TRANSFORMA INSIGHTS

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LoRaWAN® for Smart Water Metering: Enhancing Efficiency and Sustainability

The benefits of smart water metering are many and varied, particularly including significant upsides in terms of both cost and sustainability. Low Power Wide Area (LPWA) connectivity technologies meanwhile, and particularly the LoRaWAN wireless networking technology, are particularly well-suited to supporting smart water metering.

In this report we discuss the benefits smart water metering (or Advanced Metering Infrastructure, AMI, for water) and how LPWA connectivity can support AMI for water. We also discuss LoRaWAN's role as a key option in the LPWA wireless connectivity ecosystem for AMI for water.

The benefits of Low Power Wide Area (LPWA) connectivity

The term LPWA includes a group of fast-growing wide area wireless technologies that are optimised for connecting 'things', not people. For decades wide area wireless networks (principally as offered by mobile network operators) have competed to provide consumers with more data and at higher speeds. Whilst the demand for such services seems to be near insatiable, this direction of development overlooks the needs of many IoT connected devices which generally require only low bandwidth connectivity, preferably at low cost, and often supported by battery power.

This is the exact gap that LPWA technologies are designed to fill. LPWA technologies generally offer:

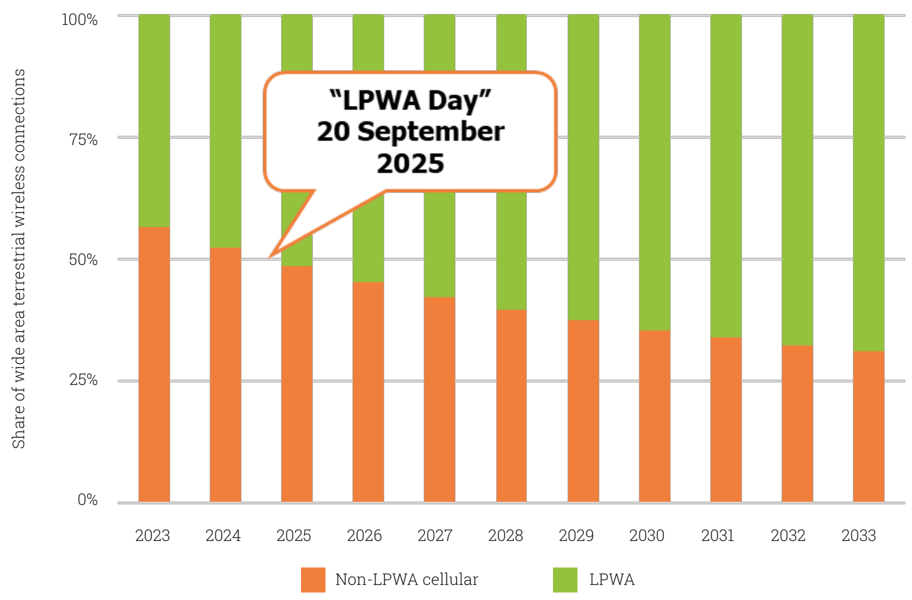
- Low costs, often with communications modules costing of the order of a few dollars and low network connectivity costs.
- Long battery life, often up to 10 years for basic monitoring applications, allowing for flexibility of deployment.
- Wide-area coverage, including broad outdoor coverage and good indoor penetration to reach devices that may not be ideally located from a radio-propagation perspective.

These benefits, which are ideally suited to many IoT applications, have been achieved by making two key trade-offs and LPWA connections have reduced throughput and increased latency. All in all though, the combination of pros and cons described above is a good match for a wide range of IoT solutions. Examples include smart metering, industrial infrastructure monitoring, environmental monitoring, security monitoring, a number of energy and natural resource management applications that are growing in importance, and so on.

The list of assets that can usefully be monitored with a low-cost battery powered device connected to a wide area network is almost limitless. As a result, and although the term 'LPWA' has only been in existence for a little more than a decade, Transforma Insights expects that the number of LPWA IoT devices will soon dominate the wide-area wireless IoT market, with what we term 'LPWA Day' (when more than 50% of the market for wide area wireless connectivity for IoT will be supported by LPWA) in around late September 2025, as illustrated in Figure 1, (right).

Figure 1: LPWA and non-LPWA Cellular connections for IoT

Source: Transforma Insights, 2024



LoRaWAN is a key LPWA technology

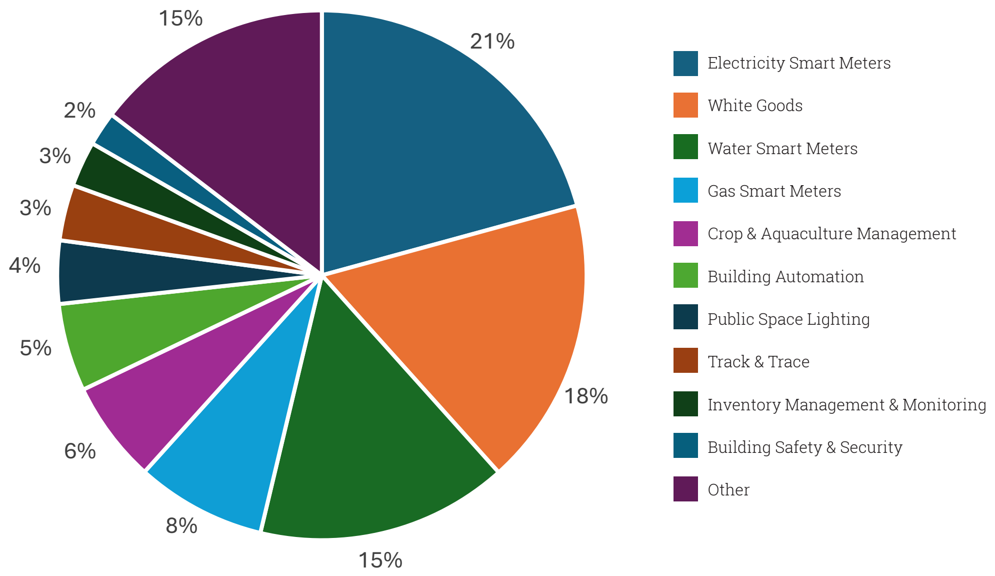
The LPWA market as a whole splits neatly into two segments. The first segment is comprised of technologies that tend to be deployed into licenced spectrum owned by mobile network operators. These include NB-IoT and LTE-M, which together are referred to as mMTC (Massive Machine Type Communications) and are part of the 5G cellular standards. The second segment includes a range of licence-exempt technologies, of which LoRaWAN is currently the dominant standard and we expect that it will remain dominant for the next decade at least.

LoRaWAN can be deployed as a regional or country-wide network as-a-service, or as a private network. Accordingly, LoRaWAN is a particularly well suited not only to smart metering applications but also to many agricultural, smart cities, industrial campus, and commercial in-building applications.

Figure 2, (right), illustrates the major applications that will comprise the more than 2 billion licence-exempt LPWA IoT connections that we forecast will be active by the end of 2033.

Figure 2: Licence exempt LPWA IoT connections, 2033

Source: Transforma Insights, 2024



LoRaWAN is a Low Power Wide Area (LPWA) networking protocol designed to wirelessly connect battery operated devices using campus, regional, national, global or hybrid networks, including terrestrial and non-terrestrial options. It is an open standard and development of the technology is led by the LoRa Alliance®, with membership comprised of hardware manufacturers, network operators, solution providers, and other ecosystem companies.

Benefits of smart water metering

Loss of treated water is a significant issue in many countries and results both in consumers paying for water that is ultimately not used and also utilities treating water which they consequently cannot charge for. One of the most significant benefits of smart water metering solutions is thus their potential to identify leaks based on a combination of usage patterns and also potentially identification of pressure drops within a distribution grid.

Traditionally, water leaks may have been difficult for building owners or utilities to notice, particularly if they are out of sight or in unoccupied or leased buildings. The deployment of smart water metering systems allows for much quicker and more precise identification for both in-building and network leaks. The impact of improved leak detection also extends to reductions in consequential damages, such as to the fabric of buildings or public infrastructure (for example, roads) near network leaks.

Meanwhile, smart water metering benefits are not only limited to reducing losses but also making consumers more aware of their habits, encouraging them to reduce their consumption of water. For instance, A research study by Sydney Water in Australia has demonstrated a 6% decline in the water use over a period of two years in residential areas with the deployment of smart water meters[1]. The data obtained from smart water meters also helps utilities to run personalised awareness campaigns. For instance, Singapore's Public Utilities Board has plans to customise its engagement strategy by incentivising customers to conserve water based on their consumption patterns.

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Water leakage in numbers

According to the US Environment Protection Agency (EPA), household leaks can waste nearly 1 trillion gallons (3.8 trillion litres) of water annually in the United State and 10% of homes have leaks that waste 90 gallons or more per day. The most common types of leaks found in the home are dripping taps and showerheads, worn toilet valves and outdoor leaks.

Utilities' water loss, or non-revenue water (NRW) is a significant cost for many water utilities. NRW is defined as water that has been supplied into a distribution network but that is lost at some point during its journey, either through physical losses such as water leaks and theft or through operational issues such as metering inaccuracies or incorrect billing. It has been estimated that NRW costs governments and utilities approximately USD39 billion annually, much of which cost is in developing countries.

These dynamics clearly translate directly to significant sustainability benefits, specifically in terms of reducing both water wastage and water usage.

Closely related to these leakage and sustainability benefits is the concept of smart water metering as a strategic imperative for regions that suffer from water scarcity. According to a report from the World Resource Institute, at least 50% of the world's population lives under highly water-stressed conditions for at least one month of the year. Growing populations and the deployment of irrigation systems for agriculture and livestock to enhance production and also the development of manufacturing all contribute to increased water consumption. As such, the more efficient use of available water resources can unlock development potential, particularly in regions that are subject to some level of water stress.

Regulations have generally not so far had the same degree of impact for smart water metering as for smart gas and electricity metering, however in certain markets regulations can stimulate the deployment of smart water meters. The highest profile regulatory initiatives in water markets are typically provisions to reduce water wastage, particularly in regions that can experience water stress. Examples include in India, California in the USA and Italian regions Piedmont, Liguria, Lombardy and Trentino. More broadly, and with more significant impact, a wide range of sustainability-related regulations and also sustainability reporting requirements for enterprises and public bodies can stimulate the adoption of smart water metering and management systems.

Smart water metering and water leakage
Based on research by Transforma Insights, we estimate that on average smart water meters reduce both residential and commercial water usage by 6-9% and that smart water grid solutions, including water sensors deployed in the water grid and distribution network can result in 15% water savings.

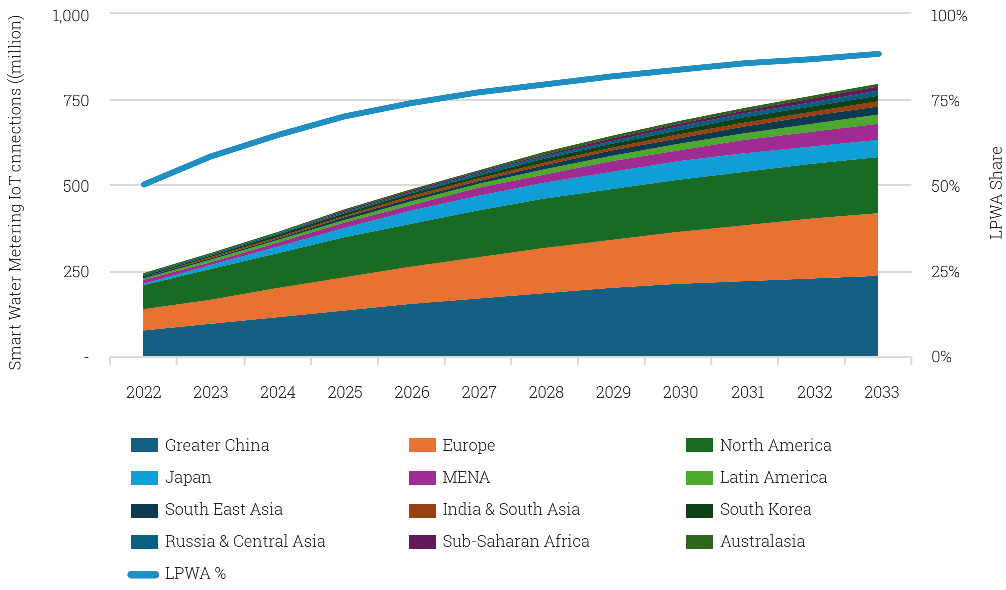
LPWA and Smart water metering

LPWA technologies are generally the favoured choice for connecting smart water meters. Smart water meters are typically separated from any electricity supply meaning battery-powered devices are required, something for which LPWA is better optimised than traditional cellular technologies, and cheaper. The meters themselves are often installed and expected to operate for 20-years or more, making long battery life imperative to reduce the need for battery changes and associated truck rolls during the service period. Furthermore, smart water metering generates only small amounts of traffic with little requirement for low latency communications, making LPWA technologies the natural choice. LPWA is also useful in providing extended coverage as a lot of smart water meters are installed in locations that lack conventional cellular coverage, such as basements or beneath manhole covers.

So well suited are LPWA technologies for smart water metering that Transforma Insights forecasts that 88% of smart water meters will be connected using LPWA technologies in 2033. Figure 3, (right), illustrates the installed base of smart water meters in various regions around the world over the coming decade, together with the proportion of the total installed base that will be connected with LPWA technologies.

Figure 3: Smart Water Metering IoT connections and LPWA share

Source: Transforma Insights, 2024



> **Smart water metering generates only small amounts of traffic with little requirement for low latency communications**

[1] https://agupubs.onlinelibrary.wiley.com/doi/full/10.1002/2014WR015812

Deploying LoRaWAN solutions

Any utility looking to deploy LoRaWAN-connected smart water metering will need to procure several different components that together comprise a full solution, often referred to as Advanced Metering Infrastructure (AMI). Typically, each component (hardware, connectivity, software applications and operations and maintenance) can either be procured in isolation, or multiple components can be purchased together from a turnkey provider.

An early key consideration for any utility adopting smart water metering is thus whether to build a private LoRaWAN network or whether to use a public LoRaWAN network as-a-service (if such a network is available). In the former case, the network build process is relatively simple and low-cost compared to the cost of an equivalent cellular network. In particular, since LoRaWAN is licence-exempt there is no requirement to procure access to radio spectrum. Meanwhile, the favourable signal propagation characteristics of LoRaWAN ensure that network access points can be relatively sparsely deployed whilst still achieving the required grades of service. Importantly, if during network deployment it transpires that there are any network coverage gaps, then the network can be easily enhanced with new access points (potentially using traditional cellular connectivity to support back haul, or LoRaWAN relay points) to provide the necessary coverage.

Meanwhile, any utility opting for a LoRaWAN network as-a-service approach would find the service broadly similar to more traditional cellular network-as-a-service propositions as provided by established mobile network operators. The main differences would be that fees for access to radio spectrum would not be a necessary component of the network costs, and the existence of 'build your own' alternative approaches to securing connectivity act as an effective price constraint.

To some extent combining the best aspects of these two alternative approaches, specialist organisations exist that can design, deploy and operate private LoRaWAN networks on behalf of a specific utility client.

This latter approach has additional benefits, particularly where relatively sophisticated network deployment partners are engaged, since these partners often have established strong capabilities to offer network-as-a-service to multiple client organisations.

Accordingly, such a partner can be well-positioned to offer a private network deployed for a specific client to multiple other potential users. This represents not only a potential revenue upside to the original network-deployment client, but also a relatively simple and low-friction way for many potential users in a local area to gain access to LoRaWAN coverage.

Such coverage could, for instance, be used to support multiple smart city monitoring applications, or gas or electricity smart metering or public space lighting.

Meanwhile, vibrant ecosystems exist for the provision of LoRaWAN connected smart water metering end-point hardware and associated software application suites.

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The future of LoRaWAN

Ultimately, LoRaWAN coverage is likely to evolve to become a blend of private (in-building, campus and city) networks, public city networks and nationwide public networks and with extended coverage provided via satellite. Accordingly, LoRaWAN coverage will be much more of an application-driven collection of networks (by design) than more traditional cellular wireless coverage as provided by mobile network operators. In this context, roaming between networks has become a key development area within the LoRaWAN ecosystem and peering can now be supported between any combination of private and public LoRaWAN networks (subject to commercial agreement).

Recently, LoRaWAN relay capabilities have been introduced to enable stronger support for deep in-building devices and particularly when satellite connectivity is used to provide wide area coverage for those in-building devices. Soon these relay capabilities will be enhanced with the option of long-life battery-powered relay nodes to provide LoRaWAN coverage to the most hard-to-reach locations, where a power source might not be available even for a relay node.

In parallel, a range of developments are ongoing to better support device identification and onboarding to LoRaWAN networks and to support Firmware Over The Air (FOTA) updates in anticipation of regulations that will stipulate that IoT connected devices can be updated to ensure security.

In all, the LoRaWAN standards are evolving quickly and supported by a vibrant ecosystem, focussed on developing and enhancing the capabilities that are needed to address key markets for LoRaWAN, particularly including smart metering.

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Conclusion: Unleashing the Power of AMI for Sustainable Water Management

As water utilities across the globe face climate change, rapidly growing populations, and the need to satisfy high customer expectations, sustainable water management practices become imperative. Global water demand is expected to rise by 20-30% by 2050 (compared to 2019 levels[2]). Water utilities should act now to prepare for the consequences of this paradigm shift.

To better address water management challenges utilities around the world are adopting Advanced Metering Infrastructures (AMI) comprised of digital ("smart") meters and carrier-grade wireless communication networks optimised for meter reading. LoRaWAN is ideally suited to the demands of smart water metering, helping utilities to unlock new levels of efficiency, sustainability and customer satisfaction, paving the way to a more resilient and resource-efficient future.

Prior to the use of network connected meters, traditional water meter reading was labour-intensive, error-prone, and lacked real-time data availability. The introduction of low-cost carrier grade wireless networks by companies like Netmore has revolutionised water metering by enabling remote, automated data collection, real-time monitoring, enhanced leak detection, and improved customer engagement, ultimately driving new levels of efficiency into water utility operations.

In turn, the adoption of AMI allows water utilities to achieve reductions in operating costs whilst enhancing sustainability through better leak detection and water conservation. Additionally, high quality and timely consumption information sourced from AMI better enables water utilities to take data-driven operational and planning decisions, to protect revenues, and to better prepare for fast-evolving future water markets. Related benefits include enhanced customer satisfaction and, where applicable, regulatory compliance.

Netmore – Proven leadership for water utility AMI

Netmore is a leading provider of AMI connectivity for water utilities globally, with one of the largest installed bases of contracted smart meters. LoRaWAN AMI networks designed, deployed, and managed by Netmore are among the most capable. They are high-density, built with abundant capacity, and secure.

With deep domain knowledge and experience supporting the needs of water utilities across Europe and the United States, Netmore is dedicated to pioneering the transformation of the utility sector and reshaping society for the better.

[2] https://www.unwater.org/publications/un-world-water-development-report-2019

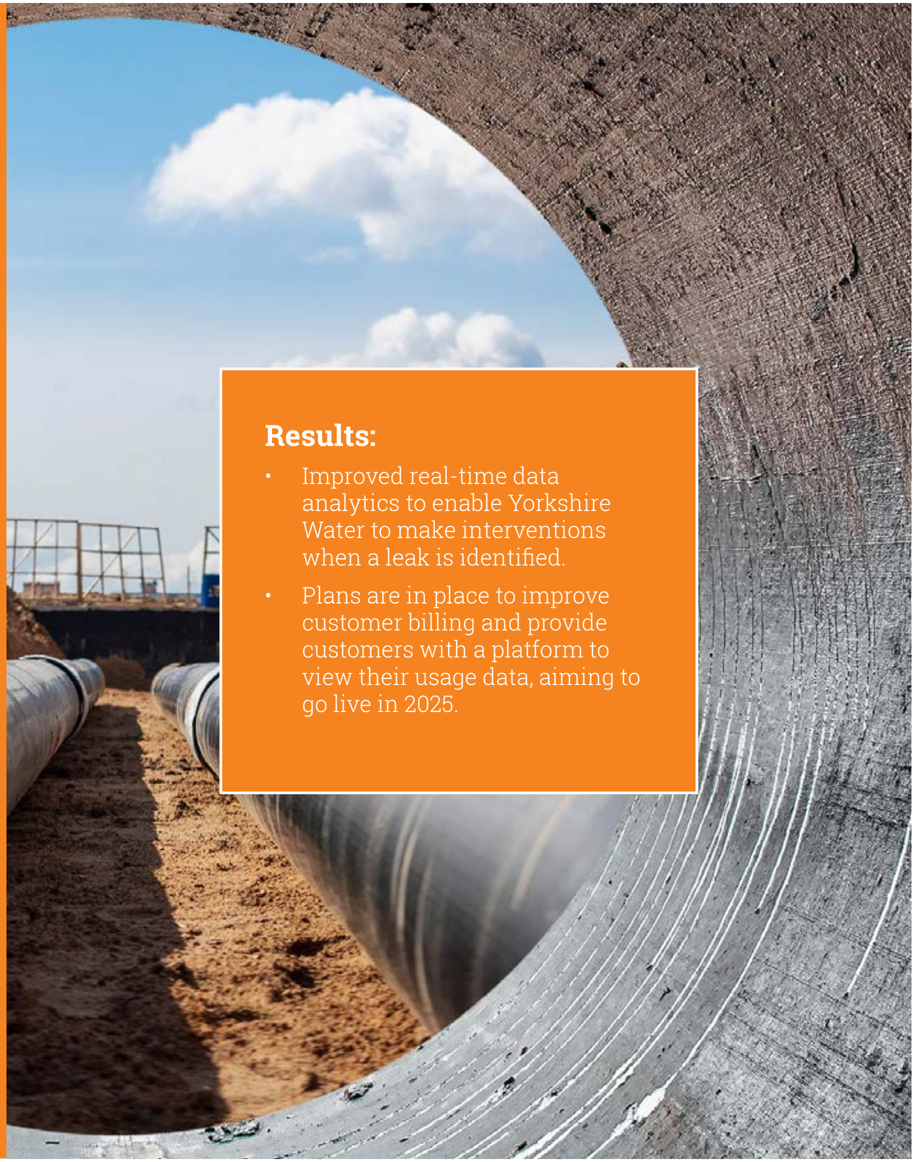
Case study:
Yorkshire Water, in the United Kingdom, awards a £ 47 million smart water metering contract.

Yorkshire Water is a leading water utility company catering to over 5.5 million regional household and 140,000 business customers in the Yorkshire region of the United Kingdom. As a responsible provider, the company ensures the water's safety and quality through various treatment techniques such as coagulation, flocculation, sedimentation, and filtration.

To ensure the water meets regulatory standards, Yorkshire Water monitors its quality at over 1,000 locations throughout its service area. The company also handles wastewater treatment and disposal through several treatment plants that eliminate contaminants using physical, chemical, and biological processes, producing treated effluent that meets regulatory standards.

Yorkshire Water's commitment to infrastructure maintenance and growth is evident in its investment in various projects and initiatives. The company has a strategic ambition of a 50% reduction in leakage by 2050 and is focusing on what it terms the Customer Side which equates to roughly 30% of all district metered area (DMA) leakage. The use of smart meters and the real-time use of data analytics will support this initiative.

In a recent digital transformation move, Yorkshire Water collaborated with Netmore to deliver an intelligent water metering framework that covers up to 360,000 properties. Yorkshire Water Services conducted a thorough evaluation of available solutions for connecting intelligent water meters ultimately selecting Netmore's technology and solutions due to their ability to provide a step change in the services offered, focusing on improving capabilities in water demand management and customer service. Implementing Netmore's AMI and LoRaWAN solutions will enable Yorkshire Water to more accurately measure and track water usage, identify leaks and inefficiencies, and provide more accurate billing information to customers.



Results:

- Improved real-time data analytics to enable Yorkshire Water to make interventions when a leak is identified.
- Plans are in place to improve customer billing and provide customers with a platform to view their usage data, aiming to go live in 2025.

Case Study:
Western Municipal Water District (Western), California

In 2018, Western Municipal Water District in Riverside County, California was testing AMI. It had run a pilot study to read 100 meters remotely, as a step towards eliminating drive-by reads in the future for its more than 24,000 retail customer accounts. The results revealed a reading success rate of more than 99 percent.

Western implemented an Advanced Metering Infrastructure (AMI) network solution, designed using planning tools and a cloud-based LoRaWAN network management system provided by Senet (now Netmore) to ensure long-range connectivity and maximise network performance. Once completed, Western was able to begin installing meters at will, anywhere within their service area. This capability allowed Western to change out meters at an aggressive rate, focusing on the oldest meters first – which would have the greatest impact on metering accuracy.

The new capability has allowed Western to significantly enhance the operational efficiency of collecting meter readings. Western has also experienced a reduction in water loss from 12 percent to no more than 3.5 percent, which is not only a financial benefit but also a significant sustainability benefit, particularly in California's water stressed environment.

Additional sustainability (and cost) benefits derive from the far smaller number of meter reads which Western has to physically send someone out to get. Further cost benefits derive from improved customer service and the ability for Western to respond to, for example, questions about bills very quickly and with access to accurate and detailed metering information. Customers can also be more quickly alerted to any water leaks on their premises.

Results:

- Eliminated 3rd Party meter reading contract
- Reduced water loss from 12% to less than 3.5%
- Ability to provide customers with "leak alerts"
- Eliminated re-reads for high readings
- Reduced carbon footprint by eliminating drive-by meter reading