While We Are At, Nutrients Too, in Clark County

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Agenda

- Clark County, OH, Southwest Regional Wastewater Treatment Plant

- Design Development
  - Requirement – Expansion, Upgrade
  - Goal – Nutrient Removal

- Retrofit Details
  - Nutrient Removal

- Initial Performance

- Questions
Project Basis / Overview – Regulatory Drivers

- **Regulatory Activity**
  - Mad River TMDL
  - OEPA’s Nutrient Reduction Strategy (Pending)
  - Gulf of Mexico Hypoxia Program (Pending?)

- **New NPDES Permit (March 2015)**
  - Capacity Expansion: 2.0 MGD → 4.0 MGD Rating (Future Need)
  - Monthly NH$_3$-N Limit Decrease: 2.5 mg/L → 1.7 mg/L
    - **Additional Future Limits?**
      - Assess Nutrient Removal Options
<table>
<thead>
<tr>
<th>Parameter</th>
<th>Requirement / Limit</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flow</td>
<td>Report (MGD)</td>
<td>Daily</td>
</tr>
<tr>
<td>Dissolved Oxygen</td>
<td>Minimum 5.7 mg/L</td>
<td>Daily</td>
</tr>
<tr>
<td><strong>BOD$_5$</strong></td>
<td>mg/L</td>
<td>lbs/day</td>
</tr>
<tr>
<td></td>
<td>12</td>
<td>401</td>
</tr>
<tr>
<td></td>
<td>8.0</td>
<td>267</td>
</tr>
<tr>
<td>TSS</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>18</td>
<td>602</td>
</tr>
<tr>
<td></td>
<td>12</td>
<td>401</td>
</tr>
<tr>
<td>Ammonia-N (NH$_3$-N)</td>
<td>3.2</td>
<td>107</td>
</tr>
<tr>
<td></td>
<td>1.7</td>
<td>57</td>
</tr>
<tr>
<td>E.Coli</td>
<td>284 #/100 mL</td>
<td>Summer Weekly</td>
</tr>
<tr>
<td></td>
<td>126 #/100 mL</td>
<td>Summer Monthly</td>
</tr>
<tr>
<td>Phosphorus (as P)</td>
<td>Report</td>
<td>Monthly</td>
</tr>
<tr>
<td>TKN (as N)</td>
<td>Report</td>
<td>Quarterly</td>
</tr>
<tr>
<td>Nitrite Plus Nitrate (NO$_x$-N)</td>
<td>Report</td>
<td>Monthly</td>
</tr>
</tbody>
</table>
# Influent, Effluent Parameters – Design v. Actual (Startup)

<table>
<thead>
<tr>
<th>Stream</th>
<th>Parameter</th>
<th>Unit</th>
<th>New Data July 2014-Sept 2014*</th>
<th>Old Data for Comparison</th>
</tr>
</thead>
<tbody>
<tr>
<td>Influent</td>
<td>pH</td>
<td>SU</td>
<td>7.90</td>
<td>7.95</td>
</tr>
<tr>
<td></td>
<td>TSS</td>
<td>mg/L</td>
<td>391</td>
<td>315</td>
</tr>
<tr>
<td></td>
<td>CBOD₅</td>
<td>mg/L</td>
<td>234</td>
<td>162</td>
</tr>
<tr>
<td>Effluent</td>
<td>Flow</td>
<td>MGD</td>
<td>1.3</td>
<td>1.5</td>
</tr>
<tr>
<td></td>
<td>Water Temp</td>
<td>°C</td>
<td>20.3</td>
<td>14.3</td>
</tr>
<tr>
<td></td>
<td>DO</td>
<td>mg/L</td>
<td>8.5</td>
<td>9.1</td>
</tr>
<tr>
<td></td>
<td>Max pH</td>
<td>SU</td>
<td>8.2</td>
<td>8.0</td>
</tr>
<tr>
<td></td>
<td>Min pH</td>
<td>SU</td>
<td>7.5</td>
<td>7.9</td>
</tr>
<tr>
<td></td>
<td>TSS</td>
<td>mg/L</td>
<td>4.0</td>
<td>3.0</td>
</tr>
<tr>
<td></td>
<td>NH₃</td>
<td>mg/L</td>
<td>0.57</td>
<td>0.26</td>
</tr>
<tr>
<td></td>
<td>CBOD₅</td>
<td>mg/L</td>
<td>2.9</td>
<td>2.1</td>
</tr>
<tr>
<td></td>
<td>NOx</td>
<td>mg/L</td>
<td>12.9</td>
<td>15.4</td>
</tr>
<tr>
<td></td>
<td>TP</td>
<td>mg/L</td>
<td>3.3</td>
<td>2.6</td>
</tr>
<tr>
<td></td>
<td>TKN</td>
<td>mg/L</td>
<td>1.2</td>
<td>1.3</td>
</tr>
<tr>
<td>Overflow Occurrence</td>
<td>No.</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

*Review of monthly averages only

**These influent values were used in the Basis of Design Mass Balance and Modeling Evaluations**
Phosphorus Removal by Biological Means

- **Fundamentals of Bio-P:**
  - Requires Anaerobic-Aerobic sequencing
  - **DO & NOx** must be used up for Anaerobic conditions
    - NOx in RAS/ Denitrified in Pre-Anoxic Zone
  - Need Readily biodegradable COD and VFAs during Anaerobic
  - Need Sufficient Aeration during Aerobic
- Poly-phosphate released in Anaerobic, stored during Aerobic
  - Stored Phosphorus is removed with the WAS
Importance of Influent Ratios

- **BOD/N**
  - >4.0 generally suggests sufficient BOD for effluent TN < 10 mg/L

- **TKN/NH₃-N**
  - Greater values indicate higher organic content
  - Potential for higher effluent dissolved organic nitrogen (EDON)

- **BOD/P**
  - > 30 indicates potential for effective Bio-P
  - < 20 indicates minimal removal with Bio-P

- **rbCOD/P**
  - Most rbCOD gets converted to acetate for EBPR
  - 1 mg P removal for 6–10 mg/L rbCOD
Process Modeling

- Calibrated existing plant for existing limits
- Modeling to evaluate conditions for Bio-P, BNR
  - <1 mg/L TP, 10 mg/L TN
Process Modeling – Oxidation Ditch Mode

Existing Ditches in Parallel Model Results
Secondary Effluent Variables v. Flow (MGD)

- Low HRT.
- MLSS Limit?
- DO Control?
Existing Ditches In Series Model Results
Secondary Effluent Variables v. Flow (MGD)

Hydraulics? DO Control?
Plug Flow Activated Sludge Model Results
Secondary Effluent TSS, BOD, and NH₃-N (mg/L) v. Flow (MGD)

Use Swing. DO Control? Carbon?
Oxidation Ditch vs. Plug Flow Operation

- Aerobic suspended growth process
  - Oxidation ditch (*to 3.2 MGD*) vs.
  - Plug-flow configuration (*to 4 MGD, BNR*)

![Graph showing the effect of design factor on steady state effluent ammonia levels in complete mix and plug flow suspended growth reactors.](image-url)
Oxidation Ditch vs. Plug Flow Operation

- Other Benefits
  - Improved Process Control
    - Dedicated Zones
    - Independent Mixing & Aeration
  - BNR
    - > Nitrification, TN & Bio-P
  - Lower Capital Cost
  - Lower O&M Cost
  - Floodplain
Other Benefits of Biological Nutrient Removal

- Anoxic Treatment Reduces BOD w/o Oxygen
  - Reduce Overall Required Oxygen
- Anoxic/Aerobic Conditions can enhance settleability
  - Select organisms, control filaments
- Bio-P can enhance alpha factor (oxygen uptake)
- Chem-P can increase inactive biomass
Oxidation Ditch BNR Conversion

- Converting oxidation ditches to plug flow reactors

Diagram showing the processes involved in oxidation ditch BNR conversion, including Pre-Anoxic/Aerobic/Swing, RAS, CLARIFIER, WAS, and WW.
Overview – Process Flow Diagram

- **Influent**
  - Headworks
    - U.V. Disinfection
    - Post Aer
      - Final Effluent

- **Anaerobic/Anoxic Reactors**
  - Reactor 1 (Outside Ring)
  - Reactor 2 (Inside Rings)

- **2 Plug Flow Reactors**

- **Secondary Clarifiers**

- **Return Activated Sludge**

- **Decant from Aerated Sludge**

- **Dewatering Filtrate Recycle**

- **Waste Activated Sludge**

- **Aerated Sludge Storage**
  - Inclined Screw Press
  - Long Term Cake Storage
    - Class B Disposal
Pre-Anoxic/AAnaerobic Tanks

Secondary Clarifiers
(1 New, 2 Existing)

Effluent Treatment
(Coagulant, UV, Post Aer)

EMERGENCY GENERATOR

Headworks
(Refurbished/New Screens,
Vortex Grit Removal,
Flow Distribution)

SPLITTER BOX

RAS PUMP STATION
(New RAS PUMP, Metering)

Bioreactors
(Converted Ox. Ditches)

INTERMEDIATE PUMP STATION
(3 New Pumps)

BLOWER PAD
(4 New Blowers)
Capacity Expansion from 2 to 4 MGD (10 MGD Peak)

**Influent Screw Pumps (Ex. To Remain)**
- Existing Screw Pumps to Remain (7.3 MGD Capacity)
- Update when Peak Flow reaches 80% of firm pumping capacity

**Influent Screening (Refurbish/New)**
- Existing Mechanical Screen (5 MGD) to Remain
- Add Second Mechanical Screen (5 MGD)
- Replace Bar Rack (New 10 MGD, for Redundancy)
- New Shaftless Screw Screenings Conveyor

**Grit Removal (New)**
- New Vortex Grit Concentrators (With Stacked Tray Design)
Retrofitted Headworks Layout – Plan

- Headworks Facility
  - Doubled Screening
  - New Grit Removal
  - Other upgrades
## Biological Treatment Zone Volumes

<table>
<thead>
<tr>
<th>Zone</th>
<th>Train 1 Vol (MG)</th>
<th>Train 2 Vol (MG)</th>
<th>Total Vol (MG)</th>
<th>Primary Process Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-Anoxic/Anaerobic</td>
<td>0.11</td>
<td>0.11</td>
<td>0.22</td>
<td>RAS Denitrification/Phosphorus Release</td>
</tr>
<tr>
<td>Swing</td>
<td>0.13</td>
<td>0.15</td>
<td>0.28</td>
<td>(Depends on Operation)</td>
</tr>
<tr>
<td>Aerobic</td>
<td>0.26</td>
<td>0.31</td>
<td>0.57</td>
<td>Nitrification/P Uptake</td>
</tr>
<tr>
<td>Swing</td>
<td>0.15</td>
<td>0.18</td>
<td>0.33</td>
<td>(Depends on Operation)</td>
</tr>
<tr>
<td>Aerobic</td>
<td>0.09</td>
<td>0.10</td>
<td>0.19</td>
<td>Nitrification/P Uptake</td>
</tr>
<tr>
<td>Total</td>
<td>0.74</td>
<td>0.85</td>
<td>1.59</td>
<td>BOD/Nutrient Removal</td>
</tr>
</tbody>
</table>
Ortho-Phosphorus Profile – Aerobic Swing Zones – 1.57 MGD

- Pre-Anoxic/Aerobic Swing
- Swing 1
- Aerobic 1
- Swing 2
- Aerobic 2

**Ortho-Phosphorus (mg/L)**

- INF + RAS
- Anaerobic/Anoxic Release
- Aerobic Uptake
Ortho-Phosphorus Profile – Anaerobic Swing 1 – 3 MGD

ANAEROBIC/ANOXIC RELEASE

INF + RAS

AEROBIC UPTAKE

Ortho-Phosphorus (mg/L)

Pre-Anoxic/Aerobic Swing 1 Aerobic 1 Swing 2 Aerobic 2
Ortho-Phosphorus Profile – Secondary Release

Ortho-Phosphorus (mg/L)

INF + RAS

Pre-Anoxic/Anaerobic Swing 1 Aerobic 1 Swing 2 Aerobic 2

AEROBIC UPTAKE

INITIAL RELEASE

SECONDARY RELEASE
Converted Bioreactors (Upper Level)

- 36” Effluent Pipe (To Splitter Box)
- 42” Influent Pipe (From Pre-Anoxic/Anaerobic)
- Intermediate Pump Station (3 New, 3 Ex.)
- Blower Pad (4 New PD Blowers)
- Aeration Flow Meters

- Reactor No. 1: Outer Ring
- Reactor No. 2: Inner and Middle Rings
Converted Bioreactors (Lower Level)

- 36” Effluent Pipe (To Splitter Box)
- 42” Influent Pipe (From Pre-Anoxic/Anaerobic)
- Intermediate Pump Station (3 New. 3 Ex.)
- Blower Pad (4 New PD Blowers)
- Submersible Mixers (In Swing Zones)
- Aeration Flow Meters
- Fine Bubble Diffuser
- Aeration Grids (Supply Piping Around Tank)

Reactor No. 1: Outer Ring
Reactor No. 2: Inner and Middle Rings
Biological – Equipment Installation Photos
Bioreactor Process Control

- SAMPLING POINT
- DO METER

SWING 1 | AERATION 1 | SWING 2 | AERATION 2
Bioreactor Process Flow & Control

- WALKWAY
- SAMPLING POINT
- DO METER

- REACTOR NO. 1: OUTSIDE RING
- REACTOR NO. 2: INSIDE 2 RINGS

- EFFLUENT
- INFLUENT

- AERATION 1
- AERATION 2
- SWING 1
- SWING 2

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Capacity Expansion from 2 to 4 MGD (10 MGD Peak)

Coagulant Storage and Feed
- Provisional, for intermittent use to ensure permit compliance

UV Disinfection
- Replacing Chlorine System, Increase Capacity to 10 MGD
  - Safety Concerns (Chlorine Storage)

Post – Aeration
- Convert old Chlorine Contact Tank to New Post- Air Tank
  - New Blowers, increase rating to 10 MGD

Tertiary Filters – Decommissioned in Place
Coagulant Feed – Improves / Backs Up P Removal

- **Upgraded to Biological Phosphorus Removal**
  - Low temperatures or inadequate influent ratios may inhibit BioP
  - Swing Zones in aeration mode may inhibit BioP

- **Coagulant added to enhance/back up Bio-P**

- **Can also enhance settling, reduce effluent TSS**

- **Alternatives:** Alum, Ferric Chloride, PACl, Sodium Aluminate, etc.
  - Installed: 35% Ferric Solution

- **Control:**
  - PCS automatically starts pumps when a pre-set effluent TSS is measured
    - By TSS Effluent Monitor
  - Feed rate is manually adjusted
EFFLUENT TREATMENT
Coagulant Addition, UV, Post-Aeration
Coagulant Addition – Equipment Installation Photo
Liquid Treatment – Sustained Storm (4 MGD, 3-5 Days)

**Average Flows:** 1.5 MGD

**Sustained Storm:** 4 MGD

**Headworks**
- Ex. Mechanical Screen
- Grit 2
- New Mechanical Screen
- Grit 1
- Manual Bypass Screen

**Pumped Influent**

**Anaerobic/Anoxic Reactors**
- Reactor 1 (Outside Ring)
- Reactor 2 (Inside Rings)

**2 Plug Flow Reactors**
- S1
- S2

**Secondary Clarifiers**
- 1
- 2
- 3
- U.V. 1
- U.V. 2
- U.V. 3
- Post Air 1
- Post Air 2

**Return Activated Sludge**
- Decant from Aerated Sludge
- Waste Activated Sludge

**Dewatering Filtrate Recycle**

**Final Effluent**
Liquid Treatment – Sustained Storm, Maintain Treatment

- **Average Flows:** 1.5 MGD
- **Sustained Storm:** 4 MGD
- **Storm, NR Issues:** 5 MGD

**Diagram Description:**

- **Pumped Influent:**
  - Headworks
    - Ex. Mechanical Screen
    - Grit 2
    - New Mechanical Screen
    - Grit 1
    - Manual Bypass Screen

- **Anaerobic/Anoxic Reactors:**
  - Reactor 1 (Outside Ring)
  - Reactor 2 (Inside Rings)
  - S1, S2

- **2 Plug Flow Reactors**

- **Secondary Clarifiers:**
  - 1
  - 2
  - 3
  - U.V. 1, U.V. 2, U.V. 3
  - Post Air 1, Post Air 2

- **Final Effluent**

- **Return Activated Sludge**

- **Decant from Aerated Sludge**

- **Waste Activated Sludge**

- **Dewatering Filtrate Recycle**

- **Average Flows:** 1.5 MGD
- **Sustained Storm:** 4 MGD
- **Storm, NR Issues:** 5 MGD
Future Treatment? – Growth to Capacity, Or Lower Limits

- **Average Flows:** 1.5 MGD
- **Sustained Storm:** 4 MGD
- **Storm, NR Issues:** 5 MGD
- **Storm, NR Issues:** 5 - 10 MGD

**Headworks**
- Pumped Influent
  - Mechanical Screen 1
  - Grit 1
  - Mechanical Screen 2
  - Grit 1
  - Manual Bypass Screen

**Anaerobic/Anoxic Reactors**
- Reactor 1 (Outside Ring)
- Reactor 2 (Inside Rings)

**2 Plug Flow Reactors**
- S1
- S2

**Coagulant Feed System**
- Decant from Aerated Sludge
- Dewatering Filtrate Recycle

**Return Activated Sludge**
- Waste Activated Sludge

**Secondary Clarifiers**
- 1
- 2
- 3
- U.V. 1
- U.V. 2
- U.V. 3
- Post Air 1
- Post Air 2

**Final Effluent**

**Average Flows:**
- **1.5 MGD**

**Sustained Storm:**
- **4 MGD**

**Storm, NR Issues:**
- **5 MGD**
- **5 - 10 MGD**

**Mechanical Screen:**
- Screen 1
- Screen 2

**Grit:**
- Grit 1
- Manual Bypass Screen

**Post Air:**
- Air 1
- Air 2

**U.V:**
- U.V. 1
- U.V. 2
- U.V. 3
Training Sessions and Tools (Example - RAS/WAS Calculator)

- Enter Info Into Beige Cells
- Suggests WAS flows to achieve desired MLSS
- RAS rate to maintain

### RAS Rate

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clarifier Diameter, ft</td>
<td>60.00</td>
</tr>
<tr>
<td>No. of SCs in use</td>
<td>3.00</td>
</tr>
<tr>
<td>Total Clarifier Influent, MGD</td>
<td>2.18</td>
</tr>
<tr>
<td>Tot. SC area in use, ft^2</td>
<td>8,482.30</td>
</tr>
<tr>
<td>Surface loading rate @ desired MLSS, (lb/day)/SF</td>
<td>7.10</td>
</tr>
<tr>
<td>Surface loading rate @ actual MLSS, (lb/day)/SF</td>
<td>6.51</td>
</tr>
<tr>
<td>SVI, mL/g</td>
<td>100.00</td>
</tr>
<tr>
<td>RAS rate, based on SVI, % of inf</td>
<td>50.35</td>
</tr>
<tr>
<td>RAS rate, based on SVI, MGD</td>
<td>0.73</td>
</tr>
<tr>
<td>SC Influent Solids, lbs/day</td>
<td>40,479.91</td>
</tr>
<tr>
<td>RAS solids, lbs/day</td>
<td>37,200.74</td>
</tr>
<tr>
<td>RAS, MGD</td>
<td>0.88</td>
</tr>
<tr>
<td>BR Influent TSS, mg/L</td>
<td>280.00</td>
</tr>
<tr>
<td>Desired BR MLLS, mg/L</td>
<td>4,050.40</td>
</tr>
<tr>
<td>Underflow SS, mg/L</td>
<td>11,779.86</td>
</tr>
<tr>
<td>Effluent TSS, mg/L</td>
<td>8.71</td>
</tr>
<tr>
<td>BR influent flow, MGD</td>
<td>1.45</td>
</tr>
<tr>
<td>SC Effluent Flow, MGD</td>
<td>1.42</td>
</tr>
<tr>
<td>WAS flow, MGD</td>
<td>0.03</td>
</tr>
<tr>
<td>Minimum RAS Flow at Target MLSS, MGD*</td>
<td>0.70700</td>
</tr>
<tr>
<td>Minimum recommended RAS Flow, calculated based on current MLSS*</td>
<td>0.53</td>
</tr>
</tbody>
</table>

### WAS Rate

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre Anoxic Tank Volume, MG</td>
<td>0.11 each</td>
</tr>
<tr>
<td>Train 1 (outer ring) Tank Volume, MG</td>
<td>0.63 each</td>
</tr>
<tr>
<td>Train 2 (inner ring) Tank Volume, MG</td>
<td>0.74 each</td>
</tr>
<tr>
<td>No. of Pre-Anoxic/Anaerobic Tanks online</td>
<td>1.00 of 2 total</td>
</tr>
<tr>
<td>Is Plug Flow Bioreactor Train 1 online?</td>
<td>1.00 1 for yes, 0 for no</td>
</tr>
<tr>
<td>Is Plug Flow Bioreactor 2 online?</td>
<td>0.00 1 for yes, 0 for no</td>
</tr>
<tr>
<td>Pre: Anoxic working vol, MG</td>
<td>0.11</td>
</tr>
<tr>
<td>Bioreactor working vol, MG</td>
<td>0.63</td>
</tr>
<tr>
<td>Tot. Online Tank Volume, MG</td>
<td>0.74</td>
</tr>
<tr>
<td>Influent Flow, MGD</td>
<td>1.45</td>
</tr>
<tr>
<td>Actual current MLSS, mg/L</td>
<td>3,349.00</td>
</tr>
<tr>
<td>Desired MLSS, mg/L</td>
<td>4,050.40</td>
</tr>
<tr>
<td>MLSS to be removed, lbs</td>
<td>-4,328.76</td>
</tr>
<tr>
<td>Extra MLSS to be pumped in addition to WAS, MG</td>
<td>-0.04</td>
</tr>
<tr>
<td>RAS/WAS TSS, mg/L</td>
<td>11,779.86</td>
</tr>
<tr>
<td>Solids Inventory in Reactors, lbs</td>
<td>20,668.09</td>
</tr>
<tr>
<td>Desired Solids Inventory</td>
<td>24,997.45</td>
</tr>
<tr>
<td>WAS to maintain solids inventory, lbs/day</td>
<td>3,279.17</td>
</tr>
<tr>
<td>Calculated SRT at current solids inventory, days</td>
<td>6.30 Average in design modeling was 5.93 days</td>
</tr>
<tr>
<td>Calculated SRT at target solids inventory, days</td>
<td>7.62 Average in design modeling was 5.93 days</td>
</tr>
<tr>
<td>Desired WAS rate, MGD</td>
<td>0.03</td>
</tr>
<tr>
<td>Desired average WAS rate, GPM</td>
<td>23.18</td>
</tr>
<tr>
<td>SC Effluent Target TSS, mg/L</td>
<td>8.71</td>
</tr>
<tr>
<td>Hours spent wasting sludge, hrs/day</td>
<td>16.00</td>
</tr>
<tr>
<td>WAS flow rate while wasting, GPM</td>
<td>34.77</td>
</tr>
<tr>
<td>WAS flow rate to correct MLSS, GPM</td>
<td>9.00</td>
</tr>
</tbody>
</table>

**Update picture based on John’s Changes**

If a change is being made to the MLSS enter the number of days to be spent changing it. Then return to 34.77 GPM for 16.0 hours a day.
Initial Operation – Performance

Effluent Flow (MGD)

Flow Rate

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Initial Operation – Performance

Influent TSS and BOD (Conc, mg/L)

- Influent BOD
- Influent TSS

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Initial Operation – Performance

Tertiary Filters Offline
No Coagulant Use
Initial Operation – Performance

Effluent Nutrients (NH3-N, TKN, NOx, TP)

Date: 3/1/2013 to 4/1/2015

- NH3-N
- TKN
- NOx (Nitrate+Nitrite)
- TP
Initial Operation – Performance

Clark County - Southwest Regional WWTP
Effluent N Species

Date

mg/L

12/17/2014
12/20/2014
12/22/2014
12/23/2014
1/16/2015
1/18/2015
1/26/2015
2/2/2015
2/16/2015
2/17/2015
3/2/2015
3/23/2015
3/29/2015
4/10/2015
4/20/2015
4/22/2015
4/27/2015
4/29/2015

Eff Nitrogen, Ammonia (NH₃) mg/L
Eff Nitrite Plus Nitrate, Total mg/L
Eff Nitrogen Kjeldahl, Total mg/L
Initial Operation – Performance

Clark County - Southwest Regional WWTP
Eff Total Phosphorus

mg/L

Date

Eff Phosphorus, Total (P) mg/L
Nutrient Removal is more cost effective when influent BOD is managed
  Deliver the sBOD to where it is best utilized

DO control easier and better in Plug Flow mode

When matched in proper ratios to N and P, BNR is very effective

**BOD is “Free Carbon”, little or no aeration needed with Nutrient Removal**

Recycle loads from solids treatment can influence performance

Cost-Effective Expansion & Upgrade
  $7.1M Project Cost
    Optimize existing infrastructure, $2-3/GPD capital cost
    BNR (TN 10, TN 1) ($100-500k of $7.1M?)
QUESTIONS?

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Thank you!

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