Distribution System Optimization

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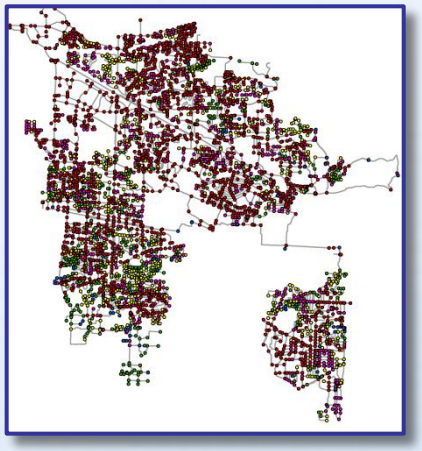
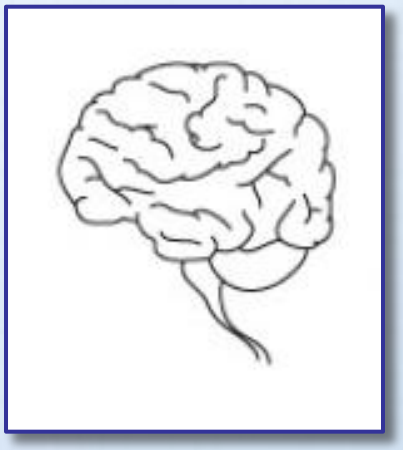
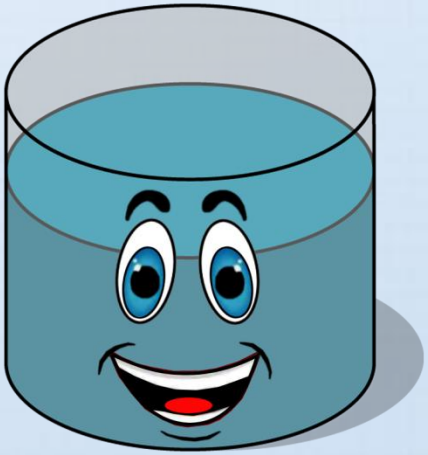
May 4, 2011

Engineers...Working Wonders With Water®

Your can use your model and your brain to do a lot more with the distribution system you already have



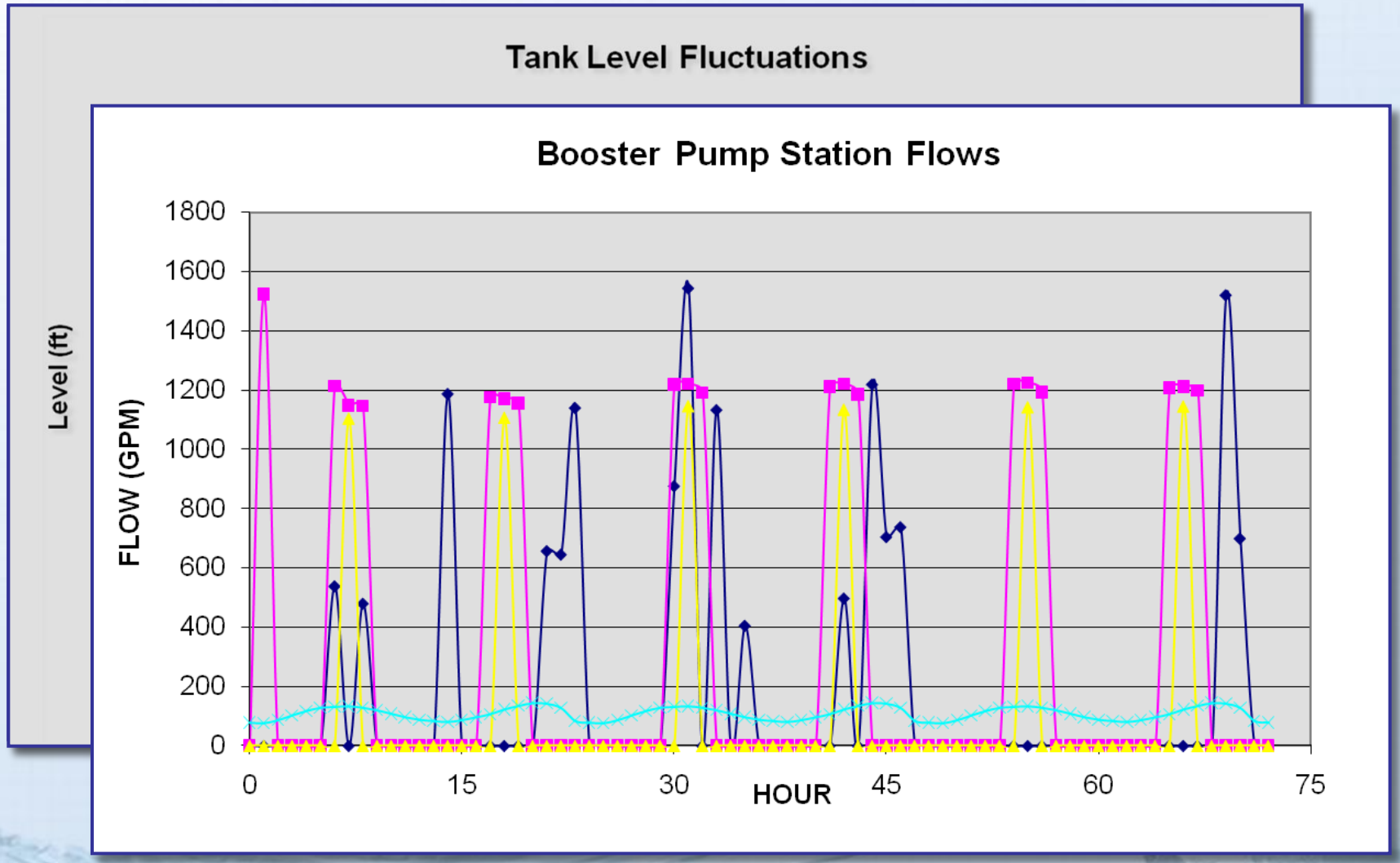




A well-managed distribution system is a happy distribution system

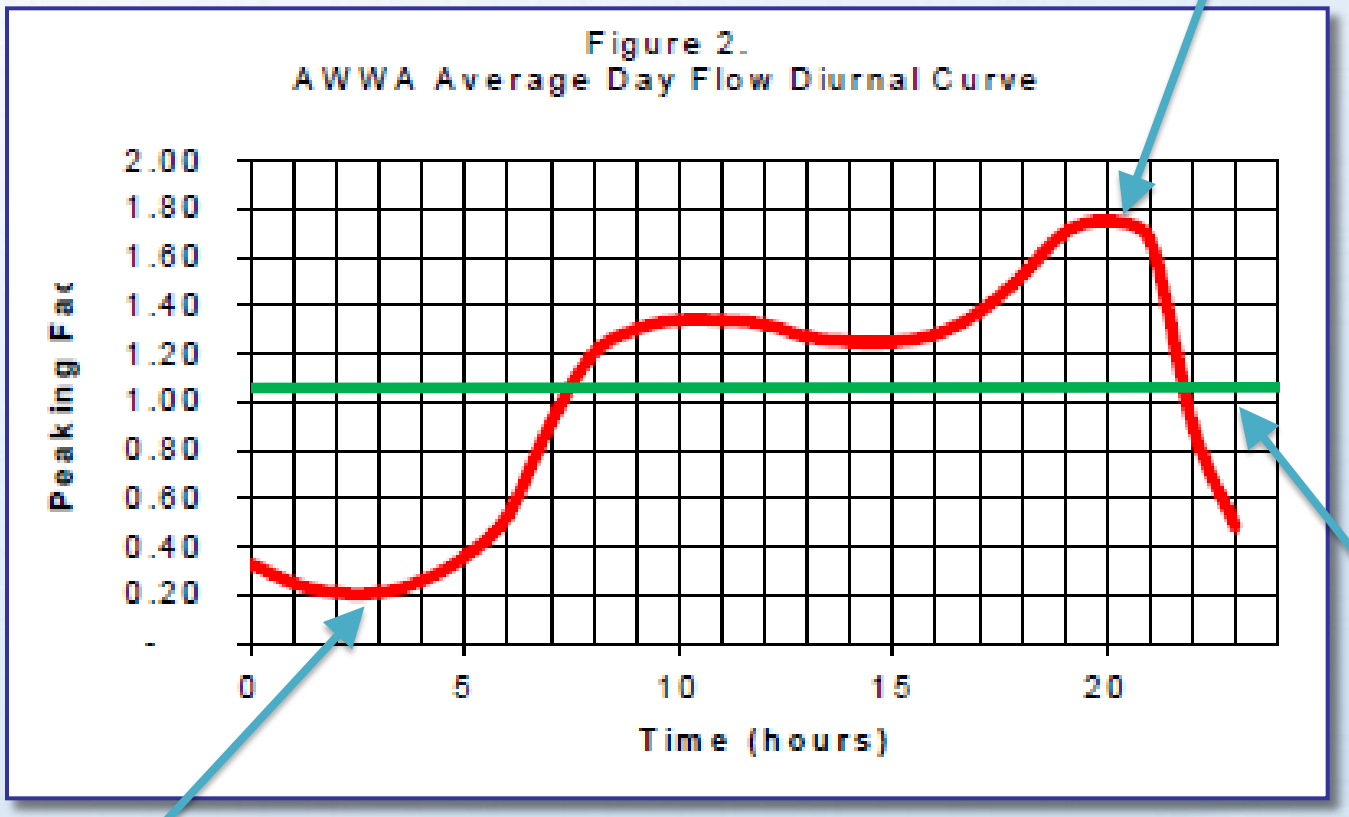
- Control water age
- Make optimal use of existing storage to avoid construction of new storage
- Maintain system pressures
- Manage mixing of different source waters

Distribution system optimization requires a model that runs in extended period simulation (EPS)



EPS requires a diurnal curve

Captures PHD



ADD
or
MDD

Captures Minimum

You really need an accurate, system-specific diurnal curve

A hydraulic model will not do your thinking for you

Operations Challenges

Potential Approach

Model Used to Verify Approach

Model Outputs Used to Refine Approach

Water Age Management

Water age management can preclude numerous water quality challenges

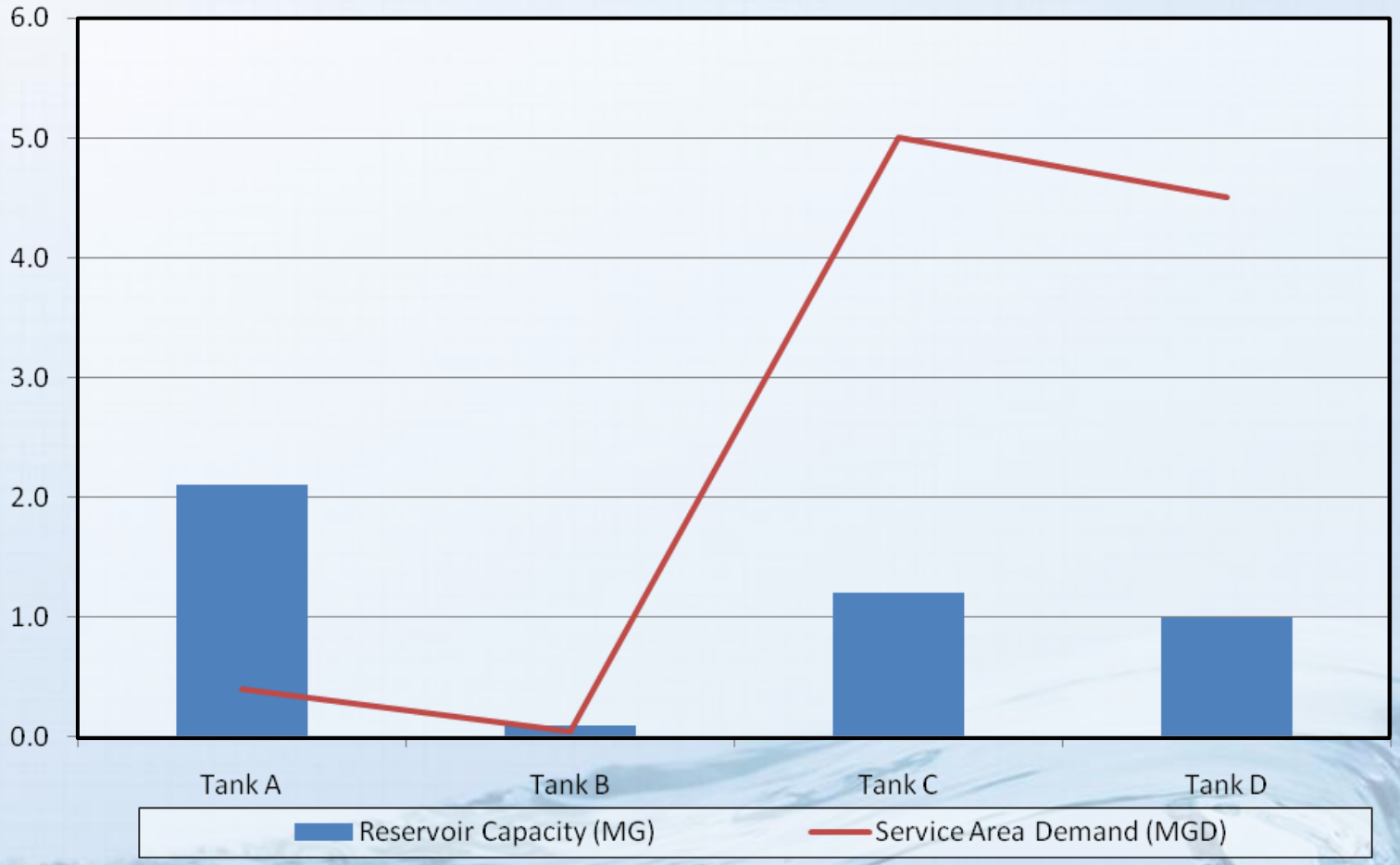
Increased Age

Increased DBP Levels (THMs/HAAs)

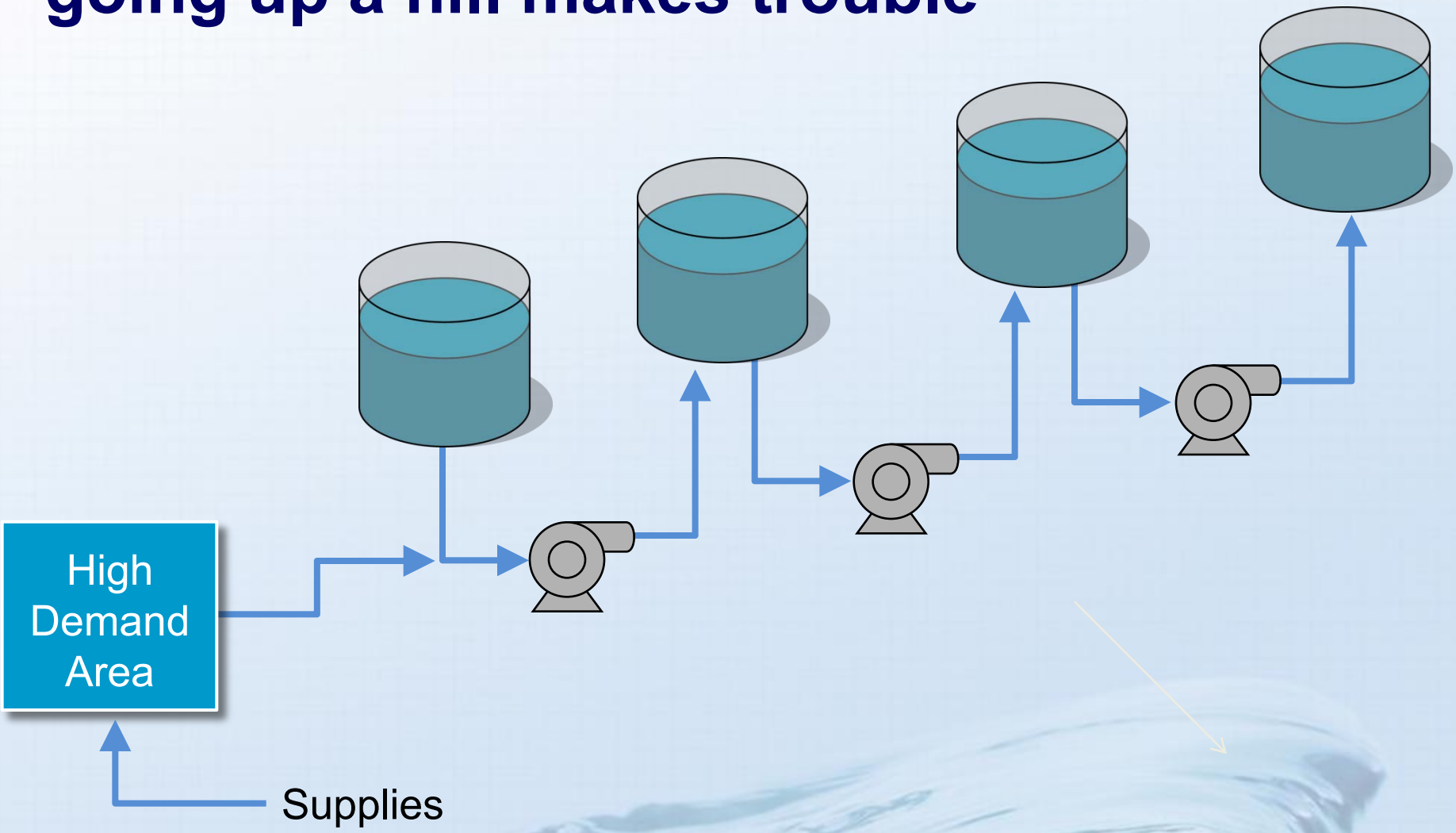
Degradation of Chlorine Residual

Nitrification

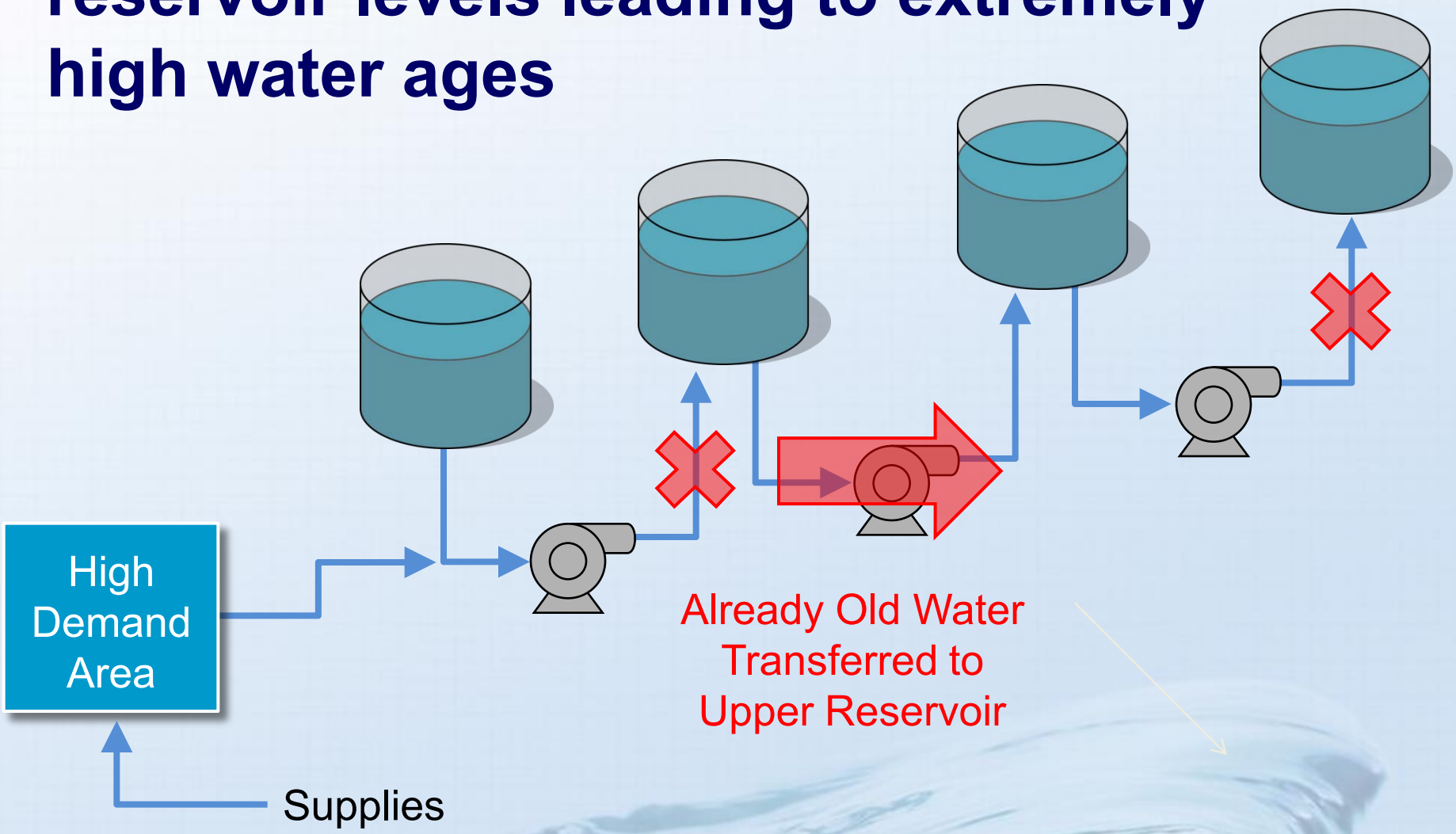
The old paradigm was to build as much storage as possible, as high up as possible



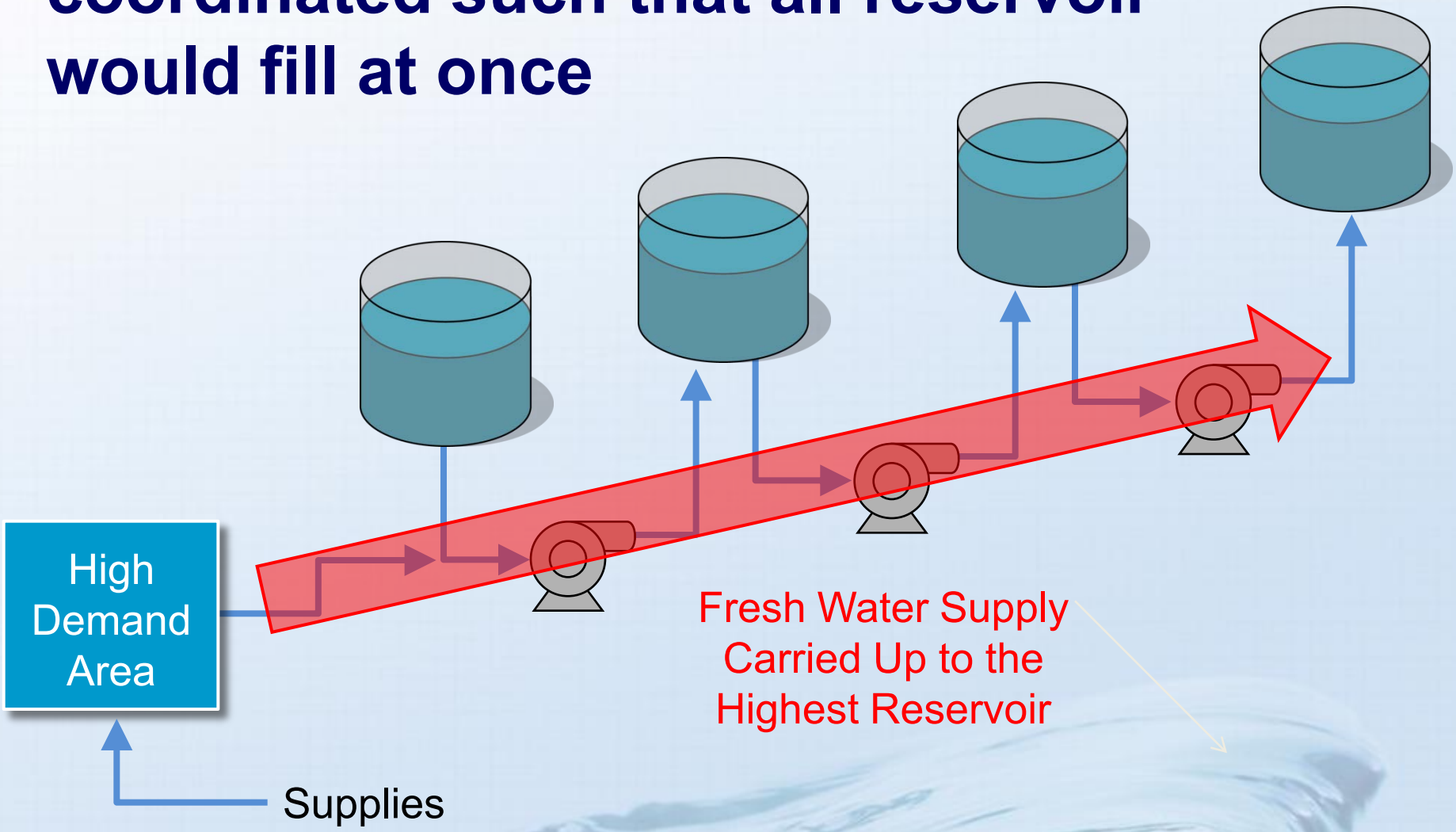
Case Study 1 – A chain of reservoirs going up a hill makes trouble



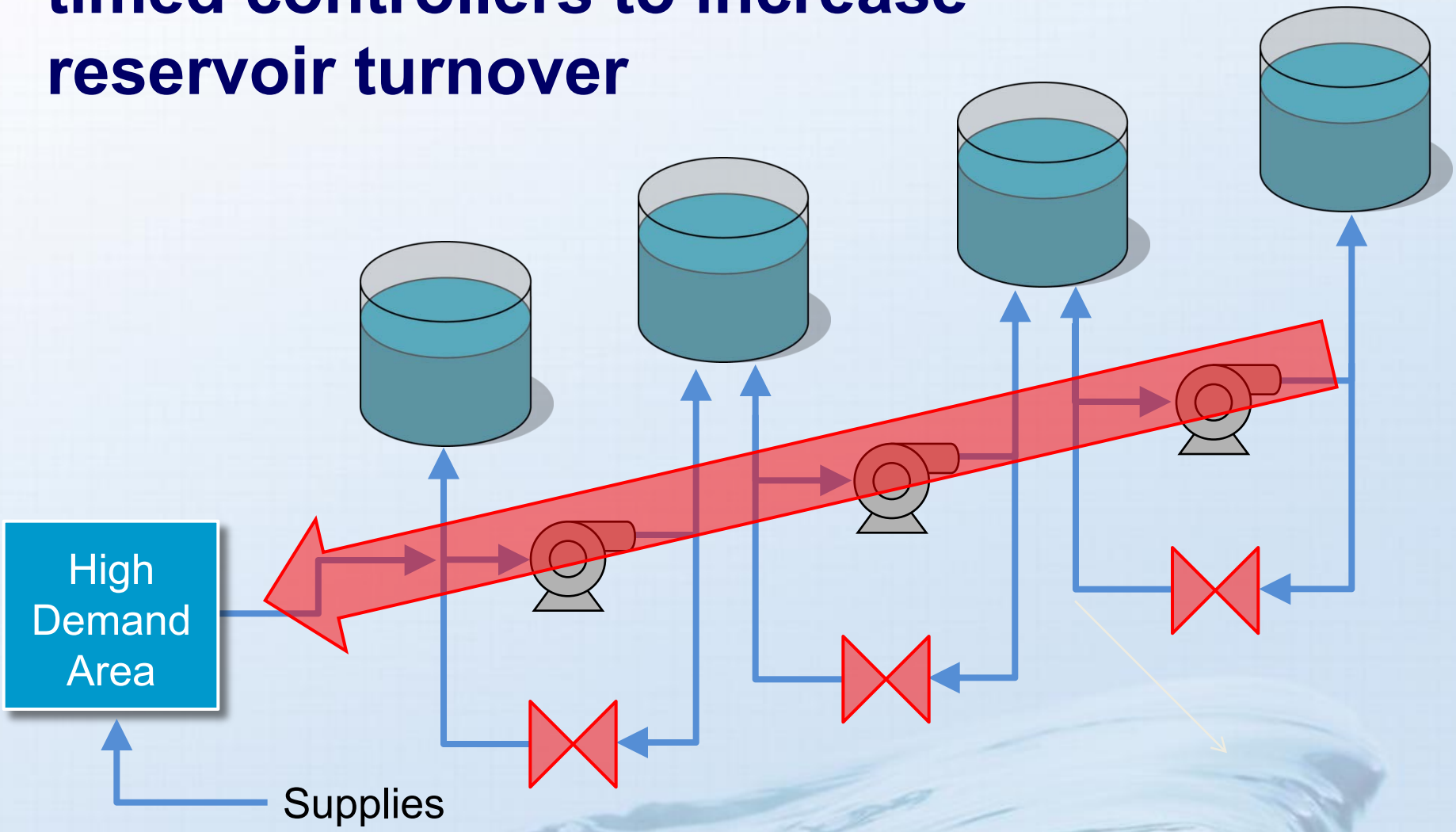
Original controls were based on reservoir levels leading to extremely high water ages



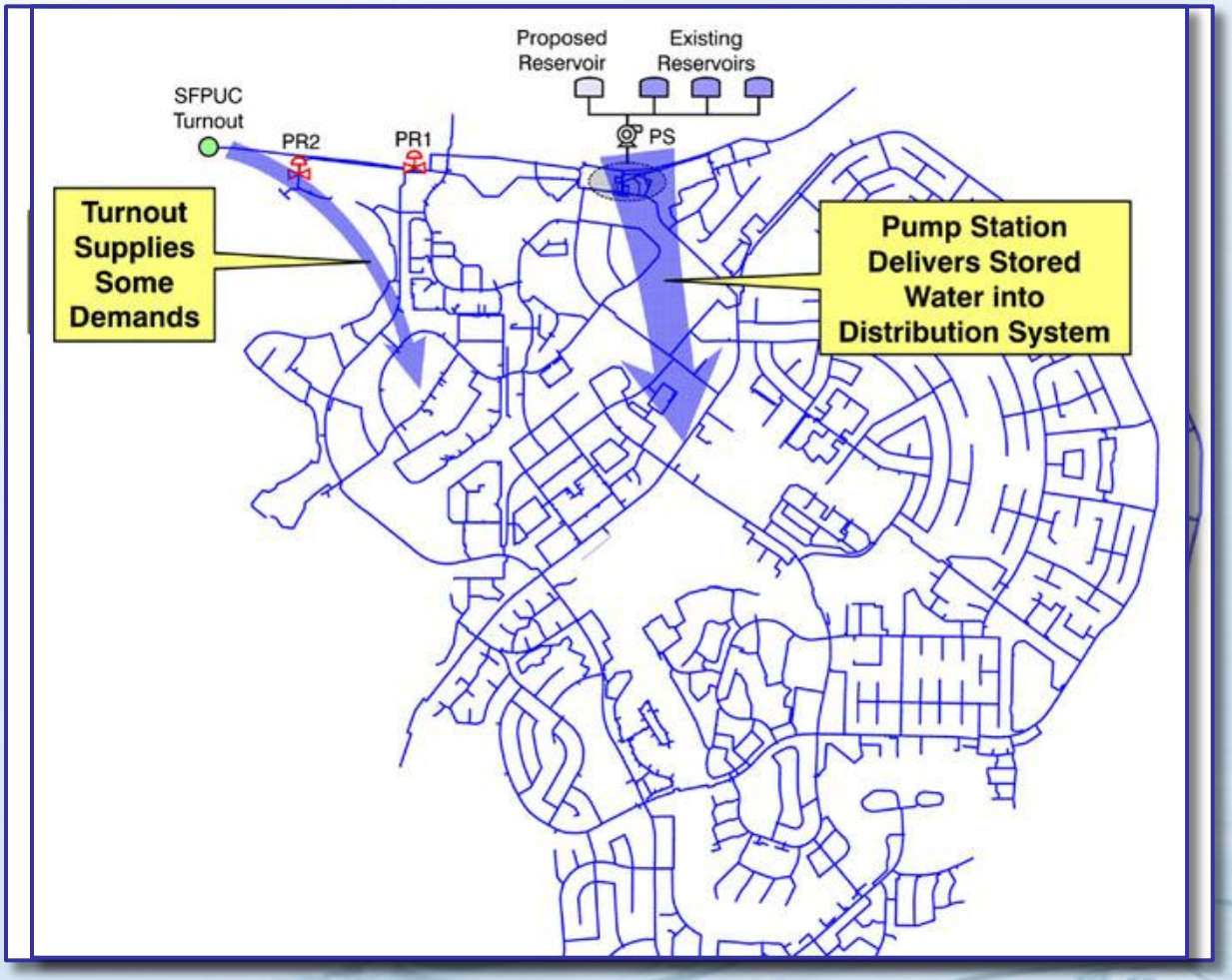
Pump station controls were instead coordinated such that all reservoir would fill at once



PRVs were also installed and put on timed controllers to increase reservoir turnover



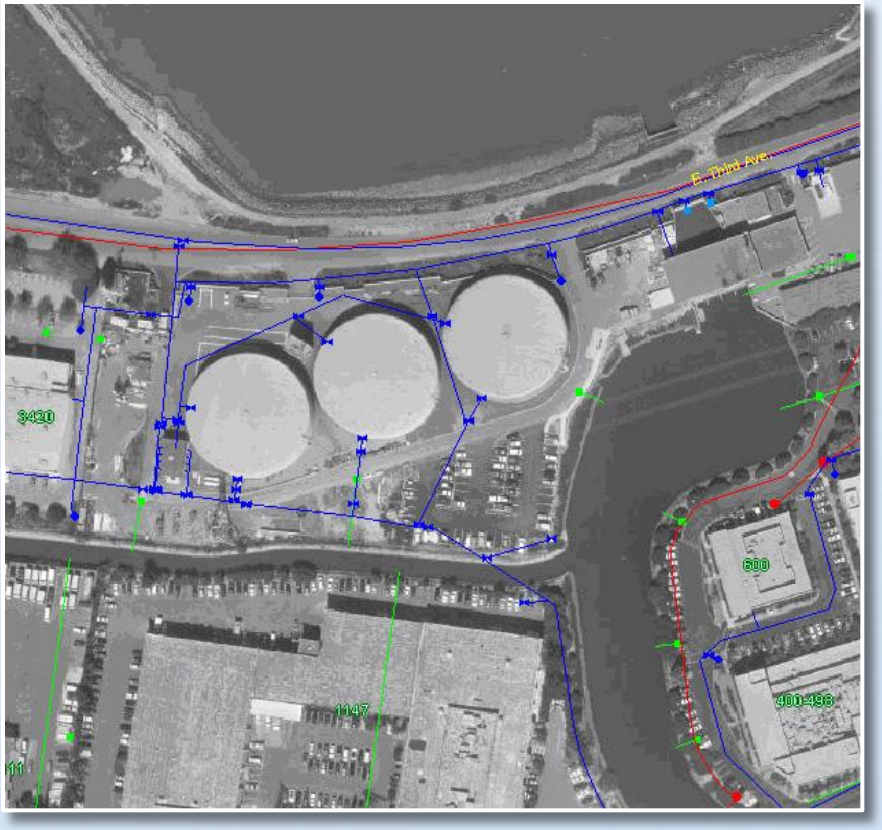
Case Study 2 – A simple system with a single large storage site



Night Operation

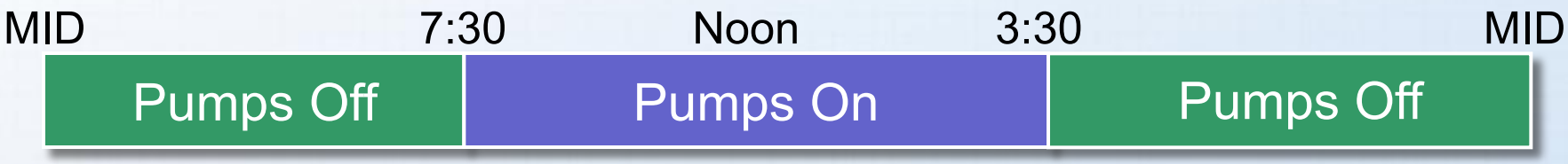
Current operations were leading to high water ages

- Insufficient reservoir turnover
- Operational strategy was not taking advantage of high water demand times of day
- Wanted to add additional storage at the same location to meet emergency storage needs



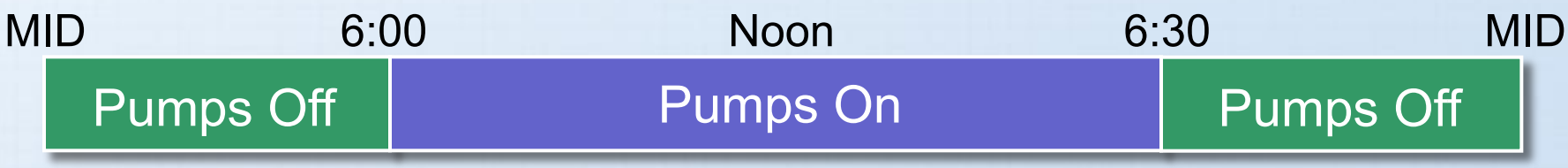
It was proposed that the City control water age through altered pump station operation

Current Operation

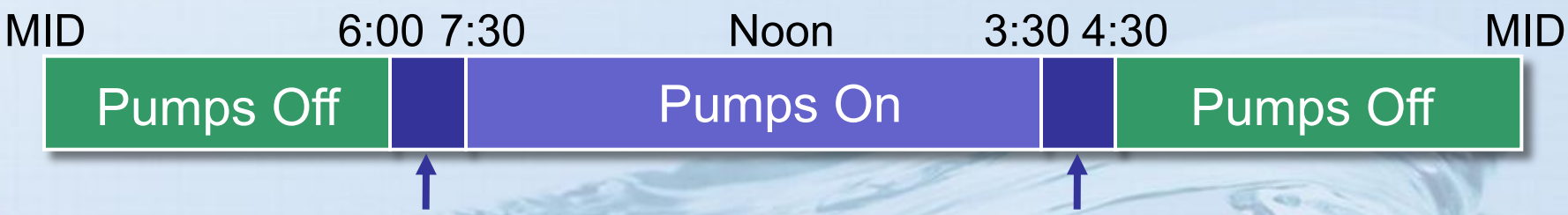


Recommended Operation

Winter



Summer



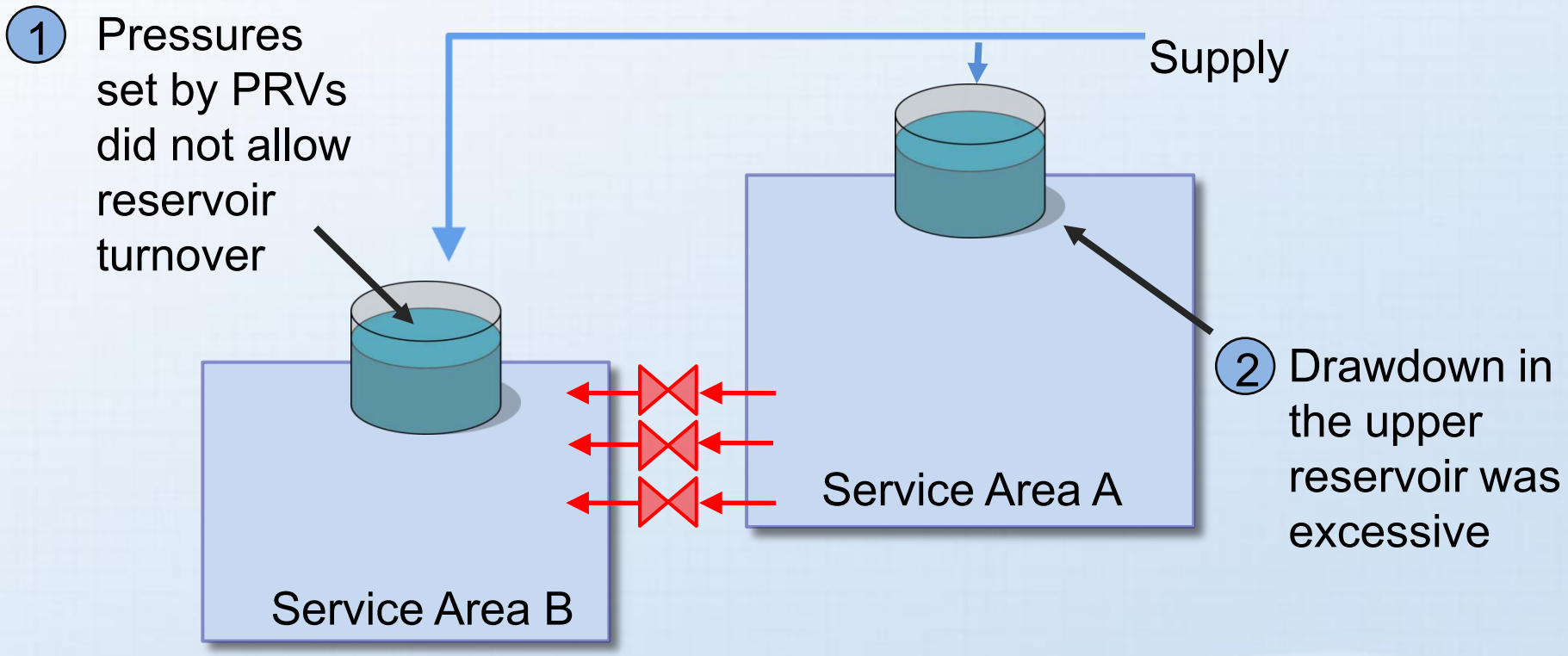
Additional pumping with proposed tank

Like for many utilities, improved water quality came at the cost of higher energy costs in both of these examples

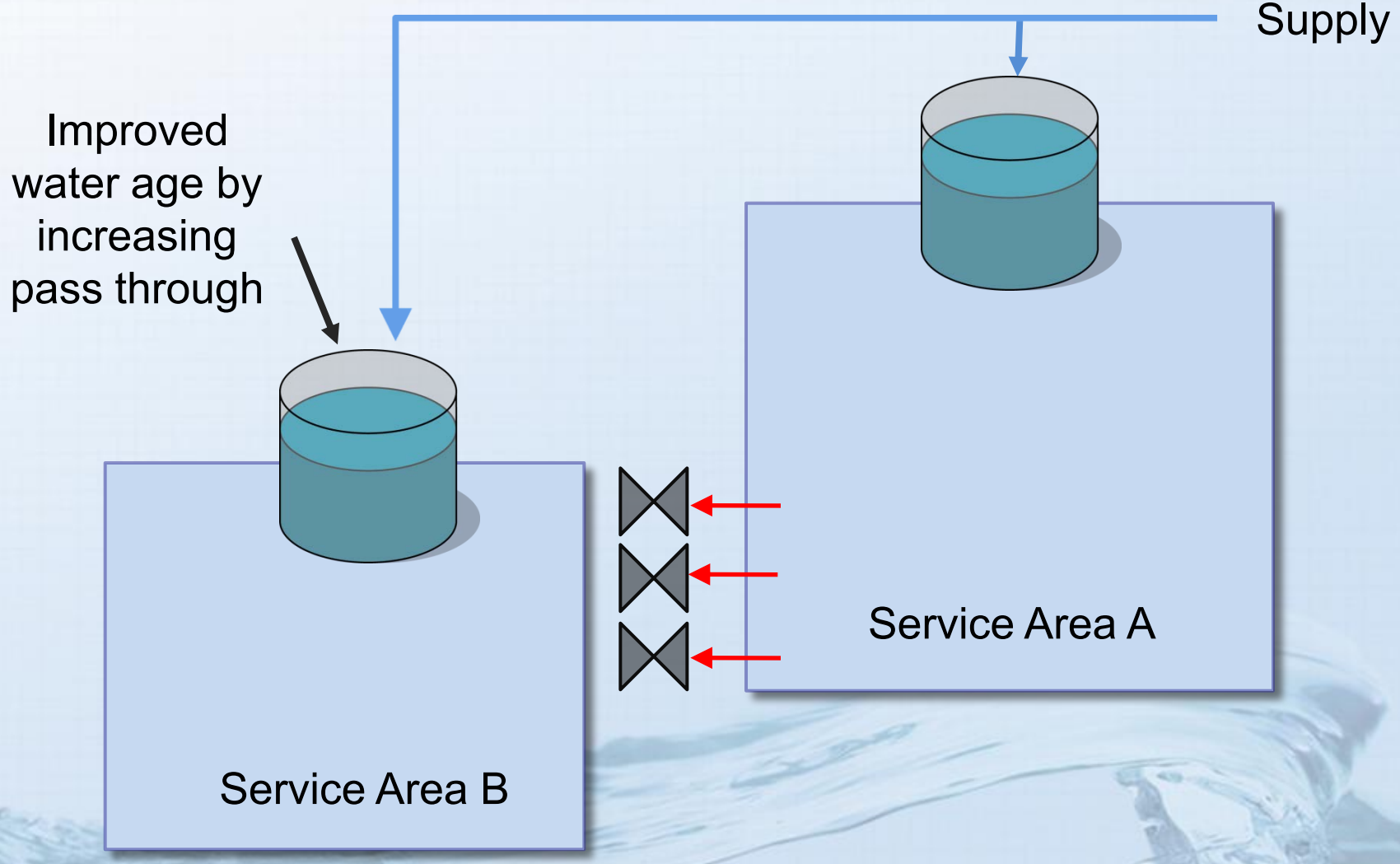
Reduced Water Age and Improved Water Quality

Energy Costs for Increasing Turnover

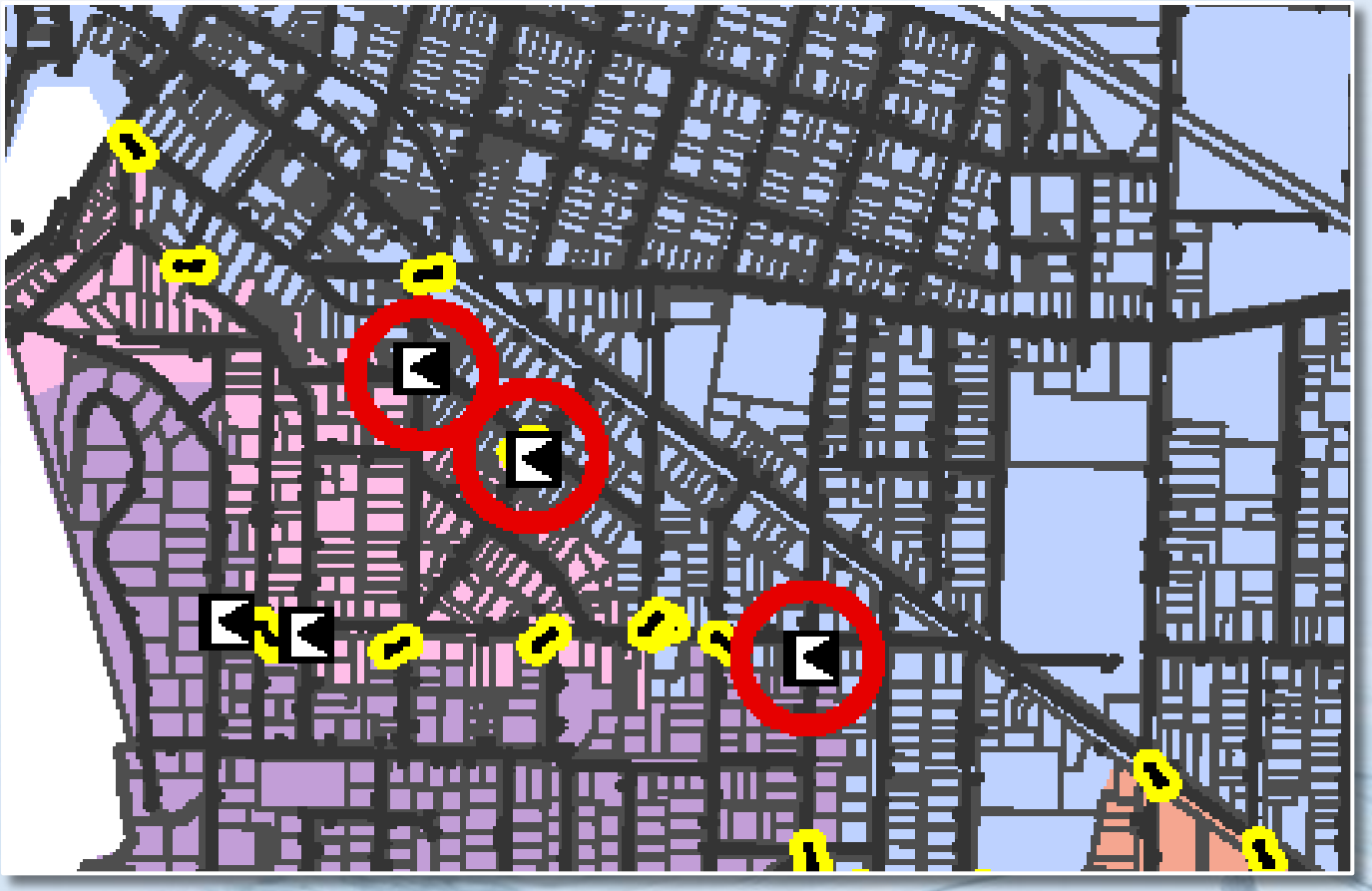
Case Study 3 – Poor turnover in a lower-elevation reservoir



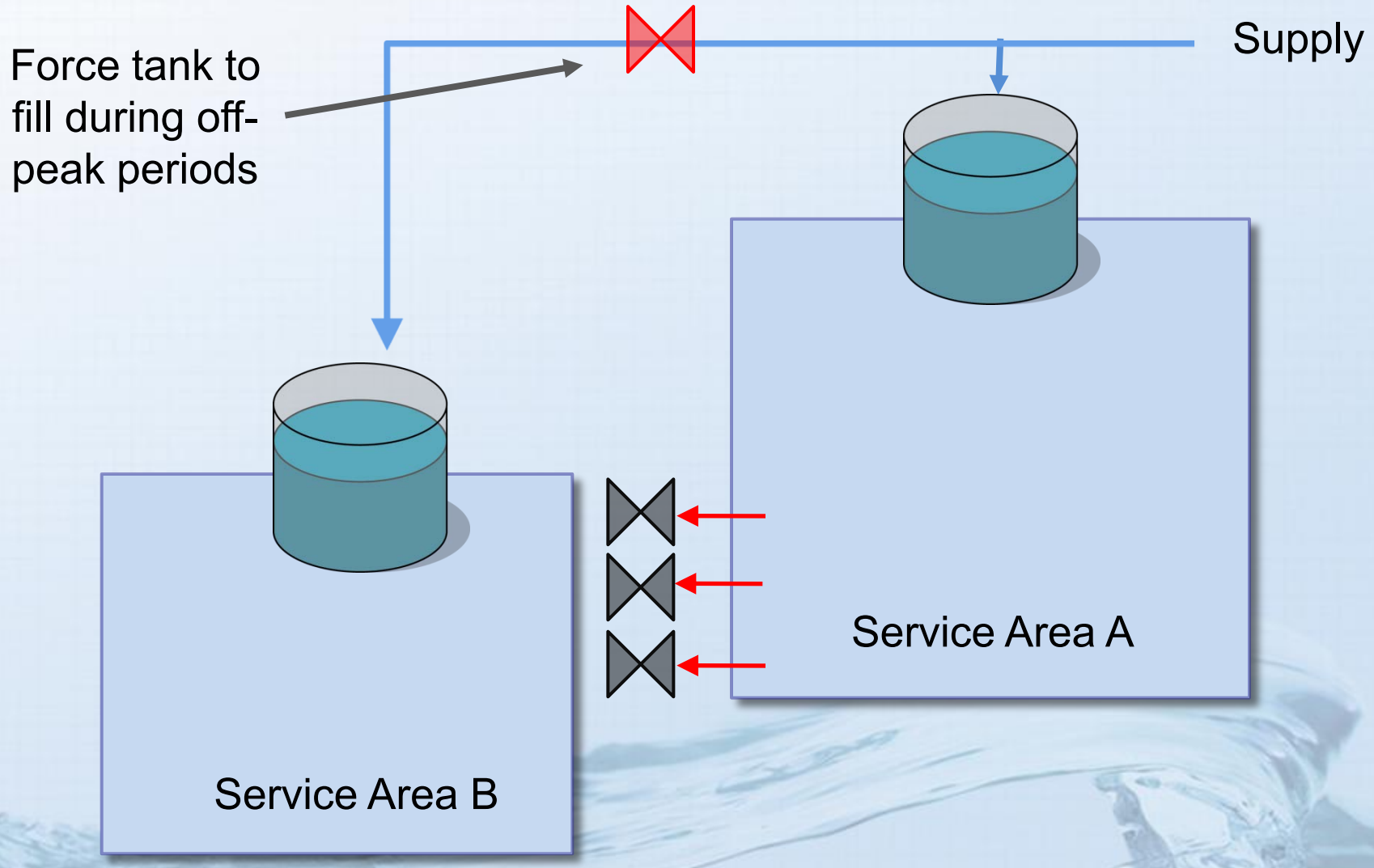
Partial solution was to reduce settings on PRVs to be closed during normal ops



The hydraulic model was used to verify PRV settings could be reduced while meeting pressure requirements

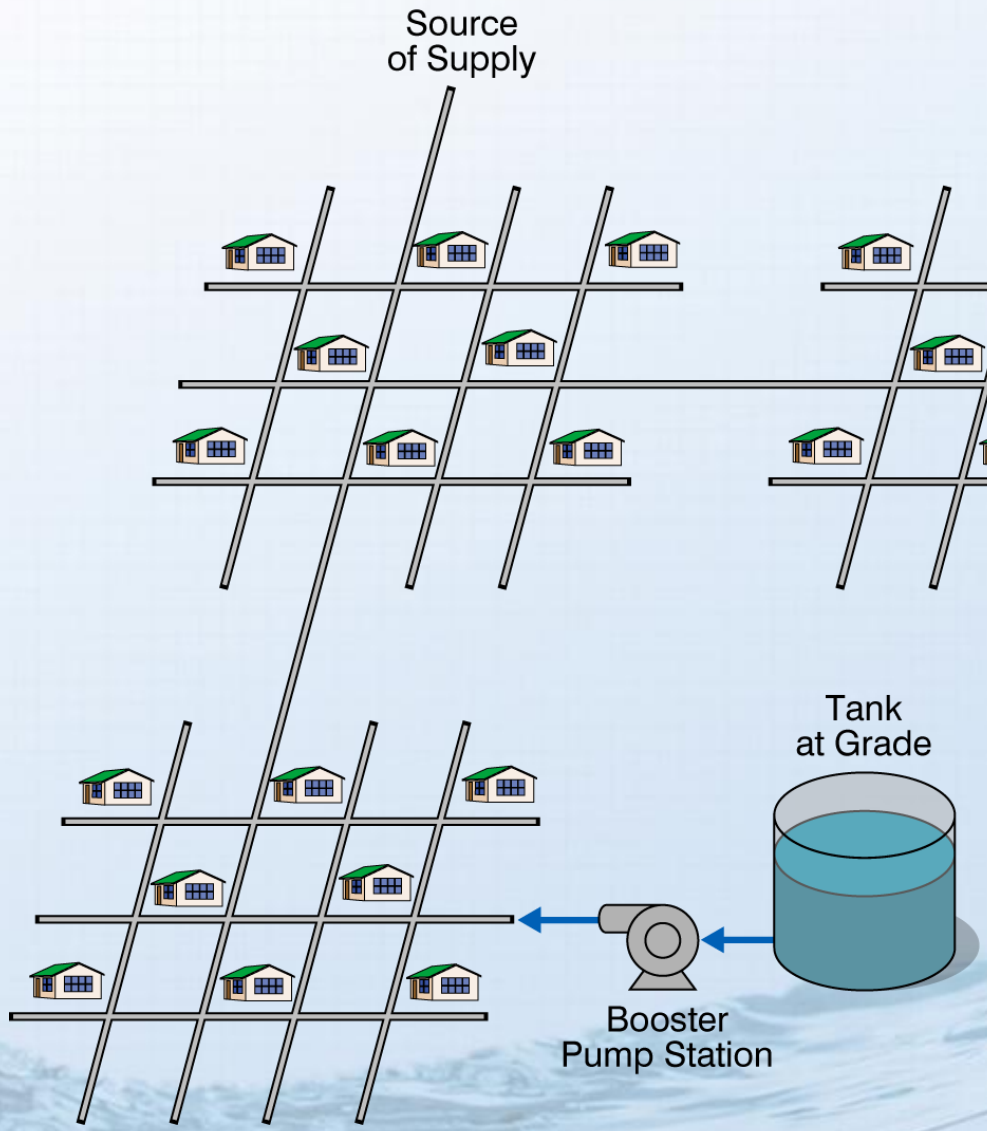


Improved use of the lower tank can be achieved through a SCADA-controlled valve



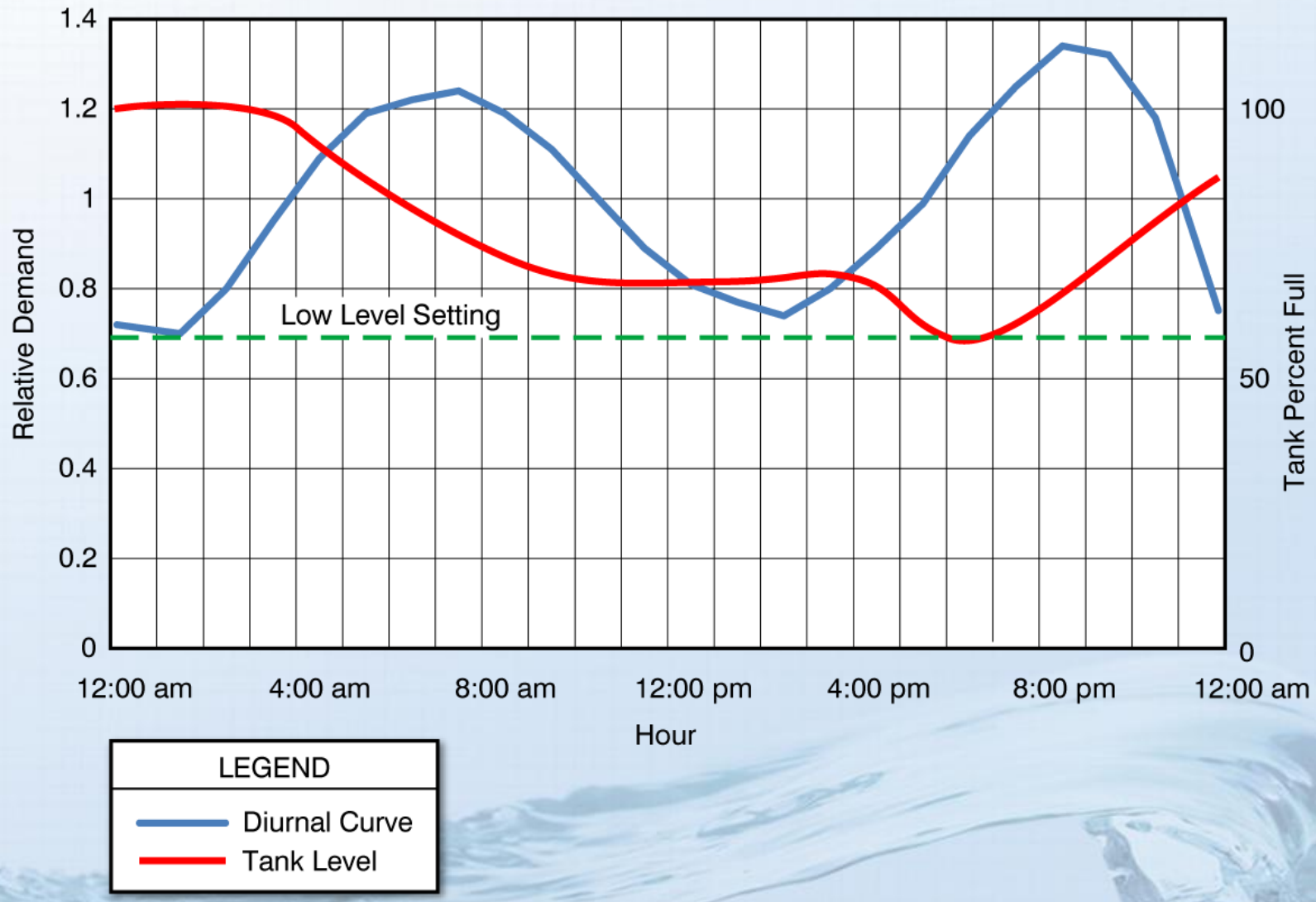
Improving Pressure Management

Case Study 4 – Use of a booster pump station in a rather flat city

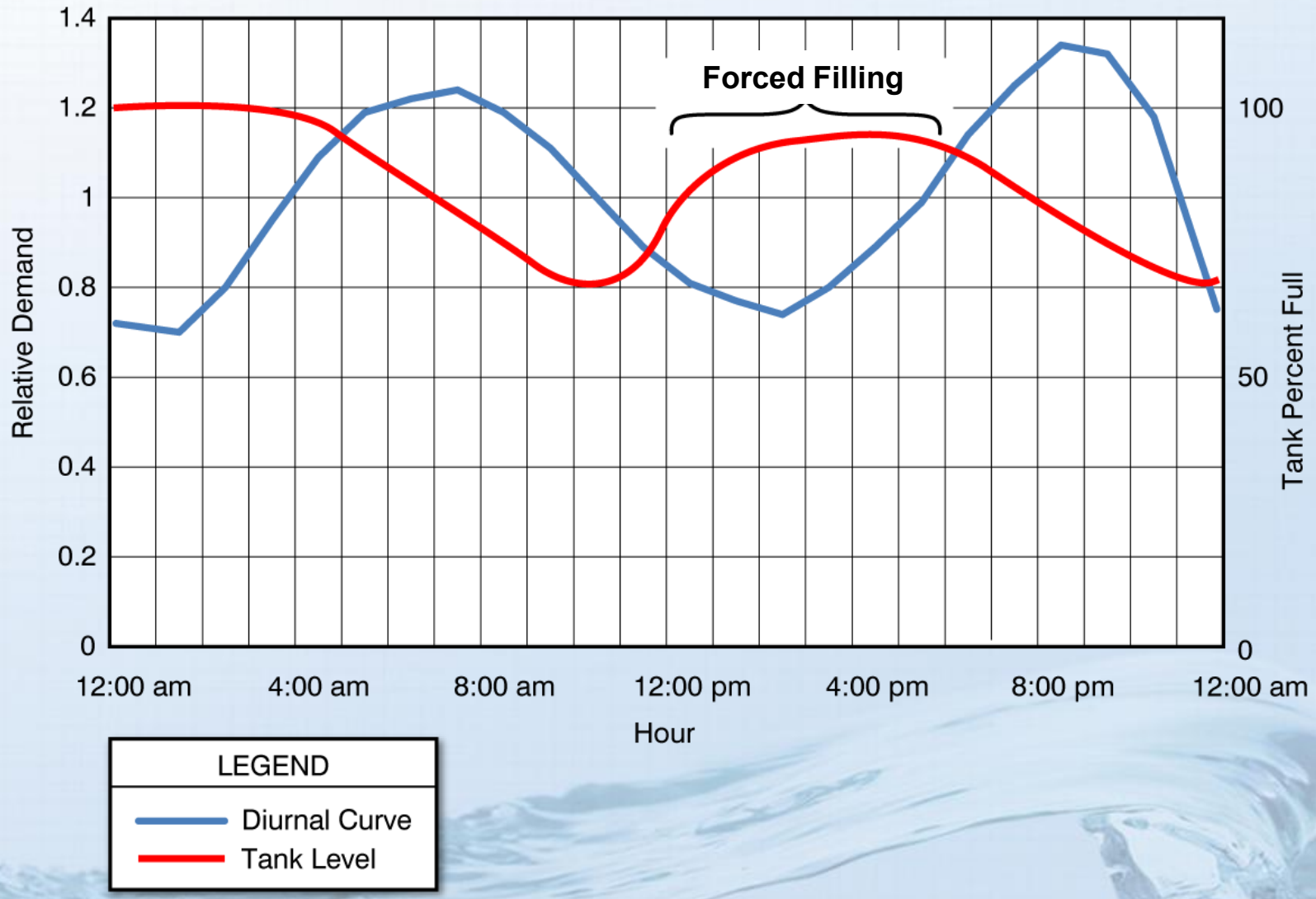


During Peak Usage Periods	
Pump Station On	Pressure ✓
Pump Station Off	Pressure X

Existing controls sometimes led to the booster pump station being unavailable during peak periods

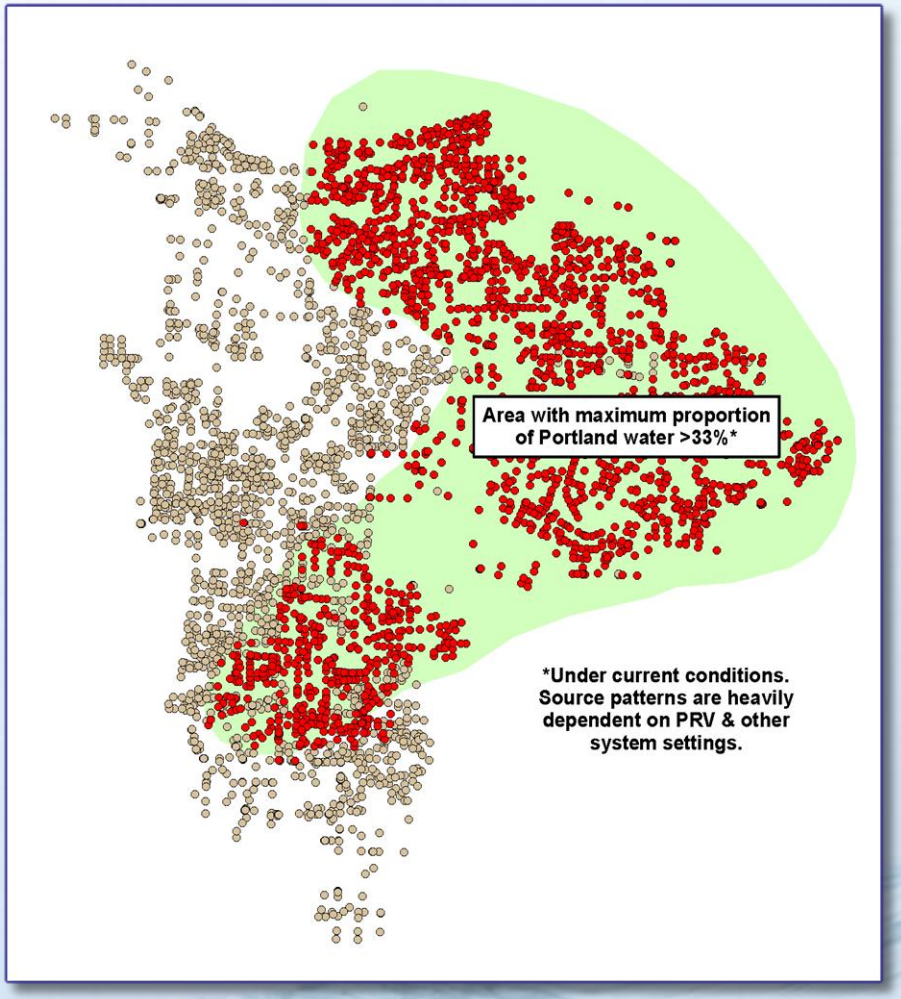


Forced filling during non-peak hours prepares the reservoir to be full when needed



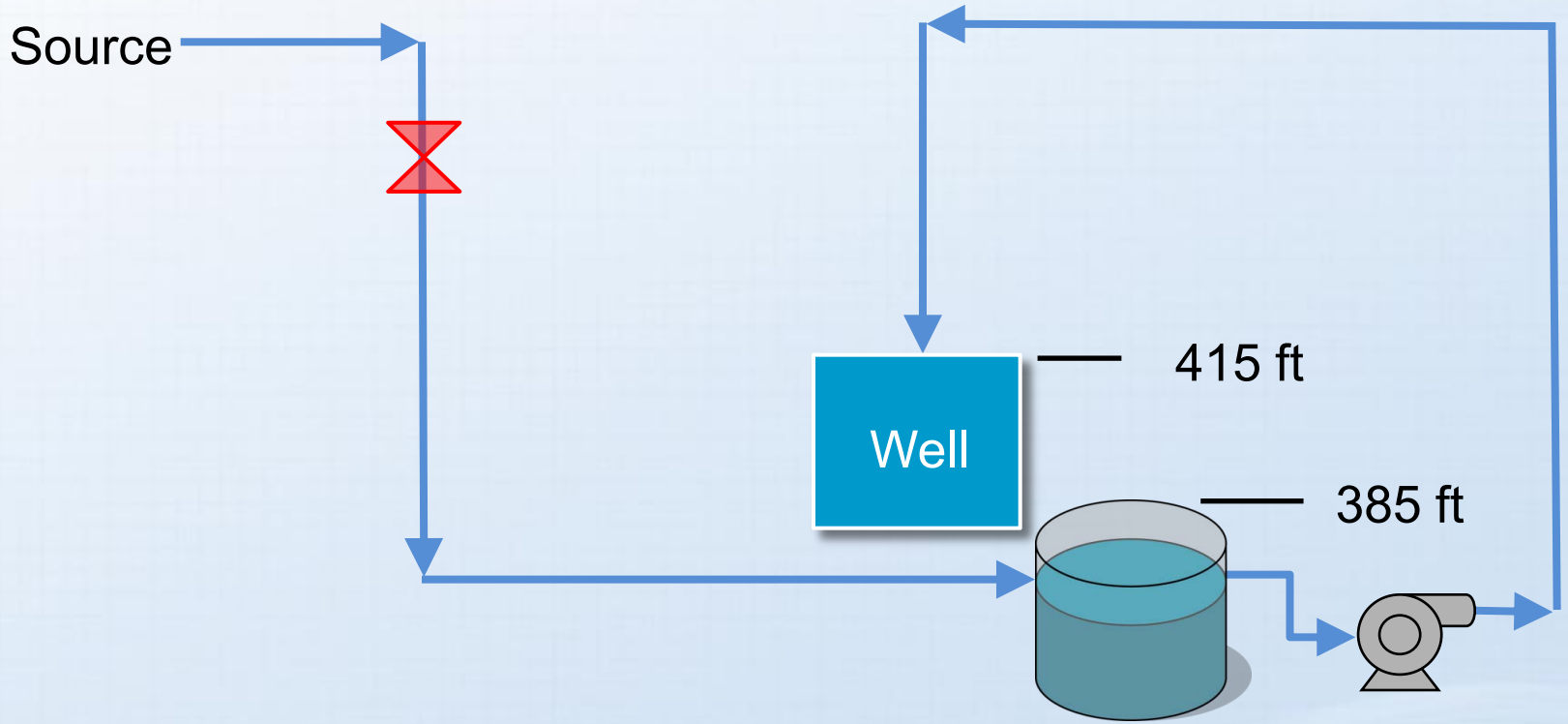
Managing Mixing of Different Source Waters

Source traces can be used to increase system understanding



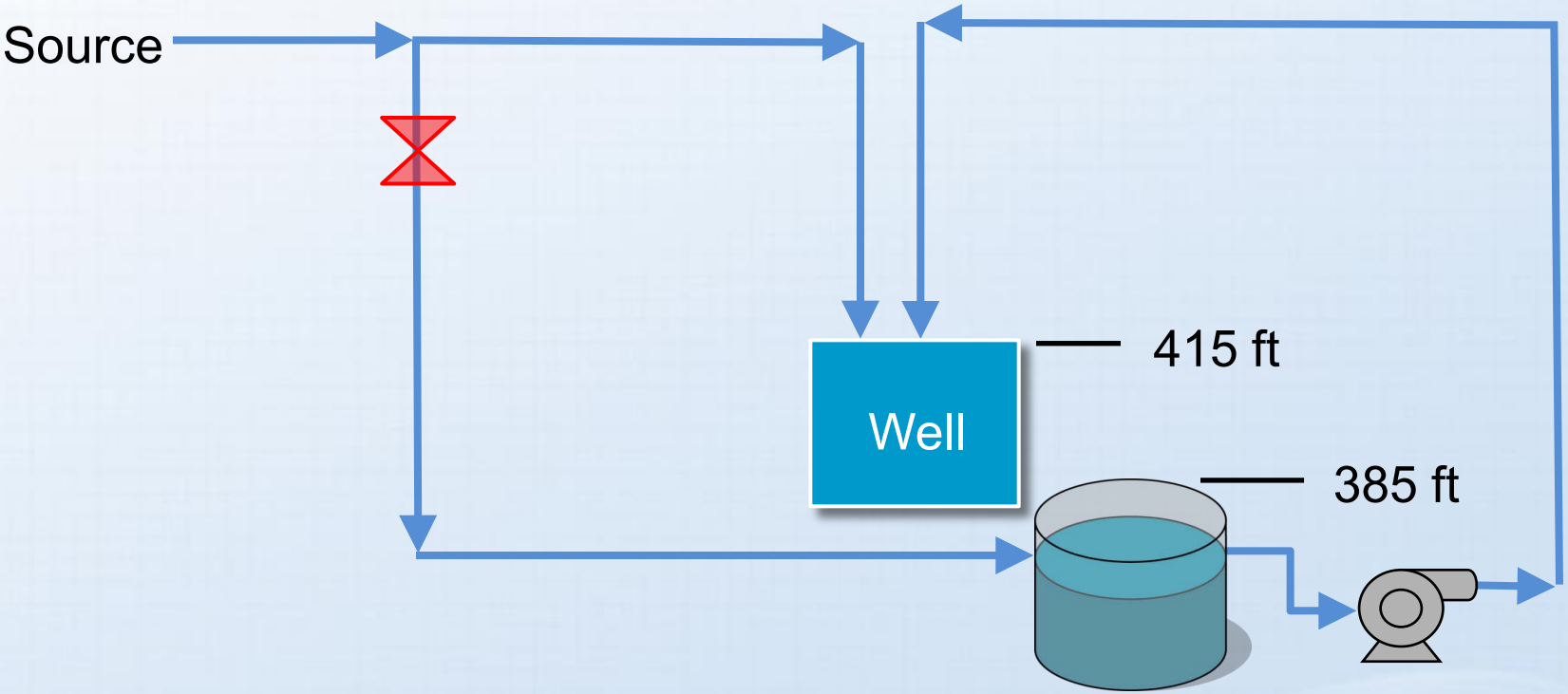
There are opportunities to optimize systems with multiple source waters and/or multiple disinfectants

Case Study 5 – Controlling ASR source waters at TVWD



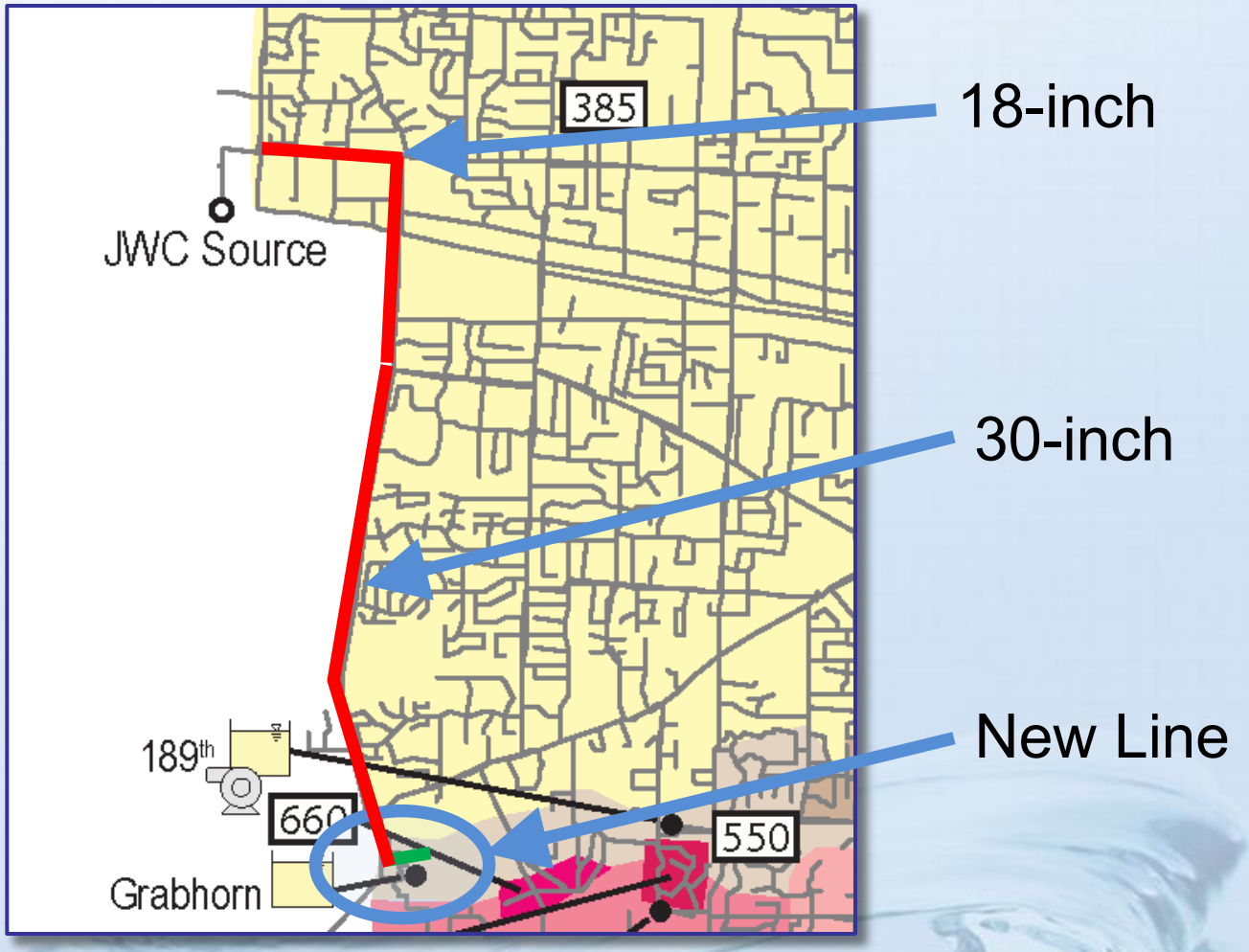
Existing system configuration did not allow source water for the well to be controlled and wasted energy for pumping

District staff had the idea of feeding the well directly from the supply line

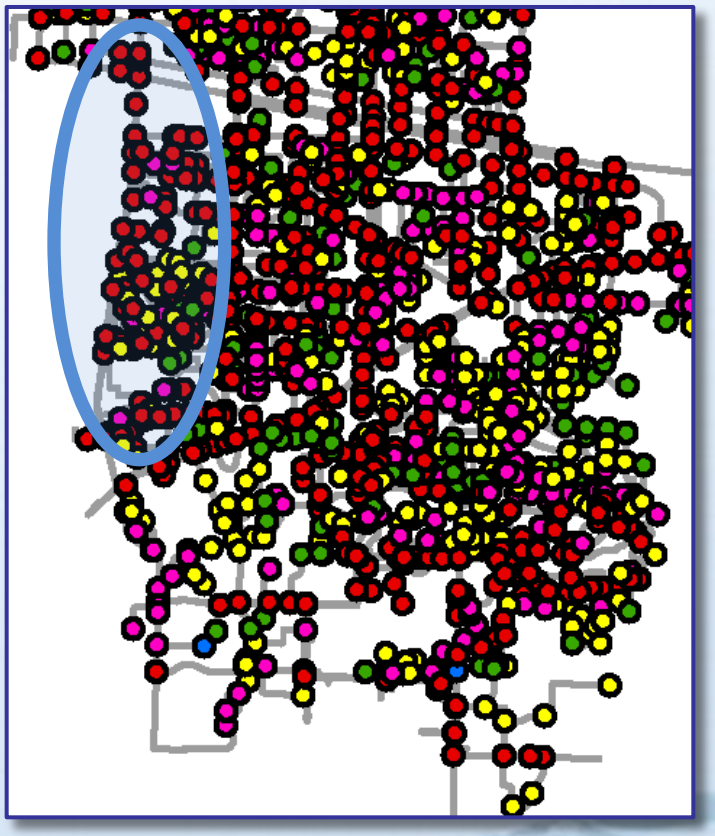


New configuration uses available head from the District's JWC supply line to recharge the well

A simple capital improvement allowed the ASR well to be served directly from the alternative supply



Hydraulic modeling was used to verify fire flows could still be achieved without the extra line

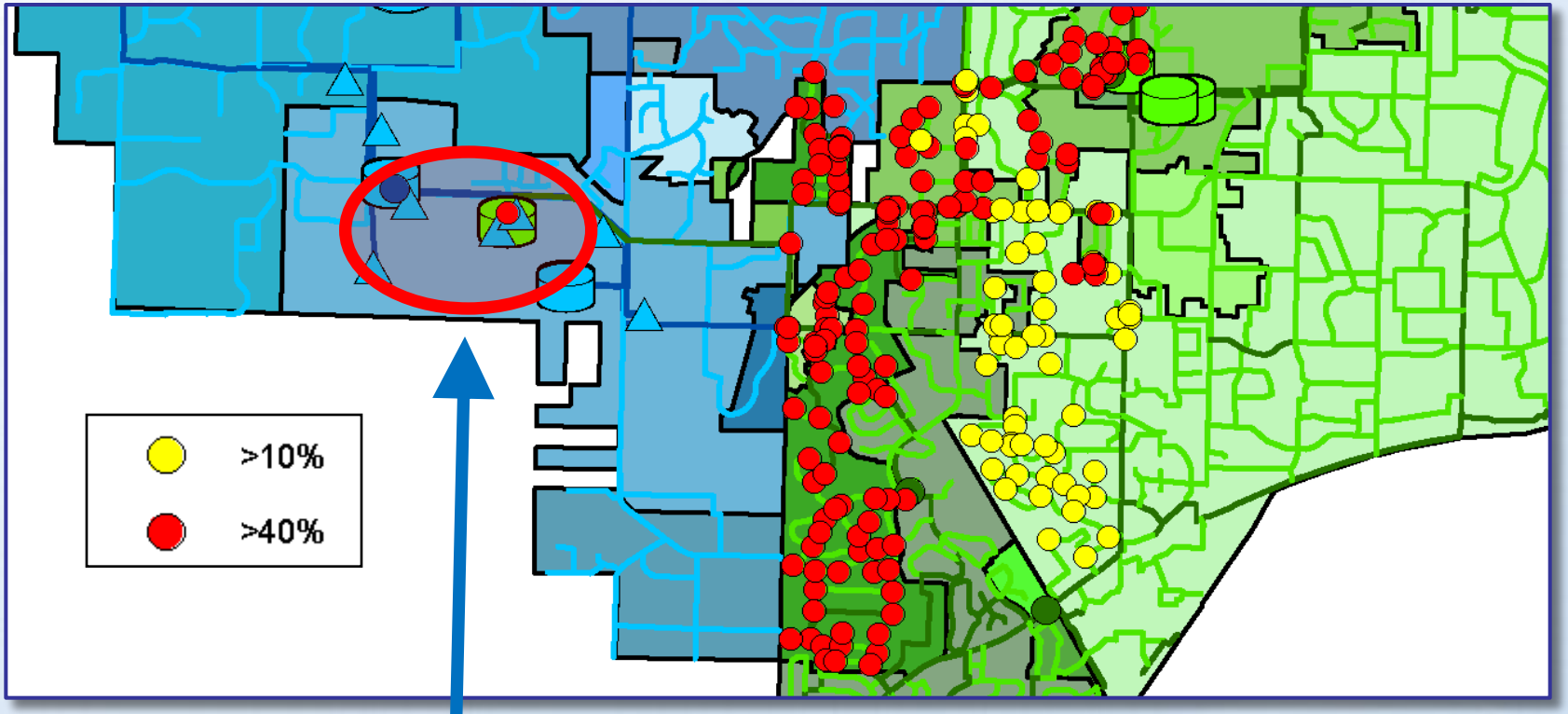


Legend

Available Fire Flows (gpm)

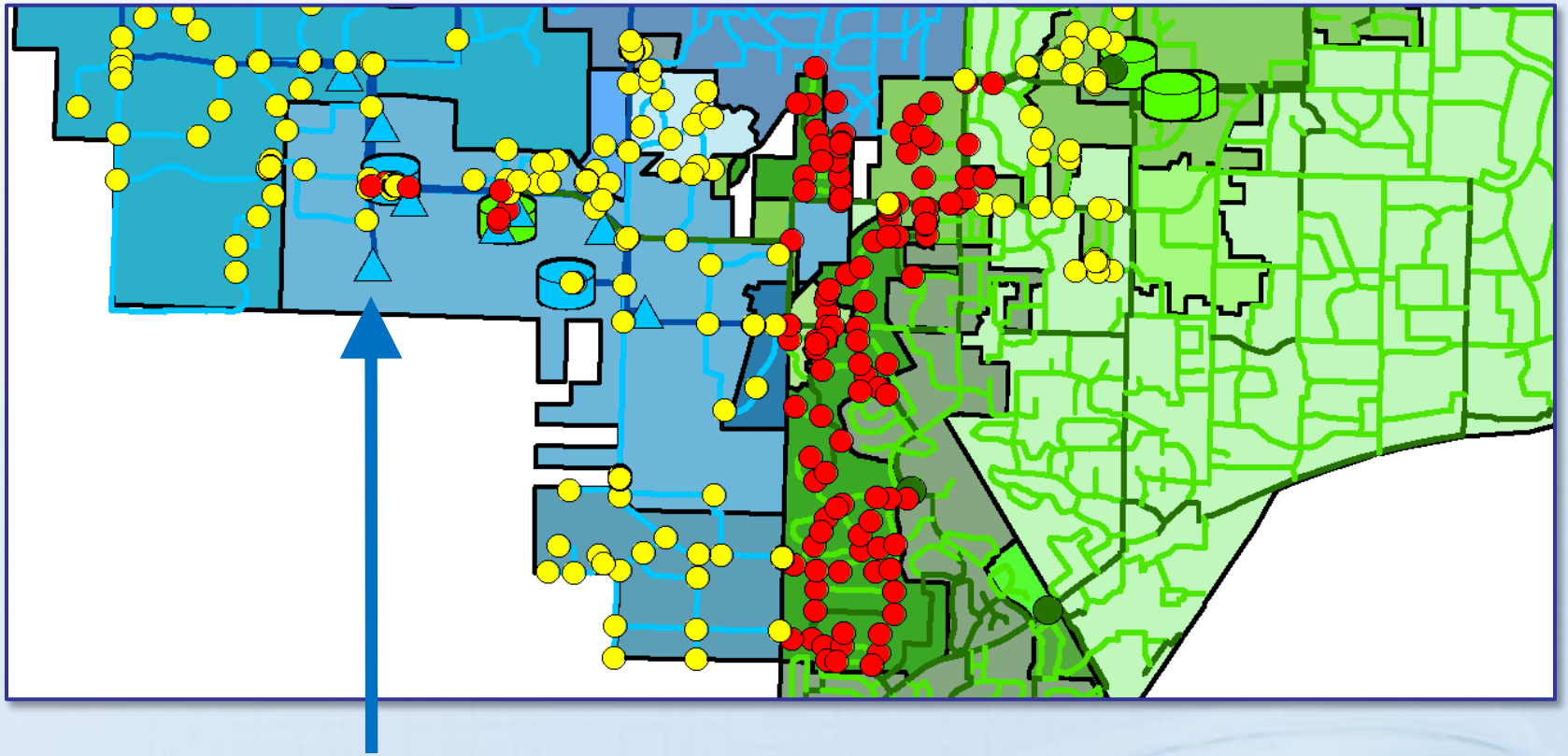
- Less than 750
- 750 - 1,500
- 1,500 - 2,500
- 2,500 - 3,500
- Greater than 3,500
- Water Distribution System

Case Study 6 – Managing well discharge waters



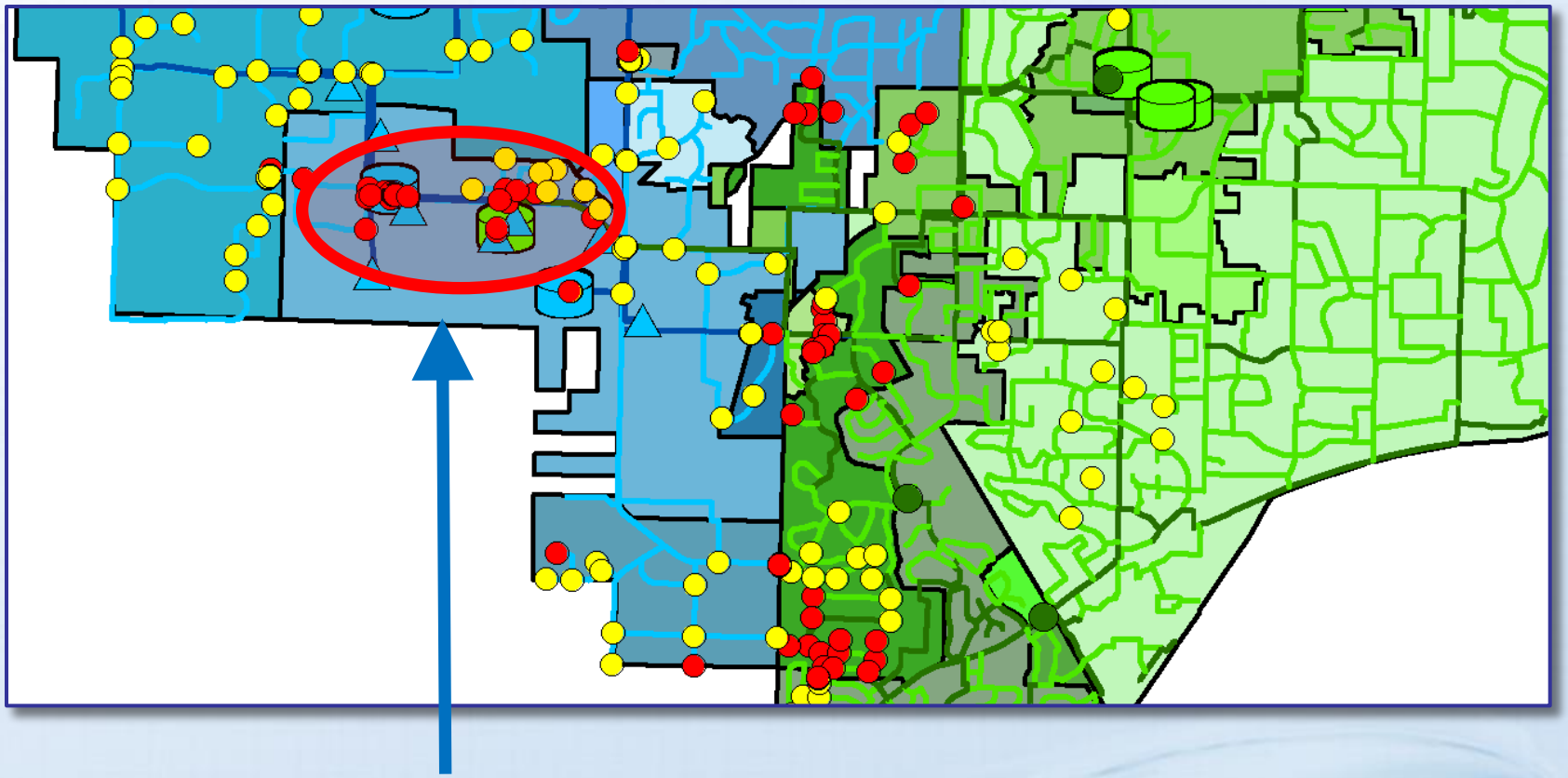
Well Water Discharging
Directly to Single Reservoir

Splitting flows 50/50 with a second reservoir was insufficient



Well Flows Split 50/50
Between Two Reservoirs

A 75/25 split gave improved dispersion of well water



Well Flows Split 75/25
Between the Two Reservoirs

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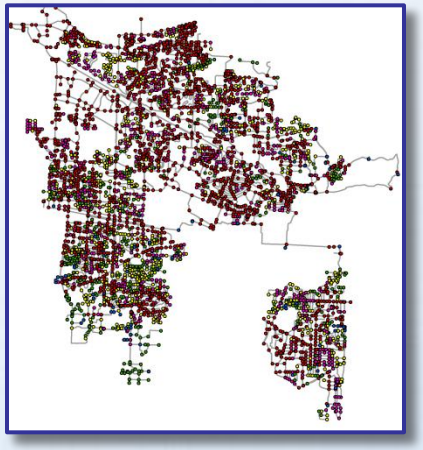

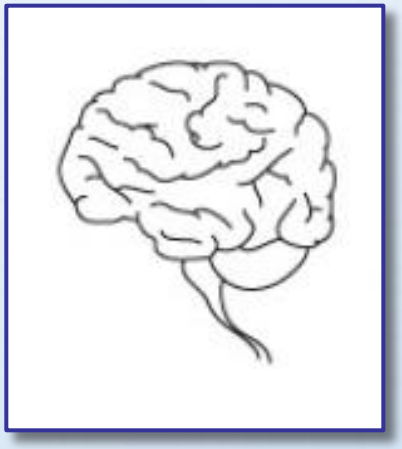

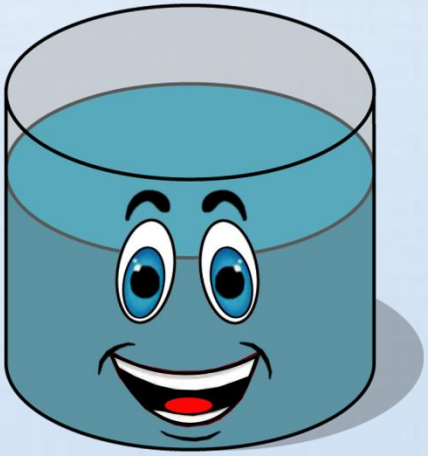

Got questions?