Caisson Wells

An Alternative to Vertical LFG Well Construction

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NSPS 2-Year/5-Year Rule

• Landfills are required to “collect gas from each area, cell, or group of cells in the landfill in which the initial solid waste has been placed for a period of 5 or more years if active; or 2 years or more if closed or at final grade.”

• Installation of GCCS components in active fill areas occurs after waste placement, requires continuous drilling and repeated replacement of extraction wells and header pipelines due to destruction of collectors in active disposal areas, overfilling and crushing of header pipelines.
Landfill Gas Collectors

- Interim Horizontal Collection Trench
- Traditional Vertical LFG Extraction Well
- Caisson Wells
Interim Horizontal Collection Trench

- Low Cost
- Ease of Installation
- Limited Life
- Air Intrusion
- Pathway for Gas and Liquids
Traditional Vertical LFG Extraction Well

- Drilled on existing slopes (typically), but based on compliance and odors
- Solid pipe used to extend well
- Requires often re-drills or companion wells
- Often damaged during filling operations
- Often watered in, requires pump installation with air and forcemain
Caisson Wells

• Drilled on existing slopes (top down)
• Installed on cell floor (bottom up)
• Does not require re-drills
• Perforated pipe used to extend well
• Caisson protects well from damage
• If installed on drainage layer (bottom up), does not require pumps, air and forcemain lines
Caisson Installation – Drilling (top down)

• Well drilled to depth using typical drilling methods.
• Well casing is set and backfilled with stone.
• Leave about 18-20 feet to ground surface.
Caisson Installation – Drilling (top down)

- Caisson assembly is lowered into the borehole.
- Caisson is backfilled with stone. Outside of caisson is backfilled with soils.
- Care must be taken to center the interior well casing – maintain the stone filter around the perforations.
Caisson Installation – Drilling (top down)

- The slip cap is removed from the well casing and the caisson top assembly is installed.
- The caisson is hooked up to vacuum and the well is operated just like any new well installation.
- Due to their weight, a caisson tends to settle more than a traditional well.
Caisson Raising

- Caisson top assembly is removed.
- Add stone to top of perforated casing.
- Section of perforated pipe is added.
- Caisson assembly is pulled up using an excavator.
- The vacuum lateral riser is raised in the same manner as for a traditional well.
- After the vacuum source and caisson have been raised, the top of the well is re-installed, and the well can be brought back online.
Caisson Raising - Continued
Caisson Installation – (Bottom up)

- Caisson wells can also be installed directly on the cell floor (drainage layer).
- Eliminates the need for drilling and/or re-drilling the well.
- Allows for thorough documentation of the well construction.
- Allows to drain liquids directly on to the drainage layer.
- Eliminates the need for pump installation in the well along with air and forcemain lines.
Caisson Installation – (Bottom up)

- Installed caisson is then periodically raised and perforated pipe extended to accommodate waste placement until well reaches its final elevation.
Caisson Installation – (Bottom up)
Caisson Installation – (Bottom up)
Top–Down or Bottom–up?

- Drilled (Top-Down) Caissons
  - Can install at any point in fill development
  - Can target locations based on landfill-specific conditions
  - Does not tie directly to the LCS

- Bottom-up Caissons
  - Need more pre-planning
  - ID locations before filling begins
  - Does tie directly to the LCS
Cost Analysis

- Traditional Vertical LFG Extraction Well

<table>
<thead>
<tr>
<th>Service</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Traditional Well (60-ft)</td>
<td>$4,254</td>
</tr>
<tr>
<td>Traditional Well Raising (40-ft)</td>
<td>$2,760</td>
</tr>
<tr>
<td>Traditional Well Re-Drill (100-ft)</td>
<td>$7,090</td>
</tr>
<tr>
<td>Total Vertical LFG Extraction Well Cost</td>
<td>$14,104</td>
</tr>
</tbody>
</table>
Cost Analysis

- Caisson Well – Drilled (top down)

<table>
<thead>
<tr>
<th></th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Caisson Well (60-ft)</td>
<td>$9,235</td>
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<tr>
<td>Caisson Well Raising (40-ft)</td>
<td>$6,352</td>
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<tr>
<td><strong>Total Caisson Well Cost (top down)</strong></td>
<td><strong>$15,587</strong></td>
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</tbody>
</table>
Cost Analysis

- Caisson Well – Installed on Cell Floor (bottom up)

<table>
<thead>
<tr>
<th>Description</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Caisson Well Installation</td>
<td>$5,044</td>
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<tr>
<td>Caisson Well Raising (80-ft)</td>
<td>$12,704</td>
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<tr>
<td><strong>Total Caisson Well Cost (bottom up)</strong></td>
<td><strong>$17,748</strong></td>
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</tbody>
</table>
Cost Analysis

• Well Cost Comparison

<table>
<thead>
<tr>
<th></th>
<th>Well Cost</th>
<th>Pump Cost*</th>
<th>Total Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Traditional Vertical LFG Extraction Well</td>
<td>$14,104</td>
<td>$4,280</td>
<td>$18,384</td>
</tr>
<tr>
<td>Caisson Well – Drilled (top down)</td>
<td>$15,587</td>
<td>$4,280</td>
<td>$19,867</td>
</tr>
<tr>
<td>Caisson Well – Installed on Cell Floor (bottom up)</td>
<td>$17,748</td>
<td>$0</td>
<td>$17,748</td>
</tr>
</tbody>
</table>

• Pump Cost* - Assumed one pump installed through life of well, no maintenance costs, replacement costs, air and forcemain costs included
Impact on Landfill Operations/Closing

• More forgiving than vertical well casings
• Relatively quick to raise with on-site equipment (track hoe, operator, 2 laborers)
• Cost comparable with traditional wells
• Should minimize/eliminate the need for liquid pumps in wells, as well as air and force main components
• Like traditional well raising – takes some pre-planning
Questions?

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