Utility Service Group

ICE PIGGING

Award Winning Technology for Cleaning Water Mains

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Utility Service Group

Outline

- Why clean mains?
- What is Ice Pigging
- Ice Pigging in practice
- Projects and Case Studies
- Summery

Current Problem

Systems need to operate cleaner and more efficient

- Sediments
  - Turbidity, Taste and Oder Issues
- Biofilms
  - Higher Disinfection Dosing, Increase DBP's
- Deposits
  - Loss of Capacity, Pumping Costs

Traditional Cleaning Techniques

Existing Technology

- Flushing, UDF,
  - Inefficient, less aggressive
  - High Water Usage
- Swabs, Pigs, Mechanical Scrapers
  - Incompatible with pipe bends, butterfly valves and changes in diameter
  - Requires Excavation
  - Customer service affected
  - Disinfection required




What is Ice Pigging?

Ice Pigging harnesses the characteristics of a semi-solid material

- **An ice pig is a semi-solid material that *<u>can be pumped like a liquid</u>***

- **But *<u>behaves like a solid</u>* 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**

- 4.7 - 5% Brine solution
- Food grade, fine table salt (NaCl)
- NSF approved
- Harmless to customer supply
- Additional chlorine may be added as disinfectant
- 75% to 90% ice fraction
- 24-27 F

Ice Pigging in Practice:

Ice Pigging

- Uses
  - Water Distribution Networks
  - Sewer Force Mains
  - Inverted Siphons
  - Chemical Feed Piping
- Benefits
  - Extremely Low Risk
  - Very Quick Timeframe

Flushing Comparison:

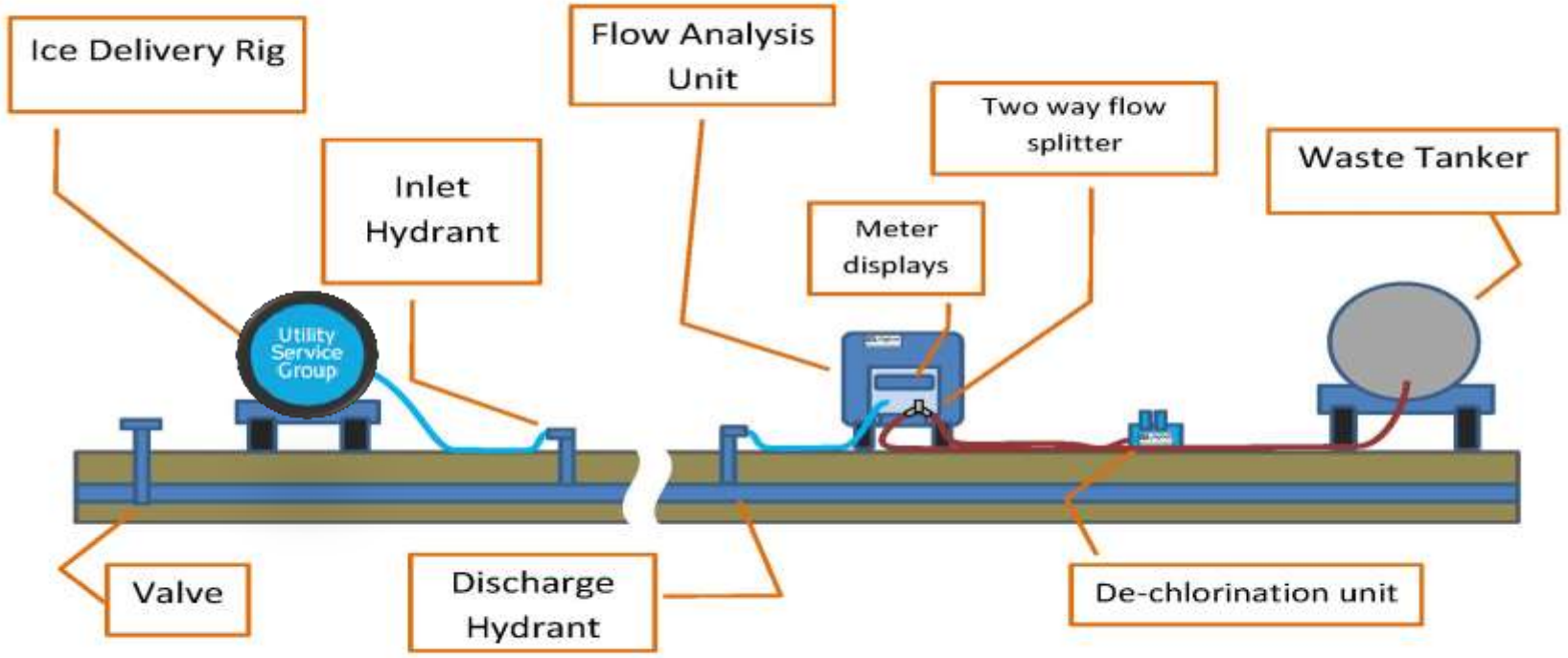
The Equipment

10T Ice Delivery Rig

Ice Production- 10T (2,700Gals)

2.2 Ton Delivery Unit

Ice Pigging Site Schematic Potable Water



Insertion via Hydrant

Insertion via Pig Launch

Extraction Point

Extraction Point

Flow Analysis System

Discharge to Sewer & Tanker

Project Reporting

- Visual Evidence of Cleaning

Project Reporting

ICE PIGGING

JOB RECORD/REPORT/SUMMARY

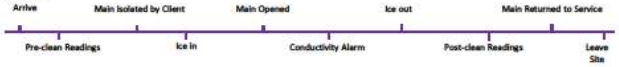
JOB INFORMATION:

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:

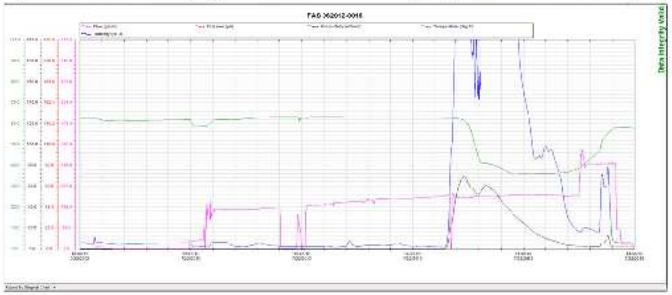
Pre-Clean Readings		Immediate Post-Clean Readings		Change
Turbidity (NTU)	15	Turbidity (NTU)	7	-8
Temperature (°F)	66.8	Temperature (°F)	60.3	-6.5
Pressure (PSI)	40	Pressure (PSI)	42	2
Conductivity (mS/cm)	0.4	Conductivity (mS/cm)	0.4	0

Timeline:



Comments:

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



ICE PIGGING

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	6.5	1.00	1623.43	3.579
2	90	151.97	62.6	10.1	0.63	765.92	1.689
3	150	194.61	62.3	16.6	1.09	1696.98	3.741
4	210	195.42	61.6	17.0	0.60	937.99	2.068
5	270	194.61	59.3	17.1	0.68	1058.67	2.335
6	330	197.98	52.9	18.6	0.68	1076.99	2.375
7	390	199.15	49.1	19.7	0.54	860.31	1.897
8	450	198.65	46.8	19.6	0.47	746.91	1.647
9	510	198.62	45.6	19.5	0.38	603.79	1.331
10	570	197.92	44.9	19.0	0.36	570.00	1.256
11	630	200.42	44.3	19.1	0.41	657.39	1.449
12	690	202.02	43.7	19.1	0.40	646.47	1.425
13	750	203.08	43.4	18.9	0.32	519.88	1.146
14	810	204.57	43.0	22.0	0.18	294.58	0.649
15	870	204.90	42.6	27.3	0.10	163.92	0.361
16	930	205.17	41.9	24.6	0.14	229.79	0.506
17	990	203.82	41.0	22.2	0.15	244.58	0.539
18	1050	205.08	40.3	18.0	0.12	196.87	0.433
19	1110	204.64	39.9	14.3	0.09	147.34	0.324
20	1170	204.71	39.1	11.4	0.19	311.16	0.685
21	1230	204.46	38.1	9.4	0.05	81.78	0.180
22	1290	203.69	36.2	7.9	0.02	32.58	0.072
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RESULT:

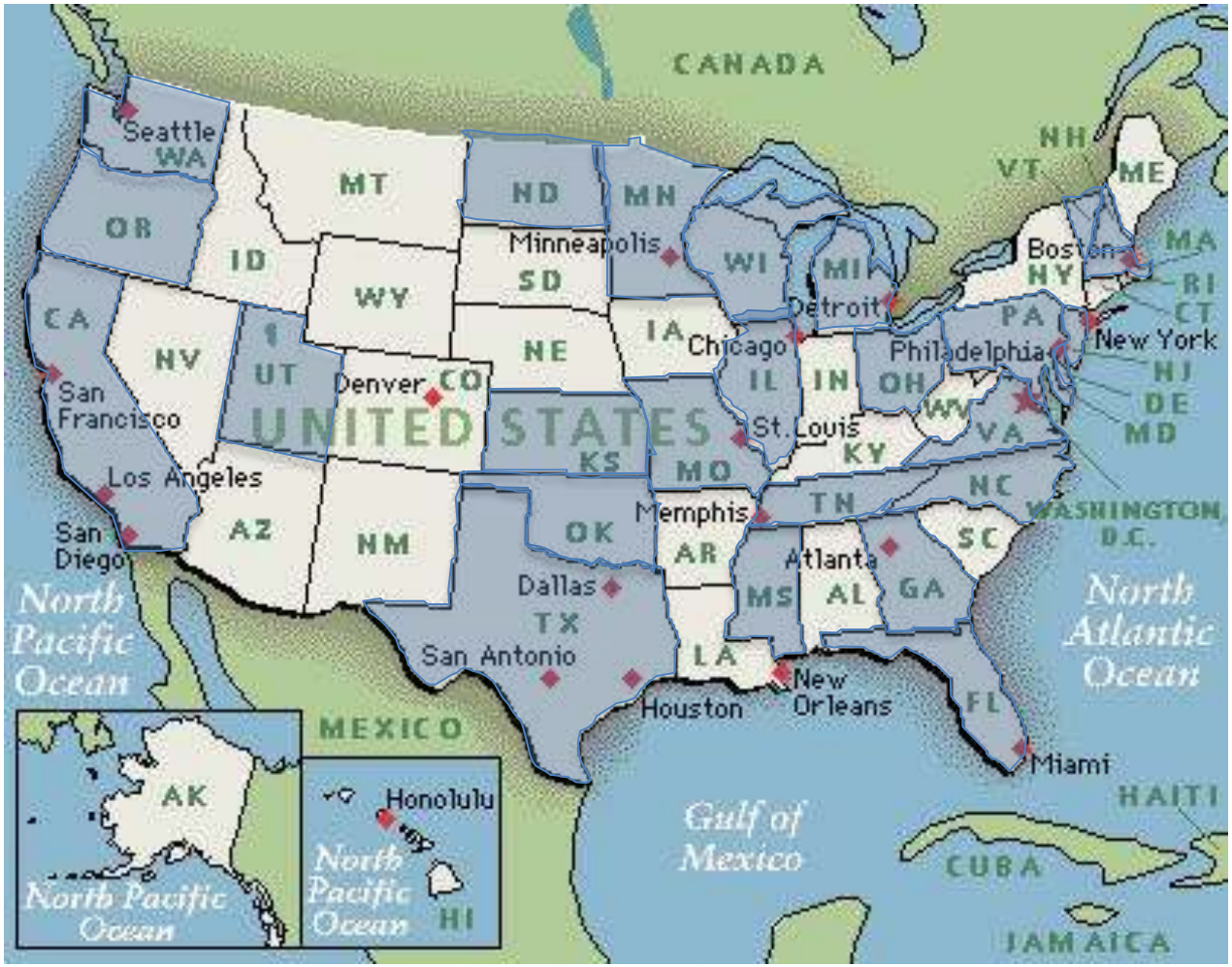
Sediment Removed (lb)	29.63	Sediment Removed per mile (lb)	43.53

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

Ice Pigging in practice

Projects Completed in the US

25 States



Keene, NH

- 6-8” Cast Iron
- 62,000 LF
- Iron/Manganese Issues
- Flow reserving with well operations
- Prior Flushing not solving the issue

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

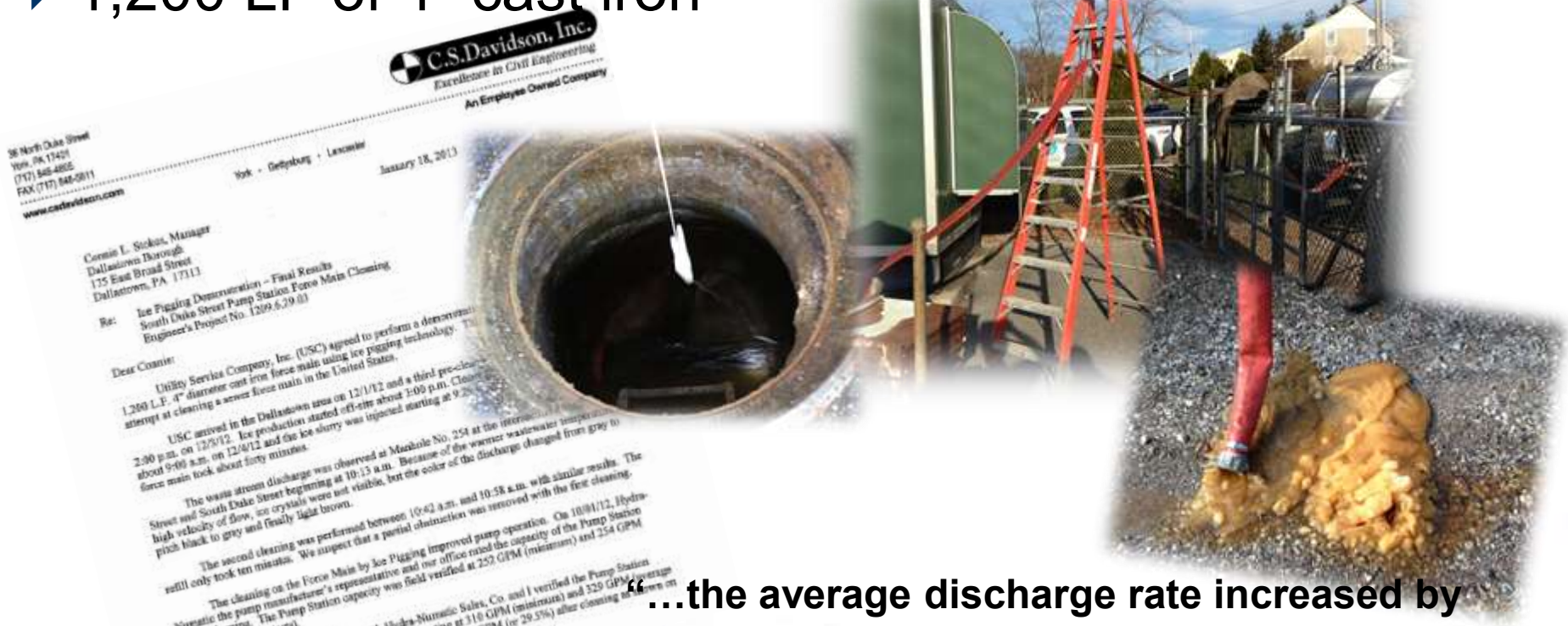
Before Ice Pigging

After Ice Pigging

- 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.

Dallastown, PA

- First sewer force main in US
- 1,200 LF of 4” cast iron



“…the average discharge rate increased by 75 gpm (or 29.5%)..”

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

Western Hills, CA

"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

- 6 mile pipe, splits into 2 pipes
- Under California and Delta Medota Aquaduct
- Inverted Siphon (gravity)

ICE PIGGING – The Benefits

- **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**

Chilling Questions?

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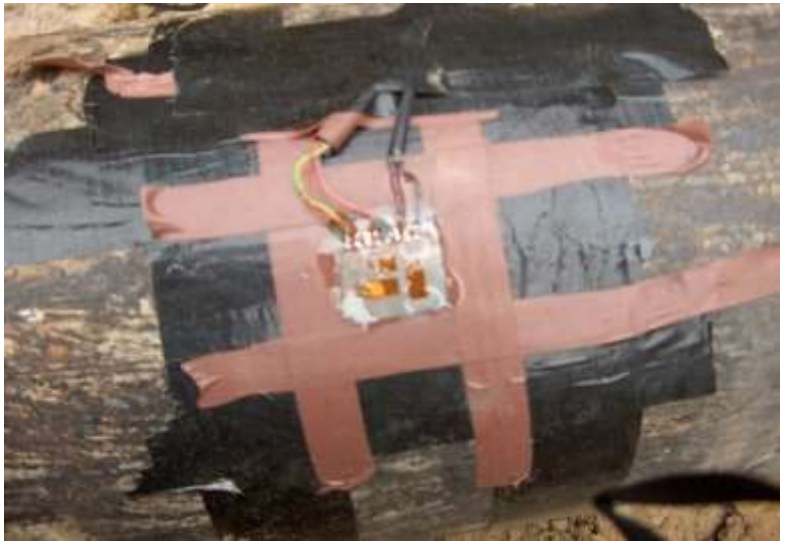
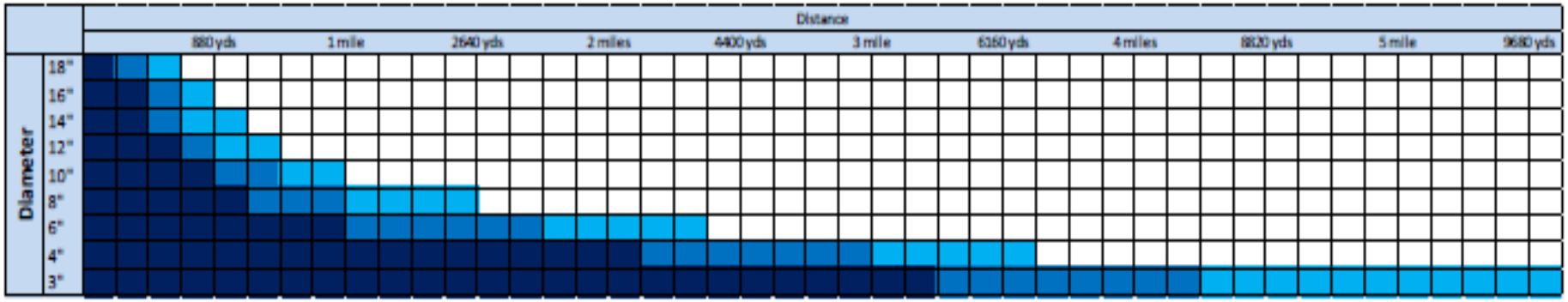
FAQ – Thermal Shock

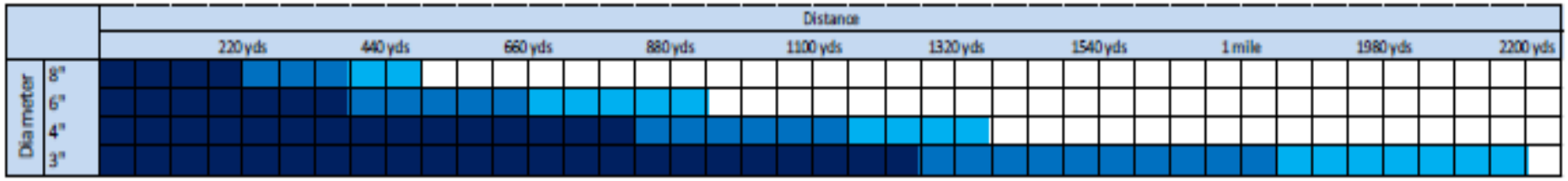


Photos of the one exposed section and the attached Strain Gauges and Temperature Sensors

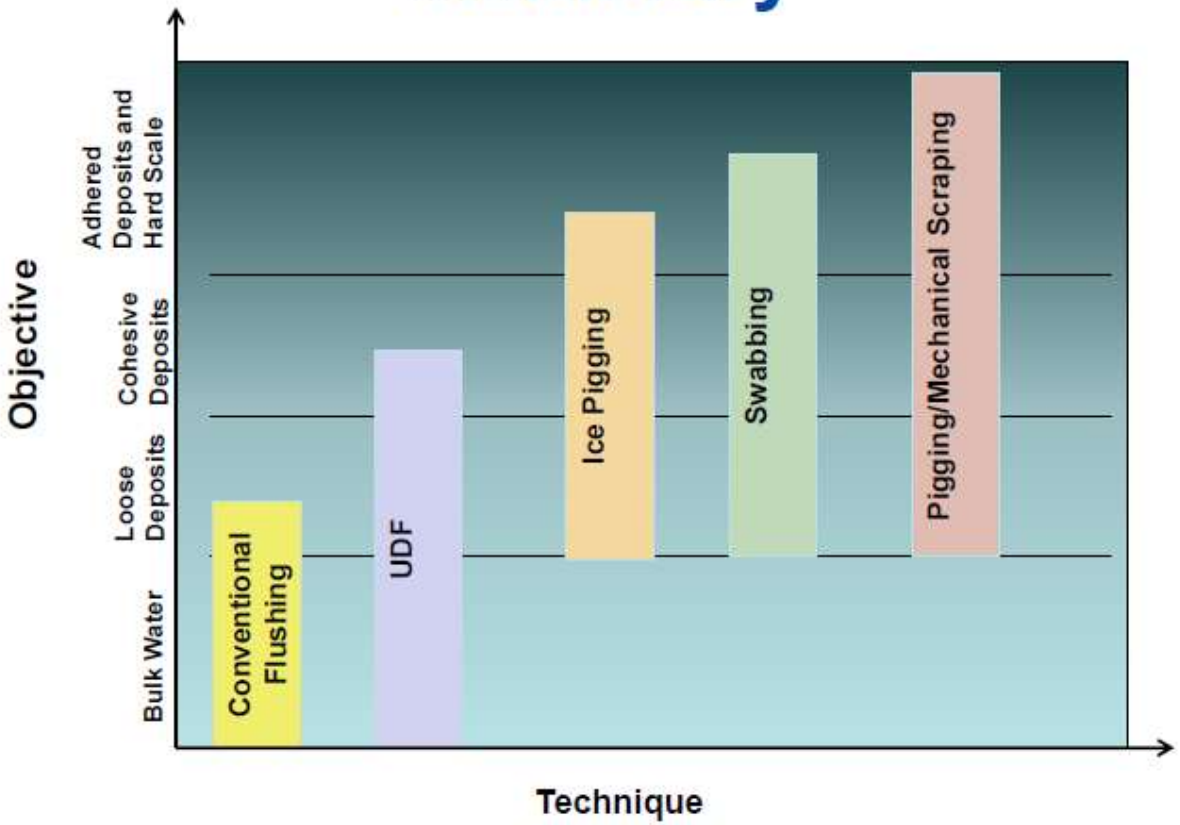
Project Planning

- Desktop Study
  - Estimate ice quantities





Main Cleaning Comparative Summary



Comparative Cost Approximations Site-Specific and Vendor Costs May Vary Significantly!

Technique	Planning Labor Costs* ($/mi)	Field Activity Labor Costs* ($/mi)	Estimated Vendor Support Cost ($/mi)	Estimated Total Cost – O&M and Capital ($/mi)**	Estimated Total Cost – O&M and Capital ($/LF)**	Estimated Frequency (years)
UDF	$3,000 1st time $1,000 repeat	$2000	$0	$5,000 1st time $3,000 repeat	0.95	0.5 - 3
Ice Pigging	Similar to UDF	Similar to UDF	$4,000 - $24,000	$9,000 - $29,000	1.7 – 5.5	3 - 7
Swabbing	150% UDF	200-300% UDF	$26,000 - $42,000	$30,000 - $48,000	5.7 – 9.1	3 - 7
Pigging	150-200% UDF	200-300% UDF	$79,000 - $106,000	$85,000 - $111,000	16.1 – 21	≥10

Adapted from work conducted by Kennedy/Jenks Consultants and Confluence Engineering Group, LLC for San Francisco Public Utilities Commission (2011), information provided by Utility Service Group for ice pigging, and work conducted by members of Confluence Engineering Group for Woodinville Water District, WA (2008).

*Assumes labor rate of $100/hr. Cost significantly impacted by # persons per crew, number of loops per mile, etc.

**Assumes no rehabilitation or major system modifications.

Service Lines