ICE PIGGING

Award Winning Technology for Cleaning Water and Wastewater Mains

Jeff Austin
Water System Consultant
Advanced Solutions

suez

Overview

1. Introduction
2. Current Problems
3. Cleaning water mains
4. What is Ice Pigging
5. Ice Pigging in practice
6. Projects and Case Studies
7. Summery
8. Questions

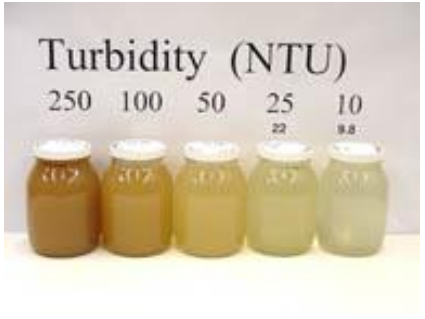
Current Problems Cleaning Options

Current Problem

Regulations require systems to operate cleaner and more efficient.

Risks include:

- **Sediments**
  - Taste & Odor
  - Customer Complaints
- **Deposits**
  - Loss of Capacity
  - Increased Pumping Costs
- **Biofilms**
  - Increased Disinfectant Byproducts
  - Higher Chlorine Dosing
- **Iron and Manganese**
  - Emerging Manganese Risks and Concerns



Traditional Cleaning Techniques
Flushing / UDG

Operational Challenges:

- **Inefficient** Scouring
- **High velocity flow rates needed**
- **High Water Waste**

Traditional Cleaning Techniques

Foam Swabs

Poly Pigs

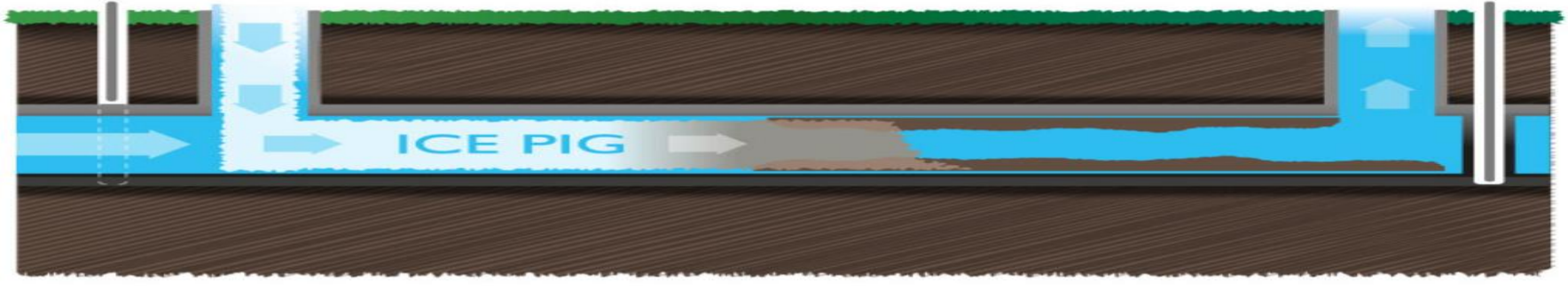
Operational Challenges:

- Bends, changes in diameter or butterfly valves
- Excavation to launch and receive pigs
- Disinfection required post clean
- Interruptions to supply
- Aggressive could lead to pipe damage

What is Ice Pigging?

How Does It Work?

- Ice Pigging harnesses the characteristics of a semi-solid material
- Semi-solid material that can be pumped like a liquid ……..
- But behaves like a solid once the pig is formed in the pipe



Controlling the semi-solid state

To maintain the correct consistency of the Ice Pig during an operation a **freezing point depressant is used**

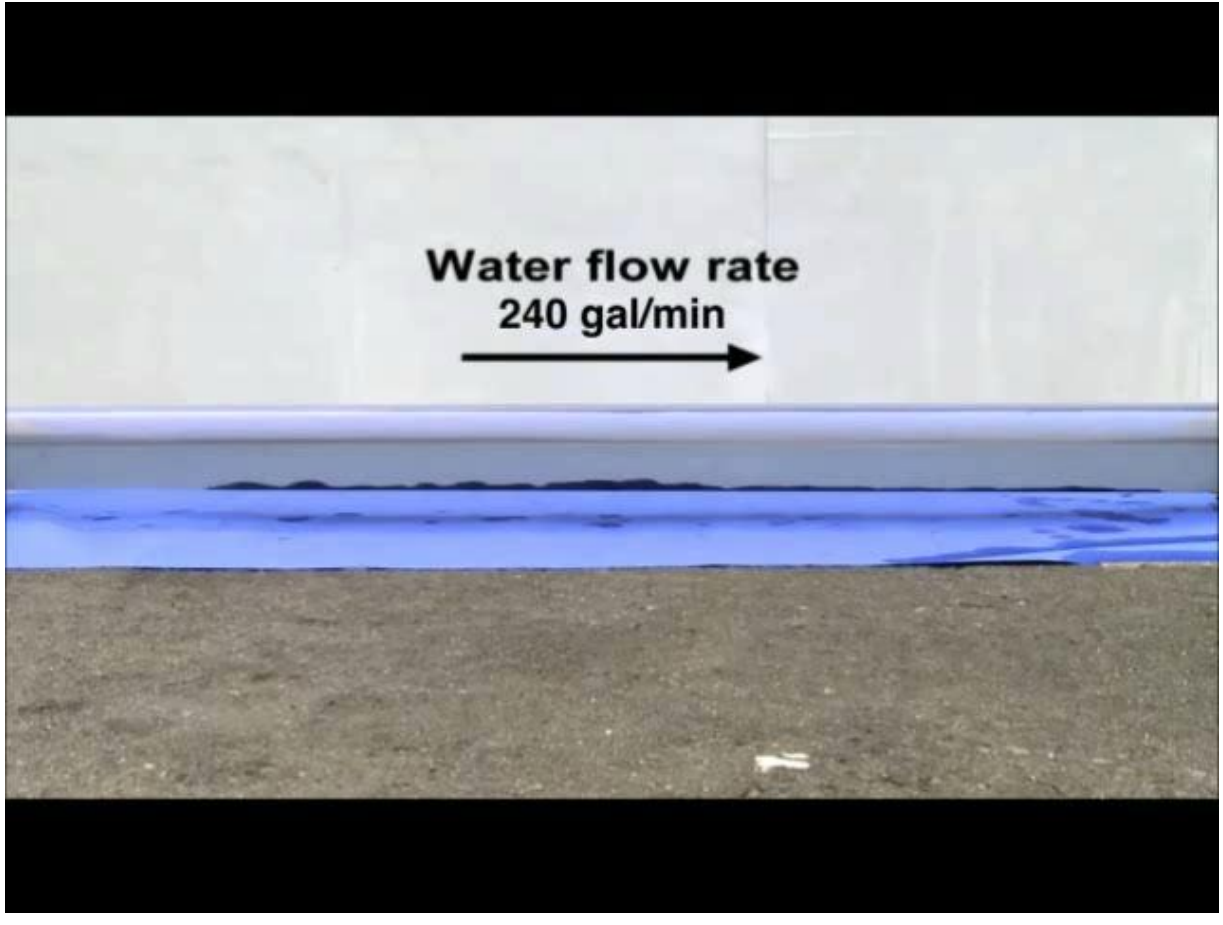
Brine Solution Blend

- **Tap Water**
- **Salt**
  - **Food Grade, NSF**
  - **Typically 5%**

- **75% to 90% ice**
- **24-27°F**

Ice Pigging in Practice:

Flushing Comparison:



ICE PIGGING

Cleaning Capabilities

- Iron
- Manganese
- Sediments
- Biofilms
- Fats, Oils, Greases (FOG)

Ice vs. Mayonnaise

Ice Pigging in practice

The Equipment: 10T – 2700 Gallons

10T Ice Delivery Rig (2,700 gallons)

Ice Generator

Ice Production

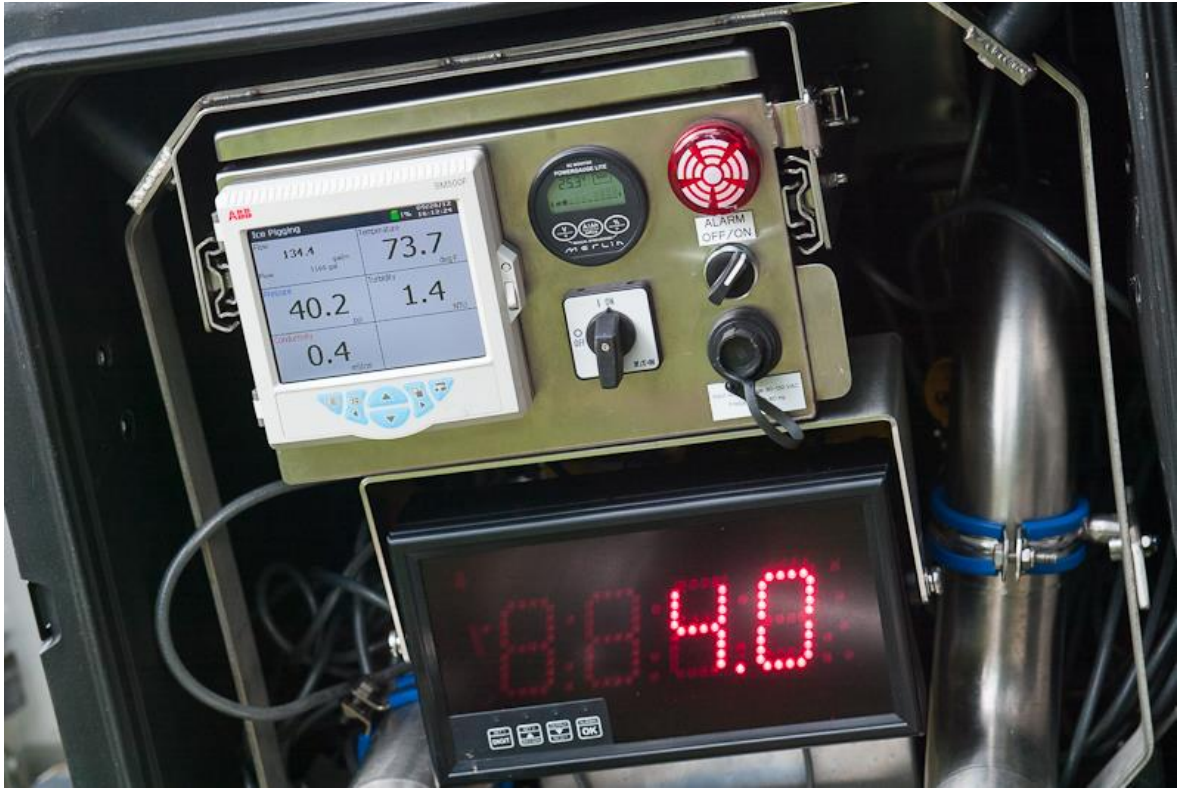
The Equipment

2.2T Demo Unit & 5T Ice Machine

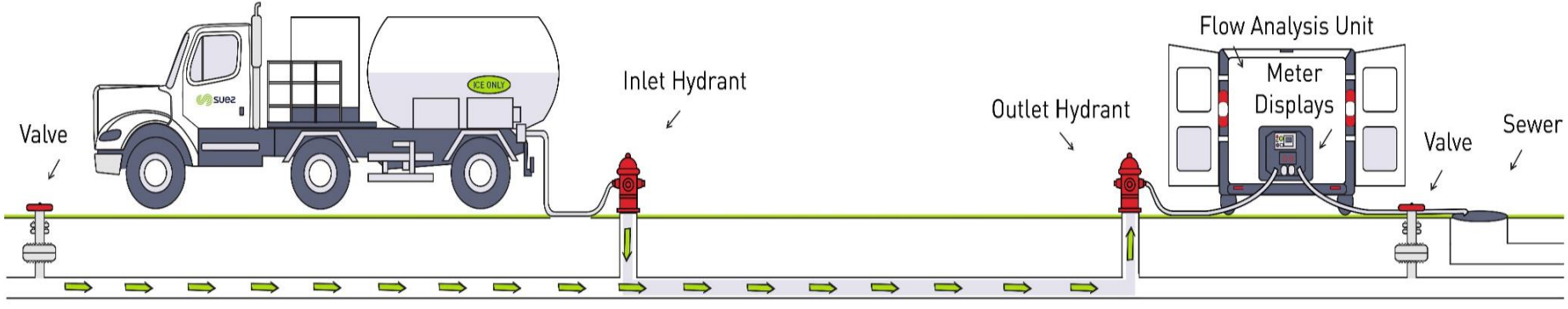
The Equipment

Flow Analysis System

- Flow
- Pressure
- Conductivity
- Turbidity
- Water temperature



Site Schematic: Potable Water



Primary Insertion: Hydrant

Other Insertion Options: via Tapping

- Tapping

- Meter Vault

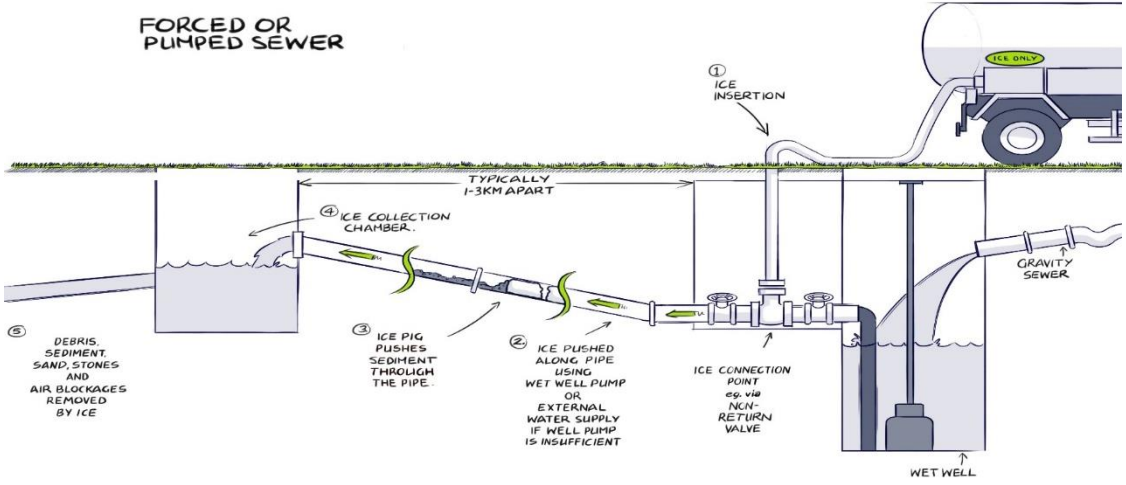
- Air Release Valve

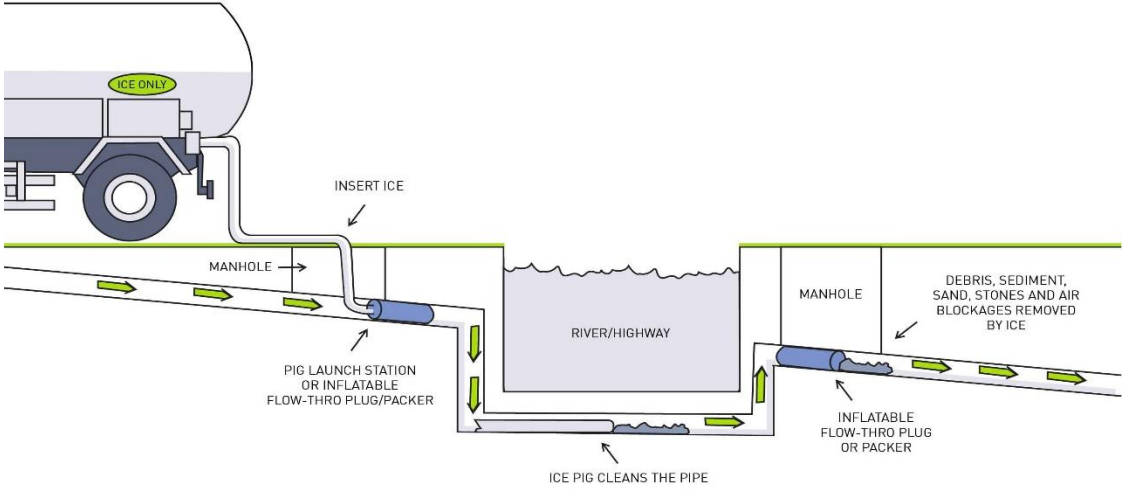
- Pig Launch

Extraction Point

Discharge

Site Schematic: Sewer





Results of the process:

PVC:

Before **After**

Cast-Iron
Before

After

Tuberculation untouched but biofilm and sediment removed

Results: What Comes Out?

① Sample from front of pig

② Sample from middle of pig as it carries through sediment

③ Sample at end of pig where water is clean again

Project Consideration

ICE PIGGING

Utility Service Group

JOB RECORD/REPORT/SUMMARY

JOB INFORMATION:

Client	City of Longview
Date	22-Jul-13
Location	Balt/19th
Insertion Point	26th Ave
Discharge Point	B102
Pipe Length	3600 Lft
Pipe Diameter	8 & 6"
Material	CI
Usage	Domest Water Distribution
Volume of Ice	2600 Gallons
Ice Fraction	90%
Total Water Used	18823 Gallons

ONSITE PROCEDURE:

Pre-Clean Readings		Immediate Post-Clean Readings		Change
Turbidity (NTU)	15	Turbidity (NTU)	7	-8
Temperature (°F)	66.8	Temperature (°F)	60.3	-6.5
Pressure (PSI)	40	Pressure (PSI)	42	2
Conductivity (mS/cm)	0.4	Conductivity (mS/cm)	0.4	0

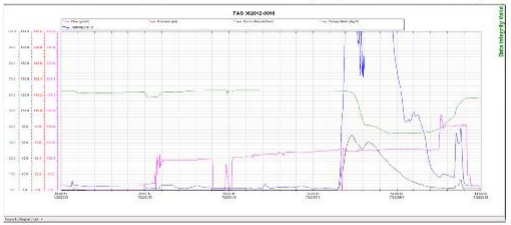
Timeline:

Arrive — Main Isolated by Client — Main Opened — Ice out — Main Returned to Service

Pre-clean Readings — Ice In — Conductivity Alarm — Post-clean Readings — Leave Site

Comments:

Maximum Flow Rate (gpm)	205	Lowest Temperature Reached (°F)	35.9	Ambient Air Temperature (°F)	75



ICE PIGGING

Utility Service Group

JOB RECORD/REPORT/SUMMARY

SEDIMENT DATA:

#	Time (s)	Flow Rate (gal/m)	Temperature (°F)	Conductivity (mS/cm)	Sample Mass (g)	Sed. Mass (g/gal)	Sediment (lb/gal)
1	60	202.95	62.6	6.1	1.00	1623.63	3.577
2	90	151.97	61.6	10.1	0.63	765.92	1.688
3	150	194.61	62.3	14.6	1.09	1696.38	3.793
4	210	195.42	61.6	67.9	0.60	637.99	2.064
5	270	194.61	58.3	63.3	0.68	1058.47	2.328
6	330	197.98	52.9	54.6	0.68	1076.99	2.369
7	390	199.15	44.1	51.7	0.54	860.31	1.893
8	450	198.05	40.9	50.4	0.47	746.91	1.643
9	510	198.62	40.6	50.5	0.38	603.79	1.328
10	570	197.92	39.9	53.0	0.36	570.00	1.254
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18	1050	205.08	35.9	18.0	0.12	196.87	0.433
19	1110	204.64	36.0	14.3	0.09	147.34	0.324
20	1170	204.71	36.1	11.4	0.19	311.16	0.685
21	1230	204.46	36.1	9.4	0.05	81.78	0.180
22	1290	203.69	36.2	7.9	0.02	32.59	0.072
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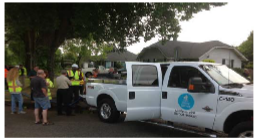
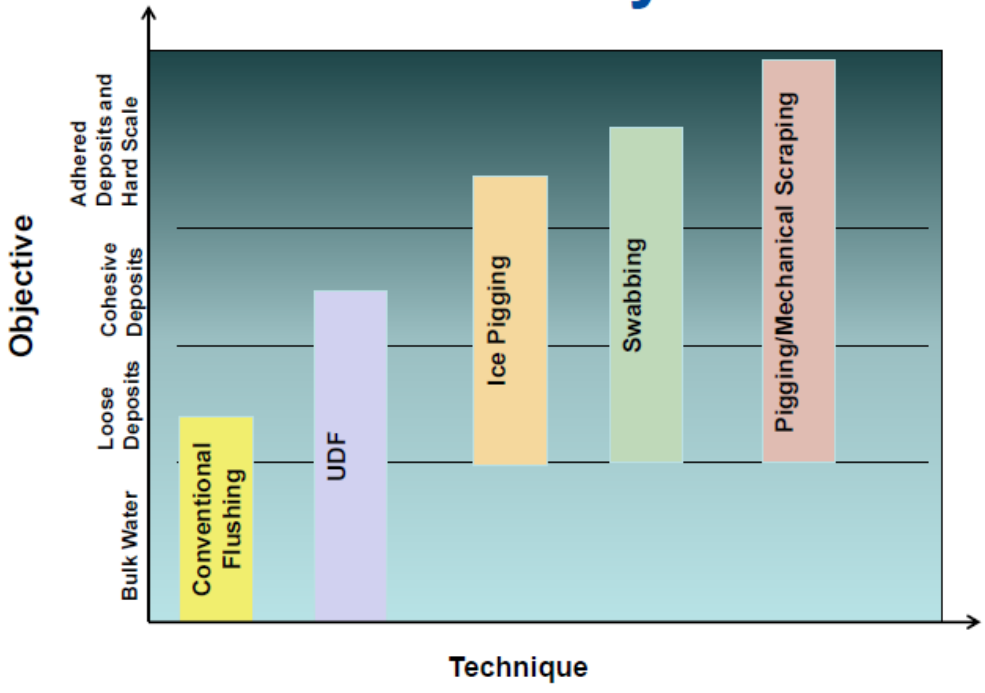
RESULT:

Sediment Removed (lb)	29.63	Sediment Removed per mile (lb)	43.53

The above values are calculated from samples taken every 60 seconds on site. For each sample the flow rate, and the sediment densities are assumed to remain constant within that 60 second period. From this we can calculate the total amount of water/ice and therefore can estimate the total mass of sediment over the sampling period



Main Cleaning Comparative Summary



Ideal Applications

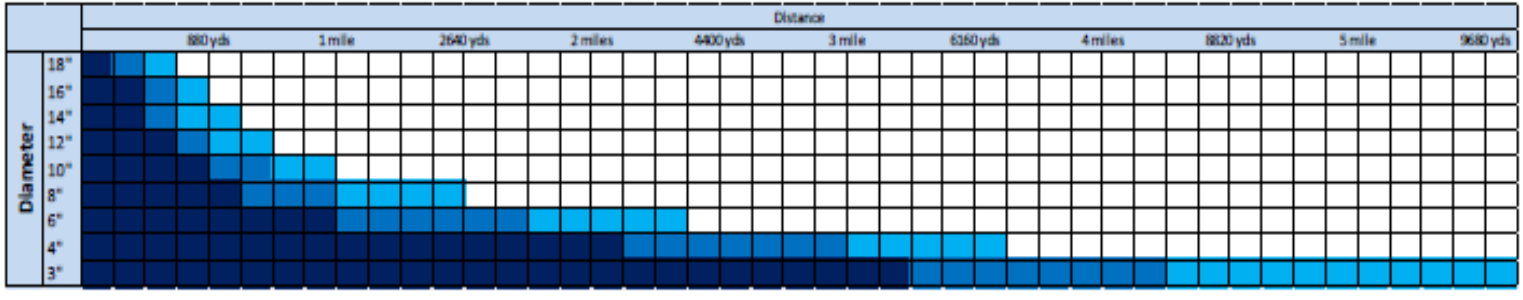
Where to Utilize Ice Pigging?

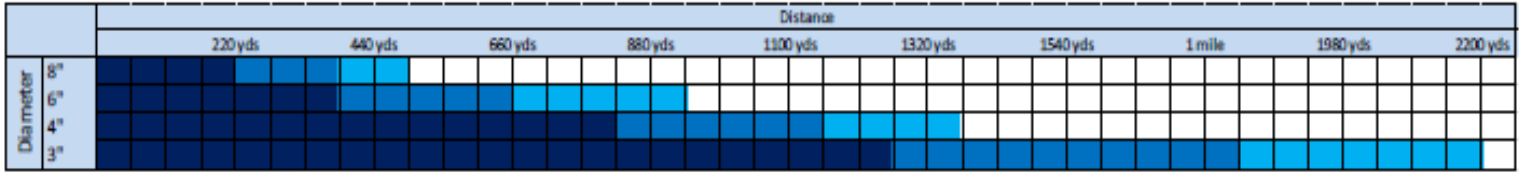
- **Ground water: Iron & manganese**
- **Surface water: sediments & biofilm**
  - Disinfectant residual drop in areas of the system?
- **Flushing too often**
- **Pipes that can’t be cleaned with traditional techniques:**
  - Multiple diameter changes, bends, etc.
  - Mainline butterfly valves or other possible obstructions
  - High Risk Pipe: Railroad crossing, creek crossings, force mains
- **Critical pipe / Minimal time to complete project**

Project Planning

Desktop Study

Estimate ice quantities





Capabilities

Ice Pigging with 10T Rig				
	6"	8"	10"	12"
	Max/Day (FT)	Max/Day (FT)	Max/Day (FT)	Max/Day (FT)
PVC/AC	12000’	7000’	4500’	3000’
CICL/DI	9300’	5280’	3300’	2300’
CI Unlined	6300’	3500’	2200’	1500’

Barriers

Is Ice Pigging Expensive?

- Consider the cost difference of cleaning once every 5-10 years compared to operational and non-revenue water of flushing regularly.

Will Ice Pigging work in my system?

- Several hundred projects across the nation
- 2”-24” diameter pipe cleaned
- Removed over 700 lbs./mile of sediment
- Numerous case studies and references available.

Budgeting?

- Options available for multi-year projects to take advantage of lower mobilization costs, economies of scale, and flattened annual fee.

ICE PIGGING - Summary

- Efficient rapid and environmentally friendly
- Combines operational benefits of flushing with the impact of solid pigging
- Ice Slurry injected through existing hydrants
- System pressure pushes ice through complex water networks
- Suitable for pipes of all size and material
- Exceptionally low risk
- Produces quantifiable results
- Harmless to public

Questions?

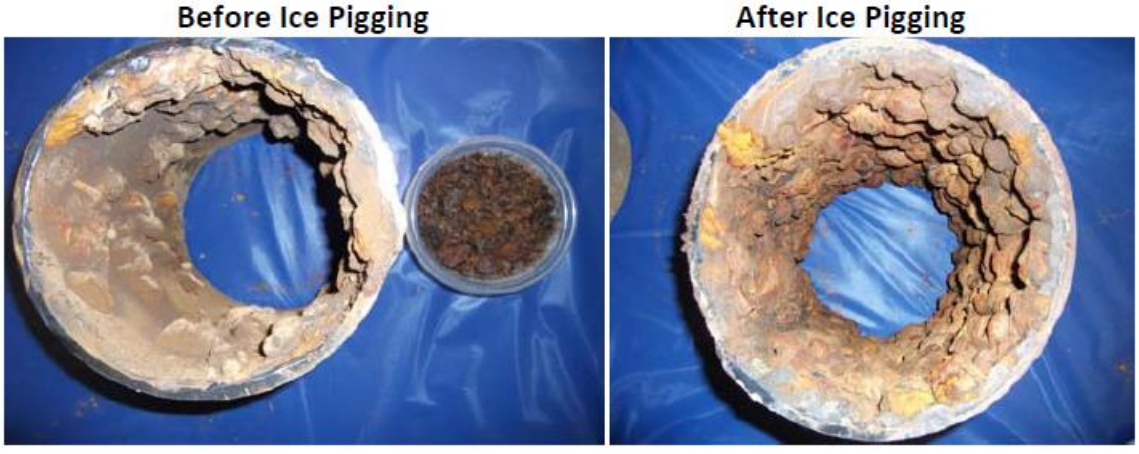
For Additional information:
Jeff Austin
503-713-8823
jaustin@utilityservice.com
www.utilityservice.com

suez

Longview, WA

- 12,200ft of 6 & 8 inch cast iron
- Ongoing pipe scale destabilization problem resulting in the release of accumulated materials
- Average sediment removal of 312 lbs per mile of pipe

Longview, WA



- Although more aggressive than unidirectional flushing, ice pigging did not appear to disrupt existing tubercles, thus supporting the on-going re-stabilization process and allowing for rapid recovery of the system post-pigging.
- There is no doubt that the City of Longview benefited significantly from ice pigging, especially when compared to the effectiveness of flushing alone within this flow-constricted section of the distribution system.

Middlebury, VT

- 12,000’ of 18” PVC Sewer Force Main - 9 runs

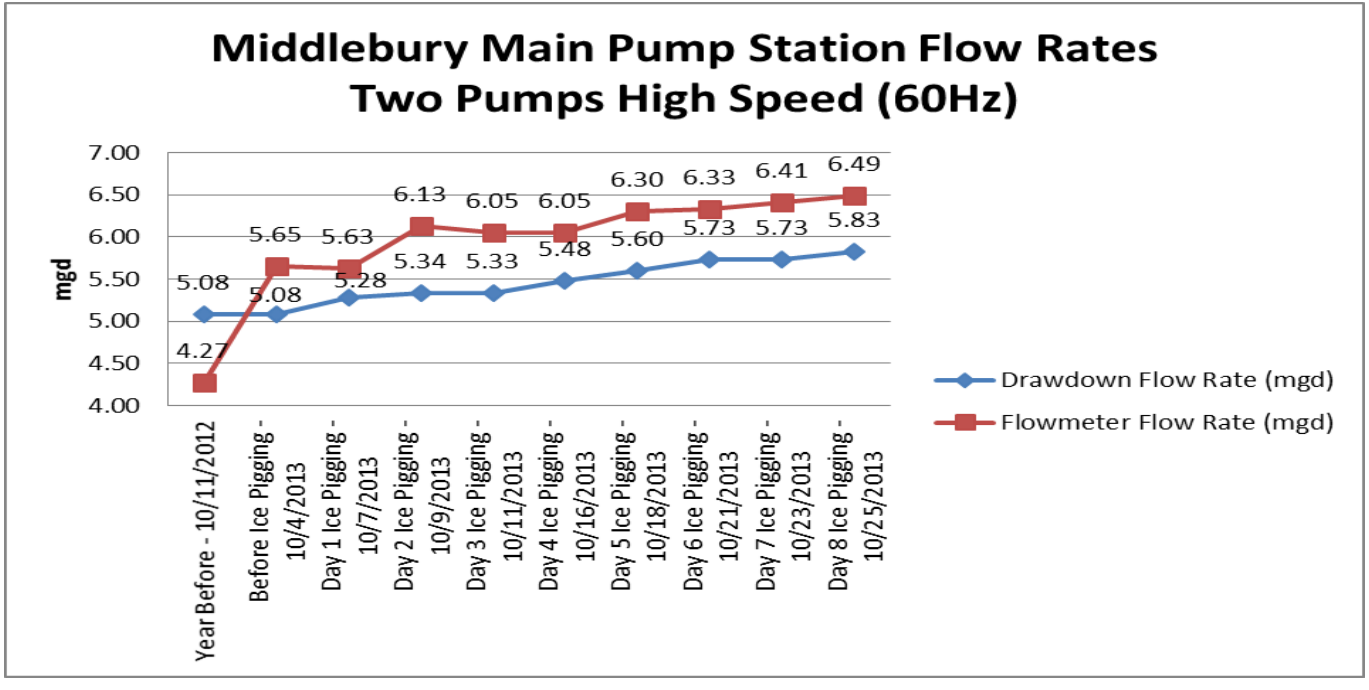
“traditional pigging proved to carry too many potential issues of catastrophic failure which we were not willing to gamble with”

“Flows returned to design spec – An increase of 445 gallons per minute”

Robert Wells, Town of Middlebury Wastewater Superintendent

Middlebury, VT

- 11% Increase in flow rates
- Returned pipe to original design capacity
- 2014 ACEC/Vermont Grand Award Winner



Western Hills, CA

Delta Mendota Aqueduct

- **Type of Main: Gravity sewer siphon**
- **Length of main: 2 x 1,400Ft**
- **Diameter and material: 12” & 14” HDPE**

California Aqueduct

- **Type of Main: Gravity sewer siphon**
- **Length of main: 2 x 3,151 Ft**

“We have been **consistently flushing** these lines but it was having little to no effect.
The ice pigging technology was **quick, efficient** and very effectively cleaned out the siphons. We now have a **flow rate consistent with the design spec**.”
I consider ice pigging to be a superior, exceptionally low risk method to clean sewer mains that otherwise could not be cleaned without risk of major disruption to the system.
We are now looking towards **a regular cleaning program using ice pigging** to ensure we do not suffer large sludge build-ups in the future”

Jerry Phillips – Western Hills Water District Manager

Ice Pigging

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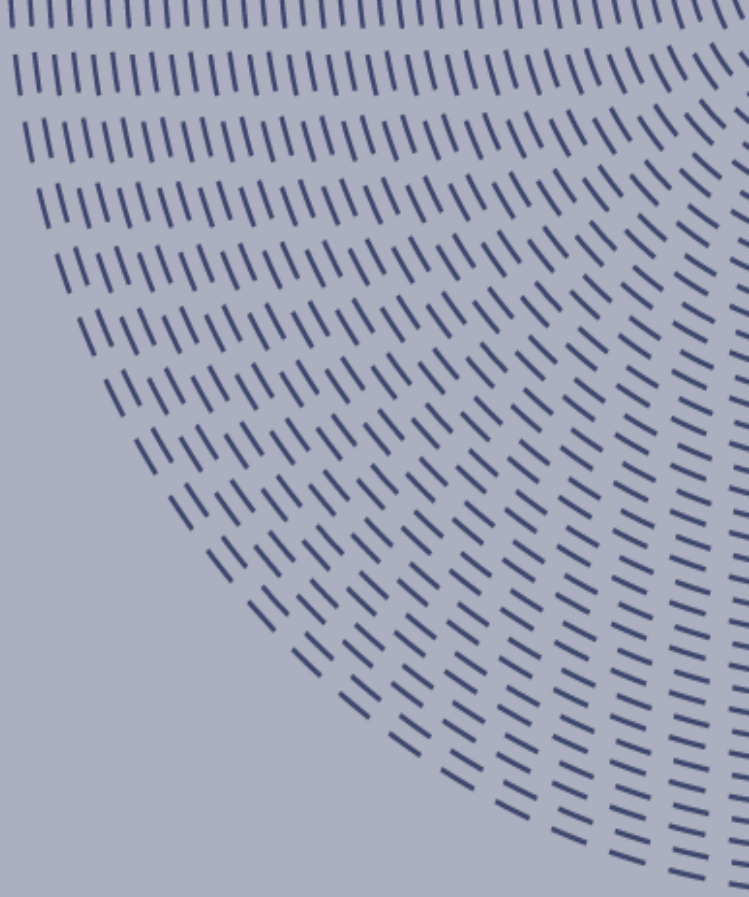


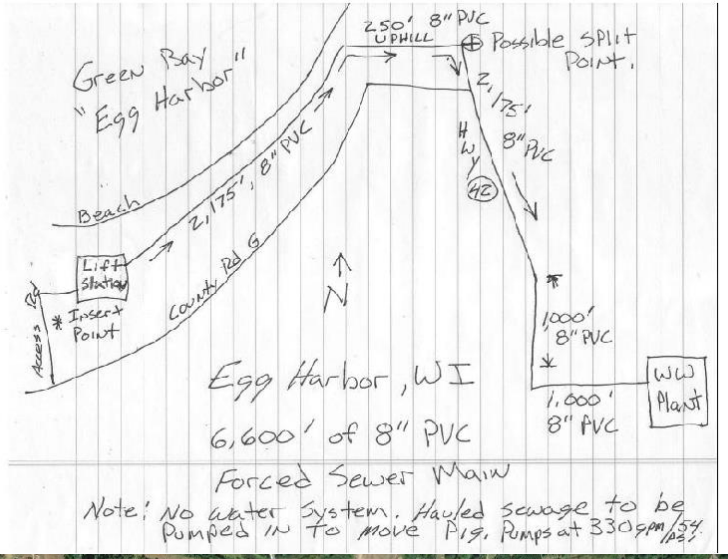
Project Planning

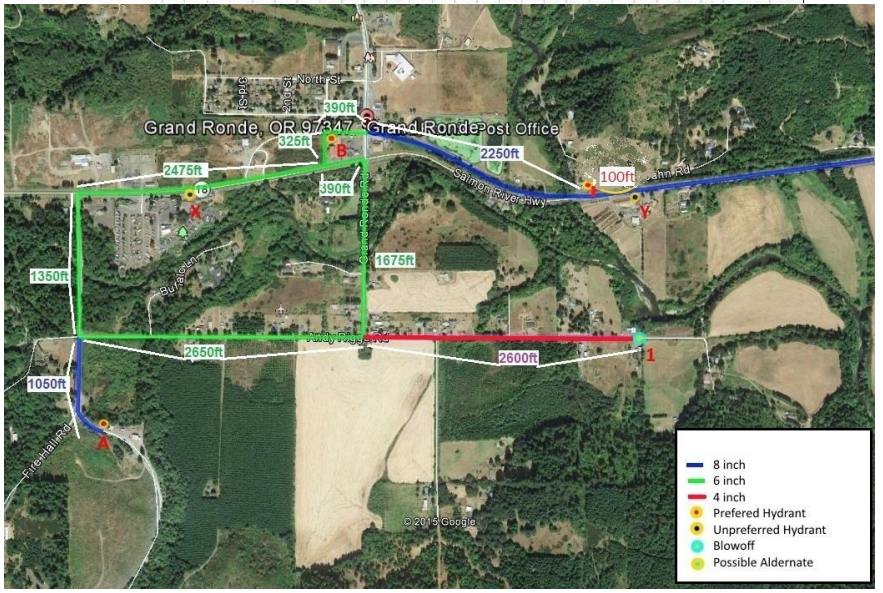
Needed Info:

- **Main diameter, material, & length**
- **Sewer/Raw/Potable?**
- **Water temperature in main**
- **Operating flows & pressures**

Maps/Sketch/Drawings

- **Location of:**
  - Valves hydrants, or other access
  - Diameters and changes
- **Lengths between locations**

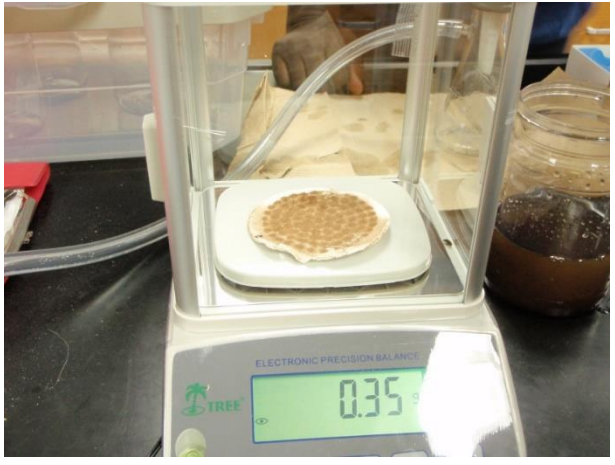




Project Reporting

Visual Evidence of Cleaning

Filtering



Project Reporting

ICE PIGGING

Utility Service Group

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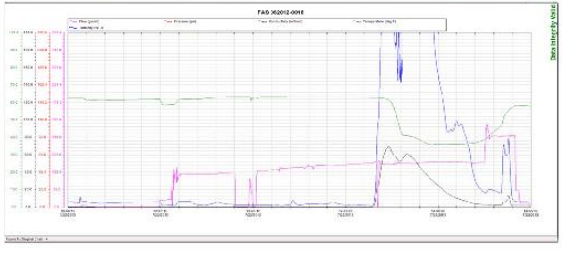

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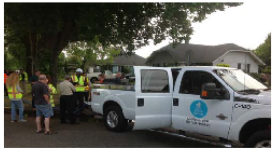


Case Study – Sharpsville, IN

Sewer Force Main

- **7 miles of 6-inch PVC**
- **5 x 10T loads of ice**

Before ice pigging;
Two pumps (20Hp & 15HP running with a flow of 45-50 gpm

Post ice pigging;
One pump flowing 120 gpm

“ Plans to build a second lift station at mid point of force main, at an estimated cost of $300K shelved”

Case Study – City of Cambridge, Ontario

Statistics

King St. Force main;
327 LF x 6” PVC Force Main

Preston St. Siphon:
3 barrels – 12”, 18” & 20”

Todd St. Siphon:
2 barrels – 12” & 22”

Grand Ave, Siphon:
2 barrels – 20” & 28”

Length of siphons all approximately 400 LF

“the build-up accumulated over the course of the 40 to 50 years since their original installation”

Case Study – City of Cambridge, Ontario

"With this new method of maintenance, we are ensuring that the pipes will perform at full capacity"

"The City saw positive results from this process at all three chosen locations, in some cases seeing pipes go from 60% capacity to 100%"
Hardy Bromberg, Deputy City Manager

metroland media
Connected to your community
Your Hometown Newspaper
CAMBRIDGE TIMES

"City of Cambridge first in Canada to try innovative sewer siphon cleaning technique"

Case Study – Danbury NC

Problem:

- **Water system 30 years old**
- **Build up of Manganese and iron**
- **Discolored water complaints**
- **Heavy sediment build up**
- **Insufficient water storage for other cleaning techniques**
- **Flushing not an option**

Case Study – Danbury NC

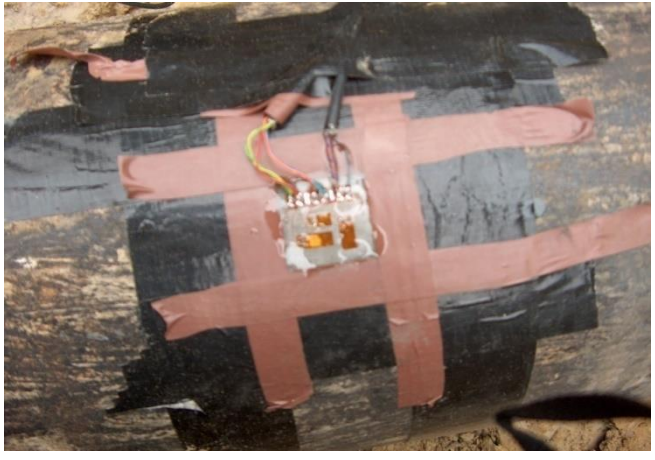
"Water quality has been greatly increased and customer complaints have all but disappeared"

Mark Delehant – Director of Public Works Stokes County NC

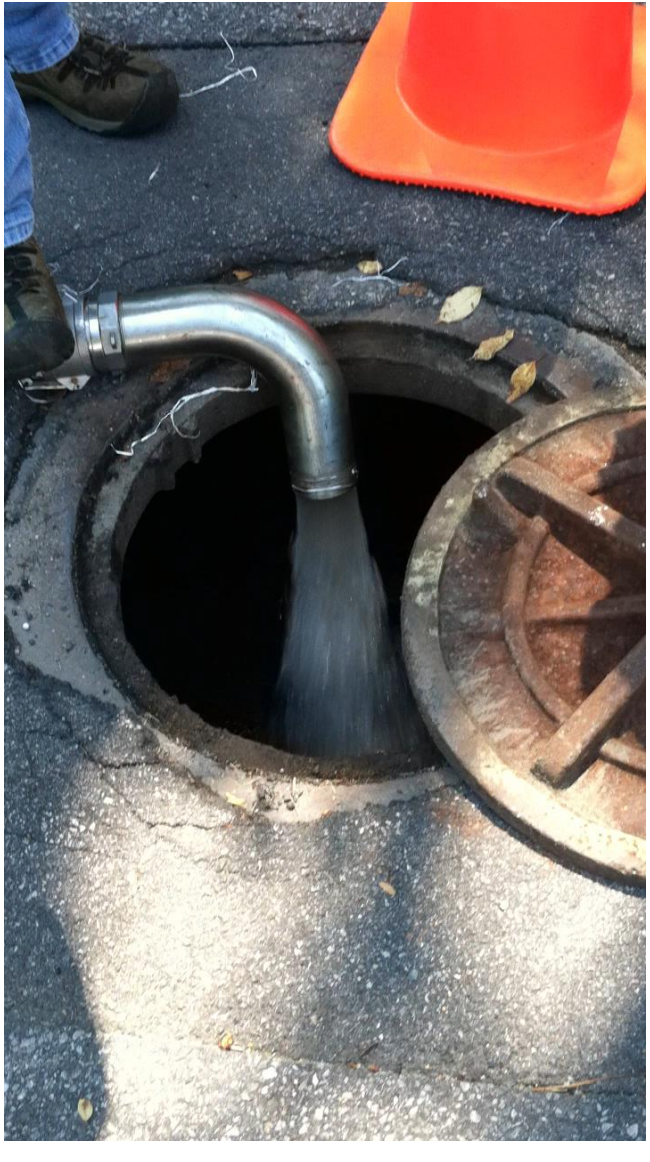
Chilling Questions?

Jeff Austin
(503) 713-8823
jaustin@utilityservice.com

FAQ – Thermal Shock



Photos of the one exposed section and the attached Strain Gauges and Temperature Sensors



Waste Water Results

Service Lines