Making The Most of What You Have

Reconfiguring, repurposing, and optimizing existing facilities to expand capacity, achieve new treatment goals, and minimize costs to ratepayers.

Andrew Dow, Donohue & Associates
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Background

- Common Drivers of Change:
  - Increased (or Decreased) Flows and Loads
  - Aging Facilities
  - New Permit Requirements
  - Energy/Cost Inefficiencies
Background

Ways to Make the Most of What You Have:

- Repurposing Existing Structures
- Incorporating New Processes or Equipment (within Existing Structures)
- Improving Capacity with Process Changes
- Improving Capacity with Modifications to Existing Equipment

Taking a Customized Approach to Sizing:

- Process Modeling
- Re-rate Evaluations
Re-Purposing Equipment

Examples of available volume:
- Abandoned or underloaded clarifiers, aeration basins
- Sludge storage tanks, secondary digesters
- Chlorine contact tanks

Potential new uses:
- Additional (primary) digester capacity
- Sidestream equalization
- New process tanks/reactors
- Additional aeration or settling volume
Example: Whitewater, WI

- Repurposed a secondary clarifier for the back-end of aeration
- Reduced construction of new aeration tankage by 48%
- Mixer installed to de-couple DO control and mixing requirement
Example 2: St. Cloud, MN

- **WASSTRIP Process:**
  - Facility switched to UV disinfection
  - Repurposed chlorine contact tank into WASSTRIP for Ostara Nutrient Harvesting
  - Plug flow layout provides improved control of retention time for phosphorus release
  - Flowrate and level can be adjusted to control retention time and P release
Case Studies

Extending Life & Loading Capacity of Existing Plants
- Grafton, WI

Increasing Wet Weather Capacity
- Fort Wayne, IN
- MMSD – Jones Island

BNR/Aeration Retrofits
- North Shore WRD
Case Study 1

- Grafton, WI WWTP
- Land-locked plant
- Aged and nearing design capacity
- Considering brand new WWTP on new site
- Phased improvement program to increase capacity (30+% ) and extend life (25+ years)
  - Realize inherent capacity
  - Address age-related deficiencies
- Saved rate payers >$25M
Grafton, WI

Current Process Configuration

1995-96: 1.4 mgd
Capacity: 1.6 mgd
Grafton, WI

Design Process Configuration

1995-96: 1.4 mgd
Capacity: 2.1 mgd
Grafton, WI

Alternative Process Configuration

1995-96: 1.4 mgd
Capacity: 2.5 mgd
Grafton, WI

The bar chart illustrates the service population over different time periods and operational scenarios:

- **1995-1996**: represents the historical service population.
- **Current Operation**: indicates the current service population.
- **Design Operation**: denotes the service population under design conditions.
- **Alternate Operation**: shows the service population in an alternate operational scenario.

The y-axis represents the service population ranging from 0 to 18,000, while the x-axis indicates the different years and operation types.
Grafton, WI

- Phase 1: Year 2000 WAS Thickening Improvements
- Phase 2: Year 2005 Activated Sludge Improvements
- Phase 3: Year 2015 Digestion Improvements
- Full Buildout Year 2025

Flow (mgd)

Population

$25M Saved
Case Study 2

- Fort Wayne, IN
- Increase peak secondary treatment capacity from 60 to 100 mgd with no additional volume through:
  - Clarifier hydraulic capacity improvements
  - Process control and operations improvements
Clariﬁer Hydraulic Capacity

Hydraulic Capacity Improvements:

- Drop efﬂuent weirs to increase hydraulic capacity of existing ﬁnal clarifiers
- Construct efﬂuent pump station
Developing an Operating Approach

- Chemical Addition - CEPT
- Primary Clarifiers
- Aeration Basins
- Secondary Clarifiers
- Flow to Ponds

- CEPT Requirements
- Treatment Requirements for Primary Clarifiers
- Operational Solids Limits of Aeration Basins

Flow diagram showing the treatment process starting with chemical addition, followed by primary clarifiers, aeration basins, and secondary clarifiers, with flow ultimately going to ponds.
Process Evaluation

Step 1: Secondary Clarifier Capacity

Step 2: Aeration Basin Operation & Capacity

Step 3: Primary Clarifier Performance

Step 4: Wet Weather Capacity
Secondary Clarifier Capacity

Limiting Solids Flux

West Clarifiers $G_a/G_L$ at 100 MGD

* $G_a/G_L$ less than 1 = safe operation
Secondary Clarifier Capacity

State Point Analysis

East Clarifiers Safety Coefficient* at 100 MGD

*Safety Coefficient = [Solids Flux Curve] - [State Point]
Aeration Basin Loading

<table>
<thead>
<tr>
<th>SVI Percentile</th>
<th>SVI Value (mL/g)</th>
<th>Limiting Solids Flux MLSS Concentration (mg/L)</th>
<th>State Point MLSS Concentration (mg/L)</th>
<th>Target MLSS Concentration (mg/L)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>85 MGD</td>
<td>100 MGD</td>
<td>85 MGD</td>
</tr>
<tr>
<td>Average</td>
<td>80</td>
<td>4,300</td>
<td>3,700</td>
<td>4,100</td>
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<td>75th</td>
<td>100</td>
<td>3,800</td>
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<tr>
<td>95th</td>
<td>140</td>
<td>3,400</td>
<td>3,000</td>
<td>3,200</td>
</tr>
<tr>
<td>99th</td>
<td>170</td>
<td>3,100</td>
<td>2,700</td>
<td>2,500</td>
</tr>
</tbody>
</table>

Determine target MLSS based on selection of acceptable design SVI
Maximum Loading Conditions:

- Primary Effluent Concentrations
- Based on dynamic simulations, cold weather, 100 mgd
  - BOD: between 150 and 225 mg/L
  - TSS: between 100 and 150 mg/L
  - TKN: between 20 and 30 mg/L
Primary Clarifier Performance

With CEPT (Ferric Chloride Dosing)

Target PE Concentration (mg/L) vs. Storm Duration (hours)
Results

- Rated maximum treatment capacity: 60 -> 85 mgd
- Flexibility to treat 100 mgd when process conditions allow
Case Study 3

- MMSD Jones Island WRF, Milwaukee, WI
- Wet weather capacity improvements
- Goal: 250 mgd -> 330 mgd
- Solids loading rate was limiting factor
- > 100 mgd of secondary capacity added
  - Activated sludge storage
  - Secondary clarifier modifications
Activated Sludge Storage

Solids Storage Sequence of Operations

1. Gate Open
   - ML In
   - Normal Operation
   - Basin Effluent

2. Gate Open
   - ML In
   - Step 1: Air Off
   - Basin Effluent

3. Gate Closed
   - No ML In
   - Step 2: Inlet Closed, Air Back On
   - No Basin Effluent

4. Gate Partly Open
   - ML In
   - Step 3: Slowly Displace Stored Solids
   - Basin Effluent

5. Gate Fully Open
   - ML In
   - Step 4: Back to Normal Operation
   - Basin Effluent
Pilot Testing – East Clarifiers

Goal: Determine if old East Clarifier capacity can be increased through modifications to minimize short circuiting and enhance flocculation. (Goal SOR of 1,200 gpd/sf)

Test Clarifiers:
- Clarifier 8: Control (no modifications)
- Clarifier 4: Stamford Baffles and Blocked Corner Weirs
- Clarifier 3: Stamford Baffles, Blocked Corner Weirs and FEDWA (Flocculating Energy Dissipating Well Arrangement) Inlets
Clarifier Modifications

Baffling/Weirs
Clarifier Modifications

FEDWA
Stress Testing
Effluent Monitoring

April 30 - May 1 High Flow Event TSS Results

J1 East Plant SSVI ~ 90-95 mL/g

Flow diversion began around secondary treatment.
Operating experience has shown implemented improvements added more than 100 mgd of capacity.
Case Study 4

- North Shore Water Reclamation District
  - Three (3) WRFs in Northern IL
  - All Two-Stage Activated Sludge Plants

- Phosphorus Removal Needs
  - New draft permit limits of 1.0 mg/L, monthly average
  - Asked to evaluate feasibility of 0.5 and 0.1 mg/L

- Aeration Efficiency Opportunities
Accomplish Bio-P in First-Stage Basins:
- Short SRT
- Minimize Nitrate Production

Nitrify in Second-Stage Basins:
- Ample Aerobic Volume
- Longer SRT
Incorporate selectors into ample aeration basin volume
Summary

- Many ways to get more out of what you have...
  - Facility Re-Rates
  - Process Modeling / Right Sizing
  - Facilities Upgrades to Extend Life/Capacity/Capability
    - Look for opportunities to repurpose existing structures
  - Wet Weather / Clarifier Capacity Improvements
    - Upstream process modifications can be a key opportunity
  - BNR Upgrades that Take Advantage of Existing Infrastructure
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