Presentation Overview

• Project Status and Schedule

• Overview of Veolia’s BIOSTYR BAF

• Summary of Preliminary Design Recommendations
Project Status and Schedule

Project Status:
• Preliminary Design: End of August, 2013

Project Schedule:
• Detailed Design and Approvals: End of December, 2013
• Tendering: December, 2013 to mid-February, 2014
• Construction: April 1, 2014 to March 31, 2016 (24 months)
What is a BAF?
Overview of Veolia’s BIOSTYR BAF

• High-Rate (efficient, 30 to 35% footprint of Conventional Activated Sludge)

• Proprietary Technology

• Fixed-Filmed Treatment Process

• BAF means:

   B - Biological (relies on “nature” and microorganisms)

   A - Aerated (to sustain microorganisms in an oxygenated environment)

   F - Filter (filters out particulate matter, similar to a pool filter)
Biological Aerated Filter (BAF) Overview

Media size varies from 3.6 mm or 4.0 mm diameter and larger
BIOSTYR Components
BIOSTYR BAF (Veolia)
BAF – Cell Interior
Design Drivers for BAF Cell Sizing

- Hydraulic Loading (Flow Conditions):
  - Average Day
  - Peak Day
  - Peak Hour

- Organic Loading (mass of contaminants in the influent)

- Effluent Requirements:
  - Monthly Average Limits (industry-standard)
  - Single Sample Limits (not industry-standard)
# Table 1: Plant Effluent Compliance Criteria (at end of discharge pipe)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Effluent Criteria (1)</th>
<th>Basis</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>Non-Freezing</strong></td>
<td>Freezing (2)</td>
</tr>
<tr>
<td>cBOD$_5$ (mg/L)</td>
<td>15 (20)</td>
<td>15 (20)</td>
</tr>
<tr>
<td>TSS (mg/L)</td>
<td>15 (20)</td>
<td>15 (20)</td>
</tr>
<tr>
<td>TP (mg/L)</td>
<td>0.8 (1.0)</td>
<td>1.0 (2.0)</td>
</tr>
<tr>
<td>TAN (mg/L)</td>
<td>3 (5)</td>
<td>5 (8.0)</td>
</tr>
<tr>
<td>DO (mg/L) (4)</td>
<td>(&gt;5.0)</td>
<td>(&gt;5.0)</td>
</tr>
<tr>
<td>E. coli (counts/100 mL) (4)</td>
<td>200 (1000)</td>
<td>-</td>
</tr>
</tbody>
</table>

Notes:
1. Bracketed values represent single sample compliance values
2. Freezing represents the period when Bay surface temperatures are below 5 degrees C, typically from December 1 – April 30.
Pre-Construction MOE Consultation (June 20, 2013)

- Single-sample non-compliance criteria is no longer Ministry practice
- MOE agrees to remove single-sample non-compliance criteria
- Allows Optimization (i.e. smaller) BAF Cells
- Additional year (3 years in total) of benthic monitoring in Owen Sound Bay after upgrades, additional monitoring cost of approx. $30,000

Recommendation 1: Agree to an additional year of benthic monitoring in lieu of single-sample non-compliance values.
Recommendation 1:

Questions or Comments?
Size and Number of Biological Aerated Filter Cells

- Single-sample non-compliance criteria: significant process ‘sizing’ drivers

- Elimination of single-sample non-compliance allows optimization of BAF (i.e., smaller BAF cells) at lesser cost

- Veolia Biological Aerated Filter Proposal:
  - Base BAF Proposal: six (6) cells at 87 m²; total area = 522 m²
  - Alternate BAF Proposal: six (6) cells at 65 m²; total area = 390 m²

  $\$800K - $1M cost savings
BAF Sizing Options
(87 m² vs. 65 m²)

OWEN SOUND PROPOSED
BAF CELL FOOTPRINT
3 x 4 NOZZLE SLABS 87 m²

OWEN SOUND OPTIMIZED
BAF CELL FOOTPRINT
3 x 3 NOZZLE SLABS 65 m²
Factor of Safety (FOS) and Sizing Implications

Non-Proprietary Technology such as Conventional Activated Sludge:

- “Regulatory FOS” through MOE Licensing Process: Managed through Effluent and Design Objectives

Proprietary Technology such as BAF:

- “Regulatory FOS” through MOE Licensing Process: Managed through Effluent and Design Objectives

And/Or

- “Commercial FOS” through Contracting Process: Managed through a Performance Guarantee and Performance Bond
Factor of Safety (FOS) and Sizing Implications (cont’d)

• Commercial FOS AND Regulatory FOS require larger cells
  • Very high effluent quality
  • Substantially exceeds MOE requirements
  • However, entails a premium cost

• Commercial FOS OR Regulatory FOS leads to optimized/smaller cells
  • Excellent effluent quality
  • Exceeds MOE requirements
  • Optimized cost
## Factor of Safety – Other Ontario Veolia BAF’s

<table>
<thead>
<tr>
<th>Veolia BAF’s in Ontario</th>
<th>Commercial FOS AND Regulatory FOS</th>
<th>Commercial FOS OR Regulatory FOS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kingston’s $115 Million Ravensview WWTP Upgrades (2006-2009)</td>
<td>TSS cBOD$_5$ TAN</td>
<td></td>
</tr>
<tr>
<td>Cornwall’s $55 Million WWTP Upgrades (2012-2014)</td>
<td>TSS cBOD$_5$ TAN</td>
<td></td>
</tr>
<tr>
<td>Owen Sound’s $45 Million WWTP Upgrades (2014-2016) – Base Option</td>
<td>TSS cBOD$_5$ TAN</td>
<td></td>
</tr>
<tr>
<td>Owen Sound’s $45 Million WWTP Upgrades (2014-2016) – Proposed Optimized Option</td>
<td>TAN (consistent with MOE’s expectations)</td>
<td>TSS cBOD$_5$</td>
</tr>
</tbody>
</table>
Kingston Ravensview BAF Performance Verification

- Performance Verification after commissioning
- September 2009 to August 2010
- Assess BAF effluent quality at rated capacity “equivalency”

<table>
<thead>
<tr>
<th>Parameter</th>
<th>MOE Criteria Limit</th>
<th>Design Objective and Performance Guarantee Requirement</th>
<th>Effluent Quality during Verification Program</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemical Biological Oxygen Demand (mg/L)</td>
<td>25</td>
<td>15</td>
<td>2.0</td>
</tr>
<tr>
<td>Total Suspended Solids (mg/L)</td>
<td>25</td>
<td>15</td>
<td>4.0</td>
</tr>
<tr>
<td>Total Ammonia Nitrogen (mg/L)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Summer</td>
<td>Non-Toxic</td>
<td>5.0</td>
<td>2.1</td>
</tr>
<tr>
<td>Spring/Fall</td>
<td>Non-Toxic</td>
<td>7.0</td>
<td>3.0</td>
</tr>
<tr>
<td>Winter</td>
<td>Non-Toxic</td>
<td>12.0</td>
<td>2.0</td>
</tr>
</tbody>
</table>

Well below MOE Criteria Limit and Performance Guarantee
Ravensview WWTP Performance Verification
Performance Guarantee tied to Design Objectives
# Performance Guarantee for 87 m² Cells versus 65 m² Cells

## Parameters

<table>
<thead>
<tr>
<th>Parameters</th>
<th>87 m² Cells (Performance Guarantee)</th>
<th>65 m² Cells (Performance Guarantee)</th>
<th>MOE Effluent Limits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Annual Average Day Flow to BAF</td>
<td>24.5 MLD</td>
<td>24.5 MLD</td>
<td></td>
</tr>
<tr>
<td>Peak Day Flow to BAF</td>
<td>65 MLD</td>
<td>65 MLD</td>
<td></td>
</tr>
<tr>
<td>Peak Hour Flow to BAF</td>
<td>82.5 MLD</td>
<td>82.5 MLD</td>
<td></td>
</tr>
<tr>
<td>BAF Media Size</td>
<td>3.6 mm</td>
<td>4.0 mm</td>
<td></td>
</tr>
<tr>
<td>Total Suspended Solids</td>
<td>10 mg/L¹</td>
<td>15 mg/L²</td>
<td>15 mg/L</td>
</tr>
<tr>
<td>Carbonaceous Biochemical Oxygen Demand</td>
<td>10 mg/L¹</td>
<td>15 mg/L²</td>
<td>15 mg/L</td>
</tr>
<tr>
<td>Total Ammonia Nitrogen (Summer)</td>
<td>2.0 mg/L¹</td>
<td>2.0 mg/L¹</td>
<td>3.0 mg/L</td>
</tr>
<tr>
<td>Total Ammonia Nitrogen (Winter)</td>
<td>4.0 mg/L¹</td>
<td>4.0 mg/L¹</td>
<td>5.0 mg/L</td>
</tr>
<tr>
<td>Total Phosphorous</td>
<td>0.5 mg/L¹</td>
<td>0.8 mg/L</td>
<td>1.0 mg/L</td>
</tr>
<tr>
<td># Cells in Operation at Peak Hour Flow</td>
<td>5</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td># Cells Available for Backwash at Peak Hour Flow</td>
<td>1</td>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>

1. MOE Design Objectives
2. MOE Compliance Limits
3. Majority of Phosphorous removal will continue through chemical addition and the primary clarifiers.
Draft Contractual Performance Guarantee

- Performance Guarantee would be modified for the smaller BAF cells

<table>
<thead>
<tr>
<th>Parameters</th>
<th>MOE Effluent Limits</th>
<th>Original 87 m² cells¹</th>
<th>Optimized 65 m² cells²</th>
<th>Effluent Quality Objective (Optimized 65 m² cells)³</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Suspended Solids</td>
<td>15 mg/L</td>
<td>10 mg/L</td>
<td>15 mg/L</td>
<td>12 mg/L</td>
</tr>
<tr>
<td>Chemical Biological Oxygen Demand</td>
<td>15 mg/L</td>
<td>10 mg/L</td>
<td>15 mg/L</td>
<td>12 mg/L</td>
</tr>
<tr>
<td>Total Ammonia Nitrogen (Summer)</td>
<td>3.0 mg/L</td>
<td>2.0 mg/L</td>
<td>2.0 mg/L</td>
<td>1.6 mg/L</td>
</tr>
<tr>
<td>Total Ammonia Nitrogen (Winter)</td>
<td>5.0 mg/L</td>
<td>4.0 mg/L</td>
<td>4.0 mg/L</td>
<td>3.2 mg/L</td>
</tr>
</tbody>
</table>

1. Exceeding any of these values for 60 consecutive days would trigger a mandatory joint assessment
2. Exceeding any of the monthly average requirements for **one month or longer** without returning to normal operation would trigger a mandatory joint assessment
3. Exceeding any of the monthly average requirements for **one month** would trigger consultation and a follow-up joint assessment, if warranted

Acceptable to Veolia from a commercial/contracting perspective; technical confirmation pending. Based on discussions to date, final concurrence anticipated within a few weeks.
Size and Number of Biological Aerated Filter Cells – Risk Management

<table>
<thead>
<tr>
<th>Risk Level</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>highest risk</td>
<td>Option A: six @ 65 m² cells with monthly average <strong>and</strong> single-sample non-compliance requirements</td>
</tr>
<tr>
<td>relatively high risk</td>
<td>Option B: six @ 87 m² cells with monthly average <strong>and</strong> single-sample non-compliance requirements</td>
</tr>
<tr>
<td>relatively low risk</td>
<td>Option C: six @ 65 m² cells with monthly average requirements but <strong>no</strong> single-sample non-compliance limits</td>
</tr>
<tr>
<td>lowest risk</td>
<td>Option D: six @ 87 m² cells with monthly average requirements but <strong>no</strong> single-sample non-compliance limits</td>
</tr>
</tbody>
</table>

Recommendation 2: Option C - six cells at 65 m²

Our recommendation is based on the following considerations:

- Acceptable to Veolia who is providing Performance Guarantee and Performance Bond
- Total Ammonia Nitrogen will be below the MOE requirements, consistent with MOE’s expectations
- City Operations supports this recommendation
- Backwash process will be automated through process instrumentation and controls
- Compliance requirements will be based strictly on monthly average limits
- Current average day flows are approximately 50% of the BAF average day capacity
Recommendation 2:

Questions or Comments?
BAF Location

• West along Waterfront

or

• East along 3rd Avenue East

• Key Considerations:
  • Geotechnical
  • Dewatering
  • Risk
  • Aesthetics
  • Capital Cost
Location of Biological Aerated Filters ‘BAF East’
Geotechnical and Hydrogeological Assessments

• Boreholes and Test Pits: 28 locations
• Groundwater Monitoring: 5 locations
• Soil Quality Analysis: 12 samples (6 locations, varying depth)

Provides a good understanding of the site setting and associated challenges.
## Key Findings

<table>
<thead>
<tr>
<th></th>
<th>BAF West</th>
<th>BAF East</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bedrock Elevation</td>
<td>15 to 30 m below surface and sloping at 18 degrees</td>
<td>2.5 to 5 m below surface</td>
</tr>
<tr>
<td>Foundation</td>
<td>Deep Piling to Rock</td>
<td>Engineered fill and directly into or on rock</td>
</tr>
<tr>
<td>Groundwater</td>
<td>Extensive requiring well point Vacuum System, area hydraulically connected to Owen Sound Bay (through sandy silt layer)</td>
<td>Minor to moderate requiring conventional sump pumping techniques</td>
</tr>
</tbody>
</table>
**Key Findings**

<table>
<thead>
<tr>
<th></th>
<th>BAF West</th>
<th>BAF East</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Temporary Sheet Piling</strong></td>
<td>Extensive to maintain stability of existing piles under clarifiers, prevent basal heave and limit groundwater inflow</td>
<td>Minimal, if any</td>
</tr>
<tr>
<td><strong>Potential for Contaminated Soils</strong></td>
<td>Minimal</td>
<td>Some anticipated; disposal at registered sites or non-hazardous landfill</td>
</tr>
<tr>
<td><strong>Seismic Site Class</strong></td>
<td>Class ‘E’ – very difficult to achieve, requires battered piles at an angle for lateral bracing</td>
<td>Class ‘C’ – typical and relatively straightforward to achieve</td>
</tr>
</tbody>
</table>
Piling on sloping bedrock presents challenges that could result in unforeseen costs.

Seismic design would require ‘battered piles’ (at an angle to provide lateral bracing) to increase pile stability during an earthquake.
Basal Heave – BAF West
Sheet Piles & Well Point System – BAF West
3D Model (Refer to PDF File)
Opinion of Probable Cost (excl. HST) – East vs. West

• BAF East (65 m² cells): $47.773 Million
  (incl. $300,000 for contaminated soil management and disposal)

• BAF West (65 m² cells): $47.827 Million
  (incl. $3,500,000 for piling)

Note: OPC’s presented above include UV disinfection and 2nd digester.
Location of Biological Aerated Filters ‘BAF East’

Additional costs with ‘BAF East’ essentially equal piling cost for ‘BAF West’:

- Demolish existing Administration Building and old Digester Complex
- Digester Complex to house new boilers
- Relocate transformers and new generator
- Approximately 20% of soil to be excavated may be contaminated
- Engineered fill required to bedrock
- Limited rock removal required
- Extended process piping for BAF influent and effluent
- Temporary facilities required (staff office trailers, Chlorine Building)
Excavation Volumes – Cut & Fill Balance (Assuming BAF East)

• Total Excavation: 22,250 m³
  (95% soils, 5% rock)

• Total Fill: 10,750 m³
  (various berms)

• Net Excess: 11,500 m³
  of which:
  – Rock: 850 m³
  – “Clean/Re-Useable”: 9,000 m³
  – “Contaminated”: 1,650 m³
    (20% of BAF excavation)

• Soil Quality Analysis: 12 samples
  (6 locations, varying depth)
### BAF West vs East – Risk that Unforeseen Challenges May Arise during Construction

<table>
<thead>
<tr>
<th>Risk Category</th>
<th>BAF West ($47.827 Million)</th>
<th>BAF East ($47.773 Million)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Foundation Piling</td>
<td>High, due to sloped bedrock</td>
<td>None</td>
</tr>
<tr>
<td>Sheet Piling to Control Groundwater, Basal Heave and Stability of Existing Wood Piles</td>
<td>High</td>
<td>Minimal</td>
</tr>
<tr>
<td>Potential for Contaminated Soils</td>
<td>Low</td>
<td>Medium</td>
</tr>
<tr>
<td>(1,650 m³, 7.5% of total excavation, 20% of BAF)</td>
<td></td>
<td>(1,650 m³, 7.5% of total excavation, 20% of BAF)</td>
</tr>
<tr>
<td>Potential for Claim/Litigation</td>
<td>Possible and could be significant</td>
<td>Deemed to be less than BAF West</td>
</tr>
<tr>
<td>Potential for Delays or Unforeseen Costs</td>
<td>Possible and could be significant</td>
<td>Deemed to be less than BAF West</td>
</tr>
</tbody>
</table>
Location of Biological Aerated Filters
‘BAF East’ - Advantages

- Risk associated with piling and dewatering is greatly reduced
- Seismic performance is improved
- Operation and Maintenance of “old” buildings along street no longer required
- Improved aesthetics along the streetscape
- Improved aesthetics along the waterfront

Recommendation 3: Implement BAF east of the existing primary clarifiers, along 3rd Ave East.
Recommendation 3:

Questions or Comments?
Replacement of Existing Screens: Background

- High wet weather flow event (once, maybe twice per year)
- Water can rise above channels and the screen retracts if motor is submerged for too long = unscreened sewage
- Risk to BAF operation and ‘Performance Guarantee’ (requires 12 mm continuous screening)
### Replacement of Existing Screens: Options

<table>
<thead>
<tr>
<th>OPTION</th>
<th>OPC (excl. Contractor Mark-ups &amp; Eng.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. New Screening Facility Upstream of BAF</td>
<td>$2 Million</td>
</tr>
<tr>
<td>2. Increase Raw Sewage Pumping Instantaneous Flow Capacity</td>
<td>$300 to $400K</td>
</tr>
<tr>
<td>3. Limit the Flow Entering the Screening Building</td>
<td>$150K</td>
</tr>
<tr>
<td>4. Add Bypass Pumping</td>
<td>$400 to $800K</td>
</tr>
<tr>
<td>5. Retrofit Existing Screens</td>
<td>$550K</td>
</tr>
</tbody>
</table>

**Recommendation 4:** Replace existing screens with two (2) new screens; less costly options have a measurable and unacceptable operational & performance risk.
Recommendation 4:

Questions or Comments?
Berming on the Adjacent Property to the North

- Creation of a landscaped feature between the plant and anticipated development to the north for visual screening purposes
- Opportunity to use approximately 6,000 m$^3$ of excess fill on-site in a cost-effective manner, thereby avoiding off-site hauling and disposal cost in the order of $80,000 to $120,000

Recommendation 5: Council to confirm that design is to proceed based on implementation of landscaped berm on adjacent property to the north.
Recommendation 5:

Questions or Comments?
## Summary of Recommendations

<table>
<thead>
<tr>
<th>Project Issue</th>
<th>JLR Recommendation</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Additional year of post construction benthic monitoring in lieu of single sample non-compliance effluent requirements</td>
<td>Proceed with the additional year of monitoring</td>
</tr>
<tr>
<td>B. Size and number of Biological Aerated Filters Cells</td>
<td>6 cells at 65 m² as opposed to the originally proposed 6 cells at 87 m²</td>
</tr>
<tr>
<td>C. Location of the Biological Aerated Filter Facility</td>
<td>East of the existing primary clarifiers</td>
</tr>
<tr>
<td>D. Replacement of the Existing Screens</td>
<td>Replace existing screens and modify channel</td>
</tr>
<tr>
<td>E. Berm on the Adjacent Property to the North</td>
<td>Council to confirm that design is to proceed accordingly</td>
</tr>
</tbody>
</table>
Thank You

Questions?