ArcGIS Water Loss Solution for Nighttime Flow Analysis

As a GIS professional you know the value that geography brings to your utility. However, the engineers and others in your organization can only realize that value when we collaborate to solve problems that combine the science of geography with the science and rigor of engineering. Water loss, and specifically nighttime flow analysis, is one of those problems. With the engineers' understanding of this issue and your knowledge and experience with GIS, together, you can battle the never-ending issue with water loss.

This new ArcGIS solution is based on two key techniques for monitoring leakage and identifying where water loss is occurring.

First, the use of District Metering Areas (DMA) is a technique of leakage monitoring that requires the installation of flow meters at strategic points throughout the distribution system that record flows into each discrete district. Each DMA has a defined and permanent boundary so that nighttime flows can be monitored in each DMA.

Second, Step Testing involves isolating smaller sections of DMAs – usually by temporarily closing valves, but sometimes by using temporary meters – and recording nighttime flows on those smaller sections. As smaller sections are monitored leaks can be pinpointed to more specific areas in the system. The sub-DMA is re-monitored after leaks are found and repaired.

Of course mapping and spatial analysis is key to both DMA and sub-DMA monitoring. It is important to know the boundaries, the location and size of mains and valves in each zone, which meters monitor what zone, and how many and what types of customers are in each zone so that an expected amount of consumption can be estimated. This expected amount of consumption is typically based on using industry standards for minimum nighttime uses that can include toilet flushing and the use of washing machines, dishwashers and outdoor irrigation.

In the context of DMA monitoring and step testing using sub-DMAs, the Nighttime Flow Analysis solution include 5 different apps that support the following workflow:

Sub-DMA Planning Map –engineers plan and create sub-DMAs with an ArcGIS for Desktop app. Using the app the engineer selects the valves to be closed and the meters that will be used to monitor the flow. Then the engineer then runs a preconfigured model that will define the boundary. The boundary will be created with a unique name and the expected flow, which is the expected consumption based on a configurable calculation according to the customer type (household / non-household) and the expected minimum nighttime flow value for that type. Once the engineer is satisfied with the result, another preconfigured model is used to save the sub-DMA to a layer that is used in real-time with the other apps.

[Screen Shot]

Sub-DMA Valve and Meter List App – field operators use a browser-based app to know which valves to close and which meters will be used to monitor the sub-DMA flow. The operators then close the valves at night and monitor the meters.

Sub-DMA Nighttime Flow Updater App – field operator then use another browser-based editing app to enter the observed sub-DMA nighttime flow value. The field operators manually calculate this Observed Flow rate based on the flow rate of the inflow meters minus the flow rate of the outflow meters. The difference between this value and the Expected Flow value (which is the expected nighttime consumption) is the estimated amount of water loss in that Sub-DMA.

Sub-DMA Viewer – engineers use a browser-based app to monitor the Expected and Current GPM flow rates of the sub-DMAs. In this app the Expected GPM is the expected consumption calculated during the sub-DMA planning and creation process and the Current GPM is the Observed Flow that was updated in the field using the Sub-DMA Nighttime Flow Updater App. Clicking on the Expected GPM value in the app gives the user the Estimated Loss for that sub-DMA. The app also provides a brief history of change showing two previously observed values for the sub-DMA selected.

[Screen Shot]

Sub-DMA Status Updater – engineers use a browser-based app to change the status of a sub-DMA from Active to Inactive. Once the sub-DMA is no longer needed, this app will filter the sub-DMA so it will no longer show in the apps, but it retains the history so it can be re-used at a later time if needed.

These Nighttime Flow Analysis solutions can be found here:
http://solutions.arcgis.com/utilities/water/help/nighttime-flow-analysis/

Interested in other ArcGIS Water Loss solutions?

Discover consumption anomalies based on high or low water use here:
http://solutions.arcgis.com/utilities/water/help/high-low-water-consumption/

Find out how crews can collect the location and information about leaks and cut response time with field analysis tools here:
http://solutions.arcgis.com/utilities/water/help/water-leak-investigator/

Early Adopter
White House Utility District serves approximately 32,000 customers over a 600+ square mile area and struggles with just over 30% water loss. They have been using DMAs and step testing for some time now. White House initially started with 7

DMAs and is working towards the eventual creation of approximately 30. The use of step testing has gone a long way in pinpointing excessive leakage after discovering it through their daily DMA monitoring as well as helping them determine how many, and where, to establish their additional DMAs.

White House Utility District is an early adopter of these solutions and has been using them for a few months. They are already benefiting from workflow efficiencies, timeliness of information, and cost savings in staff time and reduced water loss. Look for another blog or article soon providing the real-world results of their use of these solutions.