Addressing Water Shortages with Software
Executive Overview

Today’s software applications can help utilities provide adequate water supplies to communities by:

- Providing billing solutions that respond to water availability.
- Monitoring compliance with water regulations.
- Detecting leaks anywhere in the system.
- Improving infrastructure performance
- Ensuring that field crews address priority maintenance and repair issues quickly and efficiently.
Introduction

Concern about water is growing. Seasonal droughts—already a major challenge—could increase with global warming. Growing global wealth brings with it a greater demand for irrigated crops. Increased use of biofuels will further add to the demand for irrigation supplies. And unrelenting population growth pressures our already depleted underground water supplies.

Water companies—public and private—find themselves under escalating pressure to ensure the general availability of water despite all the obstacles weather, governments, and individuals throw into their paths. No one expects them to create water. But we do expect them to encourage responsible water use, minimize losses, prevent adverse environmental impacts, and enforce appropriate conservation measures.

This paper reviews a number of different ways that software can help water utilities meet these challenges.
Billing and Metering Solutions

Over the past few years, electric and gas utilities have begun to use innovative billing and metering techniques to encourage energy conservation. Time-of-use pricing and demand-response programs have helped address the economic and environmental problems that can arise from unwise energy use.

Unwise water use can precipitate similar problems. As a result, many water utilities have developed outstanding educational programs that encourage water conservation.

Now, some water utilities are joining their electric and gas colleagues by taking the next step. They are adopting new billing and metering solutions that help customers use water wisely and thus reduce the economic and environment costs of excess use.

Billing Techniques that Encourage Conservation

In capitalist and consumer-driven economies, pricing water according to amount consumed is an obvious first step in encouraging conservation. A large number of countries in both the developing and developed world, however, have no tradition of payment per volume used. Water may be a municipal service paid for in assessments based on property value or number of occupants. It may be a “public good” financed by income or sales taxes. And even utilities with a long tradition of billing for usage volume may resist submetering in apartment complexes on grounds that retrofitting apartments with meters accessible to readers outweighs the benefits.

Billing for individual consumption focuses consumers on water use. It can lead to immediate improvements in water-use habits and encourage households to fix leaking faucets and toilets. The higher the rate, the sharper that focus is likely to be.

Conservation-friendly billing does not have to mean higher rates, of course. It can mean:

- **Variable rates.**
  Variable rates track water availability. They can, for instance, rise and fall seasonally, with the level of a reservoir, or with the varying costs of water and sewage treatment. A billing system that accommodates fast and easy rate change facilitates such variable rate structures.

- **Two-tier rates.**
  These are common among energy utilities, where it is relatively easy to determine a minimum per household necessary for heating and a set of standard appliances.

  It is not so easy to determine two-tier water rates because minimums for drinking and cleaning vary significantly with the number of household members. Fortunately, today’s billing systems make it easy for utility representatives to work with customers to track household size, then use the reported numbers to calculate the bills. Including the number of individuals on the bill reminds customers to report changes promptly.
• **Graphs and charts.**
  Bills with usage graphs encourage customers to examine varying consumption and question what they are doing differently. Bills that compare usage with, for instance, neighborhood averages may inspire competitiveness.

Making usage charts available on-line—with or without accompanying bill-payment services—can appeal to an increasingly Internet-savvy population.

• **Loans.**
  Today’s billing systems frequently include functions to collect loan repayments as a regular part of the regular bill. It thus becomes far easier to lend customers small amounts for water conservation projects—automatic faucet shut-offs, “half-flush-option” toilets, xeriscaping, etc.—and match the repayment schedule to the customer’s anticipated payback period. Such loans are especially attractive to middle- and lower-income customers who cannot easily finance such projects from current funds and whose available financial institutions cannot be bothered to offer “mini-loans” at reasonable rates of interest. These loans also offer water utilities the opportunity to lower the cost of such projects by offering related equipment and do-it-yourself advice.

On a larger scale, water utilities might use loan-repayment billing techniques to jumpstart a market for water conservation options as part of a new home purchase or major renovation. Jumpstarting may be necessary because so few builders are familiar with systems to, for instance, recycle graywater or store rainwater. Builders will be far more likely to familiarize themselves with these systems, however, if they can get the project money up front from the utility and have the utility bill the customer for the option over the course of the next several years. Such an arrangement adds to the owner’s equity in the home without adding to the up-front purchase price.

**Advanced Metering**

The conservation techniques above can all be accomplished with a standard, single-read, mechanical or electromechanical water meter. Utilities expand their options when they install advanced meters that measure water consumption in intervals from 15 minutes to a day. They can offer, for instance:

• **Leak detection services.**
  Given the pattern of contemporary family and business life, it is almost a foregone conclusion that, if consumption never drops to zero for any hourly interval, a leak is present.

Consumers may be completely unaware of such leaks if they occur at slow rates inside walls or if the water drips into an underground location. All too often, they discover the leaks only after foundations crumble or landscape plants rot. Thus, there’s a substantial increase in customer satisfaction when utilities can let customers know about such problems before substantial damage is done.

• **Water regulation enforcement.**
  Many regions address droughts by limiting outdoor watering or car washing to certain days of the week. Analysis of daily water meter patterns can identify possible violators without the need to send human inspectors to every garage and garden.
• **Time-of-use water rates.**
  Many utilities pump water daily to a location from which gravity feeds can move water to properties. To take advantage of off-peak electricity rates, utilities generally try to limit pumping to nights and weekends. But costs rise if utilities, responding to consumers who use water imprudently during the day, are forced to turn on electric pumps during peak hours.

Timing the Introduction of New Programs

In countries where water metering has long been a fact of life, the decision about when to move to more advanced metering systems can be complex. It may be tempting to replace today’s standard meters with interval, communicating meters only when meters reach full amortization.

That approach avoids stranded investment. Unfortunately, it also postpones the benefits of such meters until many years into the utility’s replacement cycle.

Utilities may try to avoid this risk by introducing new programs as they install new meters. This, however, creates “have” and “have not” customers whose differing rates and opportunities can divide communities and appear to regulators as unfair discrimination.

To avoid these issues, utilities that make the decision to move to advanced metering generally try to compress the replacement cycle into one or at most two years, introducing new rates and programs only as the cycle is ending. Given the benefits that advanced meters can bring, regulators may permit utilities to recover the resulting stranded investment.

Utilities in countries where water metering has not been standard practice have the opportunity to leapfrog the entire generation of electromechanical meters and move immediately to interval meters with built-in communications. Such a move reduces such long-term costs as:

- Buying meters that will have to be discarded before they can be amortized.
- Hiring and training an entire workforce of meter readers who will be made redundant before the normal end of their working lives.
- Installing meters twice rather than once.
- Implementing a low-end but costly software billing system that will have to be substantially upgraded or replaced by the more sophisticated software advanced meters require.

Asset Solutions

Most water utilities have been free to choose metering and billing systems that best fit their needs. The same cannot be said, however, of water utilities’ asset management systems. Municipal utilities in particular may be under pressure—or even orders—to use the asset management software already in use city- or county-wide. After all, cities reason, funds to purchase, implement, and maintain software are at a premium. Should they spend money on “extra” software when infrastructure is crumbling? When century-old water pipes leak 40 percent or more of their treated water into the ground? When combined run-off and sewer systems eject raw sewage into rivers during heavy storms?
Utility managers also confront the reality of software selection hierarchies. Most cities see asset management as largely an accounting function. And accounting departments are unlikely to choose software that goes beyond accounting requirements.

Forcing water utilities to use software designed only to accommodate financial accountants results in cities’ being “penny wise and pound foolish.” Asset management systems more than pay for themselves by helping managers keep warranties in force and make cost-effective repair/replace decisions. These systems contribute to conservation by minimizing main breaks and leaks. They can also ensure that utilities make conservation-promoting future purchases by tracking asset performance and buying only products proven to meet utility expectations.

The political perspective is also important. A well-maintained water infrastructure with low occurrence of water breaks or sewage overflows leads to a satisfied constituency. The opposite creates enormous pressure on city management as constituents raise health and safety issues and question the use—or potential misuse—of public funds for infrastructure management.

An asset management system that contributes to conservation in these ways tracks:

- Asset physical condition, including: a normalized score, a view of previous scores to reveal a trend, dates of past inspections and forecasts for near-term cycles, work history, renewal activities.
- Asset financial condition, including: acquisition cost, depreciation status, replacement cost estimate, age, and remaining useful life.
- Asset risk assessment, answering questions like: What are the hazards? Which assets are most important to water conservation?
- Asset parts inventory and associated supply chain activities, including: status of critical spares, vendor/supplier performance, and occurrence of stock-outs.
- Asset failure and the causes of failure—essential information when it comes to planning major infrastructure upgrades or new equipment purchases.

To ensure purchase of a system that accomplishes these tasks, look for those that:

- Gather and store cost information in a variety of user-defined categories, Example: Labor costs broken out by regular, premium, and drive time.
- Link those cost categories to the General Ledger account structure so that they roll up, without user intervention, to appropriate levels within the chart of accounts. Support all asset types—plant and linear, under- and above-ground—in a single system.
- Support highly integrated inventory controls that are based on and driven by work planning processes.
- Make costs available on line, in real time, rolled up in ways that support individual user needs.
- Incorporate into the asset management system all financial transactions related to work processes, such as direct purchases, inventory costs, labor, etc.
• Permit users to drill down easily to actual transactions using on-line logs for timesheet charges, stock checkouts, and direct purchases related to work orders, projects, and assets.

• Provide easy access to non-financial information about assets and activities to provide a more complete understanding of the appropriate asset strategy.

• Offer lifecycle management tools that rely on verifiable asset conditions, not generalizations or assumptions.

• Readily accommodate the reporting requirements of accounting standards like GASB 34 (US) and PSAB 3150 (Canada). These standards require infrastructure definition (inventory), financial status (book value and remaining life), and asset physical condition.

• Handle linear assets. This permits you to capture all of the assets in the water infrastructure – pipes, hydrants, tanks, remote isolation valves, treatment plants, etc.

What you get from these systems is better decision-making across the board. You should expect:

• Higher reliability in the water infrastructure (e.g. fewer water line breaks and sanitary sewer overflows).

• Lower costs for water supply due to reduced losses.

• Fewer purchasing and field deployment errors, because the system identifies parts appropriate to a specific functional component.

• Realistic budgets based on clear knowledge of the full cost to put an asset into service or to extend its life.

• Projects that come in at or under budget, because project leaders can track costs daily across all categories and redeploy resources as required.

• Faster decisions, because managers must consult only one application that contains all assets of all types, no matter where they are located.

• Falling inventory and asset lifecycle costs resulting from less corrective/reactionary maintenance and less reliance on conservative estimating.

• Repair/replace decisions based on concrete, detailed data.

• Lower replacement costs. Tying condition assessment to maintenance cost, for instance, helps managers determine the optimal time to replace an asset.

Establishing a focus on operational accounting for asset management does not sacrifice financial accuracy. In fact, as asset management receives greater attention in the growing concern over infrastructure aging, asset managers will increasingly need this capability to ensure the physical and financial soundness of the operating plant.

Asset management applications that accommodate both operational and financial accounting simply acknowledge that running a utility requires far more detailed information than is available in the general ledger.
Mobile Workforce Management Solutions

Mobile workforce management applications play their most important water conservation role during emergencies, when mains rupture. These applications:

- Identify the location of field crews that have the appropriate skills to fix the problem.
- Optimize crew routing.
- Track the crew’s location. If crews are unexpectedly delayed—by a traffic jam, for instance—mobile workforce applications can re-route the crew or identify an alternative crew to address the break.

Mobile workforce software with real-time scheduling minimizes the cost of resuming normal work once emergency repairs are complete. As emergency activity ends, the software takes a fresh look at the scheduled tasks, matching crews with new assignments to minimize their travel time and maximize productivity. It assures the utility and its customers that routine inspection and maintenance—the heart of water conservation—takes place on time.

Over time, today’s mobile workforce applications—especially those with embedded business intelligence—can provide statistics that help speed field repairs. They help fine-tune crew composition, ensure that crews arrive at emergency sites with the right equipment, and identify business processes that speed or retard repair.

Ensuring quality as the workforce changes

Many water utilities anticipate severe challenges as aging Baby Boomer employees retire. These highly experienced workers are often the backbone of a water utility’s efforts maintain infrastructure and minimize leaks and ruptures. As they leave, utilities fear they will take with them the body of knowledge that helps crews cope with unusual situations and helps utilities minimize problems before they reach emergency proportions.

Fortunately, mobile workforce management software can substitute for expert supervision. It helps to automate tasks, and it guides field employees through the various steps. Such guidance provides automatic reinforcement to previous training, decreasing the time it takes newer employees to become productive.

Safety issues are also a concern. Experienced workers carry in their heads the correct safety techniques for the task at hand. Mobile workforce software incorporates that knowledge and makes it accessible via tools like checklists and context sensitive help. It ensures that less experienced crews meet utilities’ safety and compliance guidelines while still meeting the maintenance schedules that minimize water loss.

Reducing capital expenditures

Today’s water utility asset managers have often been forced to stretch inspection and maintenance cycles in response to budget constraints. They know they’re decreasing asset life. But they’ve had no choice.
The problem becomes even more acute as assets age. The risk of rupture increases, while budgets may fail to accommodate an increase in inspection and maintenance that could stave off problems.

Mobile workforce software can help put inspection and maintenance back on track. The software permits field crews to receive orders electronically rather than on paper. They can thus start their day from home rather than from a central office. Similarly, they can file reports from the field and end the day at the site of the last job. Utilities typically find this adds more than an hour to a crew’s workday—a 15 or 20 percent productivity increase. The consequent ability to get inspection and maintenance back on track results in lower investments in emergency equipment, longer asset life, and an increased ability to replace worn infrastructure before it fails.

The Value of Integration

Integrated software applications add another layer of value to the utility, especially as it tackles difficult water-supply issues. When, for instance, you integrate asset management and customer management, you permit the asset system to incorporate customer reports of asset failure and to provide constituents with the performance history of assets specifically related to properties they own or occupy.

Adding mobile workforce management to the integrated suite also ensures that, when a customer reports a problem, responding field crews have a complete view of the assets, the premise, and the customer—information that can speed repair and minimize environmental and property damage.

Integration offers yet another tool to substitute for an experienced worker’s ability to innovate. Older workers are often expert, for instance, in making workaround repairs even when someone forgot to put the “right” parts and equipment into the truck. You can help fill the gap when they retire, however, by integrating your mobile workforce and asset management applications. That integration ensures that field crews arrive at a site with the right parts. It provides crews with maintenance and repair histories that help them respond to specific repair challenges. Integration also ensures fast replacement of depleted parts inventories.

Integrating all applications to spatial databases is also important. “Seeing” on maps where problems occur and superimposing those problems onto maps of customer and asset location, customer complaints, traffic patterns, and the like can lead to faster problem identification and resolution—vital components of the network of water and wastewater services that underpin communities.
Conclusion

Software is not a magic bullet that can make water shortages disappear. Far from it. But a water utility that chooses flexible, high-functioning software can help customers adjust to and participate in conservation programs with minimal pain. It can assure customers that it is doing everything possible to maintain water infrastructure, minimize losses, and control capital expenditure. A water utility with a solid suite of software tuned to its specific needs demonstrates its commitment to the community—a commitment to resource conservation that will ensure water availability long into the future.