WET WEATHER TREATMENT FACILITY SITE
AGENDA

- PROJECT BACKGROUND
- MODEL PLAN
- MODEL RESULTS
PROJECT BACKGROUND
PROJECT DRIVERS

- Mitigate highly-active combined sewer overflow
- Located at terminus of Combined Sewer 937
- Residential area
- Frequent odor and aesthetic issues during dry and wet weather

Consent decree-driven project
PROJECT LOCATION

Upper Muddy Creek Basin

Project Location

Ohio River

Muddy Creek Basin

MUDDY CREEK WWTP

Glenview Pump Station Elimination or Upgrade
RECEIVING WATERS

Sewer debris discharges to creek during wet weather
CSO 522 VOLUME CONTROL FOR TYPICAL YEAR

- Typical Year Overflow from Existing Outfall 522
  - 66 events, 517 MG, 635 hours of discharge

- Flow Rates
  - $V_\leq 64.7\text{ MG}$: 106 mgd
  - $\leq 4$ Overflows Per Typical Year: 185 mgd
- Typical Year, 15-min Peak: 434 mgd
- 10-year, 24-hr: 988 mgd
- Outfall capacity: 1,400 mgd

Wide range of flows to manage
THE SOLUTION

Site constraints dictated facility arrangement
INFLUENT CONTROL STRUCTURE

• Dissipate energy
• Direct flows into facility up to peak treatment capacity, and release excess flows to creek
• Promote solids clean-up post event for odor control
• No dry weather flow
INFLUENT FINE SCREENS

- Remove CSO debris
- Protect downstream equipment

Chain and rake, ½” aperture, 92.5 mgd each
INFLUENT PUMP STATION

- Delivers flow into the EHRT facility
- Trench wet well design to minimize solids deposition

Influent PS with submersible non-clog pumps in trench-style wet well
SO WHAT IS THE PURPOSE?

- Manage solids and provide uniform flow distribution at diversion structure
- Avoid certain phenomena at Pump Station
  - Submerged vortices
  - Free surface vortices
  - Preswirl magnitude and fluctuation with time
  - Nonuniform distribution of velocity in space and time at the impeller eye
  - Entrained air or gas bubbles

Can have adverse affect on pump performance and can lead to maintenance issues
HYDRAULIC INSTITUTE STANDARD 9.8 - 2012

• Prove design deviating from standard
• Pump station exceeds threshold capacity of standard
• Individual pump exceeds threshold capacity of standard
• Screens creating high velocity jets near pump intakes
• Significant cross-flow velocities compared with pump bay

Properly apply standard for good hydraulic performance, or prove a custom design
MODEL DOMAINS

CFD to cover high flows not feasible with physical model
MODEL ACCEPTANCE CRITERIA

• Influent Control Structure
  • Even flow distribution
  • Sediment collection prior to screens

• Influent Pump Station Wet Well
  • Free surface vortices
  • Subsurface vortices
  • Swirl angles
  • Velocity distribution

No industry standard on physical model acceptance criteria for diversion structures
## MODEL TEST SCENARIOS

<table>
<thead>
<tr>
<th>Test Condition</th>
<th>Event</th>
<th>Q (mgd)</th>
<th>CFD</th>
<th>ICS Physical Model</th>
<th>IPS Physical Model</th>
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<tr>
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<td>25% of annual flows</td>
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<tr>
<td>4</td>
<td>Typical yr 24 hr</td>
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<td>X</td>
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<tr>
<td>5</td>
<td>2-yr 24 hr</td>
<td>643</td>
<td>X</td>
<td></td>
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<tr>
<td>6</td>
<td>5-yr 24 hr</td>
<td>873</td>
<td>X</td>
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<tr>
<td>7</td>
<td>10-yr 24 hr</td>
<td>1,053</td>
<td></td>
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<tr>
<td>8</td>
<td>25-yr 24 hr</td>
<td>1,321</td>
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<tr>
<td>9</td>
<td>100-yr 24 hr</td>
<td>1,482</td>
<td>X</td>
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INFLUENT CONTROL STRUCTURE MODEL DEVELOPMENT

Fabrication drawing checks
INFLUENT CONTROL STRUCTURE MODEL OVERVIEW
MODEL RESULTS
CFD RESULTS - VELOCITY

Eddy formation and turbulent, non-uniform flow
PRELIMINARY DESIGN ENHANCEMENTS

Two modifications proposed at ICS

Mod 1: Flow Turning Vanes

Mod 2: Flow Guiding Baffle
Modification 1 to improve flow distribution at 90-degree bend
PRELIMINARY DESIGN ENHANCEMENTS

Modification 2 to block flow to Screens 1 & 2

Mod 2: Flow Guiding Baffle
CFD & PHYSICAL MODEL RESULTS

CFD results validated with physical model
**CFD & PHYSICAL MODEL RESULTS – SCREEN FLOW**

<table>
<thead>
<tr>
<th>Test Condition</th>
<th>Event</th>
<th>Q (mgd)</th>
<th>Screen 1</th>
<th>Screen 2</th>
<th>Screen 3</th>
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<tr>
<td>1</td>
<td>25% of annual flows</td>
<td>30</td>
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<td>-</td>
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<tr>
<td>2</td>
<td>Firm treatment capacity</td>
<td>106</td>
<td>44% -&gt; 35%</td>
<td>31% -&gt; 32%</td>
<td>25% -&gt; 33%</td>
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<td>Ultimate treatment capacity</td>
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<td>49% -&gt; 40%</td>
<td>32% -&gt; 31%</td>
<td>19% -&gt; 29%</td>
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<td>Typical yr 24 hr</td>
<td>421</td>
<td>55% -&gt; -</td>
<td>31% -&gt; -</td>
<td>14% -&gt; -</td>
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<td>2-yr 24 hr</td>
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<td>69% -&gt; 41%</td>
<td>36% -&gt; 29%</td>
<td>-4% -&gt; 29%</td>
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<td>6</td>
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<td>-19% -&gt; -</td>
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<td>80% -&gt; -</td>
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<td>-12% -&gt; -</td>
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<td>1,321</td>
<td>82% -&gt; -</td>
<td>32% -&gt; -</td>
<td>-13% -&gt; -</td>
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<tr>
<td>9</td>
<td>100-yr 24 hr</td>
<td>1,482</td>
<td>77% -&gt; 47%</td>
<td>33% -&gt; 30%</td>
<td>-10% -&gt; 23%</td>
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**All screen flows meet specification**
BASELINE PHYSICAL MODEL RESULTS - GRIT

Challenge area identified at 90-degree bend
MODIFIED PHYSICAL MODEL RESULTS - GRIT

Challenge area identified at 90-degree bend

Baseline 185 mgd
Mod 2 185 mgd
Mods 1 & 2 185 mgd
Mod 3 185 mgd
MODEL FINDINGS – STONE PIT

- Large gravel to small cobbles passed the stone pit
- Consider replacing standard pit with modified trench for improved performance
- Consider armoring columns
FURTHER PHYSICAL MODEL RECOMMENDATIONS

Further enhancements possible for solids management & flow equalization
Building a world of difference.

Together

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