CH2MHILL

Using Hydraulic Modeling as a Basis for Design

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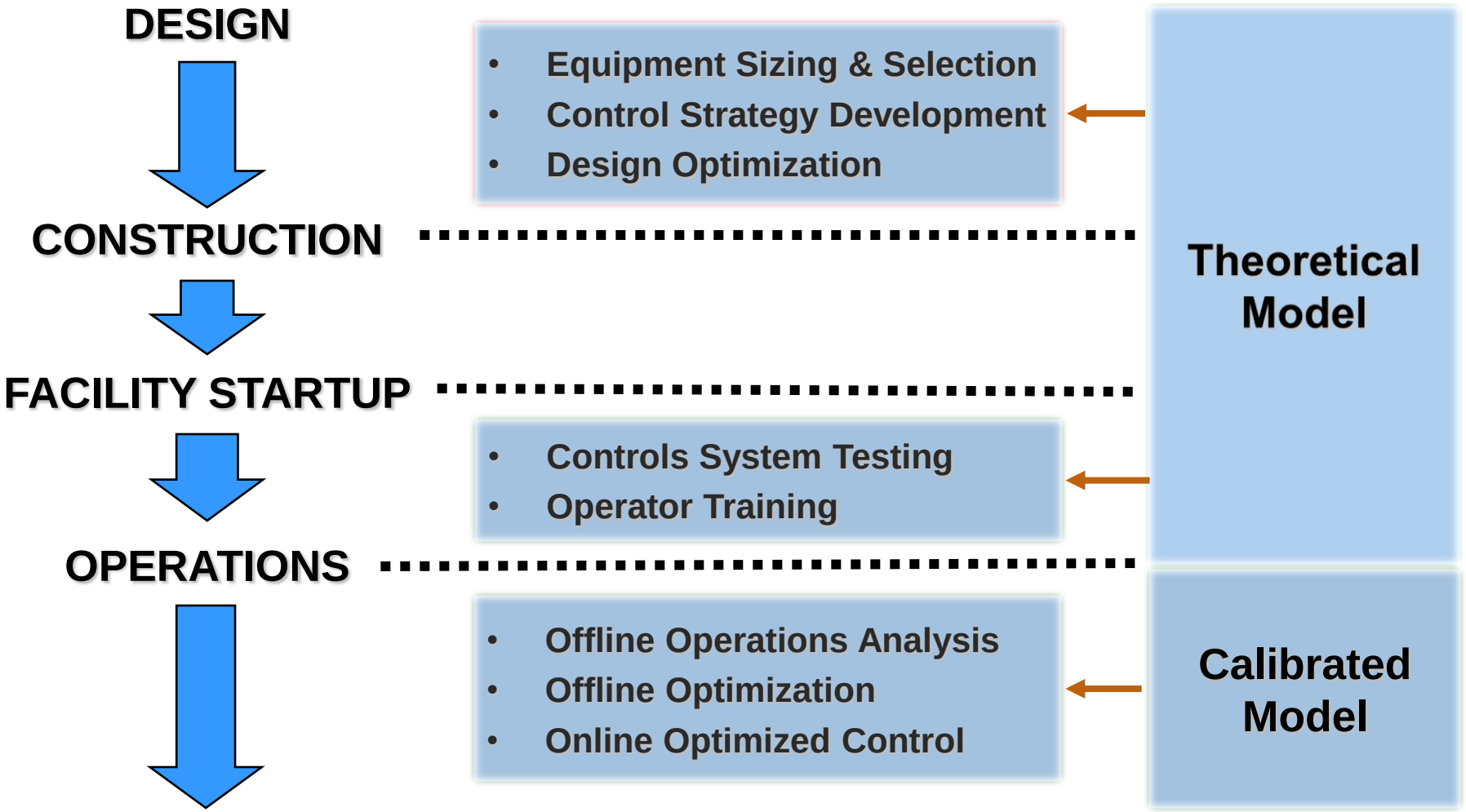
Agenda

- Hydraulic Modeling Overview
- Project/Model Types
- Developing and “Trying Out” your Solution
- Case Study Summary

Modeling for Design Approach: Where does the Model Fit In?

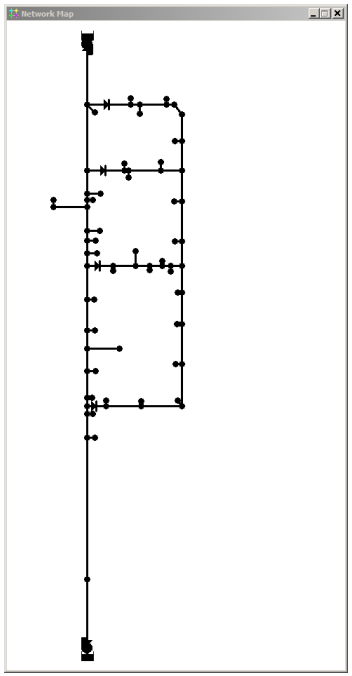


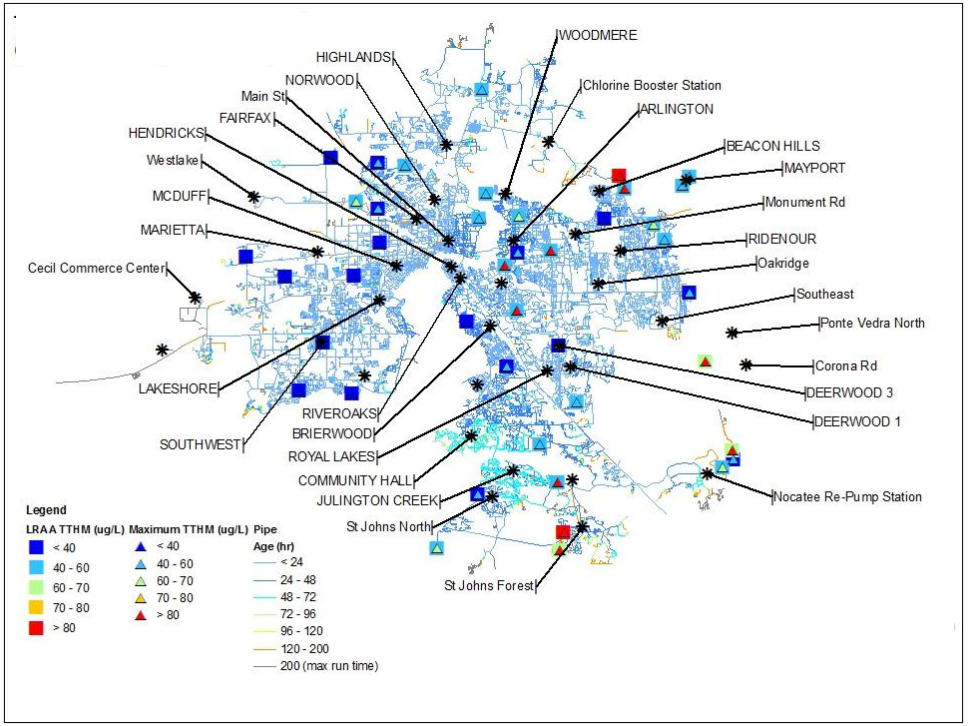
Dynamic Simulation Models

- Logically describe a system's behavior progressing through time
- Analyze complex systems & optimize performance
- Test hypotheses in a safe, low cost environment
- Improve system understanding
- Effectively communicate complex issues
- Stimulate creative thinking leading to improvement

Project Types:
Simple vs Complex Hydraulic Model

- Tailor the model complexity to the problem you are trying to solve

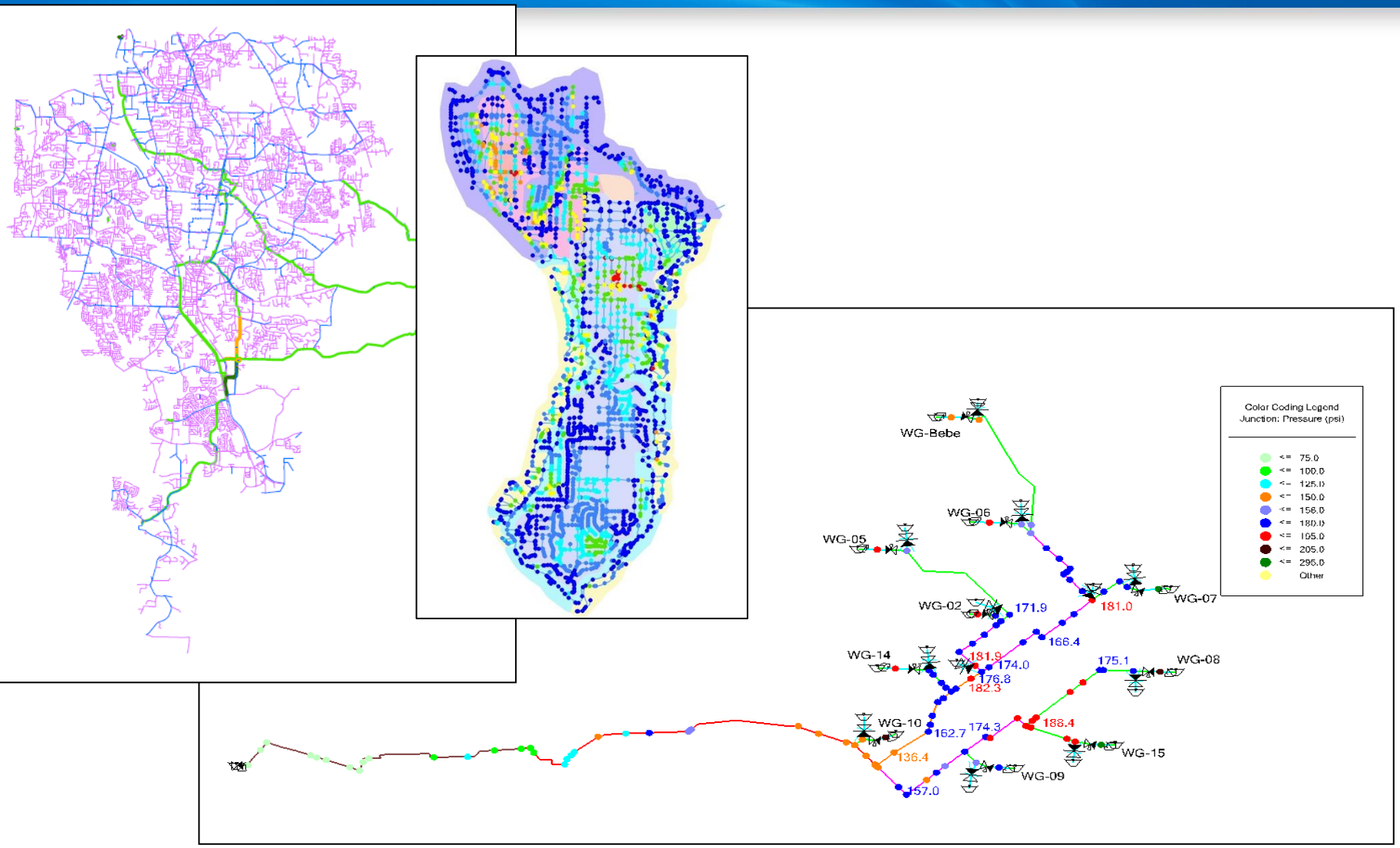




Simple, minimal controls

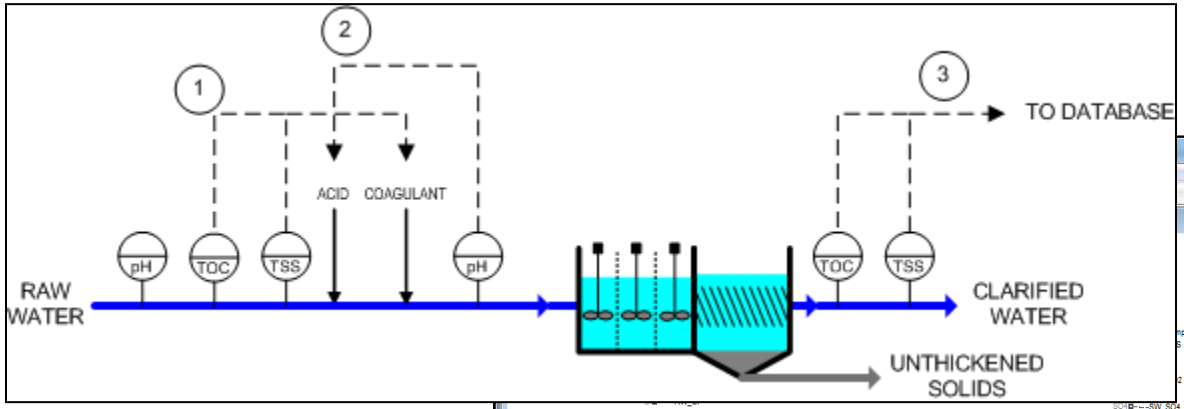
More Complex, Numerous sources and zones

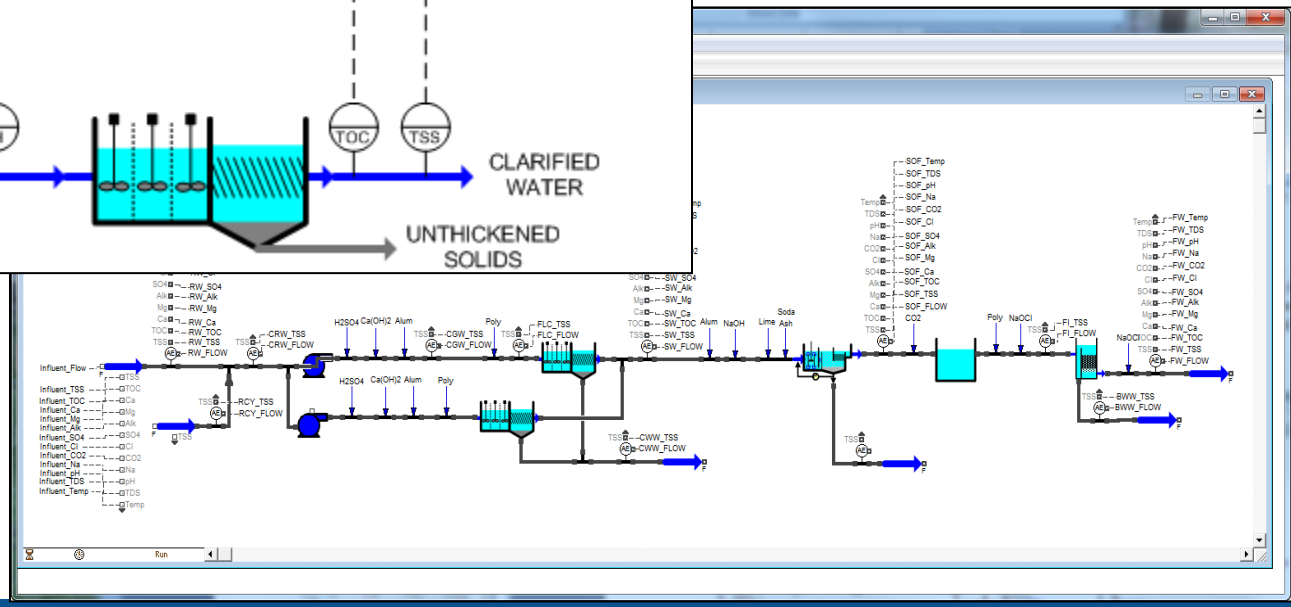
Model Types:
Distribution System, Wellfield



Model Types: Treatment Plant

- Treatment Plant Modeling
  - Hydraulics and Process Modeling
  - Chemical Addition/Reactions
  - Solids Removal





Developing and "Trying Out" Your Solution

Traditional Planning

- Size facilities to meet future demand projection
- Static evaluation
- Often, 20 – 25 year planning horizon
- Perhaps…...
  - Near Term (5 – 10 year)
  - Buildout

Modeling for Design

- ***Engineer*** facilities to meet future demand projection
- While also…..
  - Working in existing and near term operation
  - Working year round
- Operational evaluation
- Improve operation
  - Efficiency
  - Water Quality

Developing and “Trying Out” Your Solution

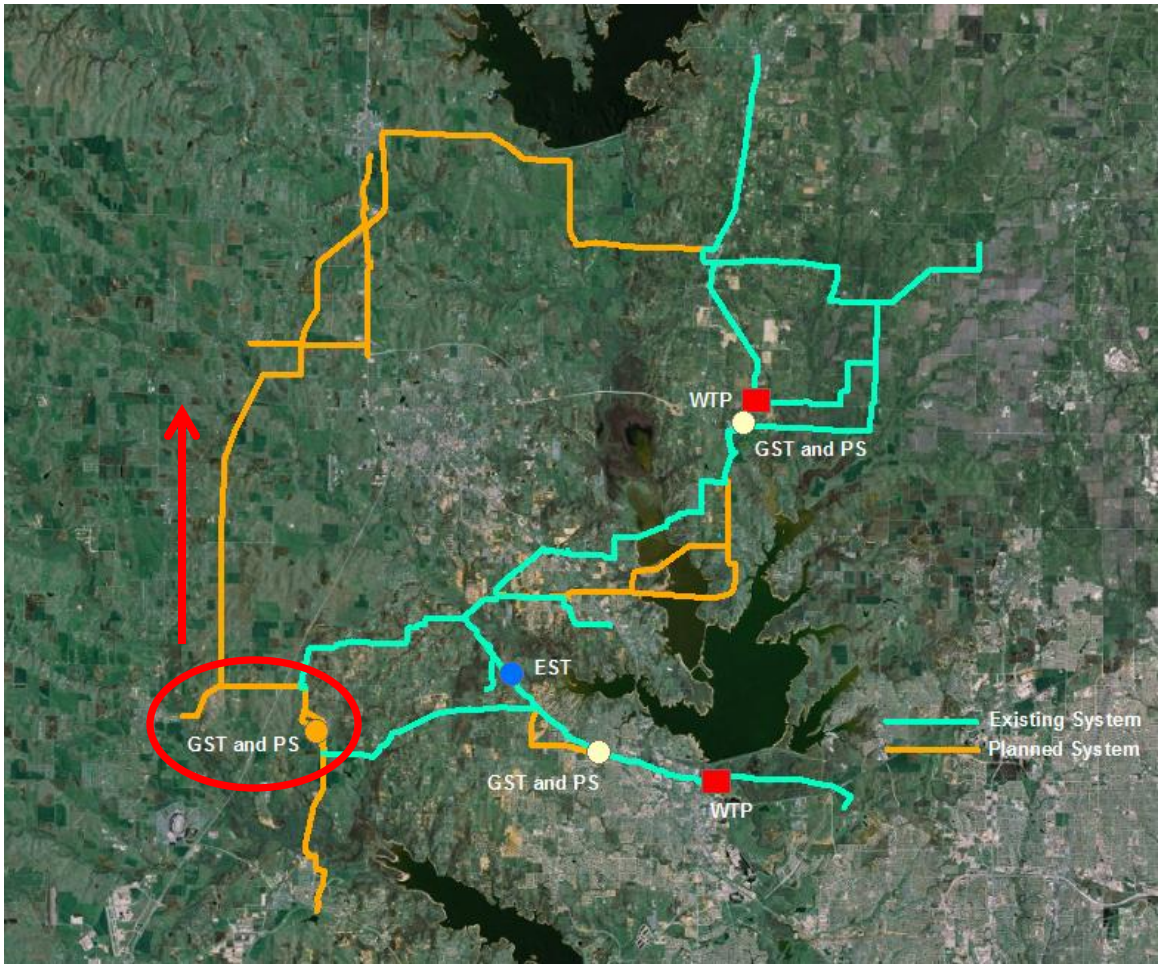
- Incorporates Whole System Behavior
- Equipment Sizing and Selection
- Impact of Varying Conditions
  - Flow
  - Water quality
- Cost Analysis
  - Energy & chemical consumption
  - Capital costs
- Operating Strategy Evaluation and Selection

Developing and “Trying Out” Your Solution

- Planning for the future yet building today
  - Will this pump work?
    - Do I build the facility and swap out pumps?
    - Do I build the facility with the future pumps?
    - How can I make it work?
- Evaluating operational changes
  - Promoting tank turnover
  - Introduction of a new source
  - Removing a tank from service
- Your hydraulic model can help you answer these questions and phase the solution

Case Study Number 1: Wholesale Transmission System

- Wholesale water provider
- System of WTPs and Transmission Mains
  - > 92 miles of pipe
  - > 600 square miles
  - Primarily > 24-inch
- "If you Build It, They Will Come"
  - Need facilities in place when development 'hits'
  - Do not want to overbuild
  - Multiple what-if scenarios drive investment level



Case Study Number 1: Wholesale Transmission System

- Goal:
  - Develop phasing plan for expanding the service area based on current information
    - Key: Make this flexible
  - Evaluate existing facilities and develop expansion plan

Case Study Number 1: Wholesale Transmission System

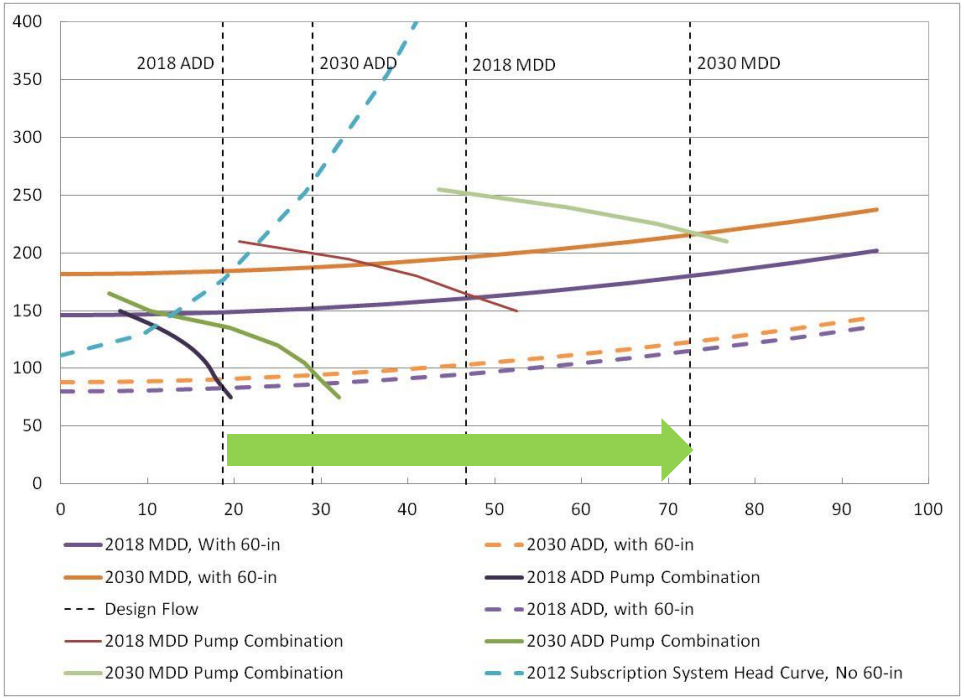
Challenge

- Wide variation in projected demand for study area

	MDD	ADD
2012	3.2	1.3
2018	7.4	2.9
2030	27.6	11.0
2040	44.5	17.8

- Inline booster initially
- Balancing Tank (10 MG) plus larger pump station for the future conditions

Even Larger Demand Variation for Facilities Supply Study Area Facilities

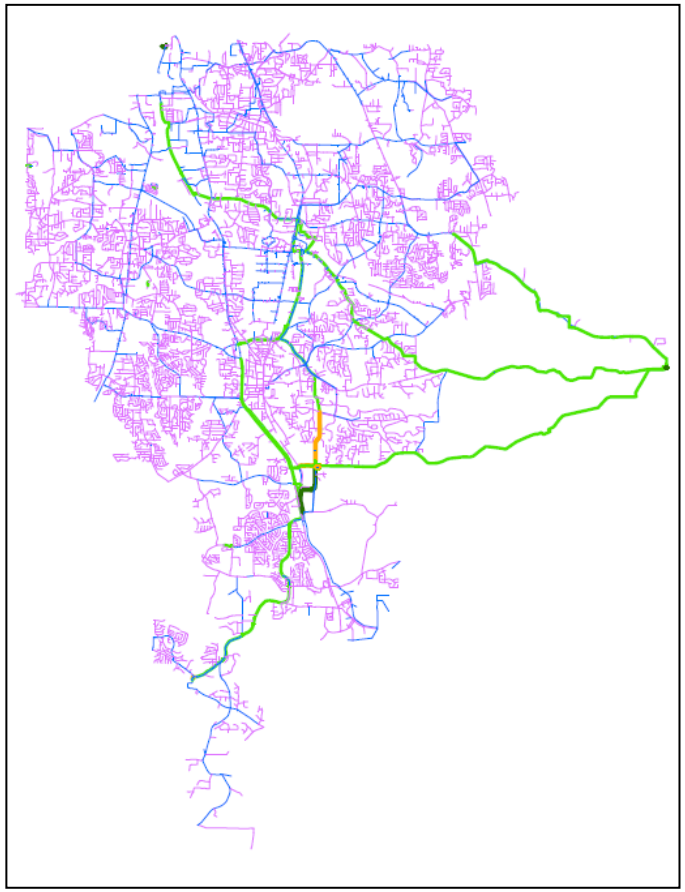


Case Study Number 1: Wholesale Transmission System

- Why use Model and Not Spreadsheet for primarily Linear System?
  - Scenario maintenance and visual interpretation of results in other areas of the system
  - Can quickly:
    - Identify pump requirements
      - Size, select, and evaluate pumps across variable speed range/multiple operating points
  - Identify limitations if future construction is delayed: Mitigate risk!

Case Study Number 2:
Distribution System Upgrades and Operational Modification

- Distribution System Summary
  - ADD = 15 mgd, MDD = 29 mgd
  - 3 GSTs and PS
  - 7 ESTs
- Distribution system developed over time with acquisition of existing systems within the County
  - Range of operating guidelines and hydraulic gradient requirements in individual systems



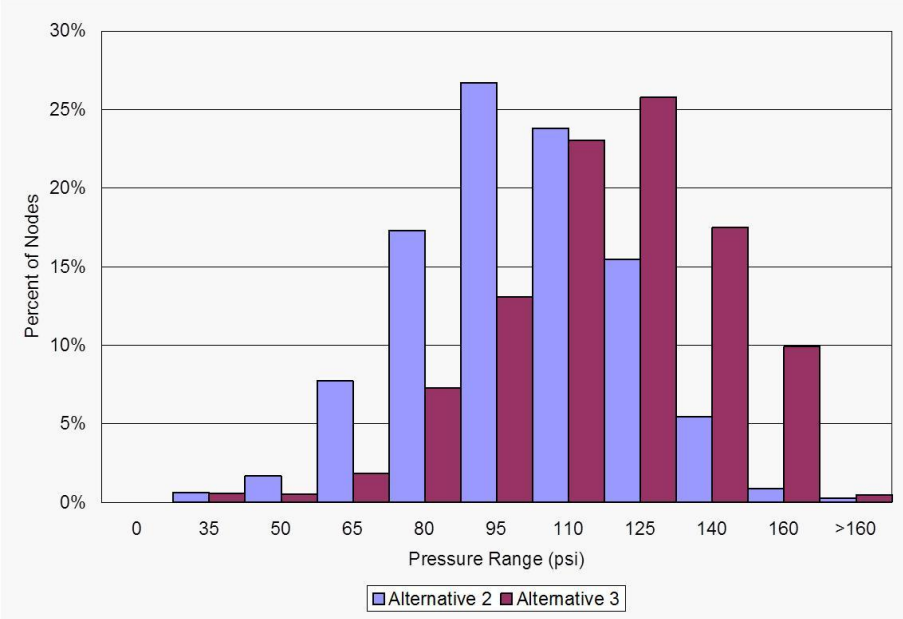
Case Study Number 2:
Distribution System Upgrades and Operational Modification

- Goal:
  - Address low pressure at high elevation areas
  - Improve water quality in distribution system
    - Currently have water quality issues because of limited tank turnover

- Options to Evaluate:
- Create new higher pressure zone (s)
  - Pro: Improves system pressure at high elevation areas
  - Con: Creates system dead-ends
- Raise HGL and remove ESTs from service
  - Pro: Improves water quality and system pressure
  - Con: Raises system pressure at moderate pressure areas

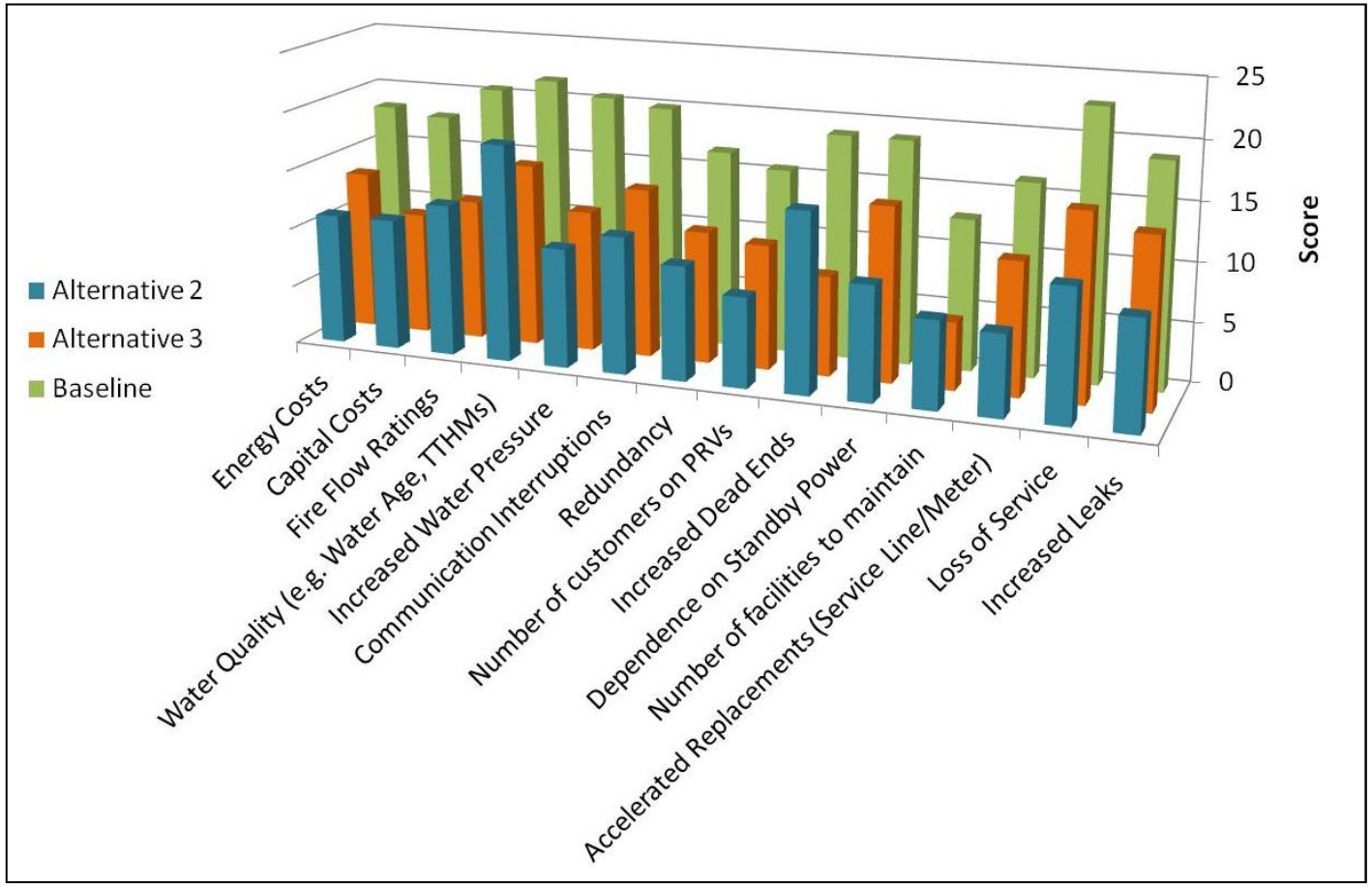
Case Study Number 2: Distribution System Upgrades and Operational Modification

- Developed scenarios to model existing, near term (5 year) and 20 year conditions
- Evaluated and compared alternatives for:
  - Water quality benefit
    - Reduction in water age
  - Pressure benefit
    - Increase in pressure
  - Pressure concern
    - Increase in pressure
  - Operational costs
    - Pumping to a higher HGL
  - Operator concerns
    - Limited floating storage
  - Capital costs



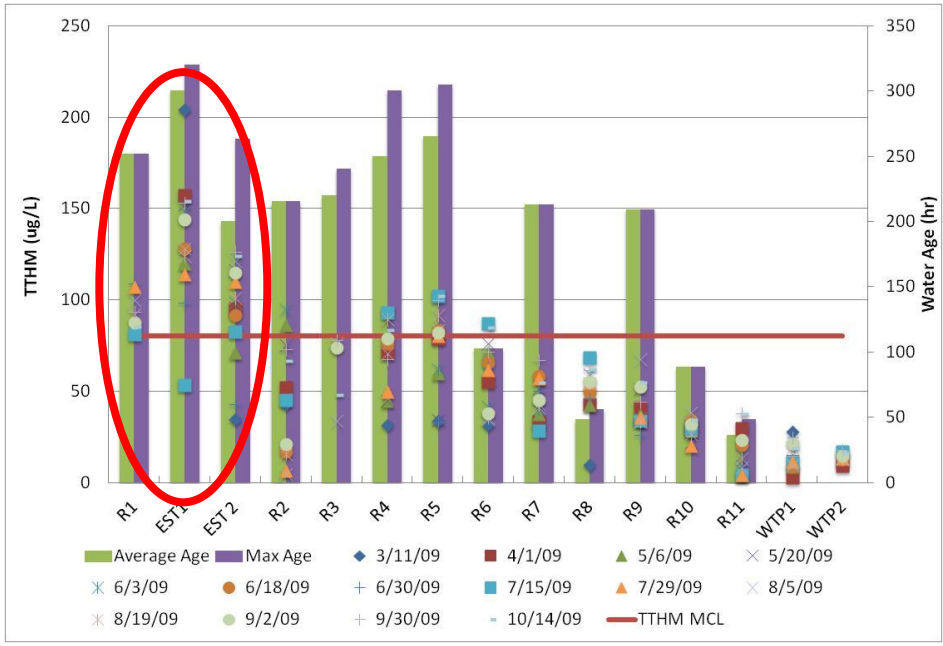
Case Study Number 2:
Distribution System Upgrades and Operational Modification

- Numerous parameters evaluated simultaneously
- Included operator concerns in evaluation for whole system approach to complex situation



Case Study 3: Distribution System Water Quality

- Large water distribution system
  - ADD 100 mgd, MDD 160 mgd
- Seasonal water quality challenges
  - Dual source supply system
- Large 40 MG tank in lowest pressure zone
  - One of 5 tanks in this pressure zone
  - “Small” pump station at this tank serves next higher zone: 4 MGD
  - Results in difficulty in turning tank over and elevated water age
- ESTs with little turnover



High TTHMs

Case Study 3:
Distribution System Water Quality

- Goal:
  - Identify opportunities for improving water quality in zones supplied by this tank

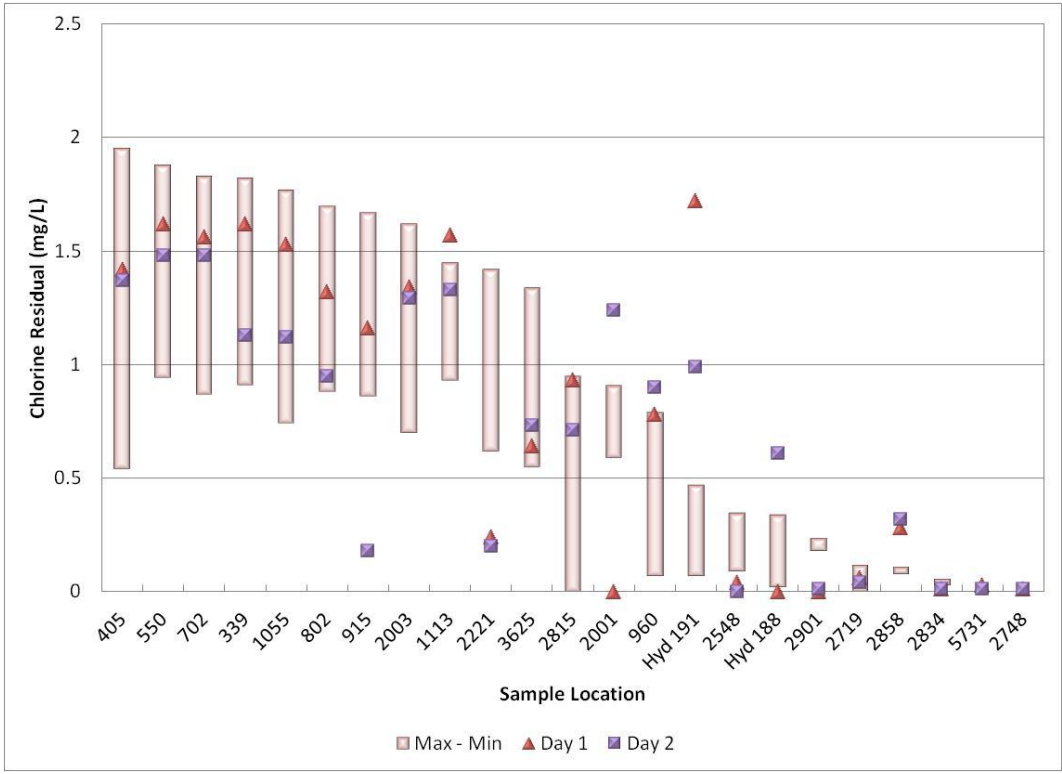
- Developed range of operational options to evaluate localized and system-wide improvements or impacts
  - Removing tank from operation
  - Operating one cell
  - Adding air stripper to remove TTHMs
  - Deep Cycling of ESTs

Case Study 3: Distribution System Water Quality

- Operational Results
- Large Reservoir
  - Removing tank from operation
    - Operate pump station as in-line station
    - Too high of a reduction in storage
  - Operating one cell
    - Reduction in storage better, but not ideal
    - Still observed concerns with elevated water age
  - Adding air stripper to remove TTHMs
    - "Reset" water age for areas that received water from large storage tank
- ESTs
  - Deep Cycling of ESTs
    - Was able to maintain required pressure, required additional manual monitoring or updated programming for 2 – 3 day cycle

Case Study 3: Distribution System Water Quality

- Requirements
  - Calibrated extended period simulation model with pump controls
    - Sometimes difficult to model variable operator preference
  - Validation that model predicts water quality similar to what is measured in the field
    - Chlorine residual
    - DBPs



Summary

- Your hydraulic model…….it's not just for planning anymore
- You've invested in your model
  - Let it work for you!
- Further the use of your model
  - Make sound infrastructure decisions
  - Efficient operations
  - Improve water quality

Questions?