Customer Problem
LFG Operators commonly use orifice plate flowmeters in landfill gas collection wellheads to measure flow at individual gas collection wells. Handheld meters are used to measure differential pressure, upstream and downstream of the orifice plate. Depending on orifice plate diameter and wellhead pipe inner diameter, standard equations derived three hundred years ago by Daniel Bernoulli are used to calculate flow.

However, the accuracy of these devices is dependent on several critical factors, often overlooked by LFG operators:

1. **Water:** Orifice plate flow meters are designed to work for single phase gas flow. Landfill gas collection wells, which produce extensive amounts of water or other liquids, create significant errors in flow measurement accuracy. Since liquids can collect on the downstream side of the orifice plate, pressure readings are impacted and error from mixed liquid/gas flow can exceed 20%.

2. **Orifice Plate size and geometry:** Using the correct orifice plate size to calculate flow is also critically important. If an orifice plate which is ¼” smaller or larger than the orifice plate size used in the flow calculations, the error in the flow measurement will exceed 25%.

3. **Location of the pressure ports:** Small variations in location of the pressure ports used to measure pressure drop across the orifice plate can create large errors in flow measurement. For example, if the pressure port located downstream of the orifice plate is ½” further downstream from well head to well head, the error in flow measurement of a well flowing 50 scfm will be nearly 20% (Table 1).

Loci Solution
Although it is possible to achieve accurate flow measurement with single phase gas flow using an orifice plate flow meter in a landfill gas collection well, several critical conditions are required in order for the orifice plate flow meter to provide accurate results. As an alternative to the OP flow meter, Loci recommends a novel flow meter based on the Venturi principle. The Flo-Wing® gas Venturi Flow meter, was developed by Energyneering Solutions, Inc., Bend, Oregon, (US Patent #8,528,420) and thousands of these devices have been in use in the landfill gas collection industry for more than 5 years. Due to improved accuracy and simplicity in LFG gas flow measurement, each Loci Controller and Guardian built after July 1, 2018 will include the Flo-Wing® Venturi flow meter as a standard component. Benefits of the Flo-Wing® are numerous and include:

- One size fits all – no moving parts, seals, or different orifice plate selection
- 2” Flo-Wing® accurately measures 2.5 - 95 scfm; 3” model 60 - 200 scfm
- No trapping of water on downstream or upstream side of orifice plate, improving accuracy in flow measurement on wells with significant liquid collection
- More compact and less pressure drop due to the “wing” configuration
- Accuracy of ± 2% from 0 – 95 (2” wellheads) or 60 – 200 scfm (3” wellheads)
- No change necessary to LFG wellheads, Flo-Wing® flow meter is integral to Loci product

WHY LOCI CONTROLS?
With financial, operational, environmental, health, and safety benefits, Loci Controls’ products and services help optimize facility management and gas collection for operators and landfill owners alike.

INCREASE REVENUE
Maximize methane flow
Control N₂ in the wellfield
Automated valve adjustments
Better collection system efficiency
Reduce plant downtime

INCREASE PRODUCTIVITY
For both plant and employees
Lower labor costs for wellfield tuning and O&M
Reduce plant maintenance costs

REDUCE ENVIRONMENTAL HEALTH & SAFETY RISKS
Reduce man hours spent in wellfield
Reduce fugitive gas emissions
Reduce odors

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**Figure 1: High accuracy of Flo-Wing® over broad flow range**

Shows experimental data comparing the flow measured using a 2" Flo-Wing®, compared to a U.S. government NIST traceable laminar flow element for flows up to 95 scfm. The Flo-Wing® produced results within ±2% versus flow calculated with the NIST traceable flow element.

**Figure 2: Flo-Wing® integrated into Loci units**

Illustrates the 2" Flo-Wing® installed as part of Loci’s Controller or Guardian Unit.

**Table 1:** Summarizes the error introduced in Orifice Plate Flow measurement caused by incorrect downstream pressure port location. This source of error is eliminated with the Flo-Wing®.

<table>
<thead>
<tr>
<th>2&quot; wellhead</th>
<th>ASTM Spec OP Flow Meter</th>
<th>Downstream port 1/4” closer (minus)</th>
<th>Downstream port 1/4” farther (plus)</th>
<th>Downstream port 1/2” farther (plus)</th>
<th>Downstream port 3/4” farther (plus)</th>
<th>Downstream port 1” farther (plus)</th>
<th>Error</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flow (scfm)</td>
<td>50.0</td>
<td>45.2</td>
<td>-10%</td>
<td>54.8</td>
<td>10%</td>
<td>59.5</td>
<td>19%</td>
</tr>
</tbody>
</table>

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