Background [1,4]
The client is a large food manufacturer that pretreats their wastewater onsite before sending it to a municipal wastewater treatment plant. Currently, the wastewater treatment system uses two technologies: Moving Bed Biofilm Reactor (MBBR) and Dissolved Air Flocculation and Filtration (DAFF). Sludge produced from this system is hauled away via a tanker truck daily. The client has a pre-treatment permit which is regulated by publicly owned treatment works and the system is hauled away via a tanker truck daily. The client pays an additional $30,000 per year for an increase in odor, the ROI, complexity, and size (footprint). Weights for importance were determined for discussions with the client. The top-rated designs were real-time monitoring, isolating MBBR tanks, and dewatering sludge.

Objectives & Constraints
The client wanted to investigate opportunities for cost reduction within their wastewater treatment facility. The main objectives for this project are:

- Reduce sludge hauling cost by 15%
- Meet a Return on Investment (ROI) of 20% for the total cost of the system

Constraints for this project were discussed with the client and deemed most important. They are as follows:

- No change to current manufacturing process
- Equipment footprint (<5 acres)
- Prevent any increase in odor
- Prevent wastewater characteristics from exceeding permit limitation

### Table 1. Pretreatment permit

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Units</th>
<th>Apr 1-Oct 31</th>
<th>Nov 1-Mar 31</th>
</tr>
</thead>
<tbody>
<tr>
<td>A mg/L</td>
<td>300</td>
<td>300</td>
<td>--</td>
</tr>
<tr>
<td>B mg/L</td>
<td>350</td>
<td>350</td>
<td>--</td>
</tr>
<tr>
<td>C mg/L</td>
<td>10</td>
<td>10</td>
<td>--</td>
</tr>
<tr>
<td>D mg/L</td>
<td>32</td>
<td>62.4</td>
<td>--</td>
</tr>
<tr>
<td>E standard</td>
<td>--</td>
<td>7.00 min 9.25 max</td>
<td>7.00 min 9.25 max</td>
</tr>
</tbody>
</table>

Real-Time Monitoring
Real-time monitors can be utilized to determine what components are in wastewater. The client currently has monitors in place to record some characteristics, but components like Characteristic A (seen in Table 1) cannot be measured in real-time. A solution to this problem is to implement a monitor for Characteristic H and find its relationship to Characteristic A. Knowing the components of wastewater results in the ability to better treat the water with equalization.

MBBR Tank Insulation [2]
Insulation would keep the tanks at a higher temperature, yielding a better removal rate of Characteristic D and has the potential to remove the $30,000 increase winter discharge payment. Implementing this alternative would not save enough money to meet the objectives of this project but is still recommended to increase treatment efficiency and keep up with stricter permit regulations in the future.

Dewatering
Dewatering equipment is used to separate solid material from liquid. Installing dewatering equipment at this facility would be used to further separate out liquids from waste. Liquid waste disposal is the highest expense at this wastewater treatment facility. Using dewatering equipment would reduce the volume of waste produced, reducing the required daily disposal to four times per week. This results in a reduction in waste disposal cost.

### Design Alternatives
The WasteWatchers investigated nine (9) design alternatives. Five (5) design alternatives, including a real-time monitoring system, insulating MBBR tanks, dewatering sludge, a vertical sub surface flow wetland, and only utilizing one MBBR tank, were evaluated.

Components that were considered include safety, potential to violate the permit, presenting an increase in odor, the ROI, complexity, and size (footprint). Weights for importance were determined for discussions with the client. The top-rated designs were real-time monitoring, isolating MBBR tanks, and dewatering sludge.

### Selected Design

#### Disk Screw Press [3]
Initial dewatering equipment considered were the disk screw press, membrane filtration, centrifuge, and filter press. To determine the best dewatering equipment, components such as sludge disposal cost reduction, potential odor issues, safety, and required maintenance were considered. This resulted in the best design being the disk screw press.

A disk screw press utilizes disks and an internal screw. This screw rotates at a very low speed keeping the waste moving through the device. The disks are stacked together with small spaces between, trapping the solid material inside and allowing the liquid to separate out.

### Conclusion
For this project, the final recommended design is the disk screw press. The client should also consider implementing real-time monitoring and isolating the MBBR tanks to improve the overall efficiency of the system.

### Economics & Conclusion

#### Economic Analysis
For the economic analysis, capital costs and recurring costs were collected from the client, representatives at Trident, HUBER, Industrial Waste Recovery, and Evoqua.

<table>
<thead>
<tr>
<th>Cost Category</th>
<th>Cost (Year 1)</th>
<th>Cost (Year 2)</th>
<th>Cost (Year 3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Sludge Piping</td>
<td>$15,000</td>
<td>$15,000</td>
<td>$15,000</td>
</tr>
<tr>
<td>Additional Ventilation Fans</td>
<td>$16,000</td>
<td>$16,000</td>
<td>$16,000</td>
</tr>
<tr>
<td>Ventilation Fans Electrical</td>
<td>$6,750</td>
<td>$6,750</td>
<td>$6,750</td>
</tr>
<tr>
<td>Total</td>
<td>$89,750</td>
<td>$89,750</td>
<td>$89,750</td>
</tr>
</tbody>
</table>

Some of the largest costs come into play with the additional equipment for odor. Although the ROI is short of the goal of 20%, the client is satisfied because this is a conservative estimate and costs may be reduced resulting in larger savings.

### References