Standing at a Crossroad: Biosolids Management Decisions in the Face of an Uncertain Future

Presented by Matt Van Horne, PE
Outline for today’s presentation

• A historical perspective and framework

• Case studies

• Closing thoughts and observations

• Questions (and maybe answers)
Master Planning Can Be Complicated…

**Cartoon Text:**

- **Panel 1:**
  
  Our project plan is so complicated that failure is assured.

- **Panel 2:**
  
  But complexity is too abstract for you to manage. So instead you will spray my energy into the vortex of failure.

- **Panel 3:**
  
  Go. I need you to finish it six weeks sooner for a trade show.
A Historical Perspective and Framework
Sewage sludge regulated under 40 CFR 503 to establish minimum standards

- Major Subsections Regulate
  - Land Application
  - Surface Disposal
  - Pathogen Reduction and Vector Attraction Reduction (VAR)
  - Incineration

- Land Application Constraints
  - Non-Hazardous
  - Criteria Pollutant Levels
  - Pathogen Density
  - Vector Attraction
State and local regulations can raise the bar above that of the 40 CFR 503 regulations.

- **Statewide Programs**
  - Application Rates
  - Seasonal Restrictions
  - Slope & Buffer Restrictions
  - Soil pH Management
  - Phosphorus Loading Rates
  - Nutrient Management Plans

- **Local Government Programs**
  - Local Oversight Function
  - Monitor Application at Sites
  - Additional Residuals Testing
  - Enforce State Regulations
  - Fee Supported Program
Watershed nutrient management programs may impact land application of residuals
Increased focus on getting “organics” out of landfills

Fugitive methane (GHG) emissions

Competition for “volume” with MSW and recycling driving MSW mass rates down

Implications of reduced MSW rates
  – Landfill compactor operation compromised with a poor MSW:CAKE ratio:
    – 15:1 = Acceptable
    – 10:1 = Problematic

Landfill disposal is becoming less attractive (more expensive) and fails to recover resources.
Increasingly stringent air emission regulations are impacting utilities that incinerate sludge.

- Changes in MACT rules driving toward lower air emissions rates
- MHI and FBI are considered differently
- “New” and “Existing” are also considered differently.
Increasingly stringent discharge limits have resulted in higher levels of treatment and...
... increased consideration of residuals handling and sidestream recycle impacts on treatment.
Aging infrastructure can bring utilities to the crossroad when considering recapitalization.
Land application may become more restrictive due to nutrient management regulatory changes.
Many Elements Drive Biosolids Improvements

What’s Next?

- Land Application Regulations
- Land Application Public Concerns
- Landfill Disposal Costs/Availability
- Air Emission Regulations
- Emerging Technologies
- Energy Neutrality
Water Resource Recovery Facility is becoming the new expectation from our former WWTPs.
The new paradigm will require getting the pieces of your plant to work together seamlessly.
Case Studies
Four Case Studies Demonstrate Various Approaches to Future Modifications

1. Multiple large facilities with interconnected biosolids handling

2. Increasing off-site processing costs drive on-site improvements

3. Holistic integrated approach to plant optimization
New York City DEP
Background

- The City-Wide Biosolids Management Plan (BSMP) is a comprehensive evaluation of the solids handling operations and infrastructure at all 14 WWTPs operated by the NYC DEP
- Analysis of current solids handling operations used as baseline for comparison with potential improvements and upgrades
- Future projections for both short (2020) and long-term (2040)
What is Driving the Need for a Plan?

- Infrastructure age

- Increasing solids loads – WAS increases can be significant

<table>
<thead>
<tr>
<th>Facility Type</th>
<th>Average 2020 Increase</th>
<th>Average 2040 Increase</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-BNR Facilities</td>
<td>7.0%</td>
<td>20%</td>
</tr>
<tr>
<td>BNR Facilities</td>
<td>25%</td>
<td>39%</td>
</tr>
</tbody>
</table>
Final Biosolids Handling Contract Approach is Complex

<table>
<thead>
<tr>
<th>Contract</th>
<th>Duration</th>
<th>Expires</th>
<th>Process</th>
<th>Disposal Location</th>
<th>Daily Amount, Wet Tons</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Avg</td>
</tr>
<tr>
<td>A</td>
<td>3 years</td>
<td>4/19/13</td>
<td>Advanced treatment</td>
<td>NJ</td>
<td>54</td>
</tr>
<tr>
<td>B</td>
<td>4 years</td>
<td>6/23/14</td>
<td>Landfill</td>
<td>VA, PA, OH, GA</td>
<td>250</td>
</tr>
<tr>
<td>C</td>
<td>3 Years</td>
<td>5/31/13</td>
<td>Landfill</td>
<td>VA, PA, OH</td>
<td>290</td>
</tr>
<tr>
<td>D</td>
<td>3 years</td>
<td>3/17/14</td>
<td>Landfill</td>
<td>OH</td>
<td>360</td>
</tr>
<tr>
<td>E</td>
<td>5 years</td>
<td>4/18/18</td>
<td>Advanced treatment</td>
<td>NJ</td>
<td>80</td>
</tr>
<tr>
<td>F</td>
<td>5 years</td>
<td>7/1/17</td>
<td>Lime treatment</td>
<td>PA</td>
<td>305</td>
</tr>
<tr>
<td>G</td>
<td>3 years</td>
<td>7/1/16</td>
<td>Lime treatment</td>
<td>PA</td>
<td>n/d</td>
</tr>
</tbody>
</table>
Driving to a Class B Biosolids Product May Require Significant Investment

- Digester capacity is limited
- Solution may be a combination of approaches
Mechanical Thickening Alternatives

Rotary Drum Thickener (RDT)
- Enclosed process
- Slow rotation speed
- Permeable drum
- Large WWTP experience

Gravity Belt Thickener (GBT)
- Highly visible operation
- Simple adjustments to improve performance
- Odor considerations
- Large WWTP experience
NYC DEP – Lessons Learned

- Even large, complex networks can benefit from a new look at biosolids handling approaches

- Defining the goals of the plan are important

- Identifying a phased approach to capital improvements is critical to balance spending

- Balancing nutrient loading from processing activities (i.e. dewatering) is important
Haifa Association of Towns, Israel
Water Regulations (Use of Sludge and its Disposal) 2004 require that:
- Starting in 2007, sludge must meet Class A requirements for agricultural land application

Off-site composting was chosen for the approach to meet these requirements
- Two concessionaries each about 150 km away from the WWTP
- Contracts are set to expire in next 3-5 years
- Price increasing at ~10% per year
## Class A Complications – 2010 Metals

<table>
<thead>
<tr>
<th>Constituent</th>
<th>Class A Limit (mg/kg\textsubscript{dry})</th>
<th>Average Pollutant Content (mg/kg\textsubscript{dry})</th>
<th>Number of Measurements (&gt; non-detect)</th>
<th>Standard Deviation (mg/kg\textsubscript{dry})</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cadmium</td>
<td>20</td>
<td>0.41</td>
<td>2</td>
<td>0.0</td>
</tr>
<tr>
<td>Chromium</td>
<td>400</td>
<td>121</td>
<td>12</td>
<td>62.2</td>
</tr>
<tr>
<td>Copper</td>
<td>600</td>
<td>519</td>
<td>12</td>
<td>152.9</td>
</tr>
<tr>
<td>Lead</td>
<td>200</td>
<td>32.6</td>
<td>12</td>
<td>6.1</td>
</tr>
<tr>
<td>Mercury</td>
<td>5</td>
<td>N/D</td>
<td>0</td>
<td>--</td>
</tr>
<tr>
<td>Nickel</td>
<td>90</td>
<td>109</td>
<td>12</td>
<td>26.3</td>
</tr>
<tr>
<td>Zinc</td>
<td>2,500</td>
<td>2,738</td>
<td>12</td>
<td>512.6</td>
</tr>
</tbody>
</table>
Variable Metals Concentrations Impact Disposal Options
## Economic Sensitivity Analysis

<table>
<thead>
<tr>
<th>Alternative</th>
<th>Master Plan 20-Year Net Present Cost</th>
<th>Updated 20-Year Net Present Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alt 2 – Thermal Drying</td>
<td>NIS 443,880,000</td>
<td>NIS 342,480,000</td>
</tr>
<tr>
<td>Alt 3 – Thermal Hydrolysis</td>
<td>NIS 239,290,000</td>
<td>NIS 227,680,000</td>
</tr>
<tr>
<td>Alt 5 – Pre Pasteurization</td>
<td>NIS 284,940,000</td>
<td>NIS 292,850,000</td>
</tr>
</tbody>
</table>

![Graph showing economic sensitivity analysis](image)
## Summary of Solids Upgrades

<table>
<thead>
<tr>
<th>Process</th>
<th>Upgrade(s)</th>
<th>Phasing/Timing</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Thickening</strong></td>
<td>Replace 2 GBTs</td>
<td>Phase 1C</td>
</tr>
<tr>
<td></td>
<td>Replace 1 GBT</td>
<td>Phase 3</td>
</tr>
<tr>
<td><strong>Co-Thickening</strong></td>
<td>Replace 3 GBTs</td>
<td>Phase 1C</td>
</tr>
<tr>
<td></td>
<td>Replace 1 GBT</td>
<td>Phase 3</td>
</tr>
<tr>
<td><strong>Digestion</strong></td>
<td>To be determined – no sooner than Phase 3</td>
<td>Dependent on decision: Class A vs Class B, desired gas production</td>
</tr>
<tr>
<td><strong>Dewatering</strong></td>
<td>Class A: discontinue use of BFPs</td>
<td>Class A: in conjunction with dryer implementation</td>
</tr>
<tr>
<td></td>
<td>Class B: None required</td>
<td>Class B: Not applicable</td>
</tr>
<tr>
<td><strong>Thermal Drying</strong></td>
<td>Installation of belt or drum drying technology potentially followed by gasification in the future</td>
<td>Unknown at this time, may be required in the next several years, pending composting facility availability and regulations</td>
</tr>
</tbody>
</table>
Haifa – Lessons Learned

• Economic analysis can’t be the only factor

• Conditions change and solutions need to be flexible

• There is inherent value in retaining control

• Cannot ignore needs for addressing existing infrastructure
F. Wayne Hill WRF, Gwinnett County, GA
This involved a comprehensive look into their whole process for a synergistic solution.
Pending new CHP system was to be added for beneficial use of digester gas.
… but the plant was “short” on digester gas production to meet maximum value solution.
Field testing confirmed a 50% increase in clarifier TSS removal from 31% to 48% after baffle installed.

<table>
<thead>
<tr>
<th>Primary Clarifier</th>
<th>% TSS Removal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary 9 – Baffle Installed</td>
<td>48%</td>
</tr>
<tr>
<td>Primary 10 – As Is</td>
<td>31%</td>
</tr>
</tbody>
</table>
Digester gas production rates increased with increased primary sludge to digestion.
Other opportunities were also identified during the primary clarifier optimization study.

- BioWin calibration and special sampling verified “true” loadings much lower helping “capacity crisis”
- Improved primary clarifier performance reduced loads to secondary process
- Digesters were still short on capacity
- Recommended co-thickening to 5.5% on RDTs replacing high energy WAS thickening centrifuges
DG2E facility generates 2.1MW output power and saves over $1MM per year in purchased power.
FOG/HSW receiving added for co-digestion of select streams to boost gas production.
Construction underway for installation of on-site struvite recovery system using WASSTRIP
Lessons Learned from F. Wayne Hill

• A “digester problem” likely does not end at the digesters

• Strict discharge requirements can drive improvements throughout the facility

• Sometimes simple is best

• Innovative solutions also have their place
What Can Your Utility do to Plan for the Future?
There are lots of factors to consider in making plans for the future and each utility is unique.
There are no “cookie cutter” solutions that will “fit” each and every situation… except maybe…

• Generally, moving to higher levels of biosolids stabilization will cost you more…

• Some technologies can recover marginal capital costs (e.g., co-generation, struvite harvesting, Co-Digestion of FOG/HSW, etc.)

• Holistic solutions can be cheaper than silo solutions.
Questions?

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WERF Research
Operational Impacts of Co-Digestion

- Survey nearly ready for distribution
- Looking for utilities in any stage of co-digestion planning or implementation
- Report expected in late 2015 or early 2016

Send an email to mvanhorne@hazenandsawyer.com to get early notification of the survey!