“No-Cost” Nitrogen & Phosphorus Removal Five Case Studies

Grant Weaver, PE & WWTP Operator
The Water Planet Company

www.cleanwaterops.com
Plants receiving Nutrient Removal O&M support

Amherst, Massachusetts  Athens North Mouse Creek, Tennessee  Athens Oostanaula, Tennessee  Barnstable, Massachusetts  Bartlett, Tennessee
“No-Cost” Nutrient (N&P) Removal

To Get Plants not Designed to Remove Nutrients ...

Experiment with Day-to-day Operations in order to ...

Create Optimal Habitats using Existing Equipment.
Optimal Habitats for Nitrogen & Phosphorus Removal

Aerobic Conditions:
- \( \text{NH}_4 \) conversion to \( \text{NO}_3 \)
- PAO uptake of ortho-P

Process Control: DO/ORP, MLSS

Anoxic Conditions:
- \( \text{NO}_3 \) conversion \( \text{N}_2 \)

Process Control: ORP, BOD

Anaerobic (Fermentive) Conditions:
- VFA formation
- PAO uptake of VFA & ortho-P release

Process Control: ORP, BOD
“No-Cost” Nutrient (N&P) Removal

Biggest Barrier to Optimization is Regulatory:
“Follow Operations & Maintenance Manual”
“No-Cost” Nutrient (N&P) Removal

Biggest Barrier to Optimization is Regulatory:
“Follow Operations & Maintenance Manual”

Regulatory Support Encourages Optimization:
“Basically, we are training operators to hide their O&M Manuals in a dark corner somewhere and start operating their systems differently than they were originally designed for...”

Paul LaVigne
Administrator
Water Pollution Control State Revolving Fund
Montana Department of Environmental Quality
## Case Studies

<table>
<thead>
<tr>
<th>Location</th>
<th>Before N (mg/L)</th>
<th>After N (mg/L)</th>
<th>Before P (mg/L)</th>
<th>After P (mg/L)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sunderland, Massachusetts</td>
<td>20</td>
<td>8.0</td>
<td>3.0</td>
<td>3.0</td>
</tr>
<tr>
<td>Upton, Massachusetts</td>
<td>22</td>
<td>6.0</td>
<td>0.2</td>
<td>0.2</td>
</tr>
<tr>
<td>Conrad, Montana</td>
<td>25</td>
<td>2.5</td>
<td>2.5</td>
<td>0.3</td>
</tr>
<tr>
<td>Chinook, Montana</td>
<td>25</td>
<td>4.0</td>
<td>2.5</td>
<td>0.5</td>
</tr>
<tr>
<td>Montague, Massachusetts</td>
<td>20</td>
<td>8.0</td>
<td>2.5</td>
<td>0.7</td>
</tr>
</tbody>
</table>
Sunderland, Massachusetts
0.5 MGD
Population: 3,700
Sunderland, Massachusetts

<table>
<thead>
<tr>
<th></th>
<th>Before</th>
<th>After</th>
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</thead>
<tbody>
<tr>
<td>total-Nitrogen</td>
<td>20 mg/L</td>
<td>8 mg/L</td>
</tr>
<tr>
<td>total-Phosphorus</td>
<td>3.0 mg/L</td>
<td>3.0 mg/L</td>
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</tbody>
</table>

Sludge production cut in half

Process changes:
- Increased MLSS to 3500 mg/L
- Mechanical aerator is cycled on and off
Upton, Massachusetts
0.4 MGD
Population: 5,700
**Upton, Massachusetts**

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<tbody>
<tr>
<td>total-Nitrogen:</td>
<td>22 mg/L</td>
<td>6 mg/L</td>
</tr>
<tr>
<td>total-Phosphorus:</td>
<td>0.2 mg/L</td>
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Fewer chemicals: PAC and sodium aluminate

Process changes:
- Air turned off in front one half of both aeration basins
- RAS rate increased to 2Q (200% of influent flow)
After a two-day training class, Operator Keith Thaut began cycling aeration ON and OFF. After one site visit, Keith began cycling the air in the sludge digestion pond and returning fermented WAS to the treatment plant. Effluent nitrogen dropped from 25 mg/L to 2 mg/L. Effluent phosphorus dropped from 2.5 mg/L to 0.2 mg/L. Sludge production declined by more than 50%.

Conrad, Montana
0.5 MGD
Population: 2,600
**Conrad, Montana**

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<tr>
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<td>25 mg/L</td>
<td>2.5 mg/L</td>
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<td>total-Phosphorus:</td>
<td>2.5 mg/L</td>
<td>0.3 mg/L</td>
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Sludge production cut in one-third
Less electricity

Process changes:
- Increased MLSS
- Return a portion of WAS to aeration
- Aeration Basin and Sludge Pond air is cycled off and on
Chinook, Montana
0.5 MGD
Population: 1,300
Chinook, Montana

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<tr>
<td>total-Nitrogen:</td>
<td>25 mg/L</td>
<td>4.0 mg/L</td>
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<tr>
<td>total-Phosphorus:</td>
<td>2.5 mg/L</td>
<td>0.5 mg/L</td>
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Process changes:
- Increased MLSS
- One of Two Oxidation Ditch Aeration Rotors is cycled off and on
- One of Two Oxidation Ditch Submerged Mechanical Aerators operates

Daily average DO target: 1.0 mg/L
Montague, Massachusetts
1.8 MGD
Population: 8,400
Montague, Massachusetts

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<td>2.5 mg/L</td>
<td>1.0 mg/L</td>
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Almost zero sludge is produced

Process changes:
- Increased MLSS
- Waste Sludge from 22 wwtps is added to influent
- Primary Clarifiers Operated as Anaerobic Fermenters
- Air to Aeration Tanks cycles off and on
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