Traverse City Regional Wastewater Treatment Plant
Membrane Technology

City Commission and Grand Traverse County Board of Public Works Joint Study Session
December 9, 2013
Agenda

- Background
- Current situation
- Recommendations
- Discussion
Background

- CH2M Hill has operated the Traverse City RWWTP since 1990
- Plant was converted to membrane bioreactor (MBR) process:
  - To increase capacity (based on flow projections)
  - To improve effluent quality (new discharge limits)
  - To fit within existing fence line (maintain adjacent park and defer construction on separate site)
- Began producing high-quality, membrane-filtered effluent July 2004
- Largest MBR facility in North America at the time (now #15)
- Excellent record of discharge permit compliance
Current Situation

- Typical membrane life
  - 8-10 years
  - End of life is not reached suddenly – potting failure and/or gradual increase in pressure and chemical cleaning requirement

- TCRWWTP membranes
  - Approaching 10 years of service
  - Plant is operating at 60% of design capacity
  - Historical low operating flux and gentle cleaning could extend membrane life
  - However, stainless steel cassettes are showing wear and have been repaired

- Episodes of impaired membrane productivity
  - Not reported elsewhere - apparently unique to TCRWWTP
  - Cause and prevention uncertain - actively being studied
  - Unpredictable - risk of not being able to process flow as quickly as it arrives

Michael Richard, PhD wrote, “The Gram positive commas were not in the flocs, but dispersed and in clump... These cause membrane plugging because of their small size, dispersed nature and positive charge...”
Recommendations

- Mitigate risk of impaired membrane productivity:
  - As soon as practical, install new membranes (modules and cassettes) in one membrane train
  - Redistribute membranes cassettes from that train to available spaces in the other trains (no waste of residual membrane life)
  - Increased membrane area (reduced flux) will allow more flow to be processed during impaired productivity events
  - Assess whether membrane age is a factor

- Monitor membrane performance and replace membranes in other trains on an as-needed basis

- Budget for replacement of membranes in other trains (half in 2015 and half in 2016)
Membrane Replacement

- ZENON 500C membranes currently installed (500C32M)
- General Electric (GE) purchased ZENON in 2006
- GE uses 500D membranes for its latest designs
  - Will not manufacturer 500C membranes indefinitely; expectation is 2 to 4 more years
  - Standard 500D48M cassette will not fit at TCRWWTP
  - However, short 500D modules in smaller cassettes will fit

1-1/2 of these (500D16M + 500D8M) fill the space of one existing 500C32M cassette
Membrane Replacement Options

- Install new 500D membranes and cassettes in one train
  - $825,000 per train
  - **Recommended** because this achieves goal of adding membrane area
  - Once 500D cassettes are installed, subsequent module replacement without cassette frames would cost ~$740,000 per train (preliminary estimate)

- Install new 500C membranes in existing cassette frames
  - $650,000 per train
  - **Not recommended** because this would not increase installed membrane area, and existing cassettes are showing wear

- Install new 500C membranes and cassettes
  - ~$725,000 per train (preliminary estimate)
  - **Not recommended** because subsequent membrane module replacement likely would require new frames (would be investing in soon-to-be obsolete cassette hardware)
## Membrane Cost Increase Since Original Installation
(New 500C Modules in Existing Cassette Frames)

<table>
<thead>
<tr>
<th>Item</th>
<th>2002</th>
<th>2013</th>
</tr>
</thead>
<tbody>
<tr>
<td>Canadian Consumer Price Index</td>
<td>100.0</td>
<td>123.1</td>
</tr>
<tr>
<td>Membrane modules</td>
<td>$377,700</td>
<td>$465,000</td>
</tr>
<tr>
<td>Warranty (2 years)</td>
<td></td>
<td>$9,600</td>
</tr>
<tr>
<td>Hoses &amp; miscellaneous parts</td>
<td></td>
<td>$30,600</td>
</tr>
<tr>
<td>GE services</td>
<td></td>
<td>$90,000</td>
</tr>
<tr>
<td>SUBTOTAL</td>
<td>$595,200</td>
<td></td>
</tr>
<tr>
<td>Local sales tax @ 6%</td>
<td></td>
<td>$36,000</td>
</tr>
<tr>
<td>CH2M Hill services</td>
<td></td>
<td>$10,000</td>
</tr>
<tr>
<td>Used module disposal</td>
<td></td>
<td>$5,000</td>
</tr>
<tr>
<td>TOTAL (rounded)</td>
<td></td>
<td>$650,000</td>
</tr>
</tbody>
</table>