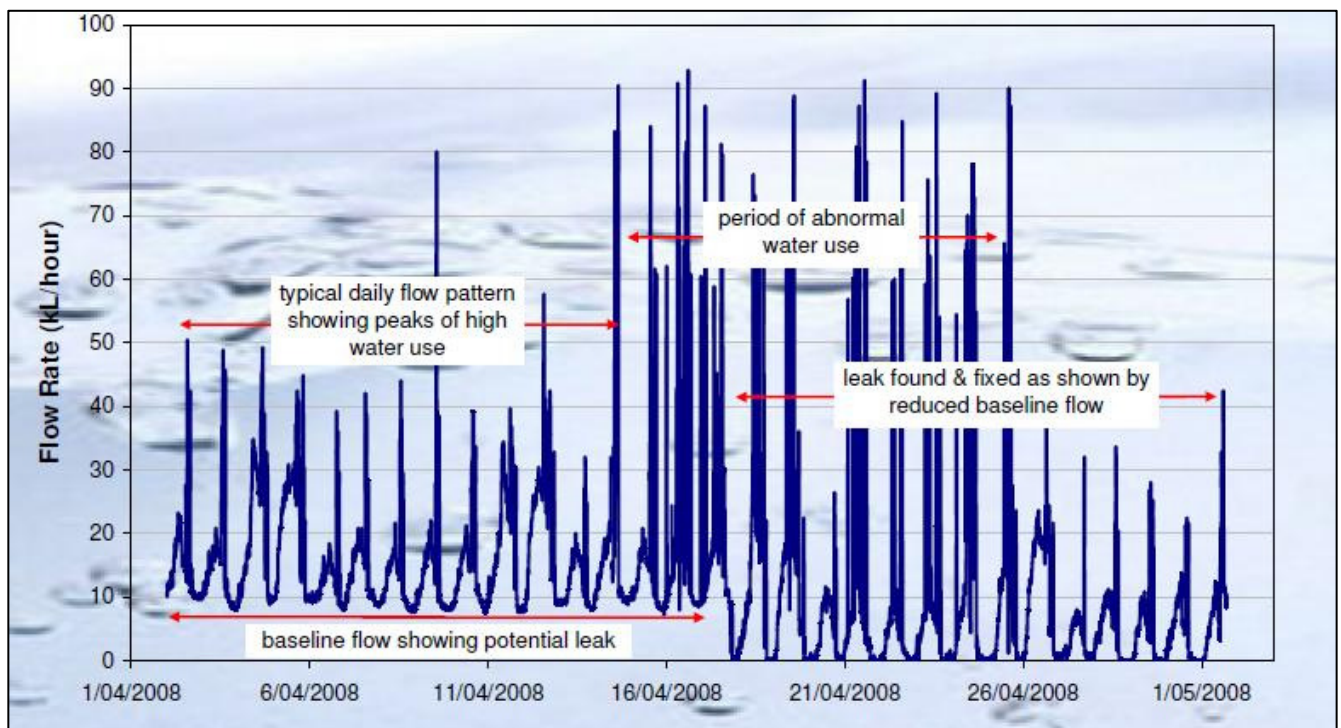
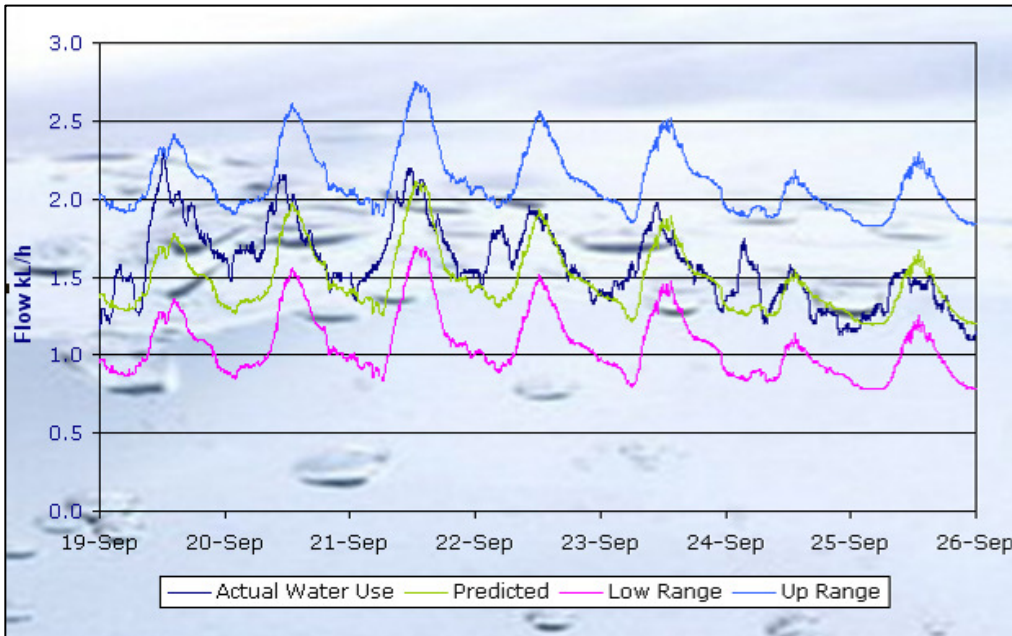


Figure 5: Water consumption at a market site

### Case Study 2: Predicting the water consumption for a cooling tower

Water consumption in a cooling tower is strongly related to the ambient temperature. For a cool store this relationship has been established and used to provide an upper and lower range band for the expected water consumption. This is now used to monitor water consumption. Usage outside this band is alarmed notifying the operator of any potential operational issues.

It has acted as an easy to observe operational indicator for when doors were left open or when the efficiency of the cooling tower operation deteriorated.



**Figure 6:** Predicting the water consumption for a cooling tower

### Case Study 3: Monitoring the Water Consumption of a Whole Village

In this case the water consumption of an entire remote indigenous community was monitored, from the water reservoir supplying water to the village to the wastewater treatment plant where water exited the site. All individual houses were also smart metered.

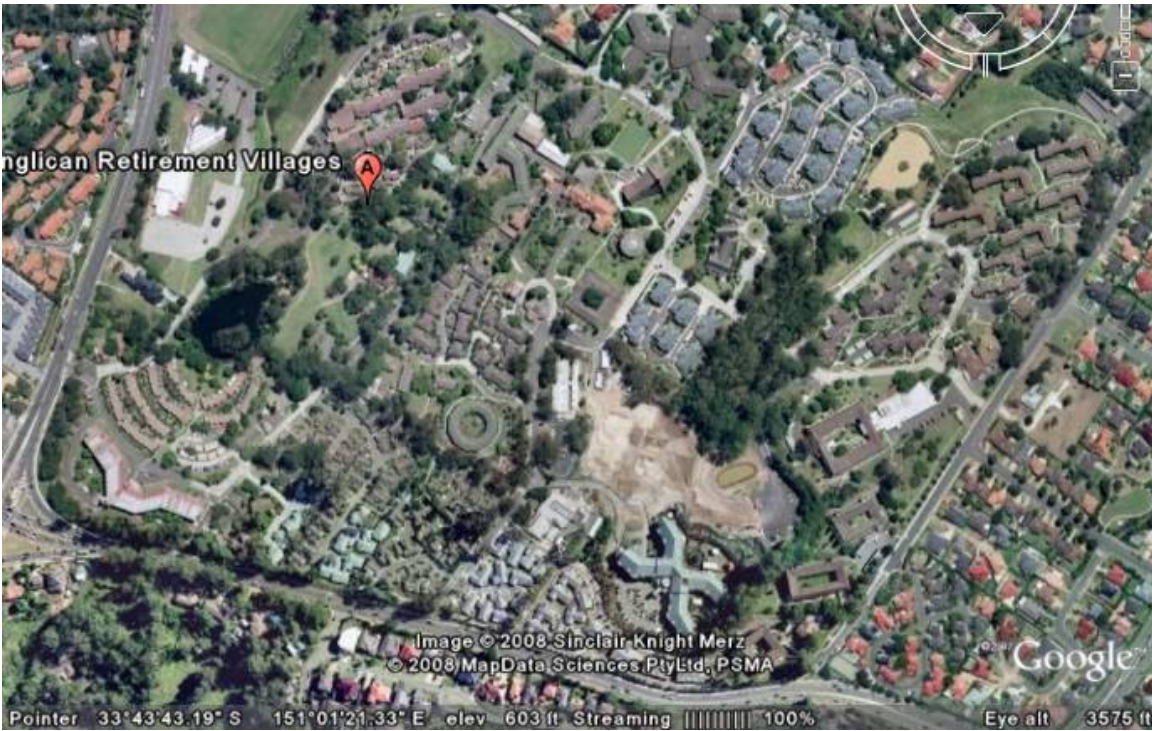
Smart metering data apart from identifying two major leakages and operational issues where water was recirculating between two reservoirs, was used to assist in assessing underlying socio demographic data. It showed the type of water using activity occurring at each house and gave an indication of occupancy patterns.



**Figure 7:** Smart metering a whole village

**Case Study 4: Residential Complex**

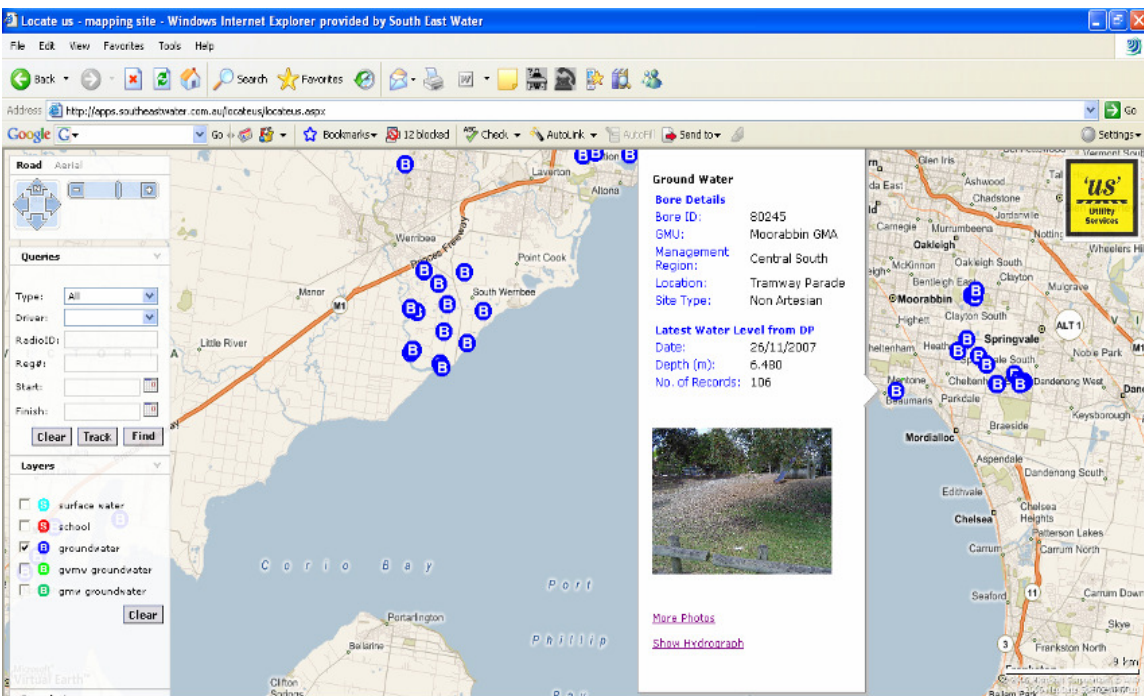
In this case a large retirement village was monitored through a multiple wireless data pickup solution. Within days leaks that had been going on for years were identified and rectified giving the whole project a payback period of less than two years.



**Figure 8:** Smart metering a residential complex

**Additional Features**

Smart metering is still a relatively young technology with plenty of ongoing developments. One recent example is overlaying a geographical information system (GIS) onto a smart metering website. The system now permits the operator to readily see the location of any smart meter. Each metering node becomes a hyperlink providing a map, aerial and photographs of the exact metering site. It also works in reverse. Clicking on any meter location on the map brings up the correlating smart metering data.



**Figure 9:** Example of merging technology: Smart metering combined with a GIS system

### **Conclusion**

Smart metering of water consumption is no wizardry. If done correctly it can be simple and robust. However, its specific needs must be appreciated. Smart metering is much more than AMR, an automatic meter reading. It can provide sophisticated usage information for water consumption issues. It is a powerful tool to support an integrated water conservation management system to achieve sustained water savings. It allows all concerned site users and managers to actively monitor the water consumption so they can readily intervene as soon as abnormal consumption is observed or an exception alarm is raised. Leakage in particular, is identified within hours. Such wastage going unnoticed for months on end becomes a thing of the past.

Understanding where, when and why what water is consumed helps to identify further water conservation opportunities and assists in achieving realistic savings. As the advantages of smart metering become clearer to more and more decision makers it will not be long before we wonder how we could ever have attempted to manage water consumption without smart water metering!

### **The Author**

**Guenter Hauber-Davidson** ([ghd@watergroup.com.au](mailto:ghd@watergroup.com.au)) is based in Sydney, Australia. He is the Managing Director of Water Conservation Group Pty Ltd, a national consulting, engineering contracting and smart metering company specifically set up to do whatever it takes to help large water users save water.