

Using Advanced Monitoring for Leak Detection and Increased System Reliability



- District Energy St. Paul Overview
- Distribution System Components
- Monitoring System Components
- Leak Locating Technology
- Stateview Multi-Meter Tool & TDR Curve
- The Value of Early Detection
- Effects of City Water Main Failure
- Lessons Learned



District Energy St. Paul Pipeline

- Downtown Saint Paul and across bridge to West Saint Paul
- Monitoring system installed during steam to hot water conversion 1983
- 200 buildings for heating and 110 buildings for cooling
- 290,000 feet of pipe
- Serves critical civic operations
 - 5 hospitals including regional Level 1 trauma center
 - State, county, city government
 - Xcel Energy Center & other entertainment
 - Residential & hotels



Adding Advanced Monitoring Systems

- Design
- Construction
- Commissioning
- Staff Training

Beyond District Energy St. Paul

- Duluth Energy Systems, Duluth, MN
- Energy Park Utility Company, St. Paul Minnesota
- City of Montpelier, Vermont
- Stanford University



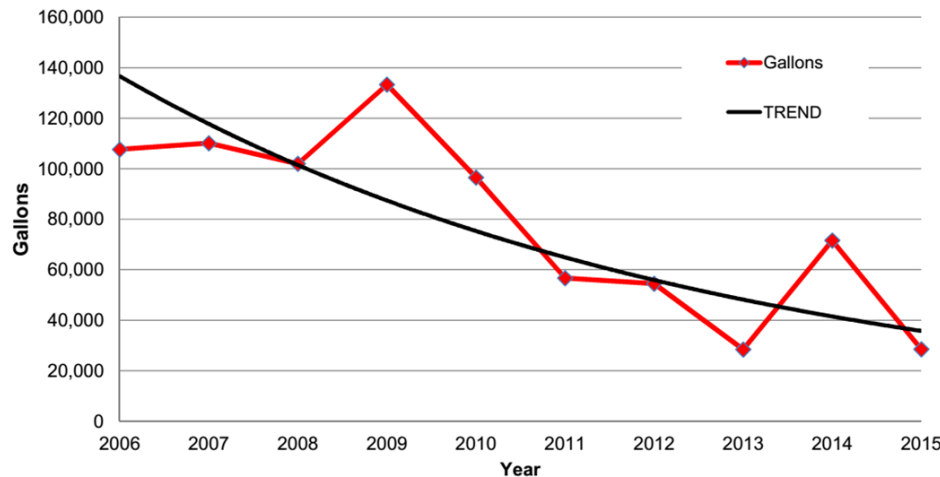
Benefits of Advanced Monitoring

- Consistent 99.99% system reliability year to year
- Reduction in number of unexpected and unplanned outages. Overall trend to reduce number of hot water pipe leak repair projects

– Year	2008	2009	2010	2011	2012	2013	2014
– Repairs	14	24	10	12	6	8	8

- Trend toward reduction in make up water for hot water loop

**HOT WATER LOOP MAKEUP TREND - Annual
2006 - 2015**



Distribution System Components



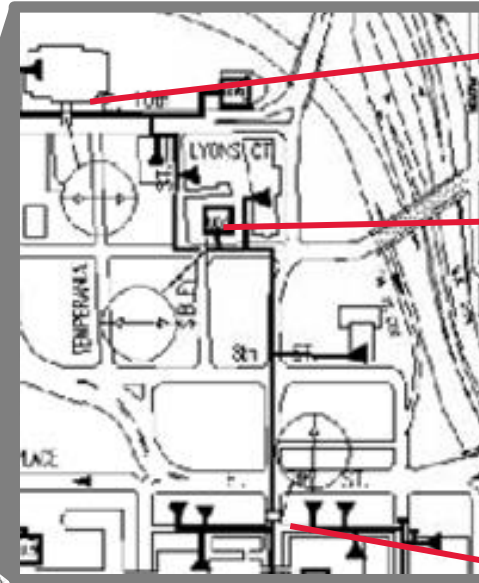
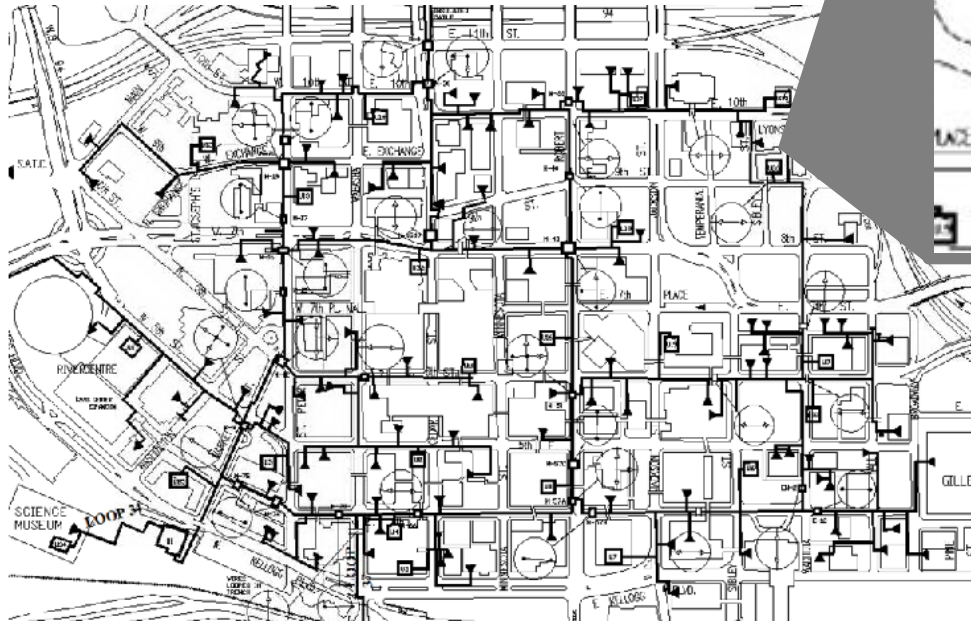
Pre-Insulated Hot Water Pipe



Monitoring System Components



Pipeline Leak Detection System



Section end

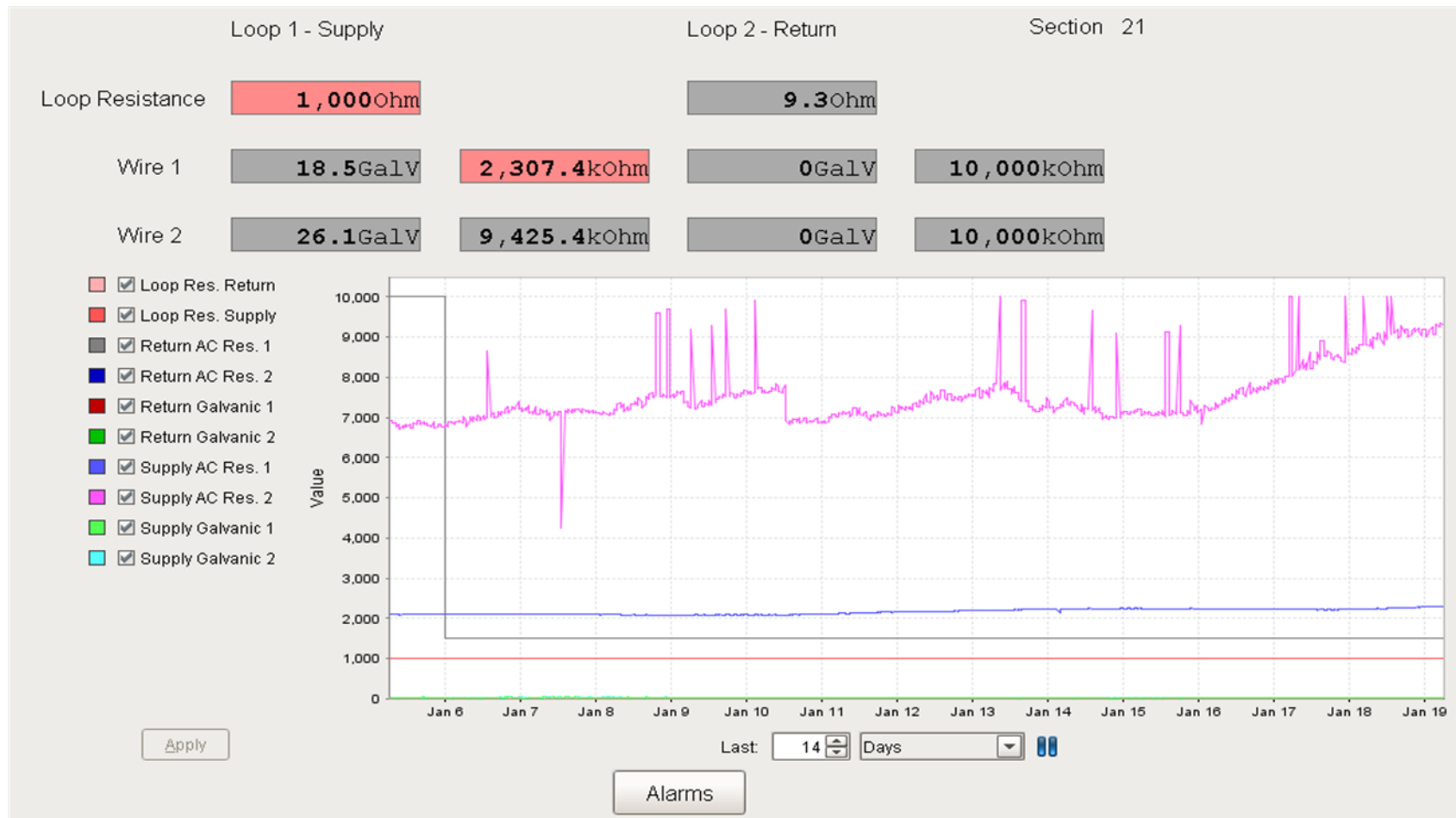
Monitoring
system unit
in customer
mechanical
room

Section end

Hot Water Pipe Monitoring System - Pipeguard



Pipe Monitoring System Report



Leak Locating Technology



Portable Leak Locating System - Stateview



Leak Location – How it Works

- Functions similarly to sonar, but instead of sound pulses, electrical pulses are sent along the leak detection wire.
- Pulse returns reflections from several different sources:
 - a field joint
 - moisture condition
 - shorted leak detection wire to the steel pipe
 - break in the wire
 - natural deviations in the pre-insulated pipe.
- Like, sonar, we are able to read the distance to the various reflections.
- The two factors for calculating the distance to the fault or deviations, is the velocity (speed of the pulse traveling along the wire) and the time it takes the pulse to reach the fault or deviation.



Stateview Multi-Meter Tool & TDR Curve



Status 0 & TDR Curve - Baseline

Measured 8/14/2012 2:16:25PM

Baseline

Normal curve

Measured by Gerry Gubash

Range	Gain	Pulse	Vel
500	13	80	930

Loop res 4,2 Ω

Galvanic voltage 0 mV

DC res 0

AC res 99999999 k Ω

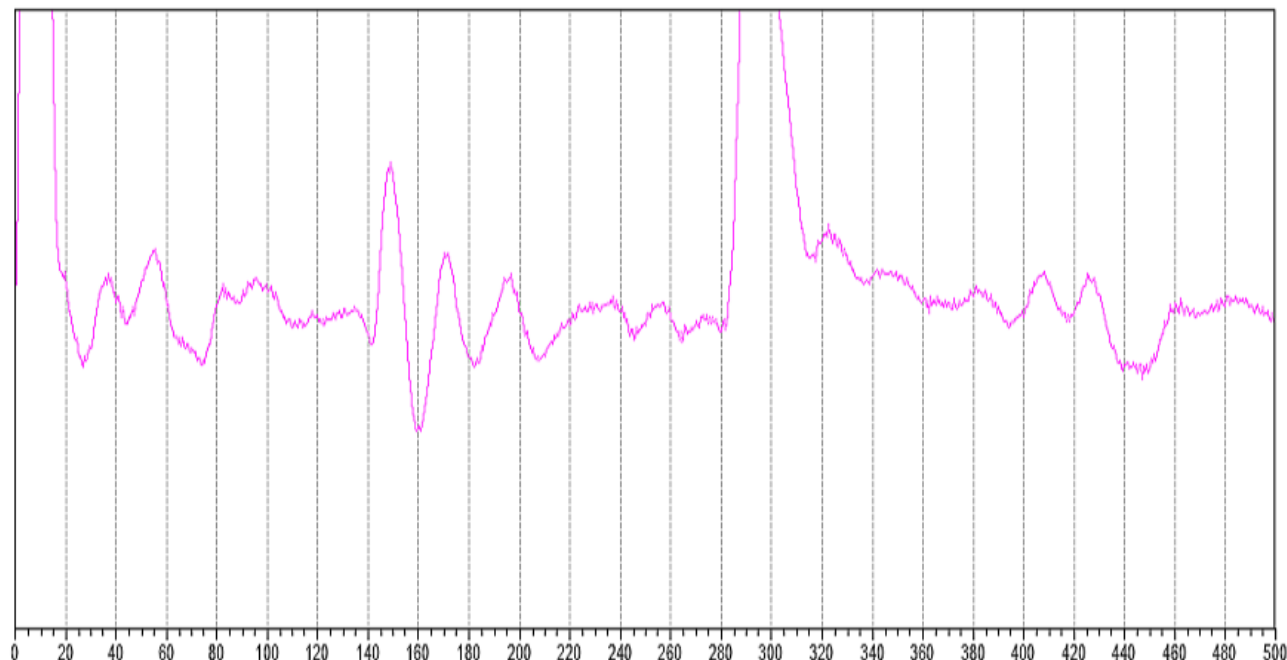
Megger M Ω

Manual status No

Status 0

OK

No remarks



Status 20 & TDR Curve – Evidence of Pipe Leak

Measured 7/2/2008 11:32:14AM

Troubleshooting

Normal curve

Measured by Gerry Gubash

Range	Gain	Pulse	Vel
500	20	20	930

Loop res 449,0 Ω

Galvanic voltage 264 mV

DC res 1

AC res 0,30 k Ω

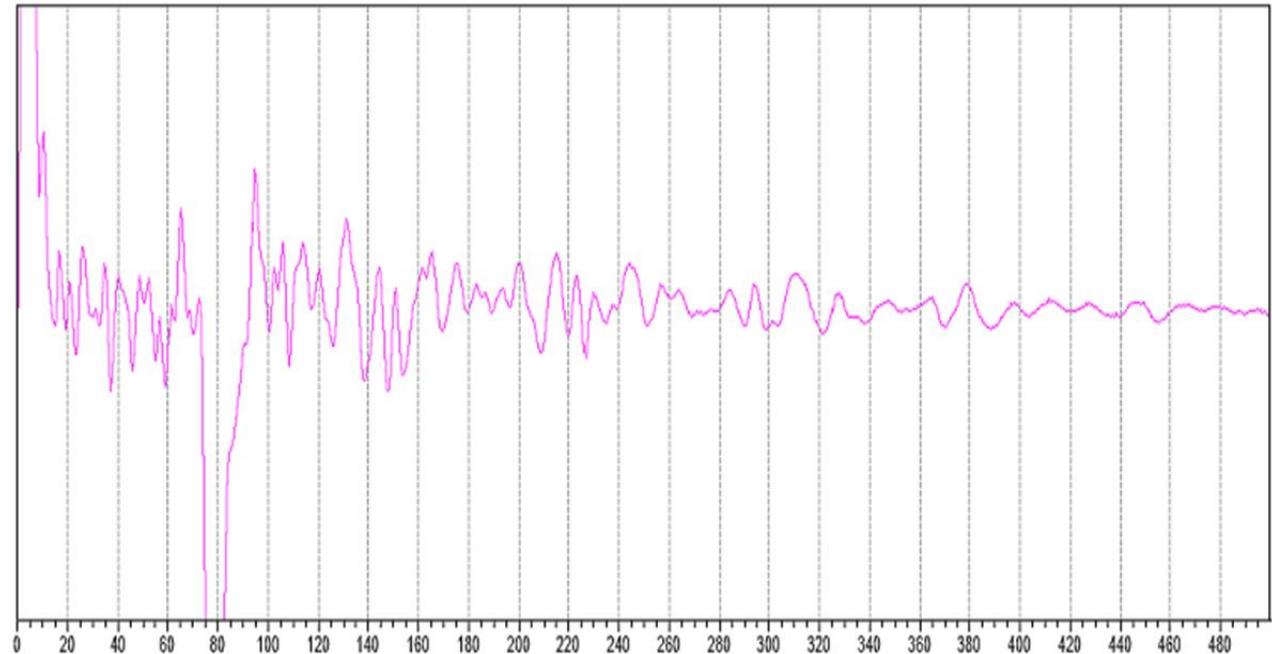
Megger M Ω

Manual status No

Status 20

Very clear indication of H2O (not located)

Observation



The Value of Early Detection



Early Detection – Status 11

Measured 12/17/2009 12:24:08PM

Measurement after repair

Normal curve

Measured by Gerry Gubash

Range	Gain	Pulse	Vel
250	20	20	930

Loop res 99999 Ω

Galvanic voltage 411 mV

DC res 1

AC res 3080 k Ω

Megger M Ω

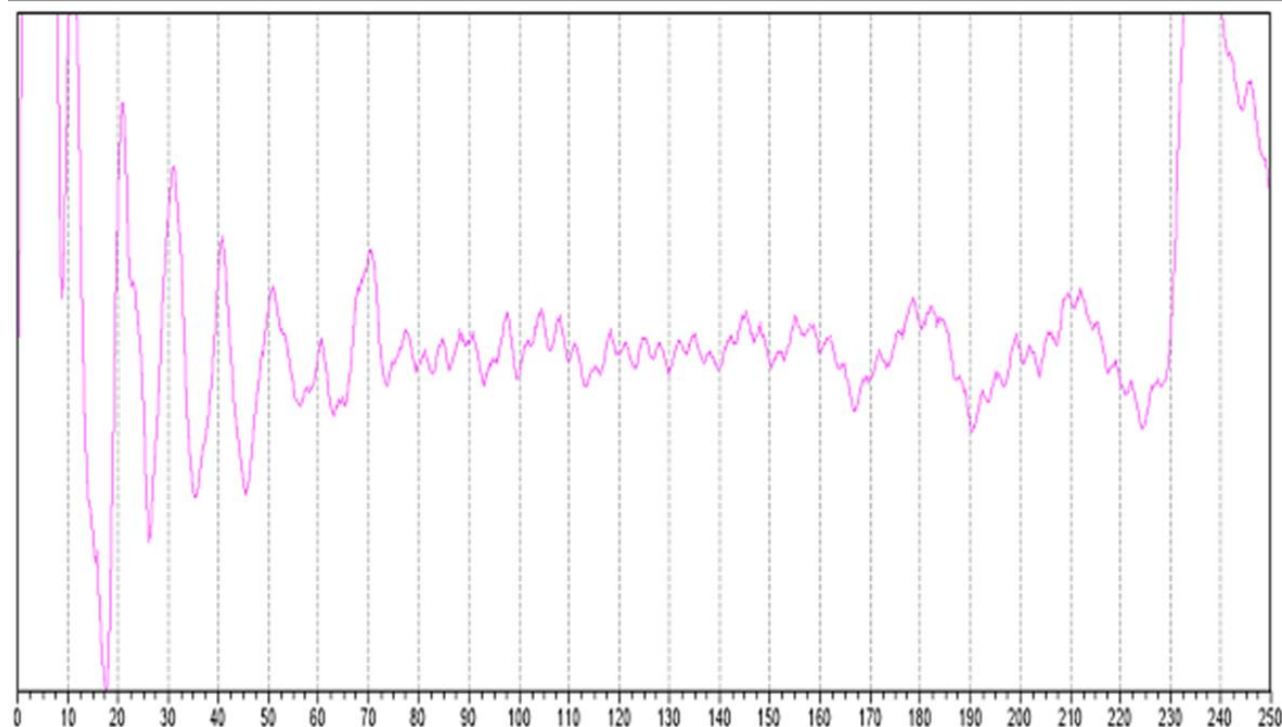
Manual status No

Status 11

Indication of H2O (not located)

Observation

Remark



Early Detection – Status 17

Measured 1/12/2011 1:21:22PM

Kontroll, se anmärkning

Normal curve

Measured by Gerry Gubash

Range	Gain	Pulse	Vel
250	20	20	930

Loop res 99999 Ω

Galvanic voltage 508 mV

DC res 1

AC res 203 k Ω

Megger M Ω

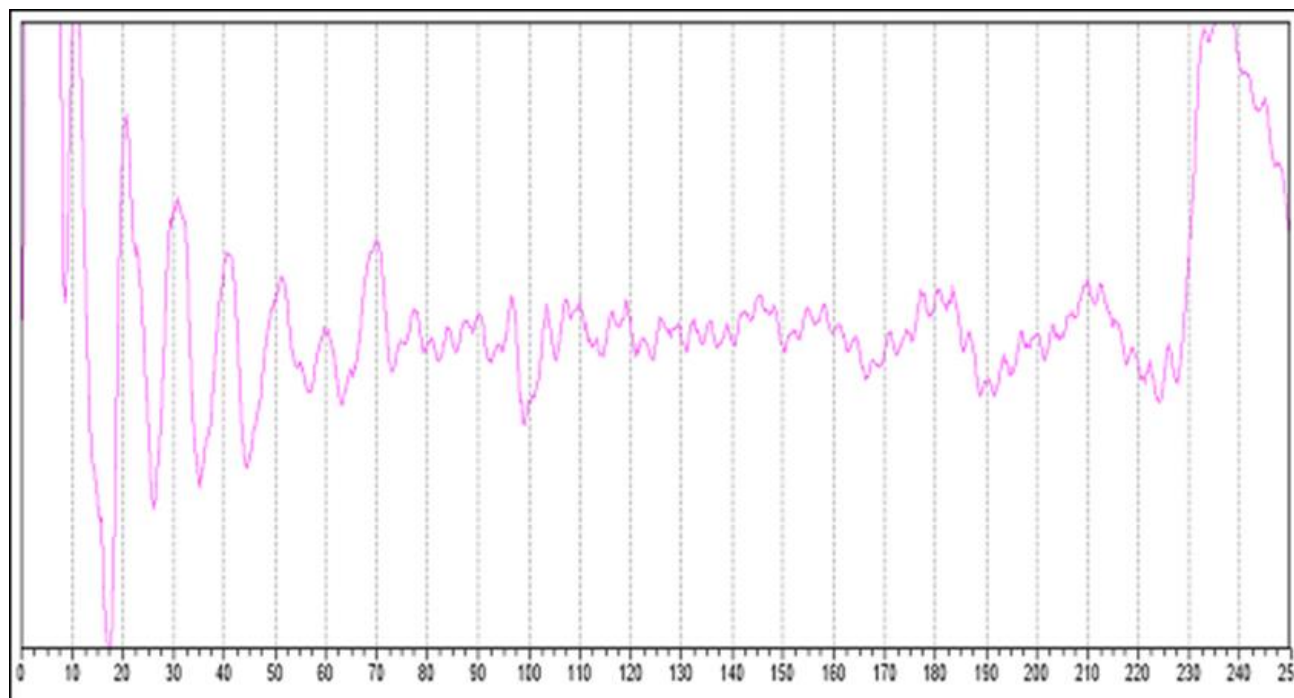
Manual status No

Status 17

Very clear indication of H2O (not located)

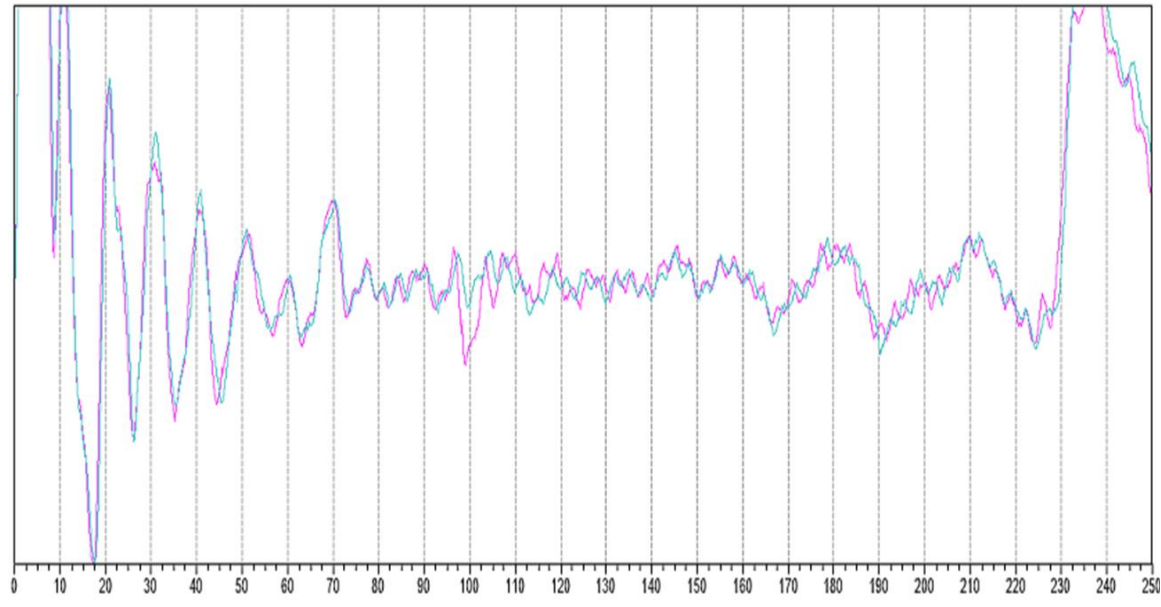
Observation

Remark

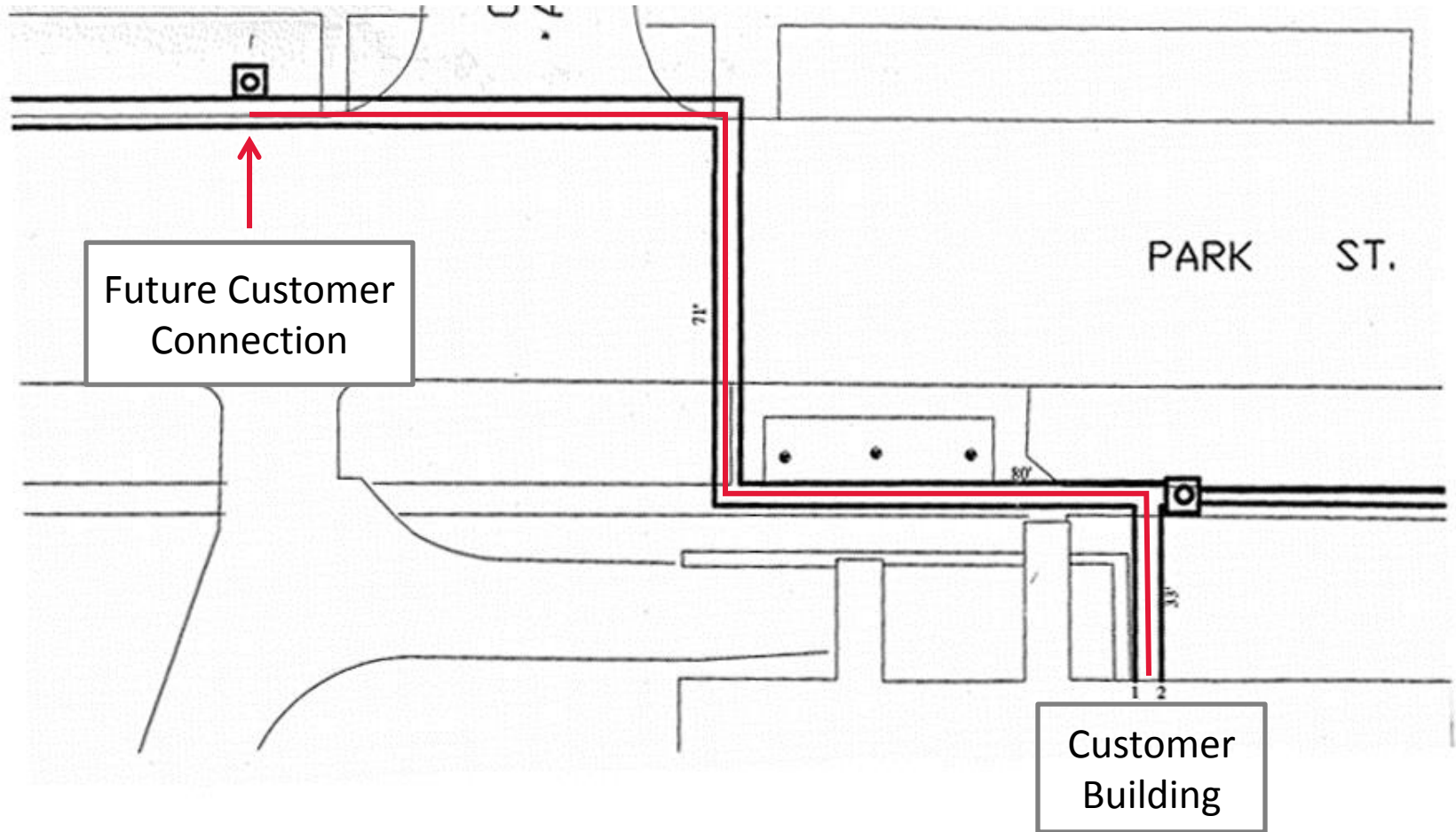


Early Detection – Comparison of Progression

Measure place bethesda				Measure place bethesda			
Loop return		Pipe right		Loop return		Pipe right	
Pipe type		Wire 1		Pipe type		Wire 1	
Direction				Direction			
Measured 12/17/2009 12:24:08PM				Measured 1/12/2011 1:21:22PM			
Measurement after repair				Kontroll, se anmärkning			
Normal curve				Normal curve			
Measured by Gerry Gubash				Measured by Gerry Gubash			
Range	Gain	Pulse	Vel	Range	Gain	Pulse	Vel
250	20	20	930	250	20	20	930
Loop res		99999 Ω		Loop res		99999 Ω	
Galvanic voltage		411 mV		Galvanic voltage		508 mV	
DC res		1		DC res		1	
AC res		3080 k Ω		AC res		203 k Ω	
Megger		M Ω		Megger		M Ω	
Manual status		No		Manual status		No	
Status		11		Status		17	
Indication of H2O (not located)				Very clear indication of H2O (not located)			
Observation				Observation			



Early Detection – TDR Curve to Drawing



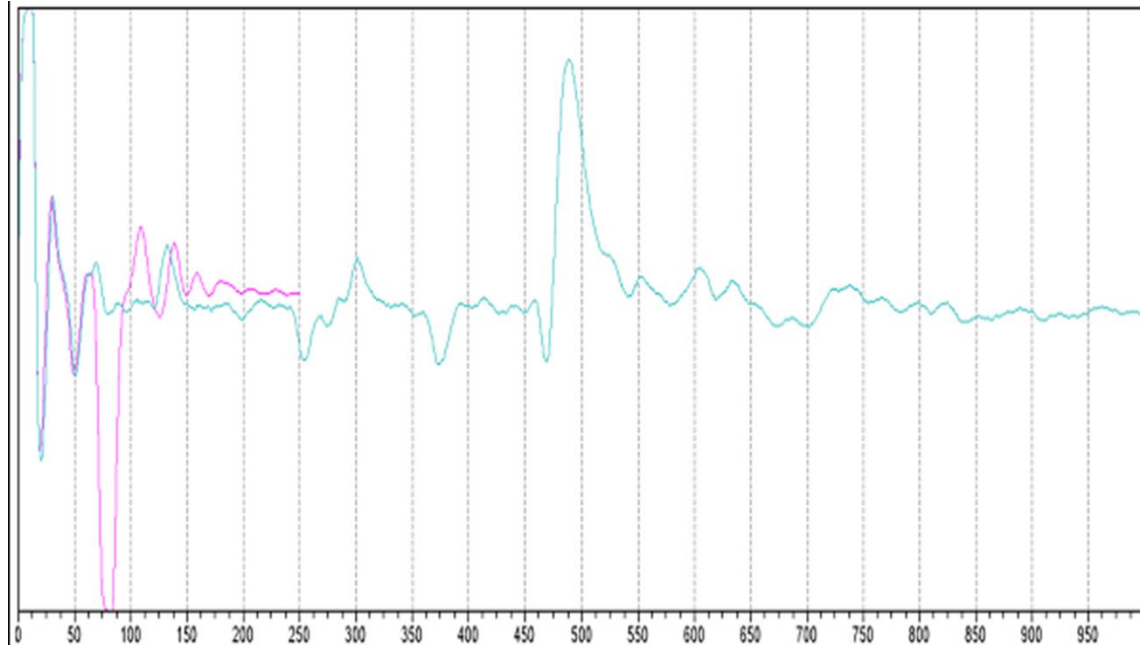
Effects of City Water Main Failure



Water Main Failure – Comparison of Progression

Measure place Straus			
Loop supply	Pipe left		
Pipe type	Wire 1		
Direction			
Measured 11/9/2007 11:38:10AM			
Troubleshooting			
Close up			
Measured by Gerry Gubash			
Range	Gain	Pulse	Vel
500	20	20	930
Loop res 99999 Ω			
Galvanic voltage 201mV			
DC res 1			
AC res 1290 k Ω			
Megger M Ω			
Manual status No			
Status 12			
Indication of H2O (not located)			
Observation			
Remark			

Measure place Straus			
Loop supply	Pipe left		
Pipe type	Wire 1		
Direction			
Measured 1/23/2009 10:02:43AM			
Measurement after repair			
Normal curve			
Measured by Gerry Gubash			
Range	Gain	Pulse	Vel
250	20	20	930
Loop res 99999 Ω			
Galvanic voltage 471mV			
DC res 1			
AC res 6 k Ω			
Megger M Ω			
Manual status No			
Status 20			
Very clear indication of H2O (not located)			
Observation			
Remark			



Water Main Failure - Insulation and Jacket Repair



Lessons Learned

- Early detection directly relates to cost savings and system reliability.
- Monitoring helps with planned maintenance and avoiding emergency repairs.
- Staff training is essential.
- One dedicated distribution team member is responsible for leak detection.
- Third-party monitoring and leak detection service and training consultation.



Questions?



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Extra slides



Electro – Fusion Joint

