The Assabet River - Six Communities, Four Facilities, Four Phosphorous Removal Technologies - Why, How, and Making it Work

Massachusetts Coalition for Water Resources Stewardship


May 20, 2013

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Associate Vice President
Session Agenda

Series of Two Presentations

• Westborough Achieving <0.1 mg/L Total Phosphorus with the Kruger ActiFlo® Technology

• Marlborough Achieving <0.1 mg/L Total Phosphorus with the Blue Water BluePro® Technology
Introduction to the Assabet River Consortium

Massachusetts Coalition for Water Resources Stewardship


May 20, 2013
Assabet River Consortium

Background

• Regional Collaboration by Hudson, Marlborough, Maynard, Northborough, Shrewsbury, Westborough and the Westborough Treatment Plant Board

• Watershed Based Management Approach to Wastewater Regulation

• Cooperative Effort to Balance Environmental Protection, Smart-growth, and Local Fiscal Stability

• Enhance Infiltration/Inflow Removal Efforts
Assabet River Consortium
Background (continued)

• Joint CWMP/EIR to Plot 20 Year Plan for Wastewater Treatment of Discharges into the Assabet River

• Four Phase Plan to Detail Needs, Options, Best Alternatives, and Final Plans

• Ran Concurrently with the MassDEP’s TMDL Study
Assabet River Consortium
Goals

• Upgrade Aging Facilities
• Address Need Areas
• Meet New Seasonal Phosphorous Limit (0.1 mg/L)
• Consider Future Lower Limits (< 0.1 mg/L)
Assabet River Consortium
CWMP Milestones

• Phase I - Needs Analysis
  – Completed May 2001
  – Tech Memo Completed October 2001

• Phase II - Develop and Screen Alternatives
  – Completed May 2002

• Phase III – Alternatives Evaluation and Plan Selection (Draft EIR)
  – Completed March 2007 (Followed Completion of MassDEP TMDL)

• Phase IV – Alternatives Evaluation and Plan Selection (Final EIR)
  – Completed December 2007
Westborough Achieving <0.1 mg/L Total Phosphorus with the Kruger ActiFlo® Technology

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May 20, 2013
Agenda

- History of the Facility
- Facility Upgrades
- Selection of TP Removal Process
- Description of the TP Removal Process
- Plant Performance
- Construction Facts
- Impacts to Sewer Users
- Photos
- Questions and Answers
History of the Facility

• Original in 1899
• Upgraded Early 1970s
• Upgraded in 1987

• Allocation of Flows
  – Shrewsbury - 4.39 mgd
  – Westborough - 2.89 mgd
  – Hopkinton - 0.40 mgd
Facility Upgrades
Baseline Improvements

- Replaced Screw Pumps
- Upgraded Septage Receiving
- Rehabilitated Primary and Secondary Clarifiers
- Replaced Aerators
- Upgraded Solids Processing
- Replaced Traveling Bridge Sand Filters with Cloth Filters
- Enhanced Odor Control Capture and Capacity

- Replaced Chemical Disinfection With Ultraviolet Disinfection
- Converted Chlorine Contact Tanks to Post Aeration Tanks
- Incorporated Green Technologies (solar power, VFDs, lighting)
- Added SCADA System
- Upgraded Electrical and Process Control Systems
Facility Upgrades (continued)
TP Removal Improvements

• Anaerobic Selector Tank for Biological Phosphorous Reduction

• Lime Silo for Alkalinity and pH Adjustment

• Kruger ActiFlo®
  – 100 Percent Redundancy
  – 2 mg/L to 0.1 mg/L

• Multi Point Chemical Addition
  – Pre and Post Primary Clarifiers
  – Pre and Post Secondary Clarifiers

• Sludge Processing
  – Co-Thickening with Primary Sludge
  – Gravity Belt Thickeners
  – Gravity Thickeners
Secondary Clarifiers
Phosphorus Treatment Building
Effluent Filtration, Post Aeration and UV Disinfection
Multichannel Oxidation System
Anaerobic Selector Basin
Primary Clarifiers
Headworks
Selection of TP Removal Process Pilot Study

• Technologies
  – Blue Water Technologies, Inc. - Blue PRO®
  – Infilco Degremont, Inc. - AquaDAF™
  – Kruger, Inc. - ACTIFLO®
  – Siemens - CoMag™

• Protocol
  – Week 1: Set-Up
  – Week 2: Coagulant Optimization
  – Week 3: Flow and Loading Optimization
  – Week 4: Stress Conditions
Selection of TP Removal Process (continued)

Pilot Study Protocol

• Standardization of Pilot Operation
  – Uniform Wastewater Quality
  – Uniform Chemical Feed
  – Uniform Sample Collection Method

• Sample Analysis
  – Engineers Laboratory Analysis
  – Certified Laboratory Analysis

• Wastewater Characterization
  – Wastewater Characterization for Overall Impact on the Facility

• Extensive Pilot Protocol
  – Detailed Schedule
  – Manufacturer Suggestions
Selection of TP Removal Process (continued)

Section Criteria

• Phosphorus Removal to 0.10 mg/L or Less
• Phosphorus Removal to 0.05 mg/L or Less
• Flow and Loading Rate Versatility
• Ability to Use Different Coagulants
• Ability to Treat Extreme Loading Conditions
• Impact on TSS, BOD$_5$ and UVT
• Removal of Metals
• Hydraulic Loading
• Power Use and Consumption
Selection of TP Removal Process (continued)

Pilot Study Results

- Technologies Met TP of 0.1 mg/L Using FeCl₃, Alum, or PAC
- Technologies Reduced the Phosphorus Concentration to Less than 0.05 mg/L with Added Polishing
- Optimum Concentration
  - Varied Between 20 and 35 mg/L for FeCl₃
  - Varied Between 40 to 80 mg/L for Alum
- Most Technologies met the 0.1 mg/L Total Phosphorus Limit Under the Simulated Plant Upset Conditions
- Most Technologies had Significant Beneficial Impact on the Upstream and Downstream Processes
- Technologies Reduced the Metal Concentrations to Within the Permit Limits
Selection of TP Removal Process (continued)

Evaluation Criteria

• Performance
  – Phosphorus Levels
  – Hydraulics
  – Track Record

• Cost
  – Capital Cost
  – O & M Costs

• Miscellaneous
  – Environmental Impacts
  – Footprint and Aesthetics
  – Responsiveness of Manufacturer

• Operation & Maintenance
  – Chemical Alternatives
  – Simplicity
  – Operations
  – Flexibility
  – Effects on Process
    • Upstream
    • Downstream

• Interview
  – Technical Knowledge
  – Engineering Support
  – Question and Answers
Selection of TP Removal Process (continued)

Conclusion

• Kruger, Inc. - ACTIFLO®
  - Achieved Low Phosphorus Levels
  - Utilizes Multiple Chemicals
  - Fit within the Existing Hydraulics of the WWTF
  - Lowest 20-year Life Cycle Cost
  - Track Record and Full-Scale Operations for Phosphorus Removal in United States
Description of the TP Removal Process

- SLUDGE
- HYDROCYCLONE
- POLYMER
- INJECTION
- MICRO-SAND
- PLATE SETTLER WITH SCRAPER
- RAW WATER
- COAGULANT
- CLARIFIED WATER
- MICRO-SAND AND SLUDGE TO HYDROCYCLONE
### Plant Performance

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<tr>
<th>Description</th>
<th>Permit/Design Values</th>
<th>2012 Values</th>
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<tr>
<td><strong>Flow (MGD)</strong></td>
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<tr>
<td>Average Daily Flow</td>
<td>7.68</td>
<td>5.7</td>
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<tr>
<td>Peak Daily Flow</td>
<td>14.43</td>
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<tr>
<td><strong>Influent (mg/L)</strong></td>
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<tr>
<td>BOD$_5$</td>
<td>250</td>
<td>210</td>
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<tr>
<td>TSS</td>
<td>250</td>
<td>220</td>
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<tr>
<td>Phosphorous</td>
<td>10</td>
<td>5.67</td>
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<tr>
<td><strong>Effluent (mg/L)</strong></td>
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<tr>
<td>BOD$_5$</td>
<td>10</td>
<td>&lt;2</td>
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<tr>
<td>TSS</td>
<td>10</td>
<td>&lt;2</td>
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<tr>
<td>Phosphorous – In Season</td>
<td>0.10</td>
<td>0.06</td>
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<tr>
<td>Phosphorous – Off Season</td>
<td>0.75</td>
<td>0.51</td>
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## Plant Performance (continued)

<table>
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<tr>
<th>Description</th>
<th>Actual</th>
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<td>Chemical Dosage (mg/L)</td>
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<tr>
<td>Ferric Chloride</td>
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<tr>
<td>Sodium Hydroxide</td>
<td>0</td>
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<td>Polymer</td>
<td>0.4</td>
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<tr>
<td>Lime</td>
<td>60</td>
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<td>Power Usage (kWH per day)</td>
<td>864</td>
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<tr>
<td>Sludge Production (dry tons/day)</td>
<td>6.93</td>
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<tr>
<td>Labor (manhours per day)</td>
<td>4 to 6</td>
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<td>Operating Cost (April – October 2012)</td>
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<tr>
<td>Total</td>
<td>$188,000</td>
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<tr>
<td>Phosphorous Pounds Removed</td>
<td>50,800</td>
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<tr>
<td>Cost per Pound of Phosphorous Removed</td>
<td>$3.70</td>
</tr>
<tr>
<td>Actual vs Pilot Study Operating Cost (%)</td>
<td>75</td>
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Construction Facts

• $54M Project Completed
  $1.8M Under Budget

• 30 Month Construction Duration Completed 45 days Ahead of Schedule

• Maintained NPDES Permit Compliance Throughout The Construction Period

• Completed Construction Activities with No Lost Time or OSHA Violations

• Utilized SRF Funding

• Secured 0% SRF Funding Resulting in a Savings of Over $17M

• Received a Federal Stimulus Grant of Over $8.0M

• Received Energy Rebate of $150K

• Receiving Alternative Energy Credit Rebate of $125K Per Year
Impacts to Sewer Users

- More Complex Processes Are Costly and Require Significant Operator Attention
- Changing Regulations Requires Added Processes and/or Modified Operations
- Aging Infrastructure Needs to be Rehabilitated and/or Replaced
- Removal of Infiltration/Inflow is a Continuous Process
- Water Conservation has Reduced Water Usage Making Projections of Sewer Rates a Moving Target
Impacts to Sewer Users (continued)

• Westborough Sewer Rates
  – Increased 150% Between 2003 and 2013
  – Increased 32% Due to the Upgrades to the Facility
  – Annual Cost Per User Now About $580 Per Year

• Shrewsbury Sewer Rates
  – Increased 310% Between 2003 and 2013
  – Increased 67% Due to the Upgrades to the Facility
  – Annual Cost Per User Now About $800 Per Year

• Grants and Low Interest Loans Reduced the Rate Increase By About 25%
Conclusions

• Conduct Pilot Testing to Select the Correct Process

• The Actiflo® process has Achieved Consistent Effluent Concentrations of Less Than 0.1 mg/L.

• Full Scale Operations were Comparable to the Pilot Study Results and Projections

• Full Scale Operating Costs are About 75% of Operating Costs Projected

• The Actiflo® Process Provides the Ability to Utilize the Most Cost Effective Chemical

• Incorporate Process Flexibility into the Design

• It’s Costly to Construct and Operate Nutrient Removal Processes
Acknowledgements

- Westborough Treatment Plant Board
- Town of Westborough
- Town of Shrewsbury
- Veolia NA (Contract Operator)

- Stantec Consulting Services, Inc. (Owner’s Program Manager)
- Methuen Construction-Interstate Electric – JV (Contractor)
- Kruger, Inc. (Process Manufacturer)
Questions and Answers