

## 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-state 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

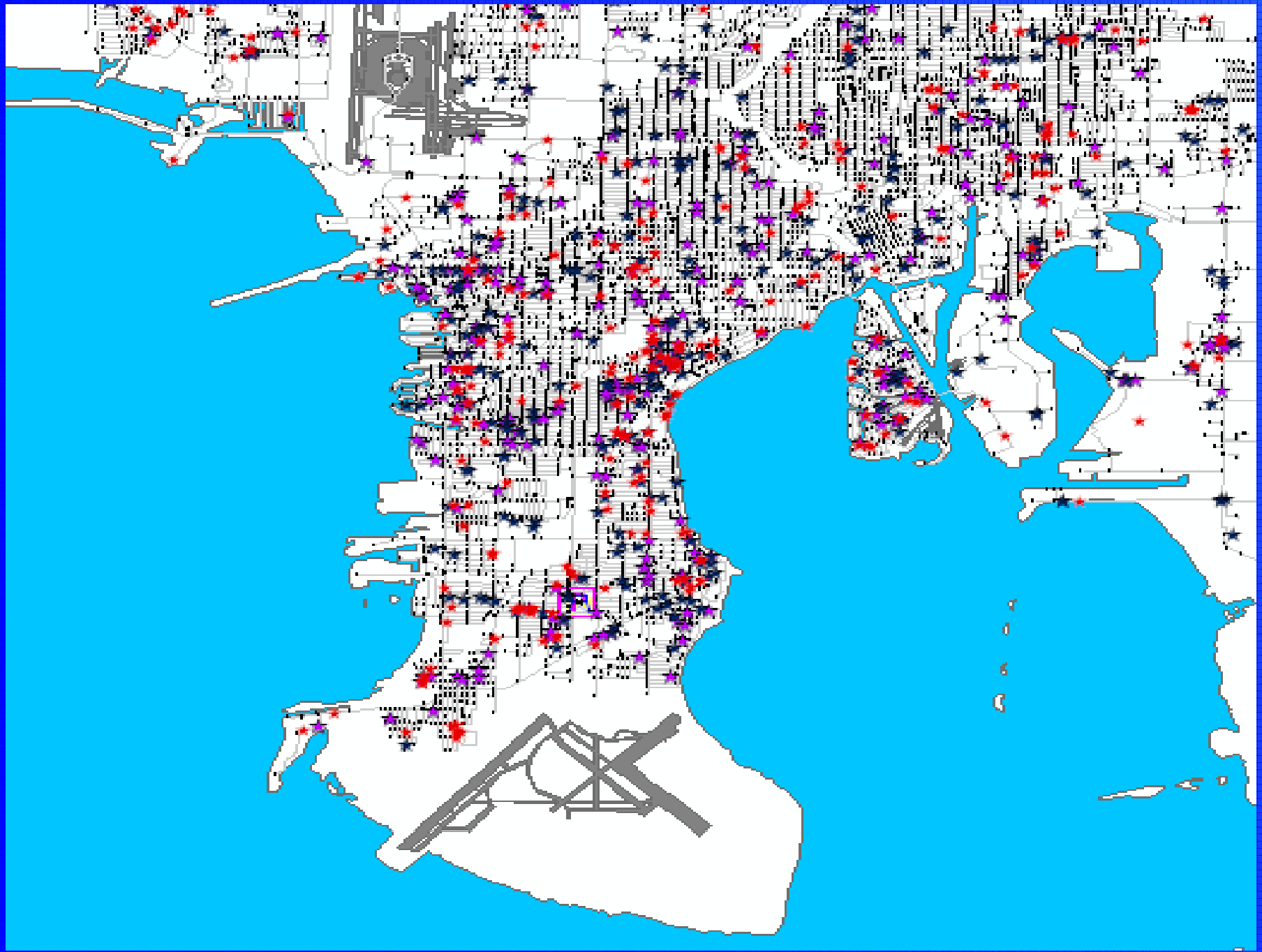
- Transients are linked to change in velocities and often those events are linked to high demand areas in the WDN
- Spatial distribution of water usage and SCADA data help to find areas prone to suffer transient problems
- Animation can illustrate temporary analysis of the problem parallel to the diurnal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

# Water Distribution Operation Issues

## 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



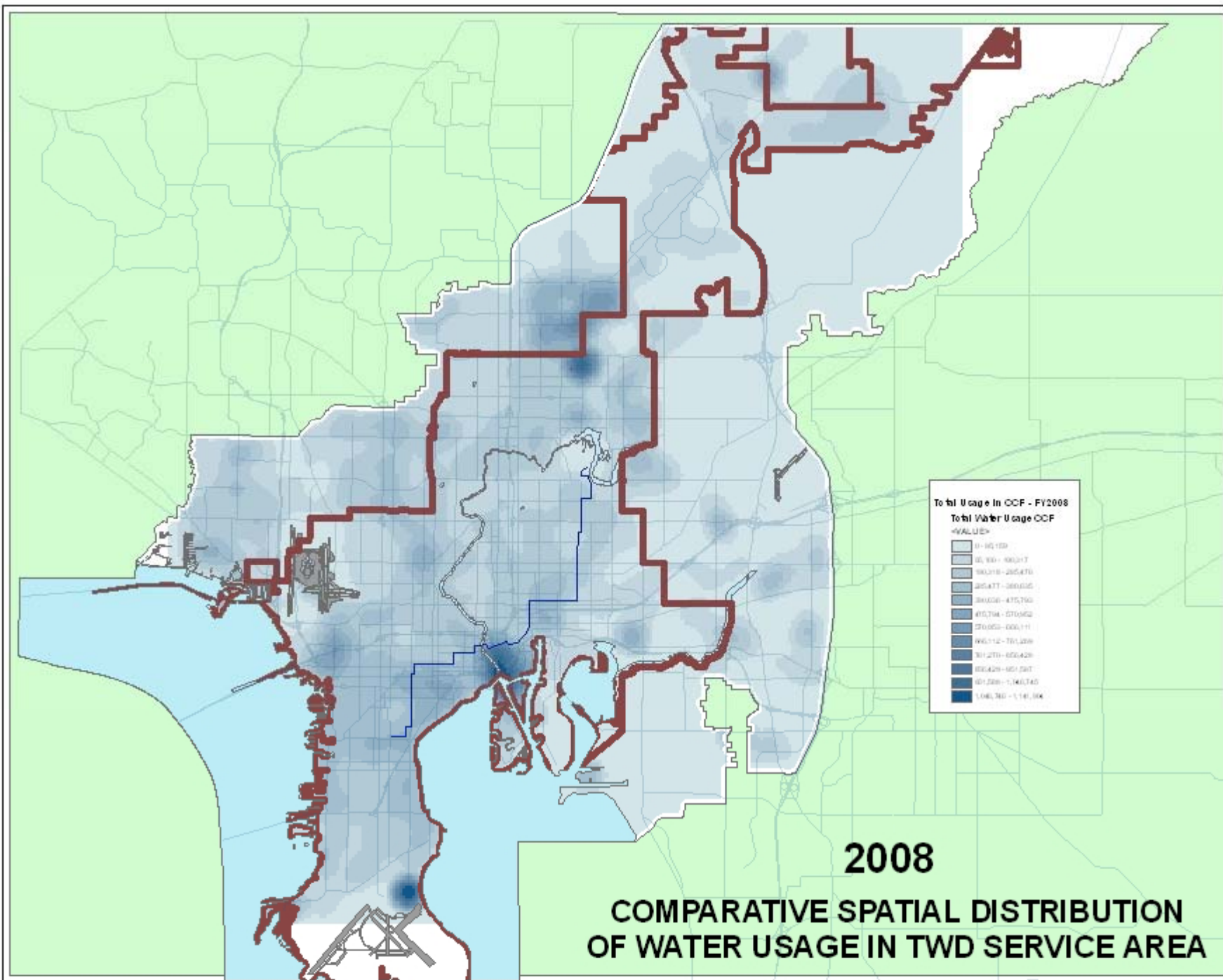


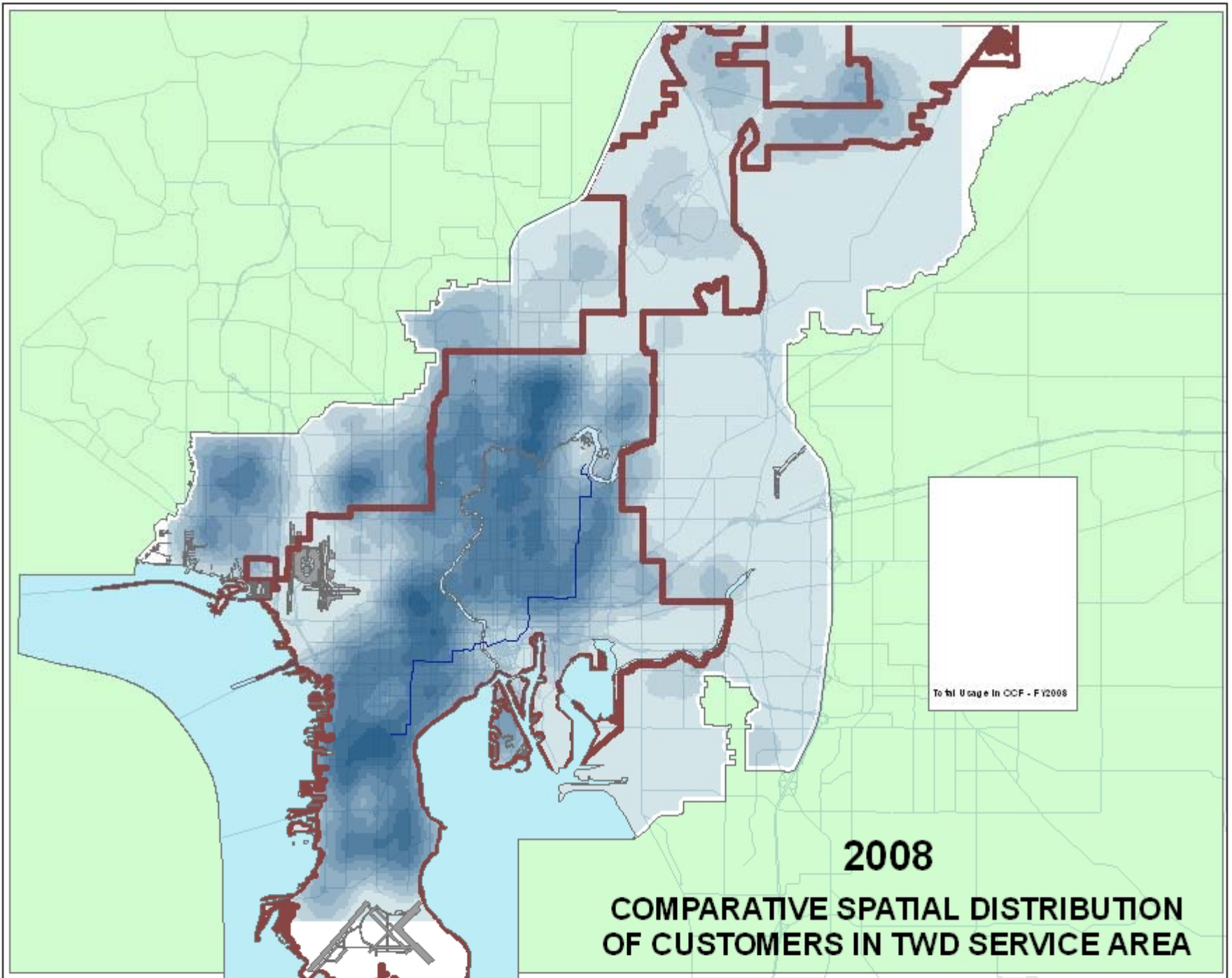
# Water Distribution Operation Issues

## 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 findings were those customers with large demand and its potential effect in the hydraulic pattern of the WDN





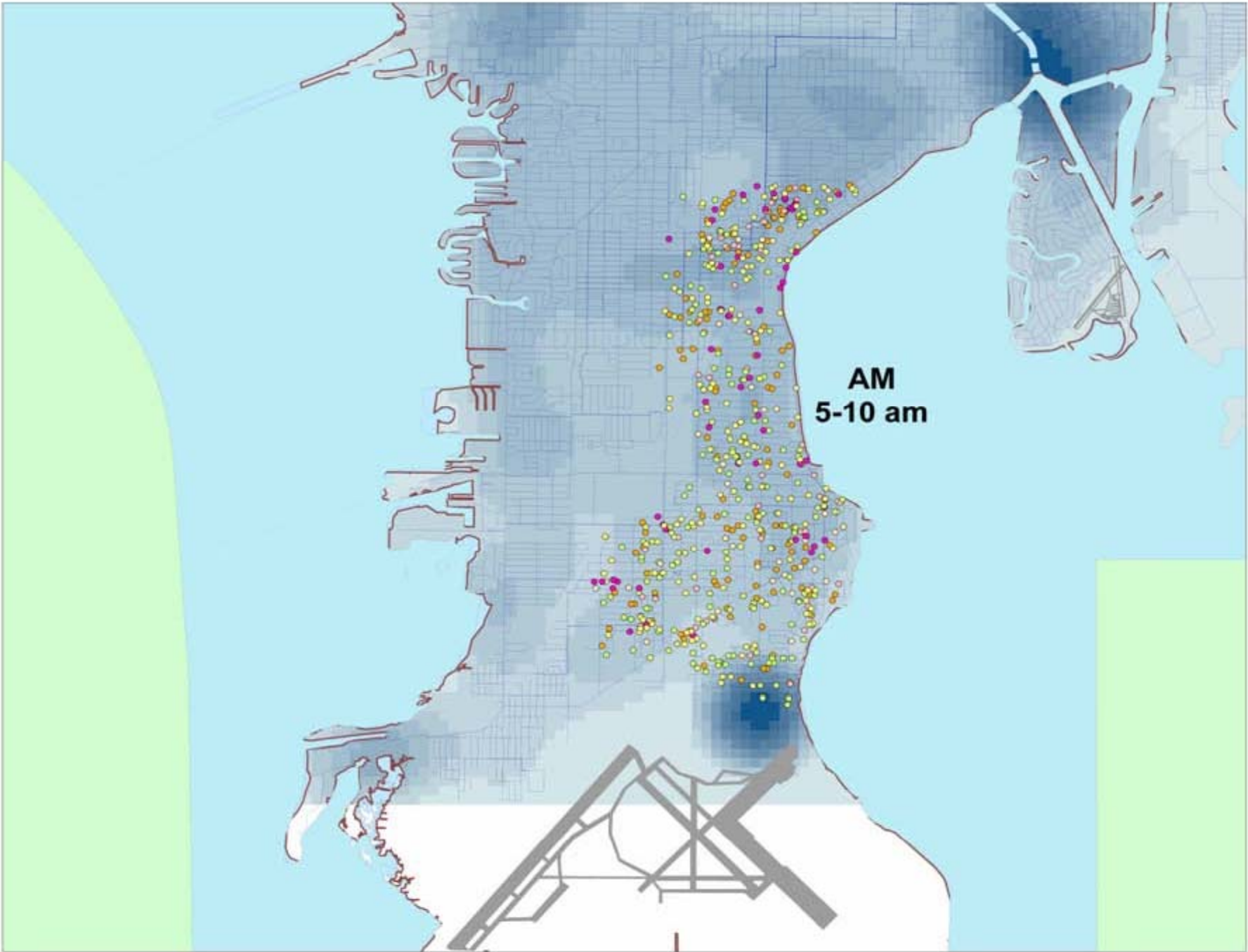




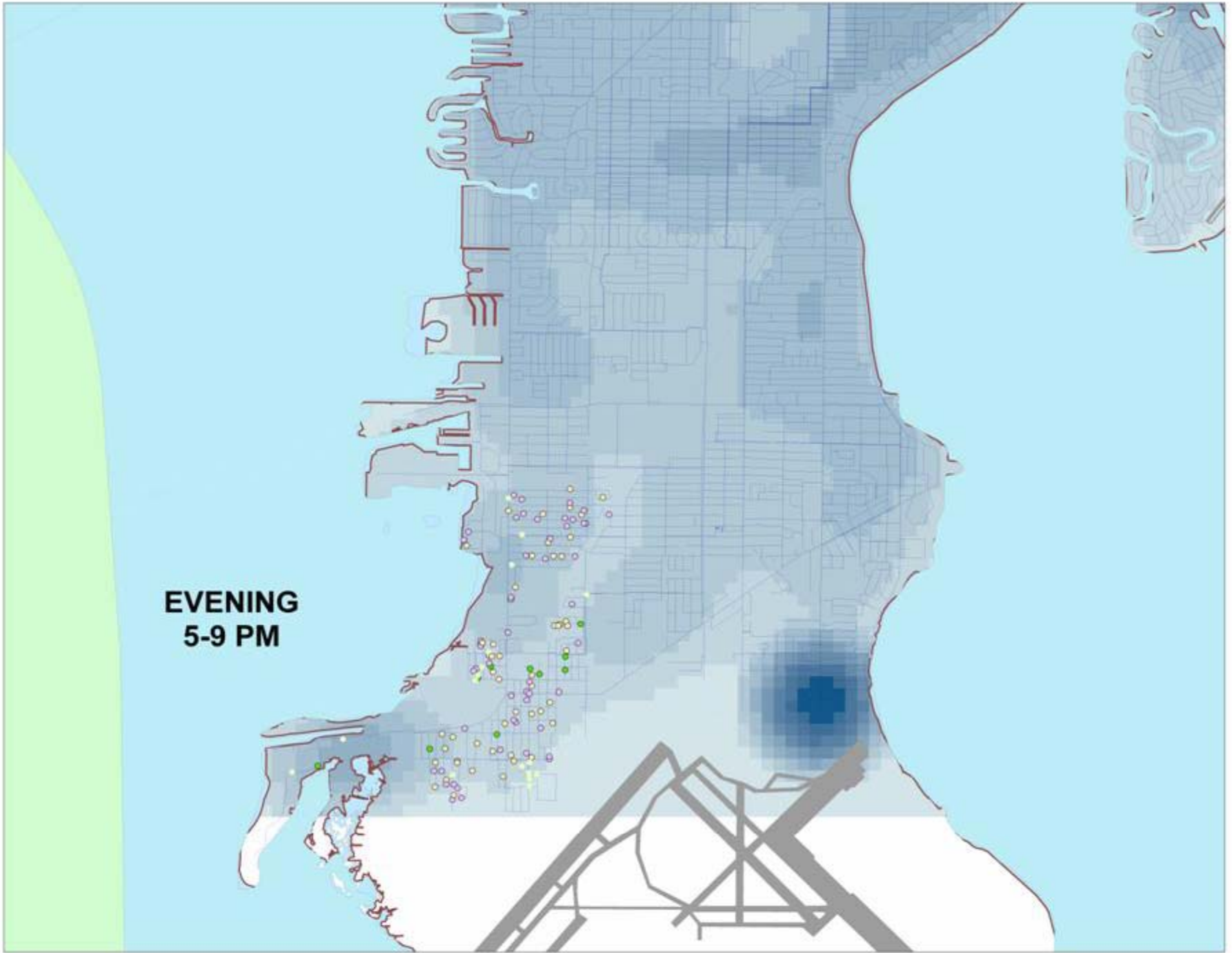
# Water Distribution Operation Issues

## 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







**EVENING  
5-9 PM**

# 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