Brown AND Caldwell

City of Columbus

Determining WWTP Screen Capacity During Wet Weather Flows

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THE CITY OF COLUMBUS
ANDREW J. GINTHER, MAYOR
DEPARTMENT OF PUBLIC UTILITIES

Screen Capacity

- Difficult to define
- Varies depending on influent wastewater
- Recently installed two new screens
- Had to evaluate existing screens
- Want to share lessons learned

Agenda

- Background
- Existing Capacity
- Design Approach
- New Screens

Background

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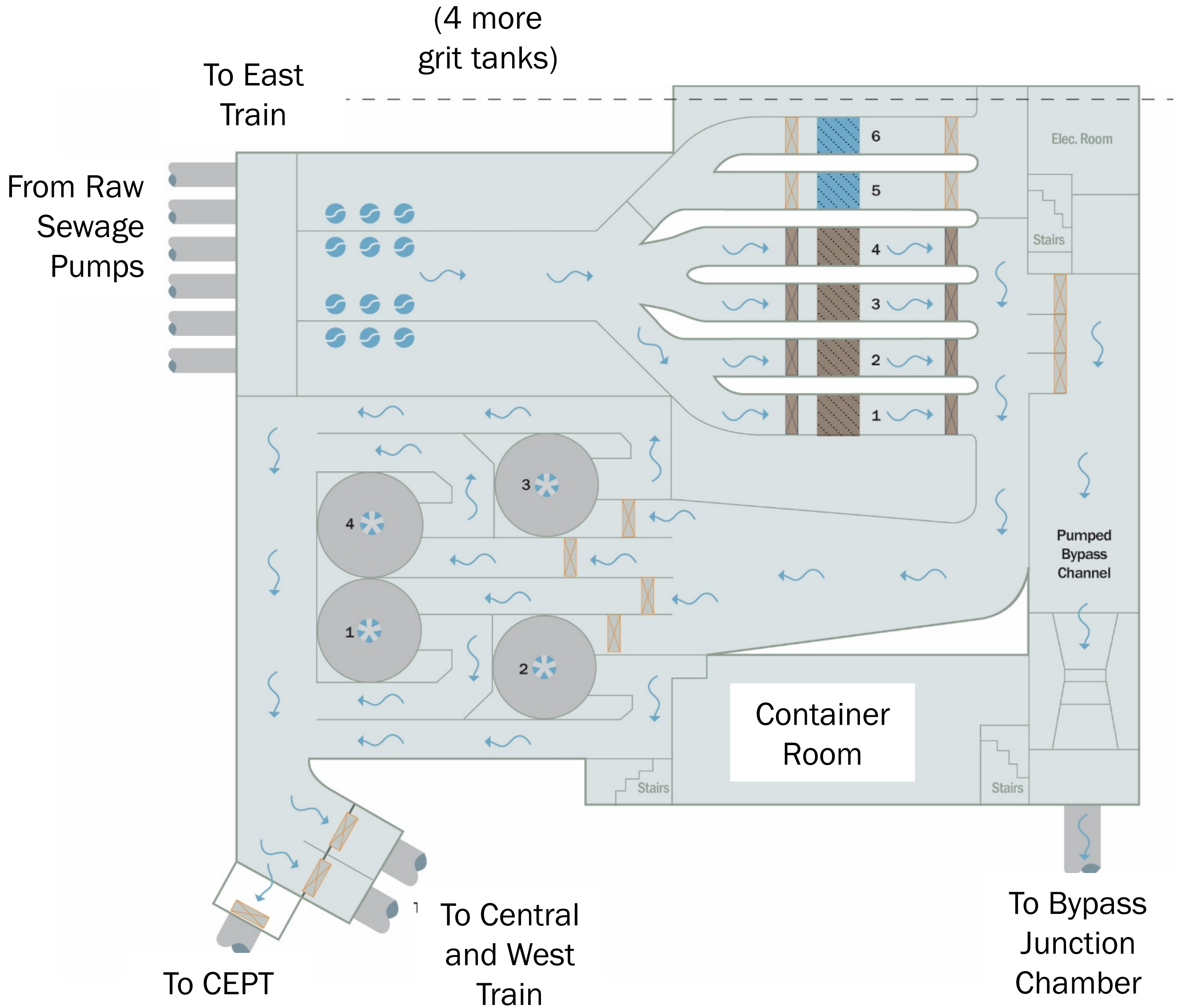
Screen and Grit Building



Fine Screen Channels

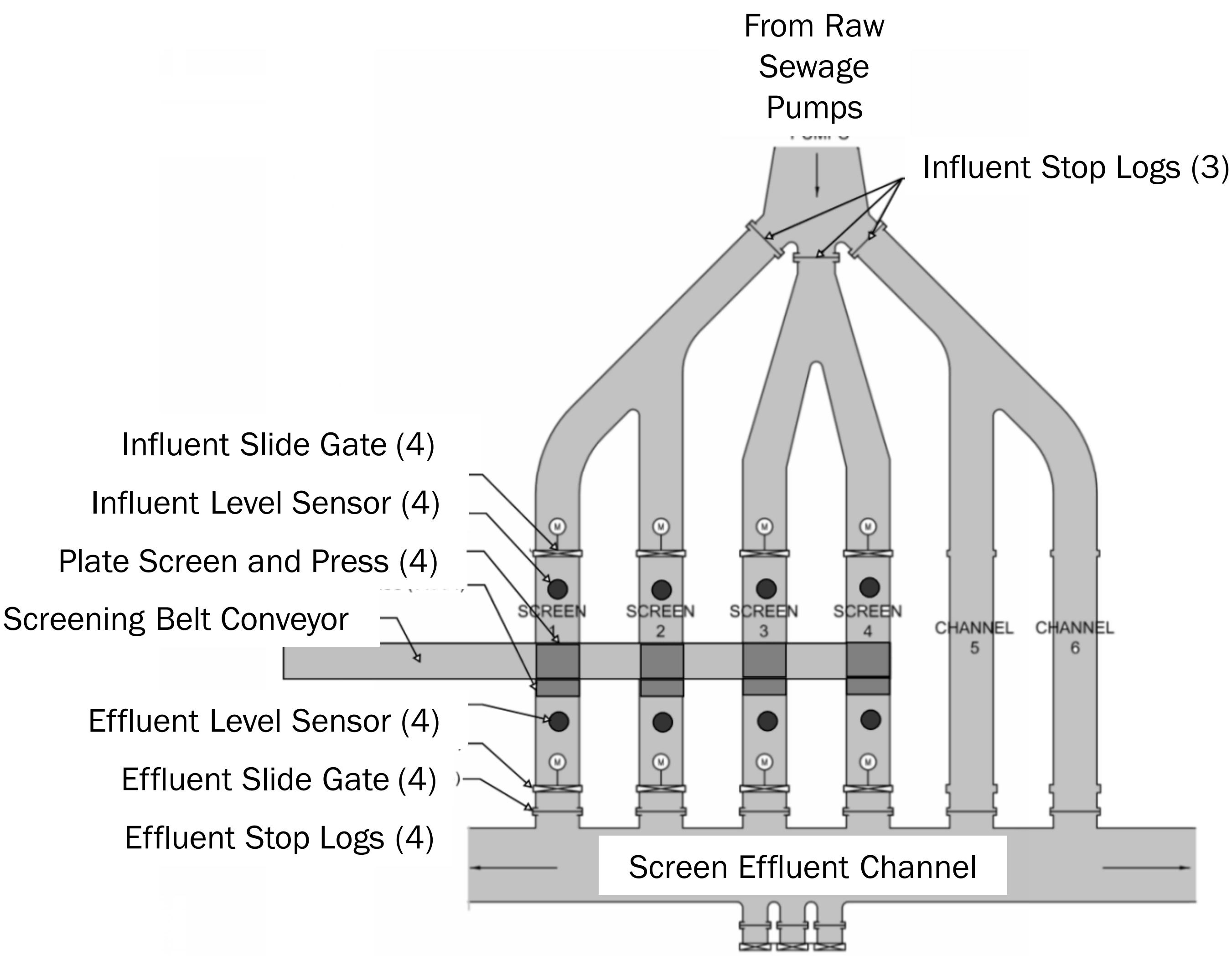


Plate Screens

Did You Flush This?

Structural Failure

- Plate screens experienced structural failure shortly after installation
- SWWTP developed comprehensive retrofit to prevent future failures
- Alternate operating procedure to increase screen speed, avoid blinding
- Caused excessive wear on moving parts, high maintenance cost
- Retrofits used expensive materials like titanium bolts, increasing cost

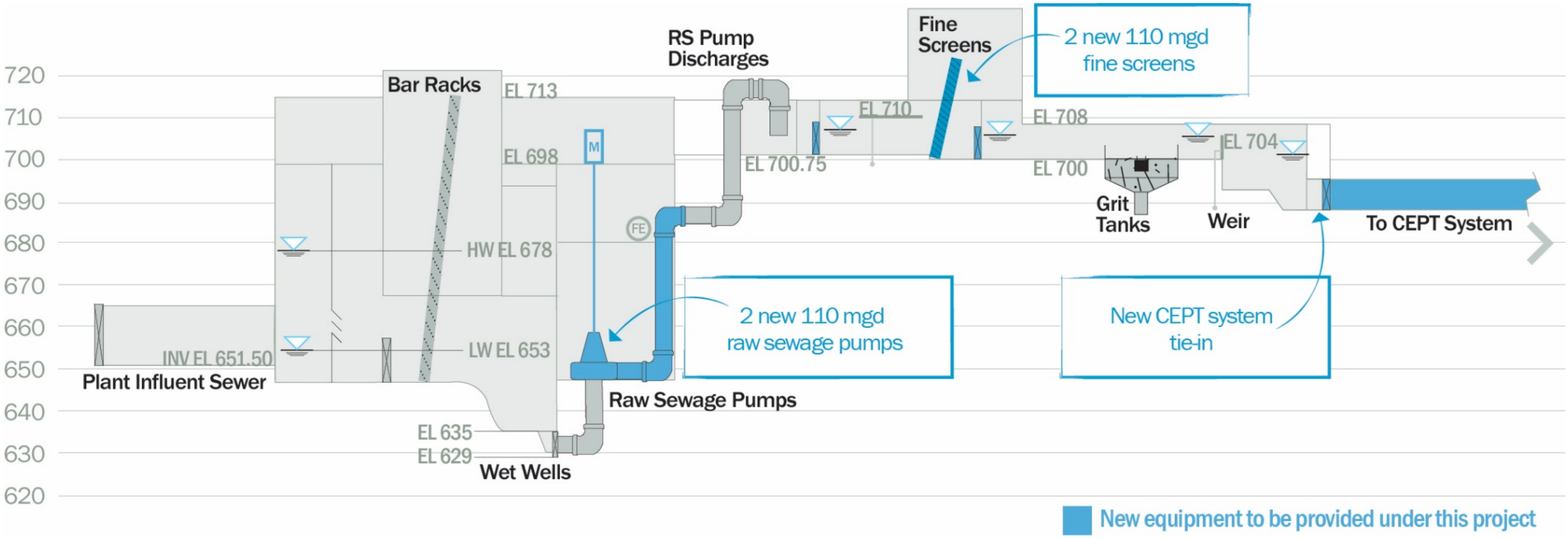
Bottom View of Screen

Side Channel View

Overall CEPT Project

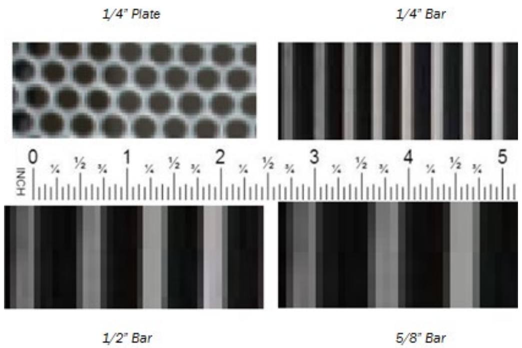
Future Headworks Profile

- Six new raw sewage pumps (two open slots, 4 replace)
- Two new fine screens
- New 110 MGD CEPT train after screens



Project Goals

- Increase screen firm capacity to 440 MGD from 330 MGD
- Consider future build out capacity of 550 MGD when sizing new screens
- Meet land application regulations (5/8-inch max)
- Address existing issues



Screen Aperture Size

Screenings on Belt Conveyor

Existing Conditions

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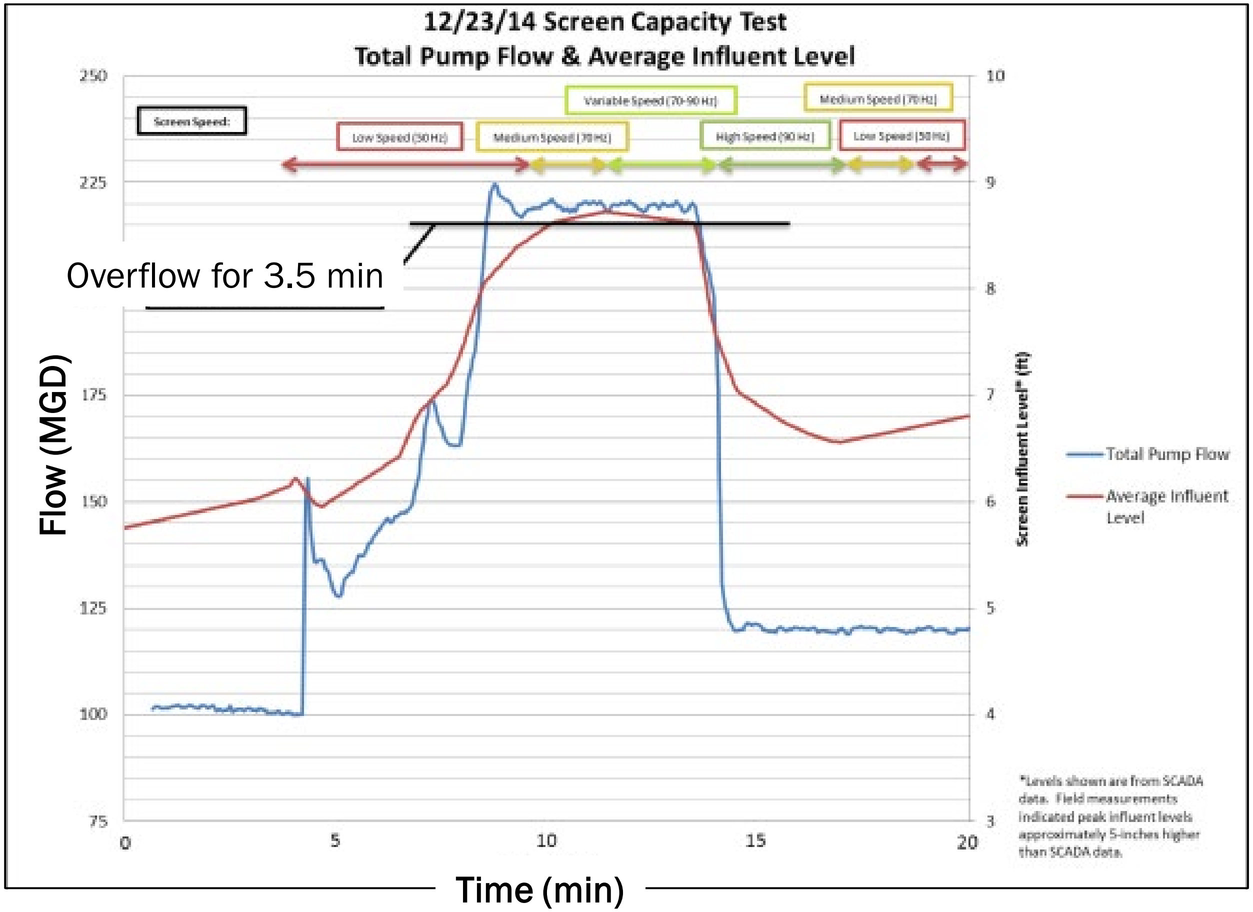
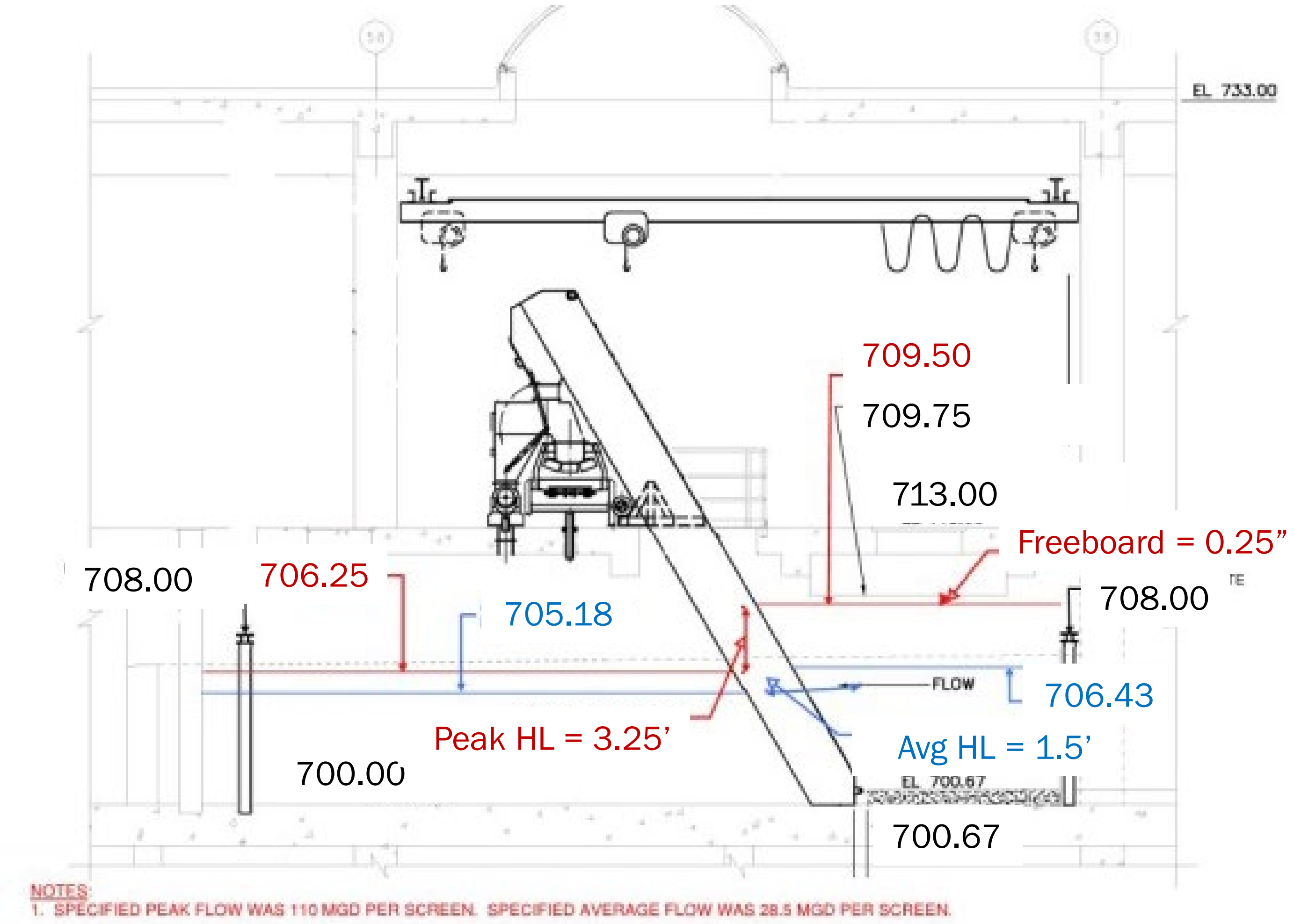
Hydraulic Stress Test



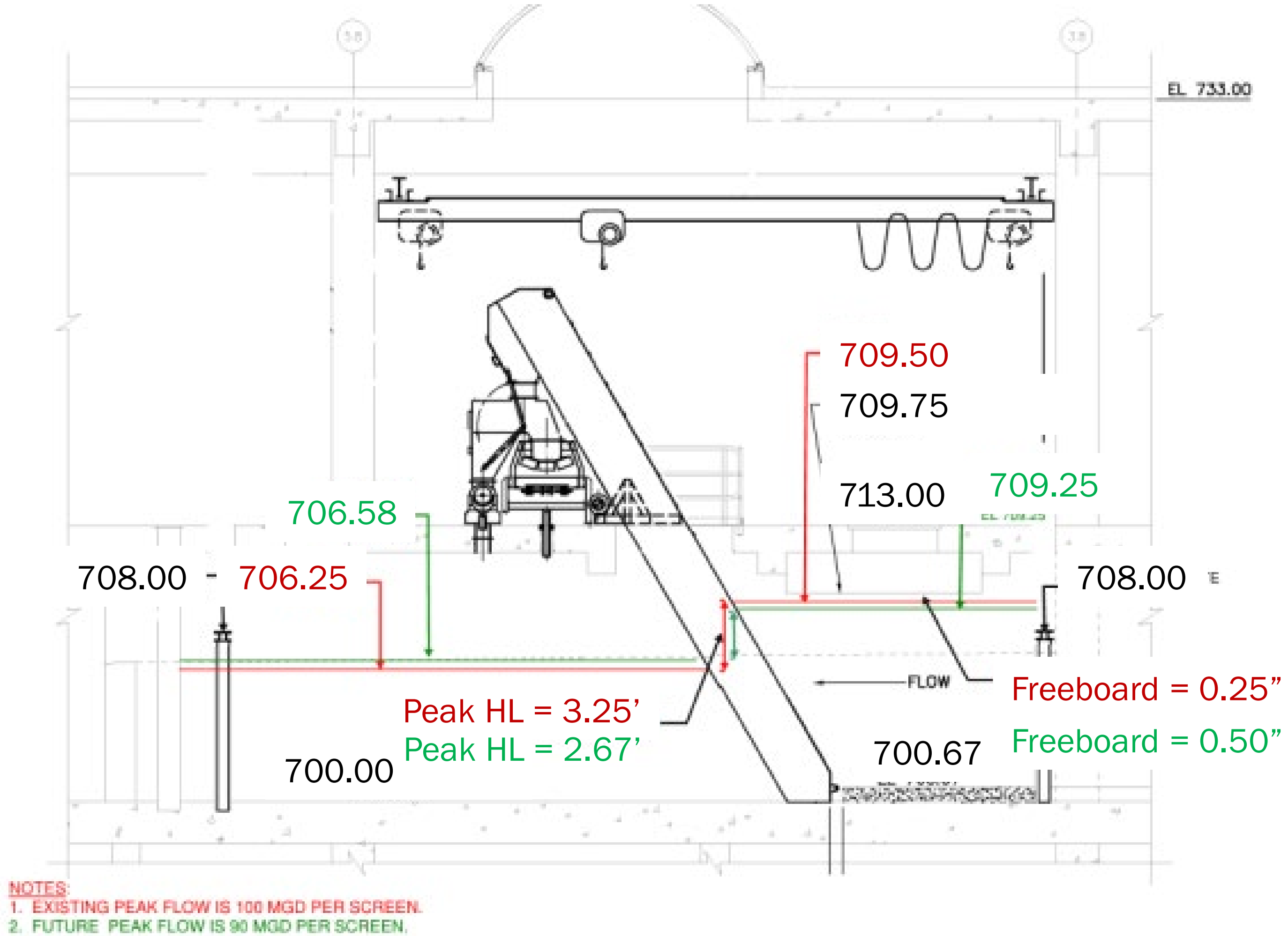
Freeboard before Test

Overflowing Bypass Weir

Existing Screen – Previous Condition



Existing Screen – New Conditions



Other Findings

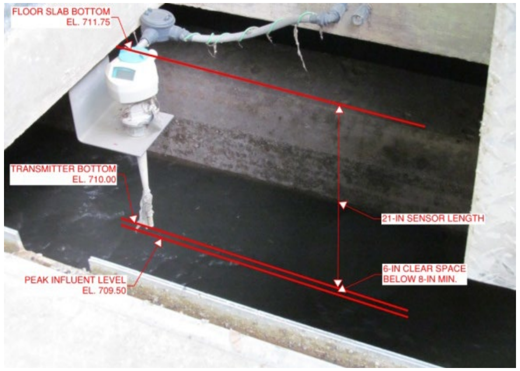
- Influent gates lower than peak level, overflowed during test
- Grit settling in influent channel in front of screen during dry weather
- Influent stop logs too difficult to close, forces operation of screens in pairs
- Effluent slide gates lower than bypass elevation, unsafe if being maintained

Overflow Influent Gate

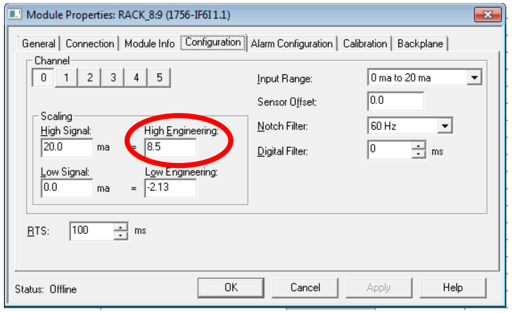
Screen Blinding (12.23.14)

Instrumentation Findings

- Influent level sensors not accurate during peak flows
- Sensor set too low within channel, inundated by flow (toilet paper)
- Affects screen speed operations
- Staff unaware of bypass events
- Programmed 3 minute delay on screen speed



Influent Level Sensor



Level Sensor Configuration

Design Approach

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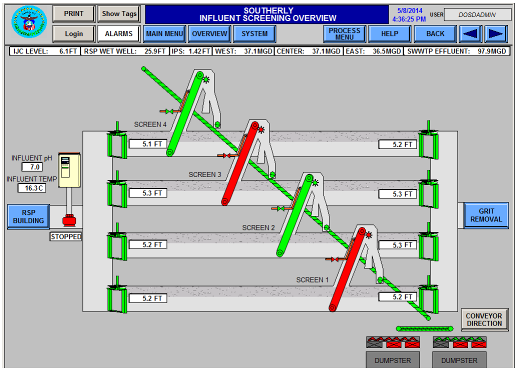
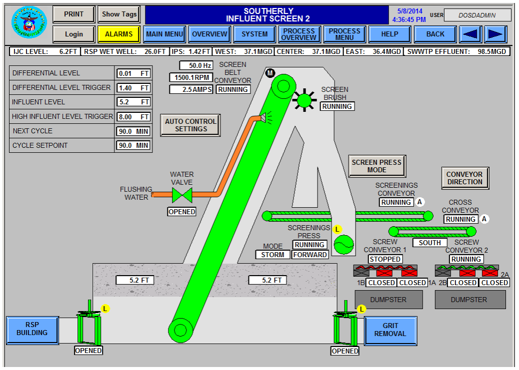
Capacity Analysis

- Existing screens in future = 90 MGD
- Why was tested flow ability lower than stated capacity?
- What capacity for new screens is needed?
- 550 MGD buildout firm requires four 125 MGD
- Capacity = slot velocity x effective area (Q = vA)
- Limited by available headloss, screen blinding



SGB SCADA



Existing Screen SCADA

Screen Blinding

- Effective area = Open Area – Screen Blinding
- Screen blinding has significant impact on effective area
- Backing into blinding for existing screens from test leads to 40% blinding
- Same as the recommended assumption in BC guide specs

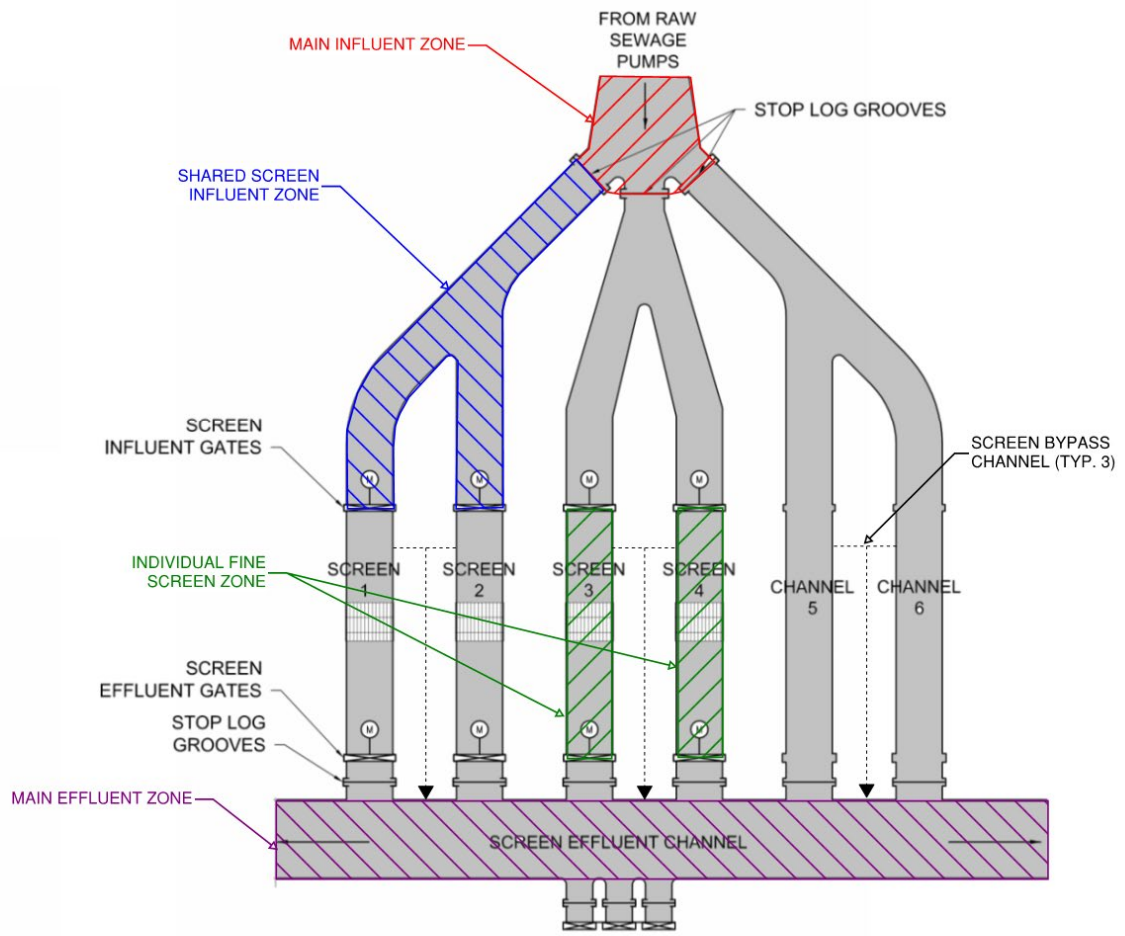
Before Test

During Test

Slot Velocity

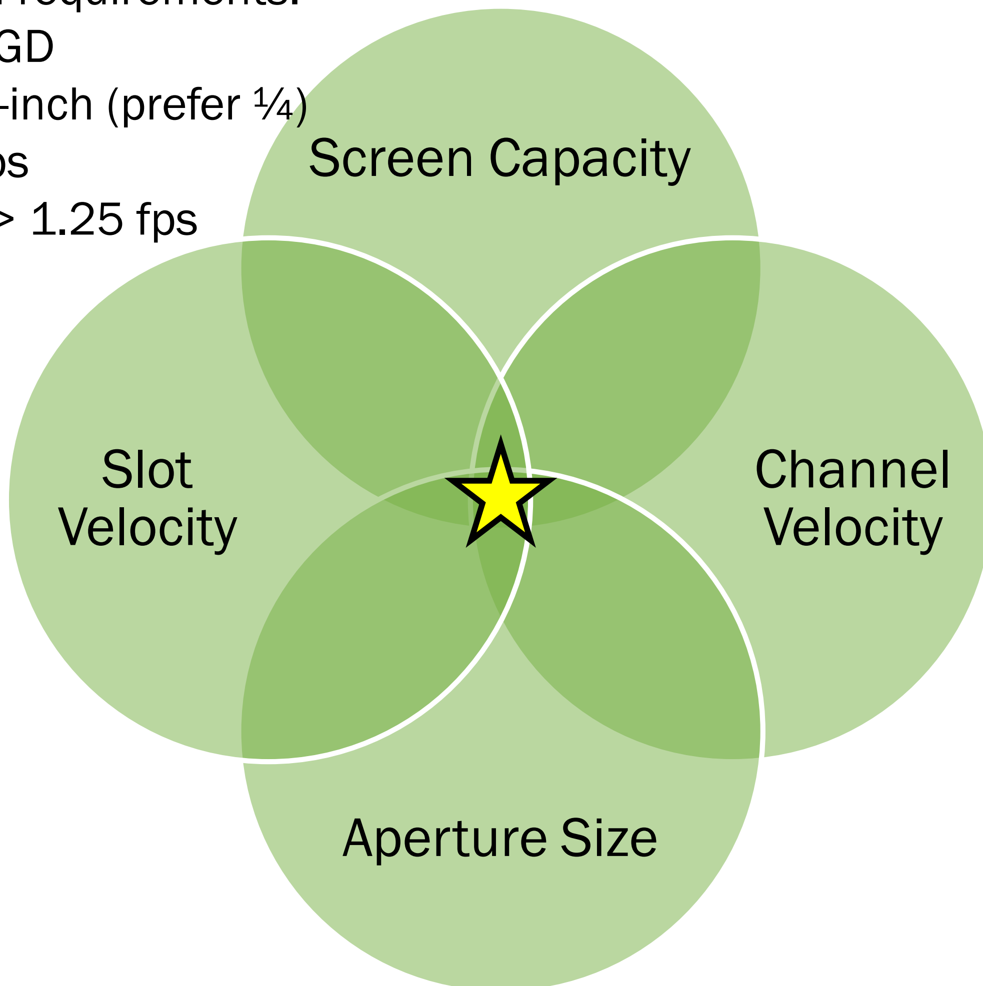
- Higher slot velocity creates greater headloss
- Higher slot velocity increases blinding potential
- Creates a cycle leading to backups
- WEF MOP 8 recommends maximum v = 4 fps
- Existing screen had 7.2 fps without blinding

Channel Velocity



Ideal Design

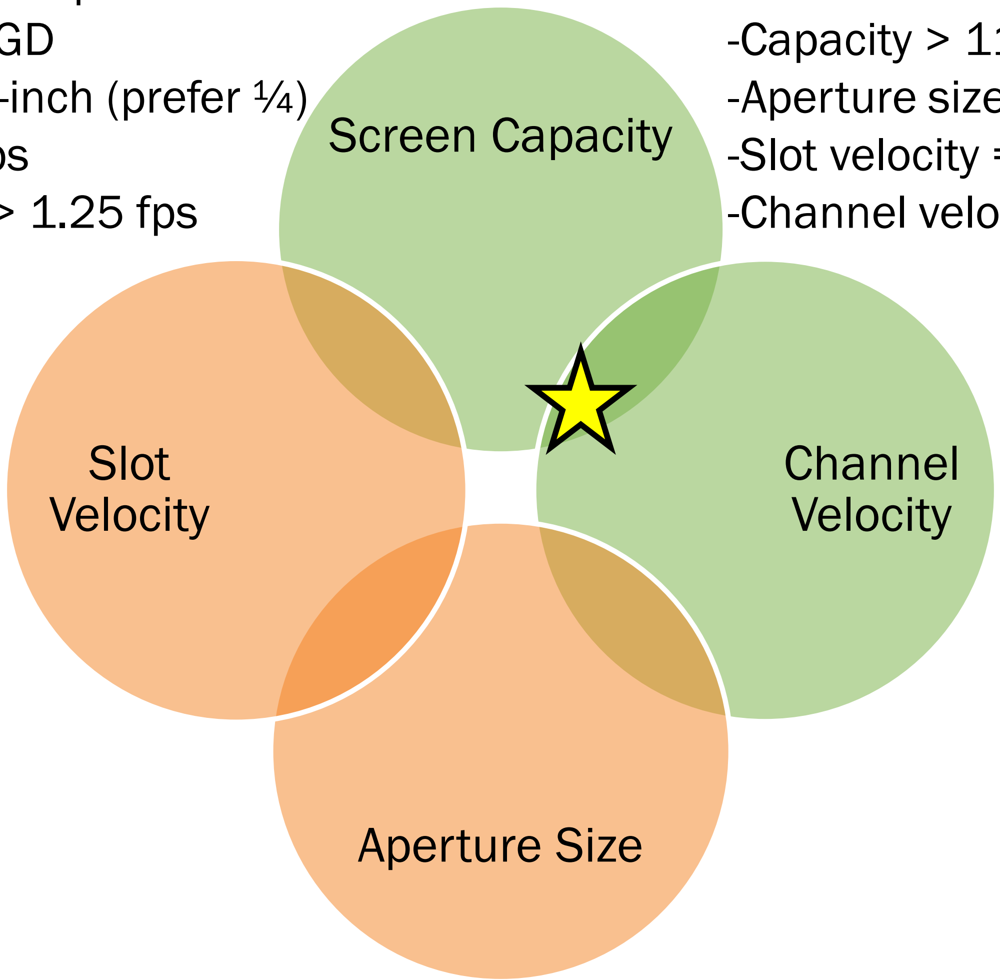
Maintain minimum requirements:
-Capacity > 110 MGD
-Aperture size < ¾-inch (prefer ¼)
-Slot velocity < 4 fps
-Channel velocity > 1.25 fps



Realistic Design

Maintain minimum requirements:
- -Capacity > 110 MGD
- -Aperture size < ¾-inch (prefer ¼)
- -Slot velocity < 4 fps
- -Channel velocity > 1.25 fps

What we could provide:
- -Capacity > 110 MGD
- -Aperture size = 3/8-inch
- -Slot velocity = 4.8 fps
- -Channel velocity > 1.25 fps



New Screens

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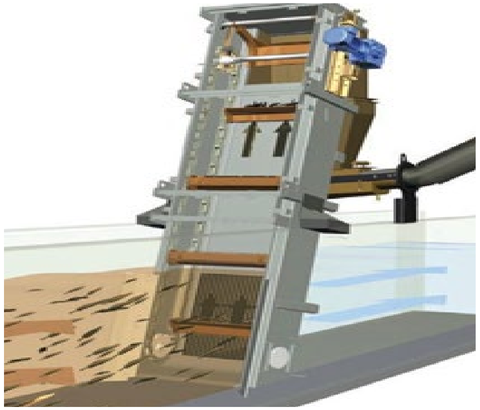
Alternative Analysis

Perforated Plate Screen

- <u>Advantages</u>
  - High capture efficiency
  - Open bid design
- <u>Disadvantages</u>
  - High headloss
  - Wash water demand
  - In-channel maintenance
  - Structural failure history

Multi-Rake Bar Screen

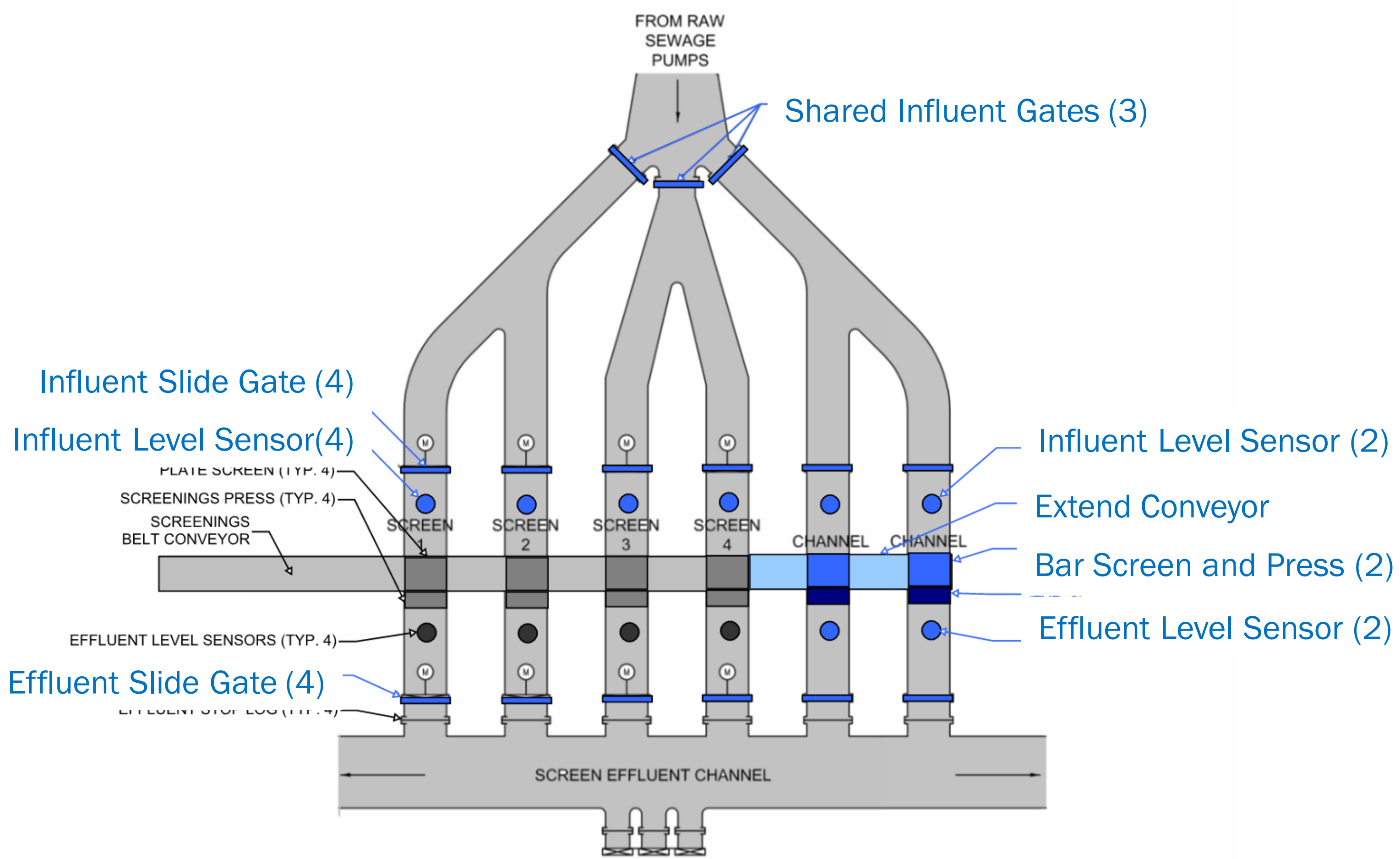


- <u>Advantages</u>
  - Low headloss
  - No wash water demand
  - Robust structural design
  - Open bid design
- <u>Disadvantages</u>
  - Lower capture efficiency
  - In-channel maintenance

Flexible Multi-Rake Bar Screen

- <u>Advantages</u>
  - Low headloss
  - Continuous removal
  - No wash water demand
  - Robust structural design
- <u>Disadvantages</u>
  - Lower capture efficiency
  - Proprietary design

Recommendations



Specification Requirements

Don’t rely on vendors to provide your screen design

- Assume 40% screen blinding minimum
- Check with hydraulic stress test on existing screens if possible
- Define Bar Loss Coefficient = 0.84
- Provide exact flow conditions and hydraulic assumptions
- Require Ohio PE structural approval of available headloss

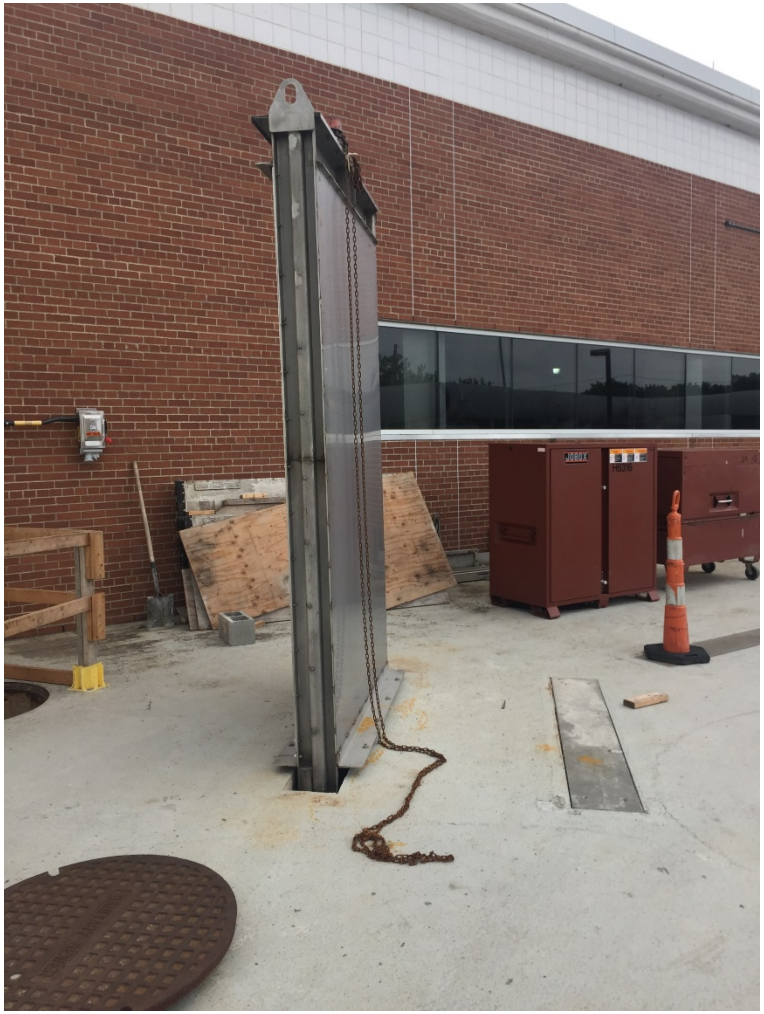
Factory Witness Testing

Screen Installation

Screen Installation

Screen Installation

Gate Installation



Operational Demonstration

Lessons Learned

- Screen capacity is difficult to define
- Influent wastewater constituency impacts capacity
- Define your requirements vs. goals
  - Screen capacity, slot velocity, channel velocity, aperture size
- Be aware of design parameters, close is better than nothing
- Incorporate operational philosophy into design
- Low maintenance is key, slow and steady wins the race

Acknowledgements

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Presenters

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Questions/Discussion