Town of Middlebury, VT
Wastewater Force Main
Ice Pigging Project

NEWEA Annual Conference
January 28, 2015
1. Project Background
2. Ice Pigging Technology
3. Middlebury Sewer Forcemain
4. Lessons Learned & Outcomes
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Project Background
In the 1990’s, the Town started planning for abandonment of the original WWTF on Lucius Lane and construction of a new 2.2 mgd WWTF at the north end of Town in the Industrial Park.
History

New sequential batch reactor WWTF placed into operation in 2001.
Old WWTF converted to a Main Pumping Station with about 12,000 lf of new 16” and 18” DI and PVC forcemain to convey wastewater to WWTF.
Main Pumping Station

Screenings building with Lakeside mechanical screen.
Main Pumping Station

Dry pit with three (3) centrifugal pumps. Two pumps operating to provide a peak flow of 6.2 mgd (4,300 gpm).
Main Pumping Station

Reused existing 2 cell wet well.
Problem

✓ Pumps were originally designed to discharge 6.2 mgd. Capacity with two pumps operating had decreased to < 5.0 mgd.

✓ Wet well is undersized with limited operating volume and emergency storage.

✓ During extreme wet weather conditions, the pump station could not keep up with incoming flows and combined sewer overflows (CSO’s) were discharged to Otter Creek.
Investigation

- Study was completed in 2005 to evaluate the wet well, pumping capacity, and forcemain.
- Town staff believed that grit accumulation in wet well and forcemain was primary cause of reduced pumping capacity.
CSO Monitoring

- During Discharge Permit renewal, the Town received a “Condition” that the CSO outfall be monitored through May 31, 2011, to determine compliance with CSO Control Policy.
- Monitoring of rainfall and overflow frequency, duration, and volume started in 2007.

- 5 events recorded
- Maximum flow ranged from 583 to 1,122 gpm.
- Volumes up to 84,000 gallons
CSO Abatement Improvements – Phase I

- Town passed a $1.8 m bond vote in October 2009 which included a $900,000 ARRA subsidy.

- Project included:
  - Wet well expansion
  - Grit removal system
  - Screenings Building upgrades
Next Steps – Phase II

✓ CSO improvements abated overflow and allows for operational flexibility with larger wet well volumes and emergency storage

✓ Town still wanted to return pump station capacity to 6.2 mgd by cleaning forcemain

✓ Alternatives were evaluated for forcemain cleaning
Goals

Middlebury’s goal for cleaning the force main was to:

- Regain the lost pumping capacity
- Improve the pumping efficiency
- Save energy
Ice Pigging Technology
What is Ice Pigging?

An innovative pipe cleaning technology to improve **water quality, flows** and **preventative maintenance**
Why Ice Pigging?

Remove the “crud” build up that impacts water quality and restricts flows.

- BIOFILM, organic matter
- Sediment, debris, sludge, oils & greases
- Iron and Manganese

Benefits

- Improve flow rates
- Reduce pumping costs
- Reduce Residual Demand
- Improve water quality (DBPs)
- Reduce customer complaints (odor, taste, color)

Protect your ASSETS!

- Keep clean & extend life
Traditional Cleaning Techniques

Flushing

Challenges:

• Not enough velocity
• Resource Allocation
• High Water Usage
Traditional Cleaning Techniques

Cleaning devices:
- Pigs
- Swabs

Challenges & Risks:
- Incompatible with pipe bends and changes in diameter
- Requires Excavation
  Excavate to launch and receive pigs
- Customer service affected
  Long interruption to supply
Where is that Pig?
Ice Pigging Advantages:

- Exceptionally low risk
- Low water usage
- 1000x more effective than flushing
- Goes around bends, 90 degrees, butterfly valves
- Adapts to changes in diameter
- Efficient and fast
- Green process
What is the Ice Pig?

- Potable water typically from the utility
- Food grade salt - Typically 5%
- Chlorine for disinfection (customer request only)
- NSF certified
How does Ice Pigging work?

Ice Pigging harnesses the characteristics of a semi-solid material

- An ice pig is a semi-solid material that *can be pumped like a liquid*
- But *behaves like a solid* once the pig is formed in the pipe
Make the ice
Transport the ice
Insert the ice slurry – Ice Pig
Wastewater Connection

- 2” insertion point
- PRVs

Insert the ice slurry – Ice Pig
Field Monitoring

ICE PIGGING

AE Aldrich + Elliott
Project Considerations:

- Map of pipeline with hydrants, valves, & scale to determine pipe lengths
- Pipe diameters and type of pipes
- Water Temperatures
- Ability to isolate mains
- Valve & Hydrant exercising
- Discharge solution – sewer, tanker or land discharge (permits may be required)
- Police or flaggers
- Public notification – water customers
Types & size of pipes:

- Asbestos cement lined
- Cast Iron
- Ductile Iron
- Steel
- PVC
- Plastic
- Sanitary force mains and siphons
- ¾” up to 24” pipe diameter
Water & WW Projects all across the U.S.

- Perry, GA
- Destin, FL
- Smyrna, DE
- Keene, NH
- Middlebury, VT
- Crystal City, MO
- Stokes County, NC
- Alfred, ME
- Jackson, MI
- Tilton, NH
WHEN to use Ice Pigging?

✓ Customer complaints – “dirty water”

✓ Dead ends and low use – water age & buildup

✓ Low Flows – Fe, Mn, organic matter, sediment, sludge, oils & greases…

✓ Losing residual

✓ Impaired Water Quality – turbidity, color, odor, Fe, Mn, BIOFILM, Bacteria hits (TCR)…

✓ Raw water lines

✓ Wastewater – force mains and siphons
Questions?

ICE PIGGING

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Middlebury
Sewer Forcemain
Plan

✓ Engineers at A+E worked with the Town of Middlebury and Utility Service Group to create a schedule and plan for the ice pigging insertion points.

✓ The number and location of insertion points (9) was determined based on the pipe diameter, pipe length and the wastewater temperature to make sure the ice pig slurry would hold together as it traversed each pipe segment.

✓ Use of existing air release /cleanout manholes for insertion points (7 of the 9) saved money.
<table>
<thead>
<tr>
<th>Date</th>
<th>Op No</th>
<th>Insertion Point</th>
<th>Discharge Point</th>
<th>Disposal Method</th>
<th>Length (FT)</th>
<th>Pipe Dia. (In)</th>
<th>Pipe Material</th>
<th>Ice Quantity (Gals)</th>
<th>Delivery Rig</th>
<th>Volume Needed (Gallons)</th>
<th>Wet Wells (Feet)</th>
<th>Pumping Time Needed 2,500 gpm (3.6 mgd)</th>
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<tbody>
<tr>
<td>7-Oct</td>
<td>Run 01</td>
<td>ARV2</td>
<td>N/A</td>
<td>N/A</td>
<td>1345</td>
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<td>PVC</td>
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<td>Run 02</td>
<td>ARV3</td>
<td>N/A</td>
<td>N/A</td>
<td>1170</td>
<td>18</td>
<td>PVC</td>
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<td>33,298</td>
<td>1.1</td>
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<td>Run 03</td>
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<td>N/A</td>
<td>N/A</td>
<td>1130</td>
<td>18</td>
<td>PVC</td>
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<td>48,258</td>
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<td>16-Oct</td>
<td>Run 04</td>
<td>ARV5</td>
<td>N/A</td>
<td>N/A</td>
<td>1555</td>
<td>18</td>
<td>PVC</td>
<td>2700</td>
<td>10T</td>
<td>68,846</td>
<td>2.2</td>
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<td>Run 05</td>
<td>New Blow off-TBD</td>
<td>N/A</td>
<td>N/A</td>
<td>1270</td>
<td>18</td>
<td>PVC</td>
<td>2700</td>
<td>10T</td>
<td>85,660</td>
<td>2.7</td>
<td>34</td>
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<td>21-Oct</td>
<td>Run 06</td>
<td>ARV6</td>
<td>N/A</td>
<td>N/A</td>
<td>1500</td>
<td>18</td>
<td>PVC</td>
<td>2700</td>
<td>10T</td>
<td>105,520</td>
<td>3.3</td>
<td>42</td>
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<td>23-Oct</td>
<td>Run 07</td>
<td>ARV7</td>
<td>N/A</td>
<td>N/A</td>
<td>1391</td>
<td>18</td>
<td>PVC</td>
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<td>123,936</td>
<td>3.9</td>
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<td>25-Oct</td>
<td>Run 08</td>
<td>New Blow off-TBD</td>
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<td>N/A</td>
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<td>141,306</td>
<td>4.5</td>
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<td>28-Oct</td>
<td>Run 09</td>
<td>Pump Station</td>
<td>N/A</td>
<td>N/A</td>
<td>1100</td>
<td>16 &amp; 18</td>
<td>DIP</td>
<td>2700</td>
<td>10T</td>
<td>155,870</td>
<td>4.9</td>
<td>62</td>
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Material Removed

✓ The sample on the left shows influent filled with materials removed by the ice pig. The sample on the right shows normal influent.

✓ Sand, grit, organics, and grease removed by ice pigging are discharged at the Wastewater Treatment Facility.
Sharing the Experience

Engineers and operators from all over New England and upstate New York were invited to observe the work and learn about the new and innovative ice pigging process.
Daily Monitoring

- Ice inserted every other day with ice manufactured on off day.
- Pumping capacity checked with same pumps (1 and 2) via drawdown testing after each cleaning to document results.
- Town had an out clause in contract if a measurable improvement was not being observed.
Flow Rate Changes – 1 Pump

Middlebury Main Pump Station Flow Rates
One Pump High Speed (60Hz)

<table>
<thead>
<tr>
<th></th>
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<tbody>
<tr>
<td>Before Pump</td>
<td>3.10</td>
<td>3.94</td>
<td>3.96</td>
<td>3.89</td>
<td>3.90</td>
<td>4.03</td>
<td>4.06</td>
<td>4.17</td>
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<tr>
<td>Day 1 Piping</td>
<td>4.25</td>
<td>4.27</td>
<td>4.30</td>
<td>4.35</td>
<td>4.29</td>
<td>4.38</td>
<td>4.34</td>
<td>4.45</td>
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<tr>
<td>Day 2 Piping</td>
<td>4.41</td>
<td>4.41</td>
<td>4.41</td>
<td>4.41</td>
<td>4.41</td>
<td>4.41</td>
<td>4.41</td>
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<tr>
<td>Drawdown Flow Rate (mgd)</td>
<td>Blue Line</td>
<td></td>
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<td></td>
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<tr>
<td>Flowmeter Flow Rate (mgd)</td>
<td>Red Line</td>
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</tr>
</tbody>
</table>

AE Aldrich + Elliott
Flow Rate Changes – 2 Pumps

Middlebury Main Pump Station Flow Rates
Two Pumps High Speed (60Hz)

Year/Before - 10/11/2012
Before ice plugging
Day 1 ice plugging
Day 2 ice plugging
Day 3 ice plugging
Day 4 ice plugging
Day 5 ice plugging
Day 6 ice plugging
Day 7 ice plugging
Day 8 ice plugging
Day 9 ice plugging

mgd
4.00 4.50 5.00 5.50 6.00 6.50 7.00

Drawdown Flow Rate (mgd)
Flowmeter Flow Rate (mgd)
Results

✓ Ice pigging successfully cleaned the force main and pump rates returned to about 6.2 mgd.
✓ Removal of accumulated deposits increased capacity of the Pump Station by more than 640,000 gallons/day!
✓ Pump efficiency was increased, lowering pump run times, saving energy, and wear.
✓ The pump station now operates at full capacity, saving energy and eliminating CSOs, protecting public health and the environment.
✓ The project was completed on schedule and within budget with no field changes or change orders!
Lessons Learned & Outcomes
Lessons Learned

✓ "Industry standard" solid poly pigging ruled out due to pipe size changes, bends, wyes, and no insert or retrieval stations.
✓ Simplicity of ice pigging.
✓ Town’s role and staff responsibility.
✓ Overcame Middlebury’s higher than normal wastewater temperature which made this technique challenging.
✓ Pumping control and programming change implemented developed to achieve scour velocity and satisfy owner’s desire for continuous flow.
✓ New, effective, and affordable pipe cleaning technology has been demonstrated for sewer forcemains in US.
Innovation

☑ This was the first use of ice pigging techniques to clean sewer force mains larger than 8” diameter in North America.

☑ This project was the longest continuous run of sewer force main (12,000 LF) ever cleaned by ice pigging in North America!

☑ Proves large diameter force mains can be cost-effectively and successfully cleaned by ice pigging.