Water Resource Recovery Facility
Hydraulic Modeling

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Imagine the result
Why are hydraulic evaluations performed
Types of hydraulic analyses (level of detail)
Validating modeling results
Examples
Why are Hydraulic Evaluations Performed

• Asked to treat more wet weather flow
• Not performing as anticipated (process or train)
• Operational considerations during wet weather conditions
• Evaluate improvement alternatives

“Generally completed with a biological analysis”
Types of Hydraulic Analyses

- Steady state conditions (average, maximum, peak hour)
- Simple hydraulic losses to develop profiles and identify potential bottlenecks
- Sometimes conservative
Types of Hydraulic Analyses

- Challenging to review
- Open Channel vs. Full pipe flow
- Submerged vs. unsubmerged weir

\[ \frac{\partial u}{\partial t} + u \frac{\partial u}{\partial x} + g \frac{\partial h}{\partial x} + g(S - S_f) = 0 \]
Types of Hydraulic Analyses

- Both Steady and Wet Weather Conditions
- Linked to the Collection System Model
- Simplified Pumps
- Simplified RAS
- Single event storage analysis
Types of Hydraulic Analyses

- Both Steady and Wet Weather Conditions
- Linked to the Collection System Model
- Throttling valves
- V-notch weirs
- Weir controls
- Detailed RAS
Computer Model Development

- Length
- Geometry
- Invert Elevations
- Rim Elevations
- Roughness Coefficient
- Minor loss coefficients
Computer Model Layout

- Visual considerations
- Primary Launder (detailed vs. simplified)
- Secondary Effluent Channel (not a side overflow weir)
Validating Results

- Peak Flows
- Stress Test
- Flow vs. Water Elevations
Validating Results

• Data review
• When the flow measurement is not at the same location as the water surface measurement
• Steady state conditions
Providing Results

- Develop statistical templates
  - Select nodes
  - Maximum water surface
  - Select links
  - Peak flow
  - Identify specific date/time
- Exported to GIS
Real Time Controls

- Open/Close sluice gates
- Pumps On/Off
- Throttling valves
- Weir gates

“Simulate 6 design flow rates with 3 different boundary conditions”
Real Time Controls

- Recommend starting with steady state conditions
- Recommend using incremental controllers
- Add detail to simulate a hydrograph response
- Proportional Integral Differential (PID) controller

“Innovyze recommends using PID controllers as a last resort”
Examples

• Uneven secondary flow split
• Flows under gallery through 48”
• 48”x48” sluice gate separating trains is normally closed
• What happens when the gate is normally open
Examples

- RAS flowrate controlled with throttling valves
- Combined lower and upper well
- Different recycle rates for the trains
Examples

- WAS controlled by meters and throttling valves
- 10% solids
- Sediment application
Examples

- Operational Flow Diversions
- Morning Glories (weir and gate control)
- Gates have to be told how to move up and down
Hydraulic Losses

- Chlorine Contact Tank
- Aeration Tanks
  - Sluice gates between passes
  - Fluid momentum losses
- Secondary Column (manufacturers headloss curve)
- Suction Header
Summary

• The hydraulic approach depends on:
  • Level of detail required
  • Complexity (real time controls)
  • Number of simulations
  • Proposed improvement evaluations
• Always validate computer modeling results
• Focus on wet weather operations