Process Treatment Selection and Design for the City of Piqua’s New WTP

One Water Conference

Jeff Macomber, P.E.
August 28, 2014
Agenda

• Project Background
• Water Treatment Goals
• Process Treatment Alternative Selection
• Design Approach
• Project Status
City of Piqua, OH – New Water Treatment Plant

PROJECT BACKGROUND
Existing 7 MGD Water Treatment Plant

- Located in floodplain
- Concern over meeting water quality goals (atrazine, DBPs)
- Inoperable valves
- Inaccuracies with flow metering
- Aging equipment
Raw Water Sources

- Great Miami River
- Gravel Quarry
- Swift Run Lake
- Existing WTP
- Proposed WTP

One Water
Water Quality

Raw Water TOC

Raw Water Atrazine
Disinfection Byproducts

Raw Water TTHM

![Graph showing THM (ppb) over time with MCL = 80 ppb for different locations]

Raw Water HAA

![Graph showing HAA (ppb) over time with MCL = 60 ppb for different locations]
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WATER TREATMENT GOALS
Capacity Assessment

- 2.9 MGD Average Day Demand
- 4.7 MGD Maximum Day Demand
- Consistent service area population of 20,600
- Industrial and commercial redevelopment opportunities

Planned Land Use Conversion for 20-yr Plan
Water Quantity and Quality Goals

**Water Quantity**
- Future max day demand of 9.0 MGD
- Select three trains of 2.25 MGD = 6.75 MGD design capacity
- Future fourth train of 2.25 MGD to reach 9.0 MGD capacity

**Water Quality**
- Treat seasonal atrazine in source water
- Comply with Stage 2 DBP Rule for TTHM and HAA5
- Maintain softened finished water
Bench Scale Testing – Oxidation

Chlorine Dioxide

Potassium Permanganate

Chlorine dioxide demand/decay in raw water from Swift Run Reservoir. Temp. = 18°C, pH = 7.7, TOC = 7.10 mg/L.

Potassium permanganate demand/decay in Swift Run Reservoir raw water. Temp. = 18°C, pH = 7.7, TOC = 7.10 mg/L.
Bench Scale Testing – Oxidation

Ozone

Ozone demand/decay in Swift Run Reservoir raw water. Temp. = 18°C, pH = 7.7, TOC = 7.10 mg/L.
Bench Scale Testing – Coagulation

TOC Removal (%) vs. Ferric Coagulant Dose (mg/L)

- Jar Test #1 (Ferric Sulfate)
- Jar Test #2 (Ferric Sulfate)
- Jar Test #3 (Ferric Sulfate + Lime)
Bench Scale Testing – RSSCT for GAC

Correlation of TOC to TTHM

\[ y = -62.885x^2 + 177.5x - 28.9 \]

\[ R^2 = 0.9533 \]

TTHM MCL = 80 ug/L
Design Point = 64 ug/L

TOC Breakthrough

Influent TOC = 1.53 mg/L
Influent Atrazine = 3.50 mg/L

Simulated Distribution System w/ 3-day Residence Time
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TREATMENT PROCESS SELECTION
Evaluated 10 Complete Process Train Alternatives

• Conventional Treatment (6)
  – Lime Softening
  – Lime Softening with Ozone
  – Lime Softening with Post-Filter GAC Contactors
  – Enhanced Coagulation and Lime Softening
  – Enhanced Coagulation and Lime Softening with Ozone
  – Enhanced Coagulation and Lime Softening with Post-Filter GAC Contactors

• Membrane Treatment (4)
  – Lime Softening with MF/UF Filtration
  – Enhanced Coagulation with Membrane Softening
  – Enhanced Coagulation and Membrane Softening with MF/UF
  – Enhanced Coagulation and Lime Softening with MF/UF
# Shortlisted Alternatives

## City of Piqua, OH

### New Water Treatment Plant Screening Evaluation

<table>
<thead>
<tr>
<th>Treatment Alternatives</th>
<th>Screening Criteria (1=lowest/worst, 5=highest/best)</th>
<th>Weighted Score (1-5)</th>
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<tbody>
<tr>
<td></td>
<td>Meet WQ Goals 30%</td>
<td>O&amp;M Issues 20%</td>
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<tr>
<td>Alternative 1A</td>
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<td>2</td>
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<tr>
<td>Alternative 3D</td>
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<td>3</td>
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</tbody>
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*Low-5, Med-3, High-1
Shortlisted Alternatives

- **Alternative 1B** – Single Stage Coagulation/Lime Softening With Ozone and Biological GAC Filters
- **Alternative 1D** – Single Stage Coagulation/Lime Softening and Post-Filter GAC Contactors
- **Alternative 3B** – Two Stage Coagulation/Lime Softening with Ozone and Biological GAC Filters
- **Alternative 3D** – Two Stage Coagulation/Lime Softening with Post-Filter GAC Contactors
Alternative 1B-Integrated Coagulation/Lime Softening With Ozone and Biological GAC Filters
Alternative 1D-Single Stage Coagulation/Lime Softening and Post-Filter GAC Contactors
Alternative 3B-Two Stage Coagulation/Lime Softening with Ozone and Biological GAC Filters
Alternative 3D-Two Stage Coagulation/Lime Softening with Post-Filter GAC Contactors
Selected Treatment Alternative

- Two-stage coagulation does not substantially improve TOC removal, so single-stage coagulation was selected
- Alternative 1D – Single Stage Coagulation/Lime Softening with Post-filter GAC Contactors selected as highest ranking alternative
- Replace Raw Water Pump Stations
- Extend Raw Water Mains, Finished Water Mains, and Lime Sludge Disposal Force Main to new WTP Site
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DESIGN APPROACH
3D/4D Design Approach

- AutoPlant 3D and AutoCAD Civil 3D interface
- “4D” Database of information
  - Motor size, design flow, pressure, pipe size
  - Increased coordination with design disciplines
  - Will be used to populate electronic O&M manual
Civil Site Plan
Lime and Soda Ash Softening
Rapid Mix, Flocculation, and Sedimentation
Recarbonation

Full-Scale Pilot Testing Recarbonation System
Biologically Active Filtration
GAC Absorbers for Atrazine and Inorganics Removal
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PROJECT STATUS
## Remaining Schedule

<table>
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<tr>
<th>Schedule Activity</th>
<th>Milestone</th>
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<tr>
<td>Ohio EPA Plan Approval</td>
<td>Expected September 2014</td>
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<tr>
<td>Bidding Period</td>
<td>October – November 2014</td>
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<td>Award Construction Contract</td>
<td>December 2014</td>
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<td>Substantial Completion</td>
<td>March 2017</td>
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<td>Final Completion</td>
<td>May 2017</td>
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Thank You!

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