Using Geostatistical Analyst, Animation and SCADA in Water Distribution Networks Management

Tampa Water Department
Florida
Nature of WDNs Engineering solutions

“...Sometimes, however, the best tools for model calibration consists of a lot of detective work, a little intuition and just a pinch of luck”

Thomas M Walski

Sherlock Holmes meets Hardy Cross

GIS provides effective tools to WDN managers and engineers in our detective work to discover and solve hidden problems.

The Presenter
Water Distribution Operation Issues

- Water Distribution networks are highly dynamic structures.
- The traditional analysis of WDN is performed using hydraulic models.
- Most common models use steady-state flow.
- The most frequent flow condition in WDN is not steady-steady flow.
Water Distribution Operation Issues

• Management of WDN involves Repair/Replacement of elements that no longer show appropriate performance
• Deterioration of water infrastructure is linked to diverse internal and external factors
• Many deterioration problems in water infrastructure are linked to transients
Water Distribution Operation Issues

• Transient regimes in WDN are inevitable and will normally occur as a result of control operations
• Transients impact water infrastructure in explosive events but in long term effects as well
• Steady-state models do not identify transient or surge problems in the WDN
Water Distribution Operation Issues

• Even though Unsteady-state models help to analyze transients phenomena in the WDN, very often it is quite difficult to identify the role of transients in the operational problems in distribution networks

• Pressure transients in WDN result from an abrupt change in the flow velocity
Water Distribution Operation Issues

- Transients are linked to change in velocities and often those events are linked to high demand areas in the WDN.
- Spatial distribution of water usage and SCADA data help to find areas prone to suffer transient problems.
- Animation can illustrate temporary analysis of the problem parallel to the diurnal curve in a WDN.
THE PROBLEM

- Tampa Water Department was facing troubles with pipe breakage in its service area
- Expensive and unscheduled repairs
- Complaints from customers
- Water Quality problems
- Traffic issues
- Multiple conjectures about the problem
THE START

- GIS helped to visualize the spatial distribution of customers to determine the location of demand and type of demand
- GIS helped to determine the spatial distribution of water usage to define the water flow through the distribution infrastructure
- The first finding were those customers with large demand and its potential effect in the hydraulic pattern of the WDN
2008

COMPARATIVE SPATIAL DISTRIBUTION OF WATER USAGE IN TWD SERVICE AREA
Water Distribution Operation Issues

THE FOLLOWING STEP

• The following step was to find a pattern in the water main breakage events
• Geostatistical analyst found an interesting temporary pattern
• A specific area suffered pipe breakage likely in the morning and other mostly in the evening
• Geostatistical analyst helped to find the spatial distribution and the temporary variation of the main breakage along time
Water Distribution Operation Issues

Transient flow?

• The previous findings made us to suspect about possible transient flow and water hammer problems
• Transients are linked to abrupt changes in velocity caused by control operations
• The following step was to analyze the pressure behavior along time of day
• Few accounts in the south and southwest end of the peninsula were demanding large amounts of water
• Animation and SCADA provided a good movie about changes in pressure along time
Water Distribution Operation Issues

Temporary pressure behavior (animation)

(Video)
Who is guilty?

The abrupt changes in pressure along the day were the evidence of transient flow problems.

Operation of valves or changes in demand could be causing this problem.

A field research pointed directly to the real causes of the problem.

Two customers with large demands were filling their tanks in a few hours and closing their valves in an appropriate way.
Water Distribution Operation Issues

CONCLUSIONS

• GIS is appropriate to analyze events in the water distribution systems.
• Events in the WDN occur in the spatial frame of the service area and along time with a close relationship with diurnal curve of demand
• SCADA provides huge amounts of raw data that can get high significance in the frame of ArcMap.
Water Distribution Operation Issues

CONCLUSIONS II

• GIS helped Tampa Water Department to solve a problem hidden within tons of data.
• Animation helped to analyze the dynamic behavior of pressure and its spatial distribution in the service area.
• Combination of Geostatistical analyst, Animation and data from sensors are powerful tools that complement steady-state models to discover and solve problems in the WDNs.