This presentation premiered at WaterSmart Innovations

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INNOVATIONS

Syrinix

Intelligent Pipeline Monitoring

Monitoring Solutions for pipelines

Watersmart Innovartions 2016

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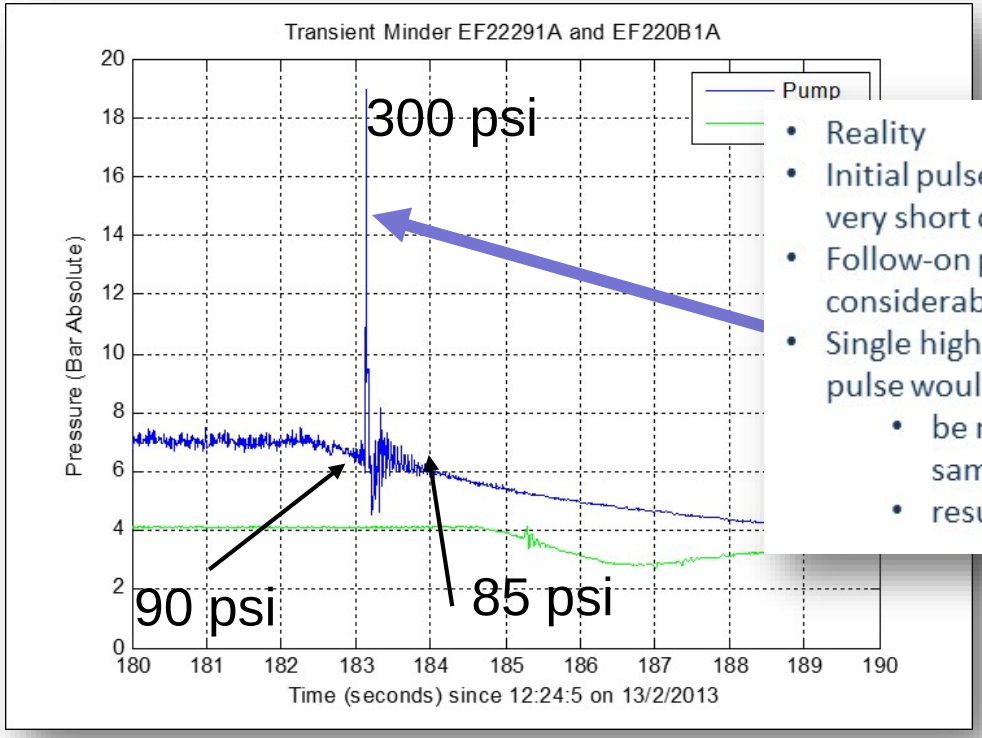
Network Calming Through the use of SMART Systems

Reduce risk, leaks breaks, water loss and costs by using information to eliminate transients

Typical Pressure wave velocities in pipe	
Steel pipe	>3000 feet per second
Cast Iron pipe	>3200 feet per second
AC pipe	3000 feet per second



- Reality
- Initial pulse very powerful but very short duration
- Follow-on pressure pulses considerably less powerful
- Single high pressure transient pulse would likely
  - be missed by less rapid sampling rate
  - result in false assurance

So What?

- There is a direct relationship between Pressure and leakage rates
- Eliminate pressure surges to reduce leakage
- Reduce pressures to reduce leakage

Water Hammer, or Transients

- **“The Proper opening and closing of valves is fundamental to safe pipeline operation”**
- **An example:**
- **800 ft long pipeline, water flowing at 4 ft per second**
- **The pressure in the line at the downstream valve is 60psi**
- **If the valve is closed over a 10 second period, the pressure increases to 82psi, i.e. water hammer increased pressure by 22 psi**

$$Pf = ((0.070VL)/t)+Pi$$

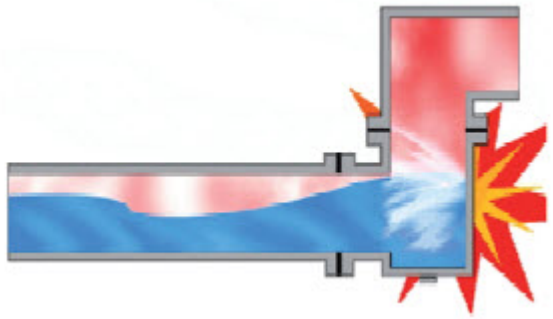
Pf = Pressure resulting from transient (water hammer)
V = Change of velocity of liquid
L = upstream pipe length
t = Valve closing time
Pi = inlet pressure (before transient)

(Source: Baker Corp white paper, May 2016)

But if the same valve is closed in one second….

- Pf = ((0.070VL)/t)+Pi

- Pf = Pressure resulting from transient (water hammer)
- V = 4 ft/second
- L = 800 ft
- t = 1 sec
- Pi = 60 psi



- Pf = ((0.070*4*800)/1)+60
- Pf = **284 psi**
- Water hammer increases the pressure by **224psi**

- NB If flow rate is higher the transient is greater…..
- *“If HDPE DR17 pipe rated at 100 psi was used, it would operate within specifications under normal conditions. If you had the transient situation – failure would result……”*

What Causes Pressure Surges

Rapid Valve Closure

Pump Starts & Stops

Improper Filling Practices

Power Failure

Rapid Changes in Demand

What Are the Risks

- Maximum Pressures

Worst Case: Destroy pipelines, tunnels, valves, pumps, & potential for loss of life

Less Severe: Crack internal lining, damage connections and flanges between pipe sections, cause deformations to equipment such as valves, air valves, and surge protection devices.

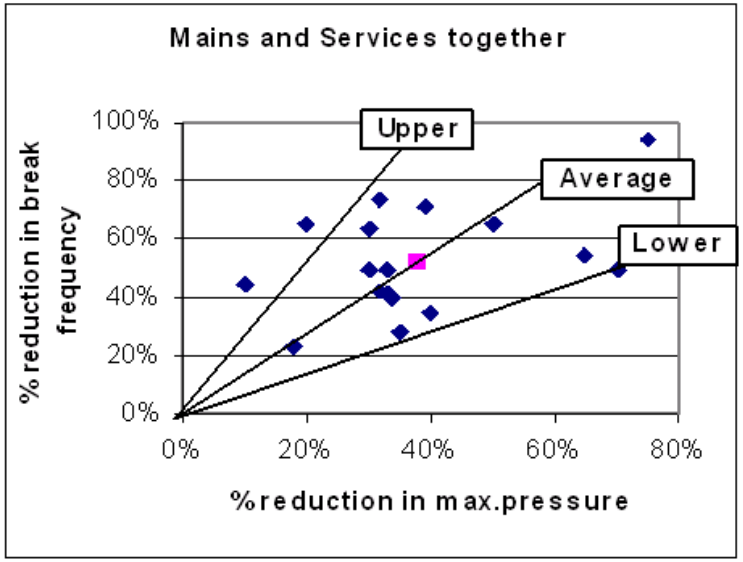
Damage isn't always noted at the time a transient happens

- Vacuum Condition
- Cavitation
- Hydraulic Vibrations
- Water Quality and Health Implications

Boulos, et al, 2005. Hydraulic Transient Guidelines for Protecting Water Distribution Systems, Journal AWWA, 97:5

Eliminate Transients: you reduce leakage

- **Two proactive methods to reduce leakage:**
  - Pressure reduction
  - Pressure Stabilization
- **Direct correlation between reducing the maximum pressures (transients and leakage)**
- **If you reduce the maximum pressure by 15% you will see a 10% reduction in leakage**
- **Transients also impact water quality**
- **But can you reduce the maximum pressure, and by how much?**



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Intelligent Pipeline Monitoring

PIPEMINDER

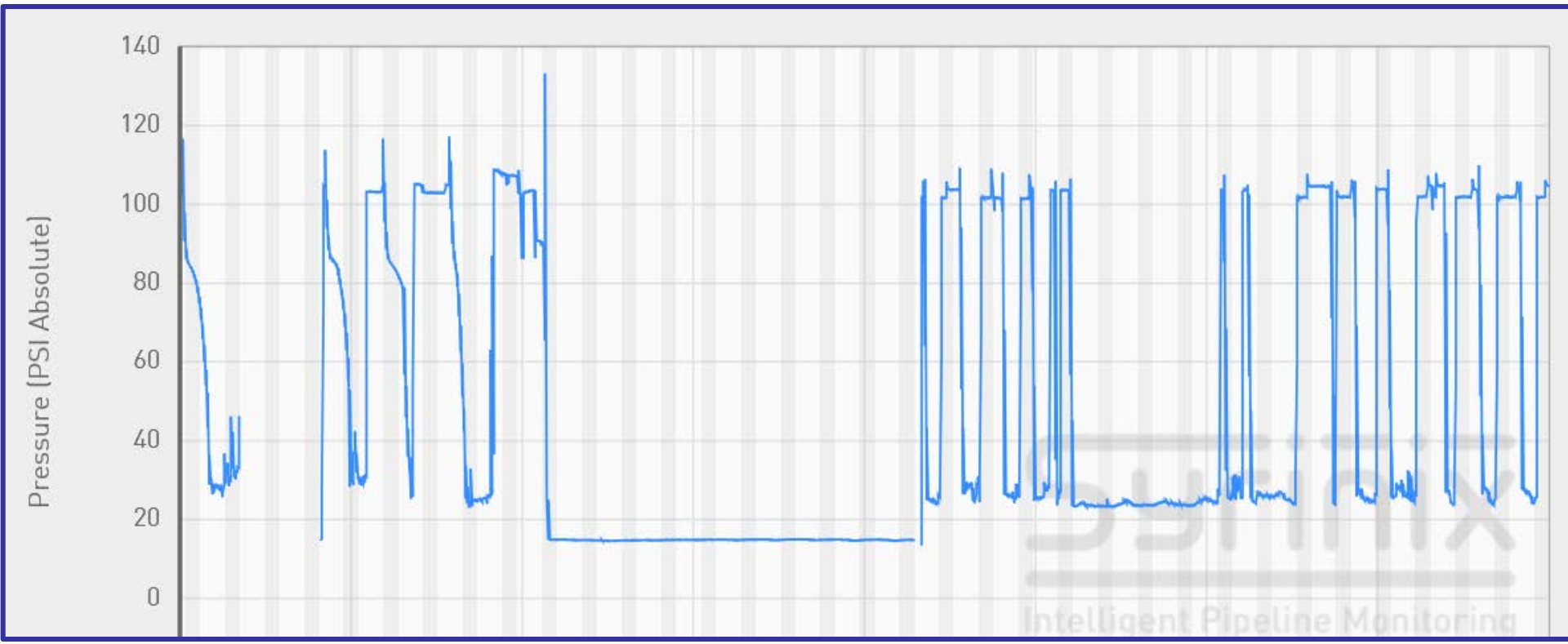
Monitors Pressures at 128 times a second

PipeMinder

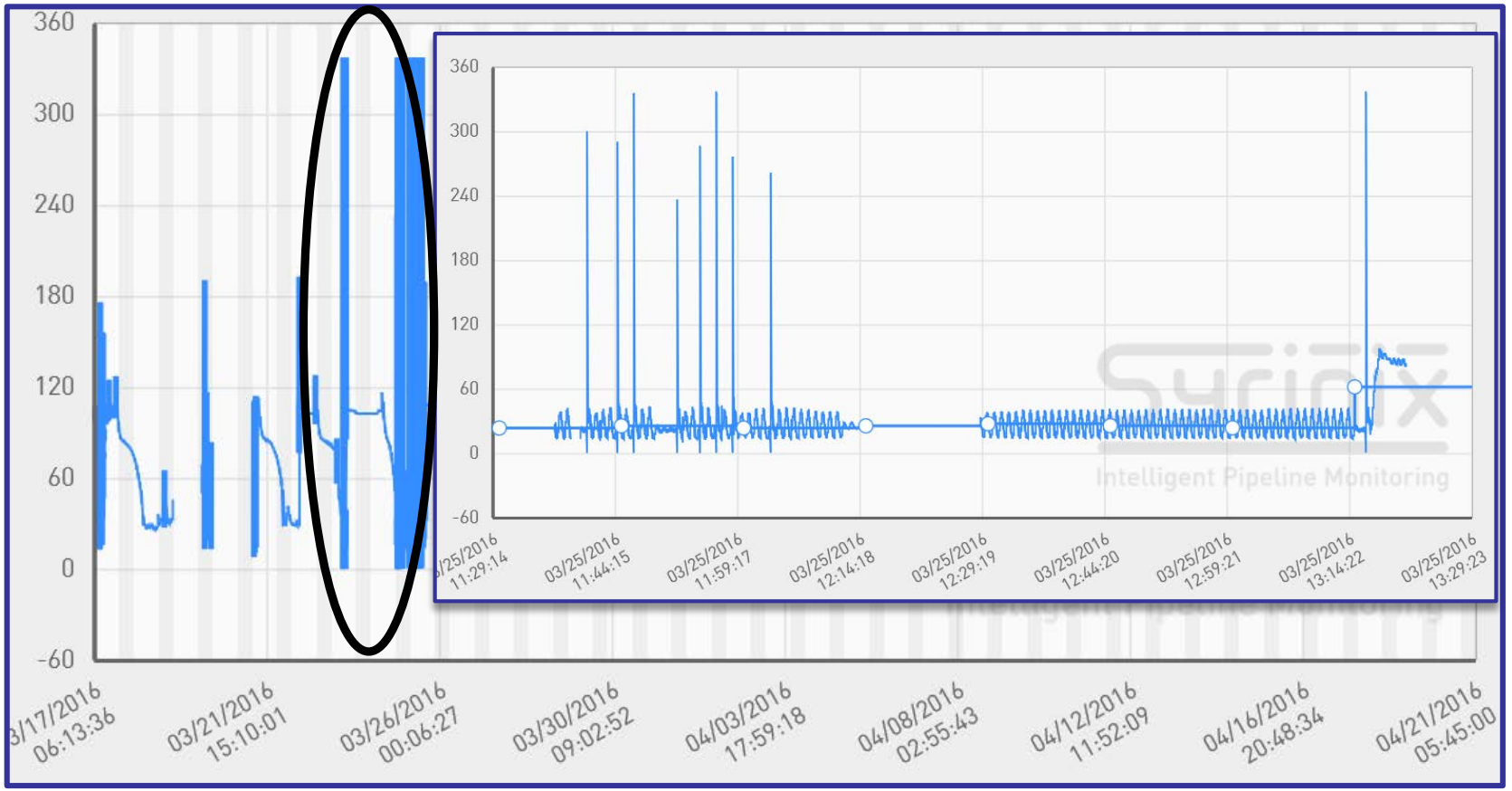
- **Monitors pressure and transients on a pipe or network**
- High sample rate – **128x per second**
- **Always on** at that rate – no accelerating only once transient detected
- Real time event notification
- Units synchronised to support transient tracking
- Battery operated – up to **5 yrs**
- **Waterproof**
- **Works on all pipe sizes**
- Easy to install

DEPLOYMENT

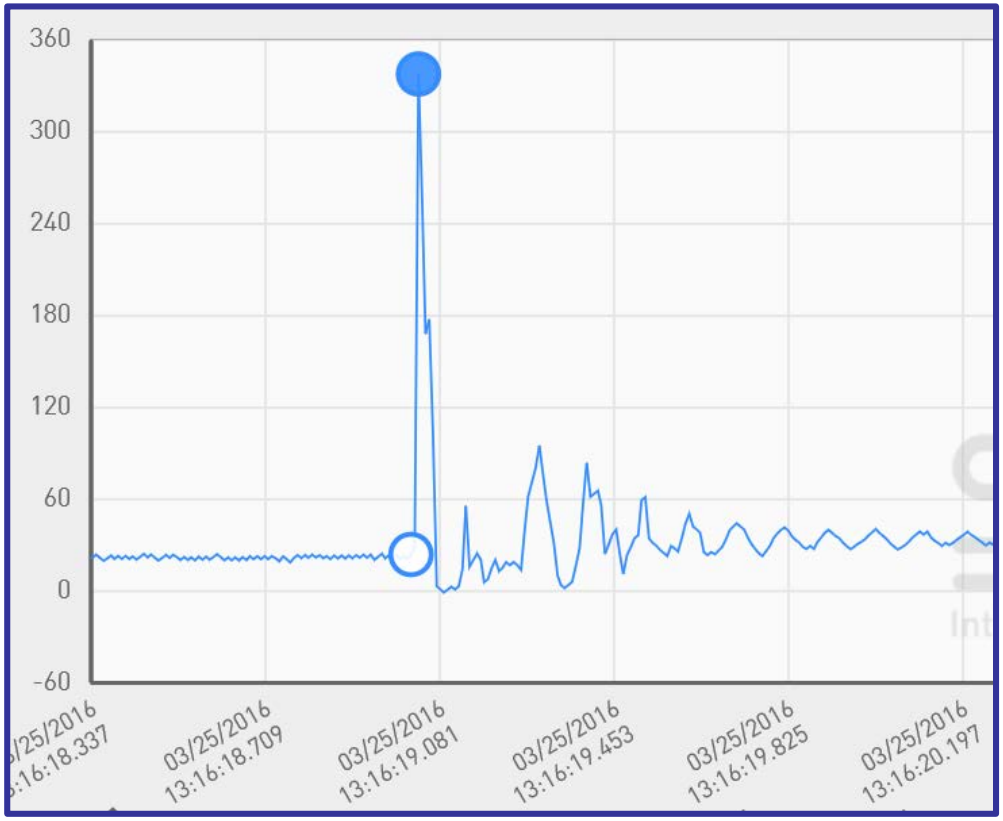
Standard Pressure Monitoring



High Frequency Pressure Monitoring



This Is What Standard Pressure Monitoring Misses!

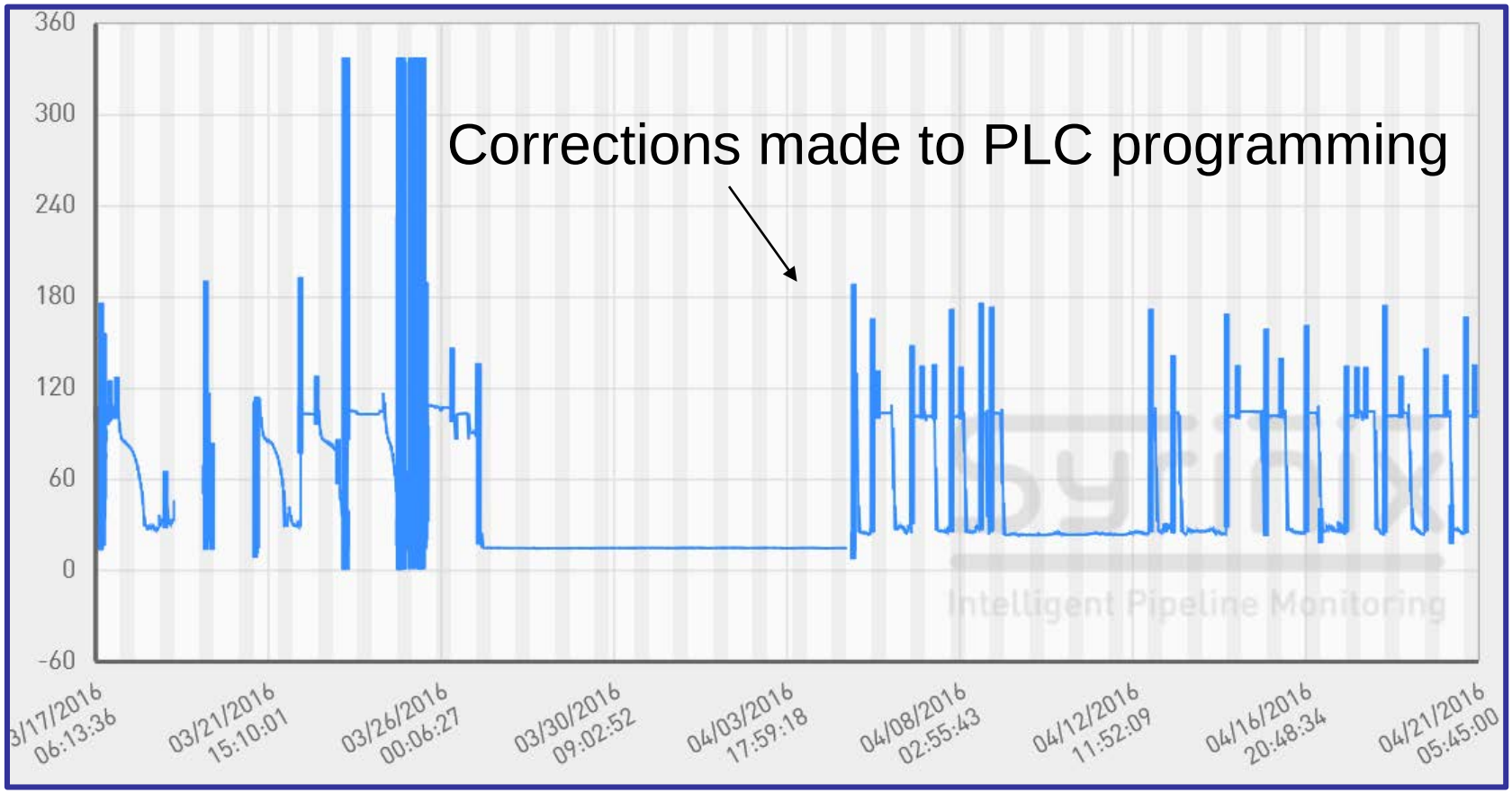


313 Psi change in .016 seconds

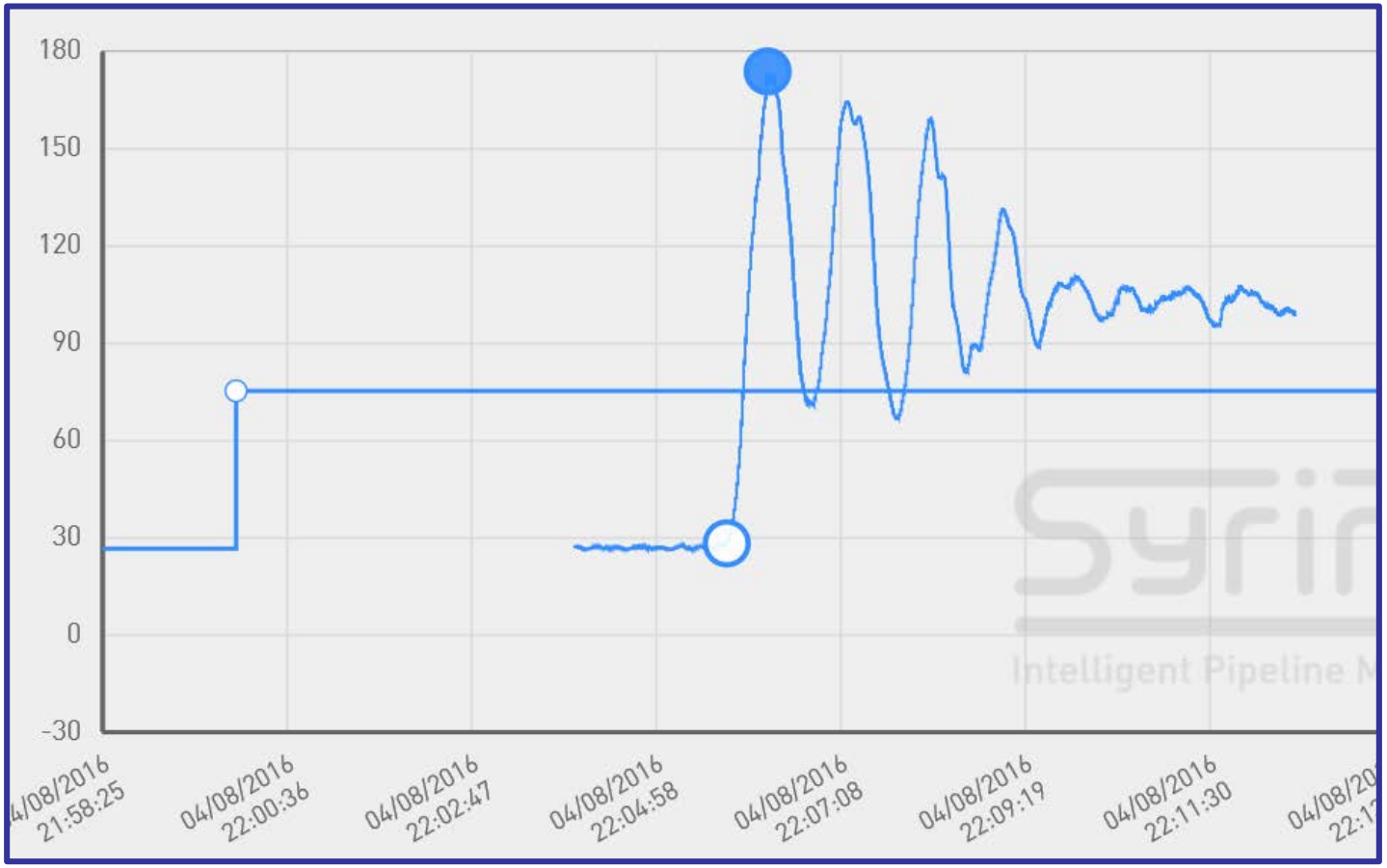
Channel	Value	Time
High Sample P...	23.902	03/25/2016 13:16:1...
High Sample P...	337.865	03/25/2016 13:16:1...

Range: 313.963 (337.865 - 23.902) **Average:** 180.884 **Time Difference:** 0.016 Seconds

Data that Resulted in Improved Operations

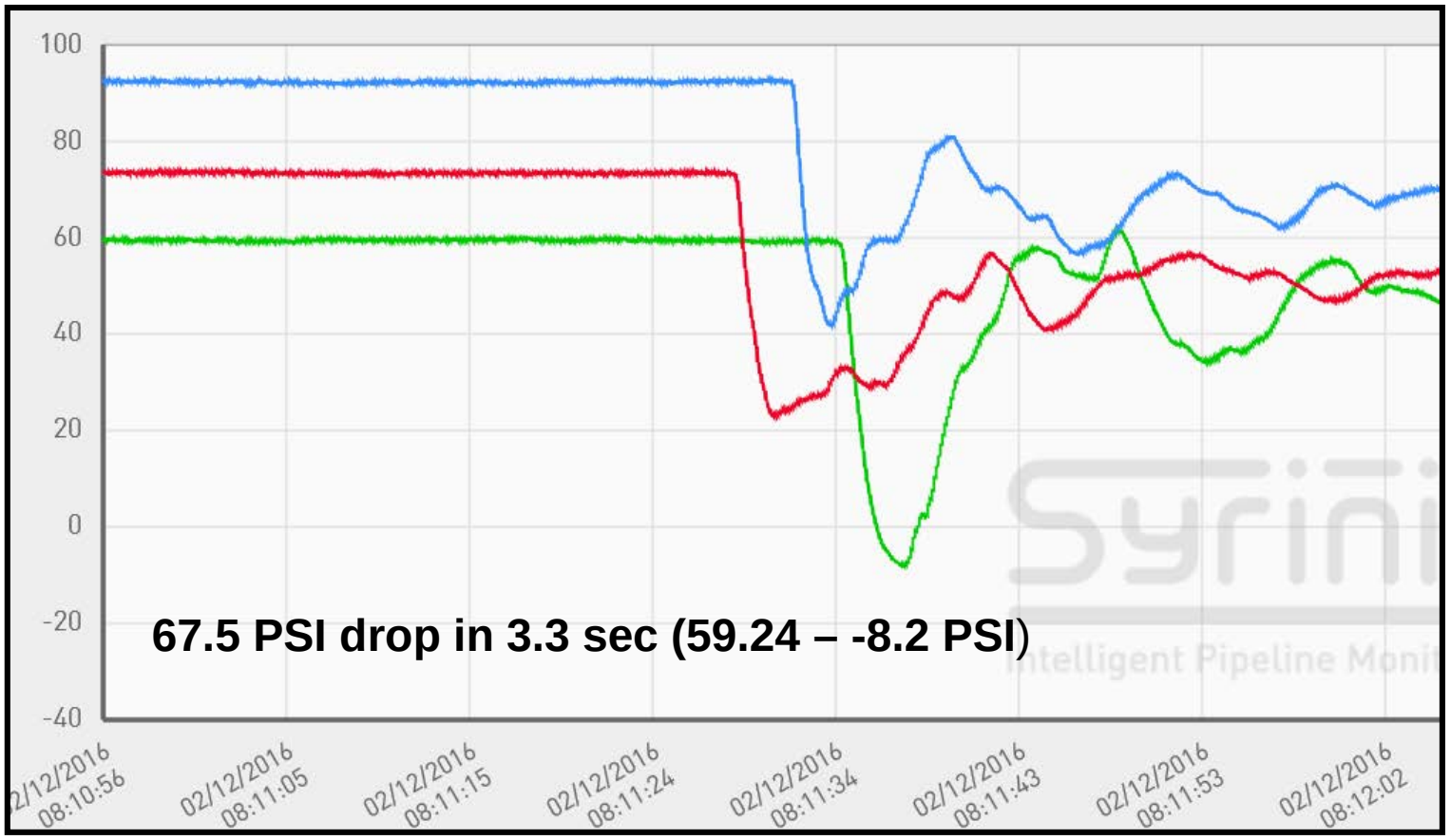


A Calmer System

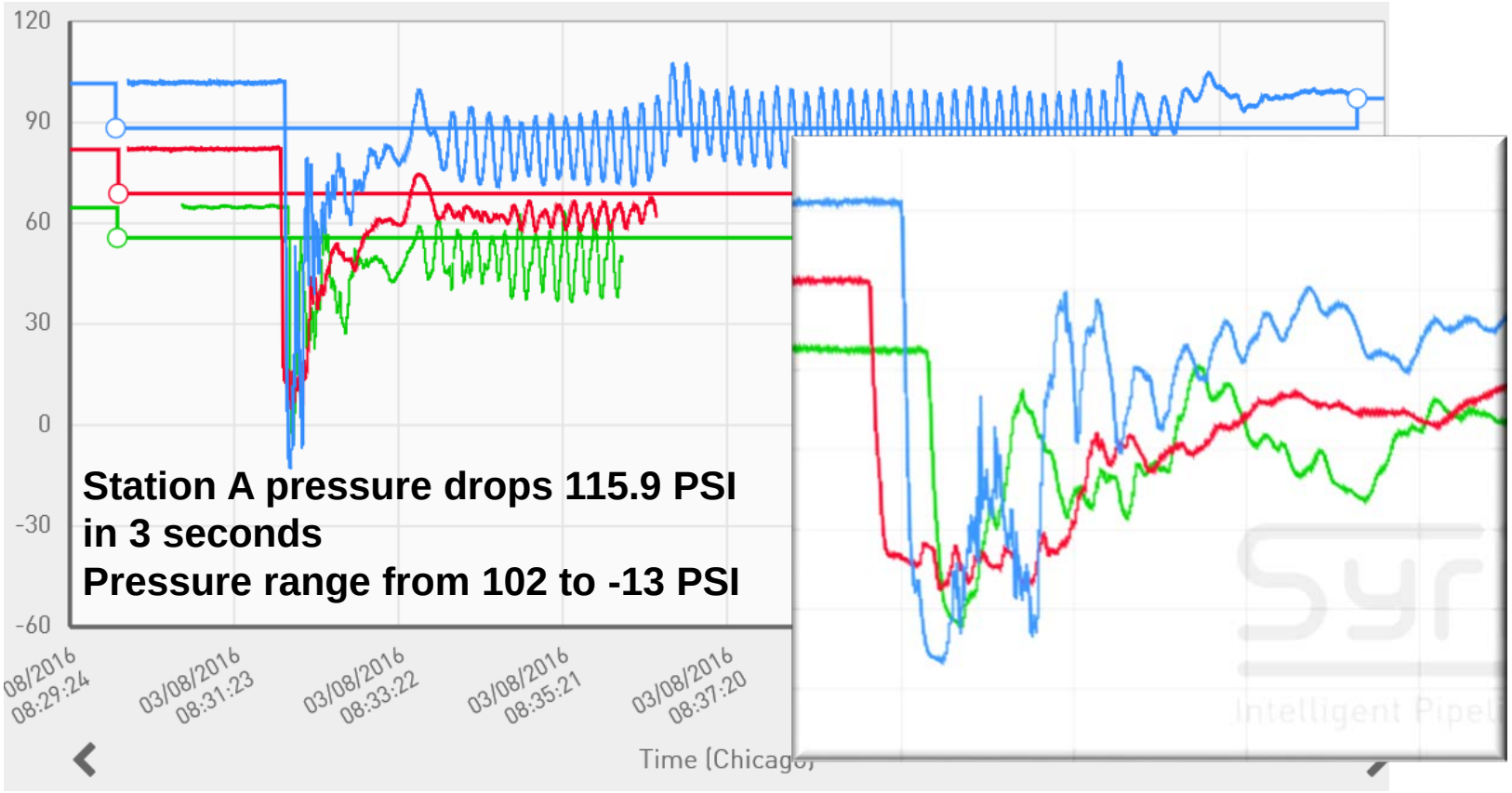


Range: 145.618 (173.886 - 28.268) **Average**: 101.077 **Time Difference**: 29.000 Seconds

Vacuum Conditions Created by Back Spinning Pump



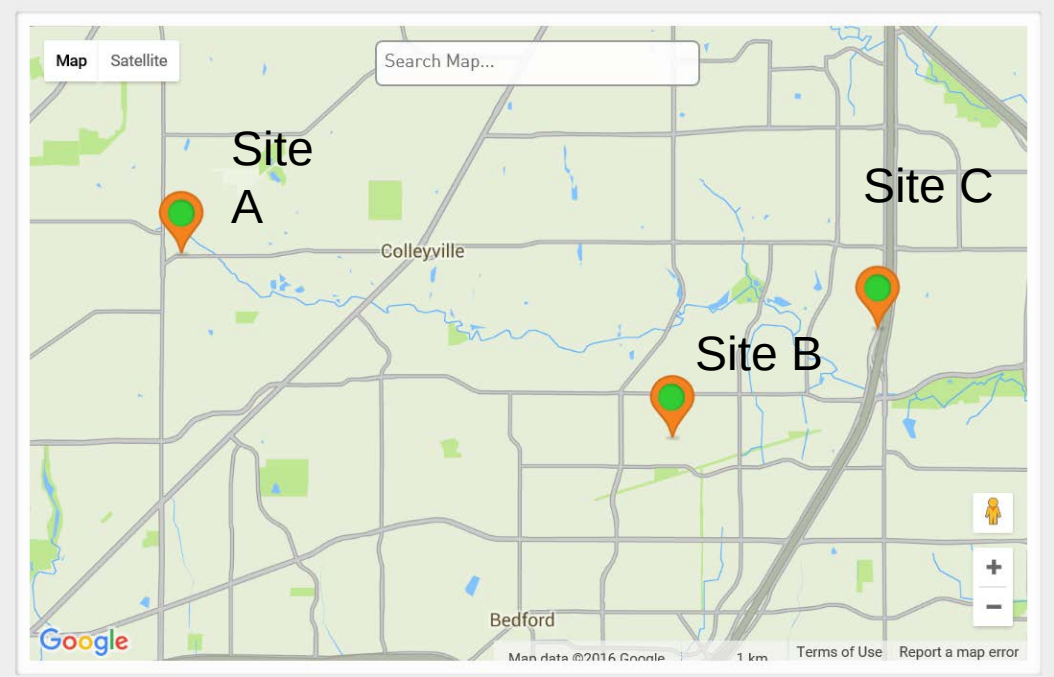
Impacts from a Power Failure



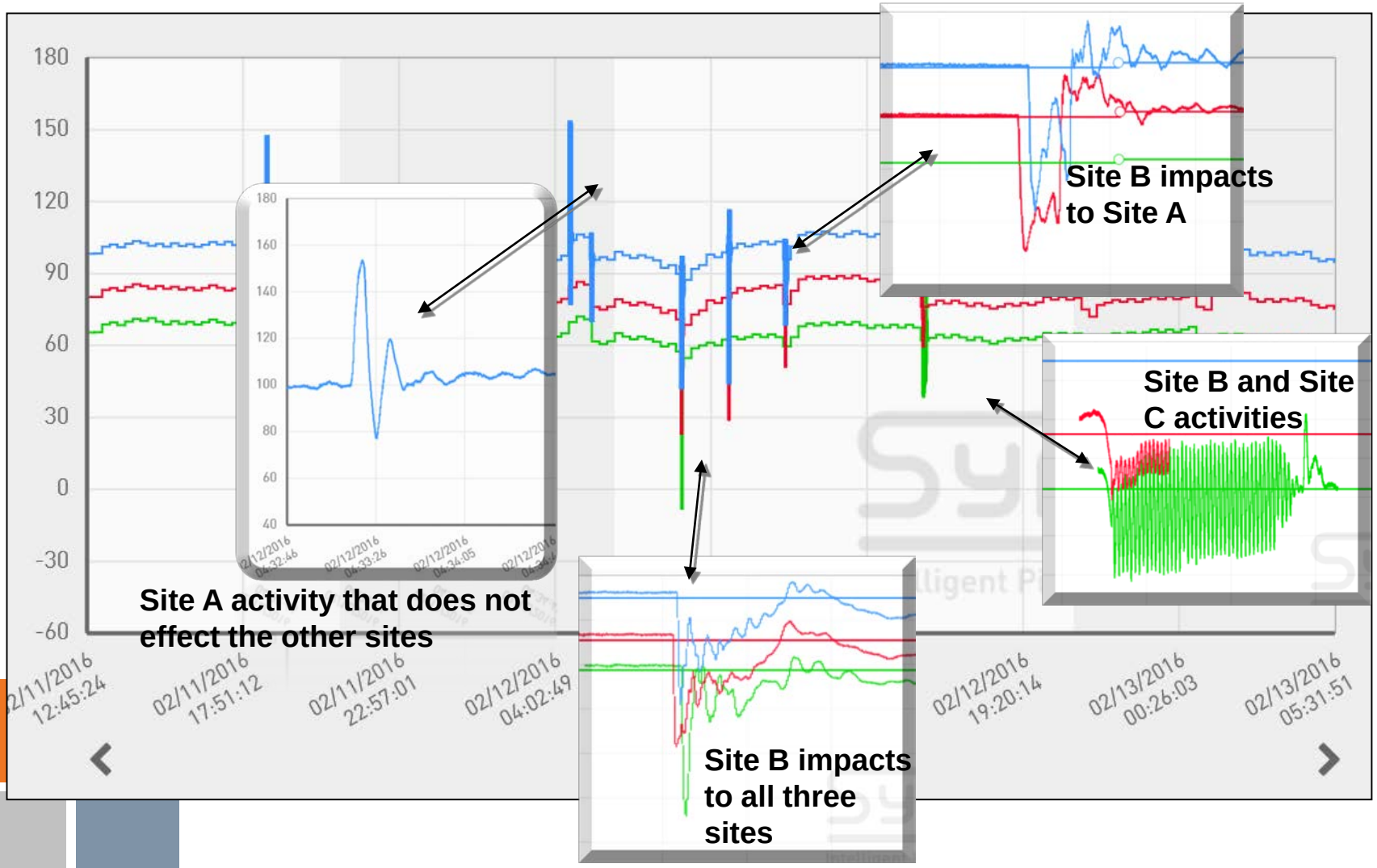
Duration: 14.9 Minutes

PipeMinder Pilot

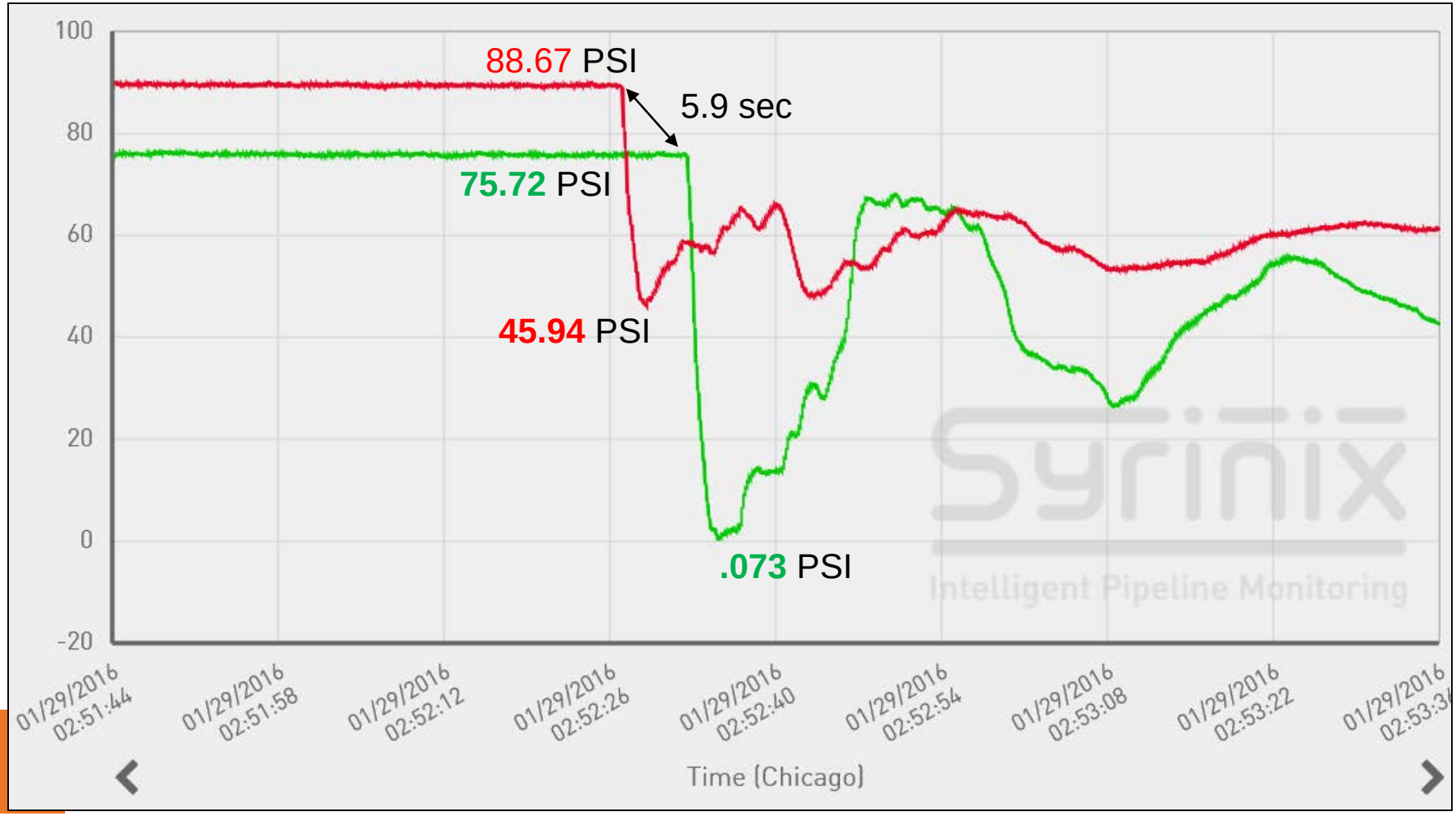
- Installed on January 21, 2016
- Three locations identified as:
  - Site A
  - Site B
  - Site C
- Different pipelines
- Several miles apart



Transients – Source and Impact

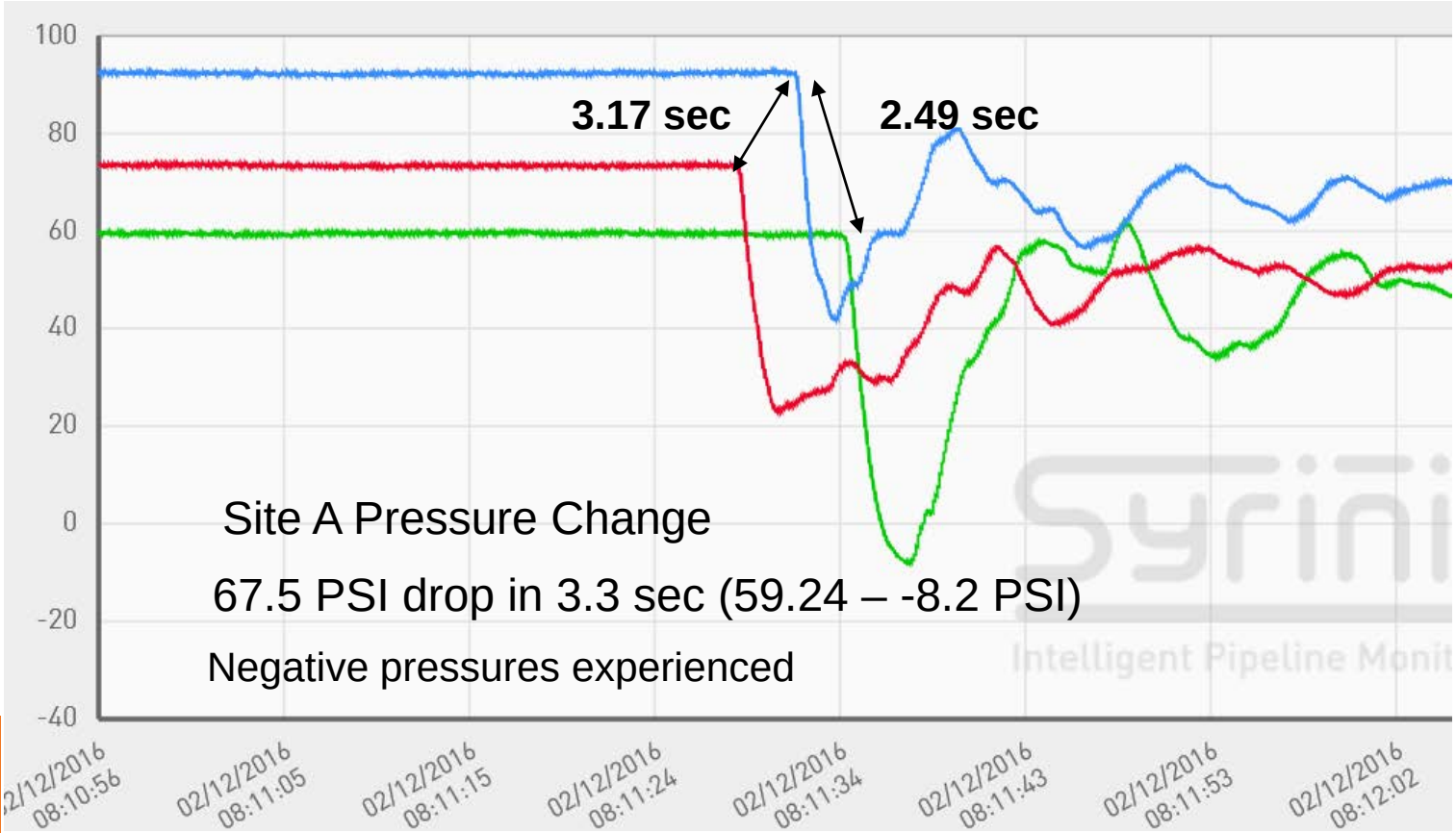


January 29 Event Details

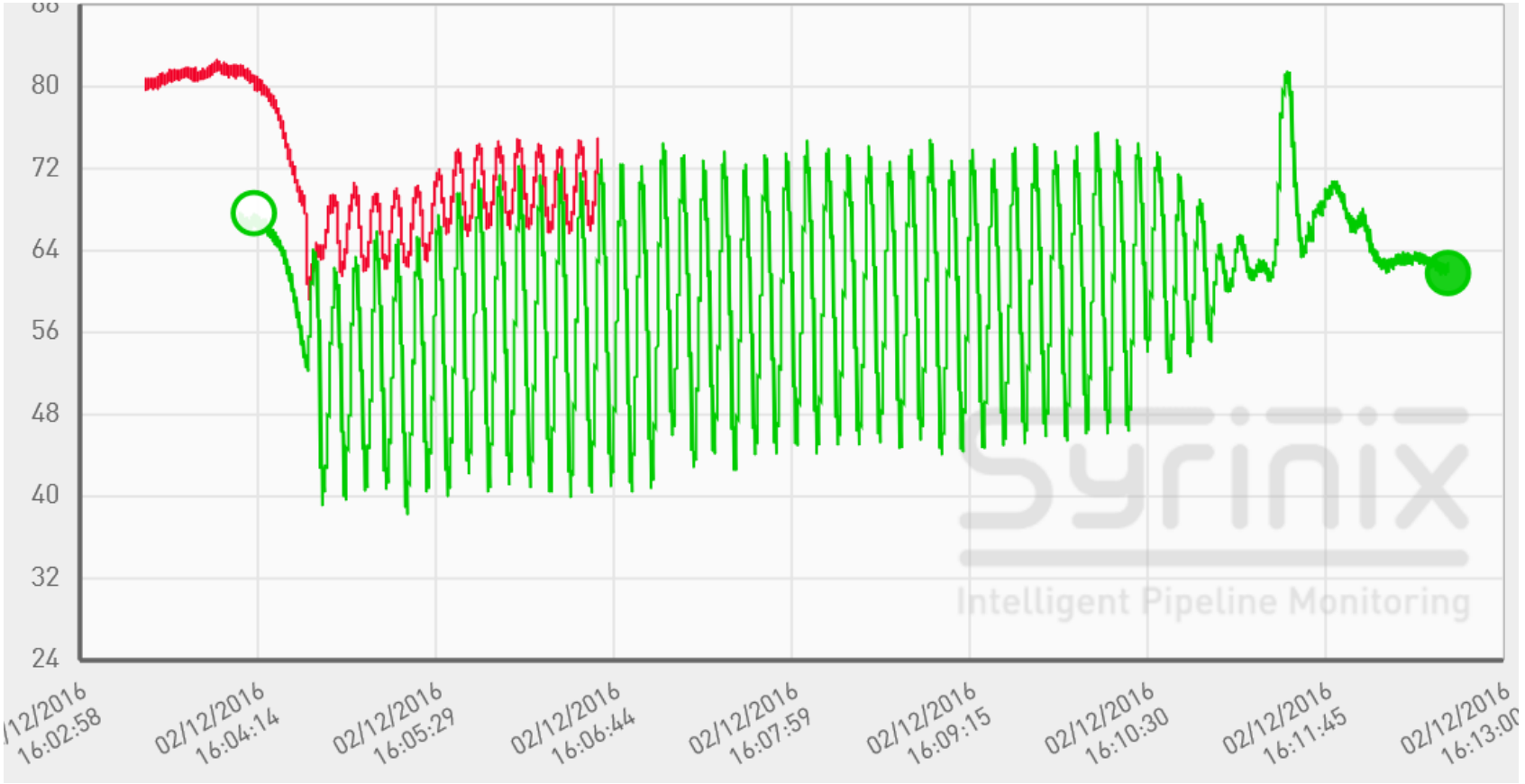


Distance apart: 3.7 Miles
Site B drop in PSI: 40 PSI in 2.11 seconds
Site A drop in PSI: 75.3 PSI in 2.6 seconds

February 12, 2016 Event Details

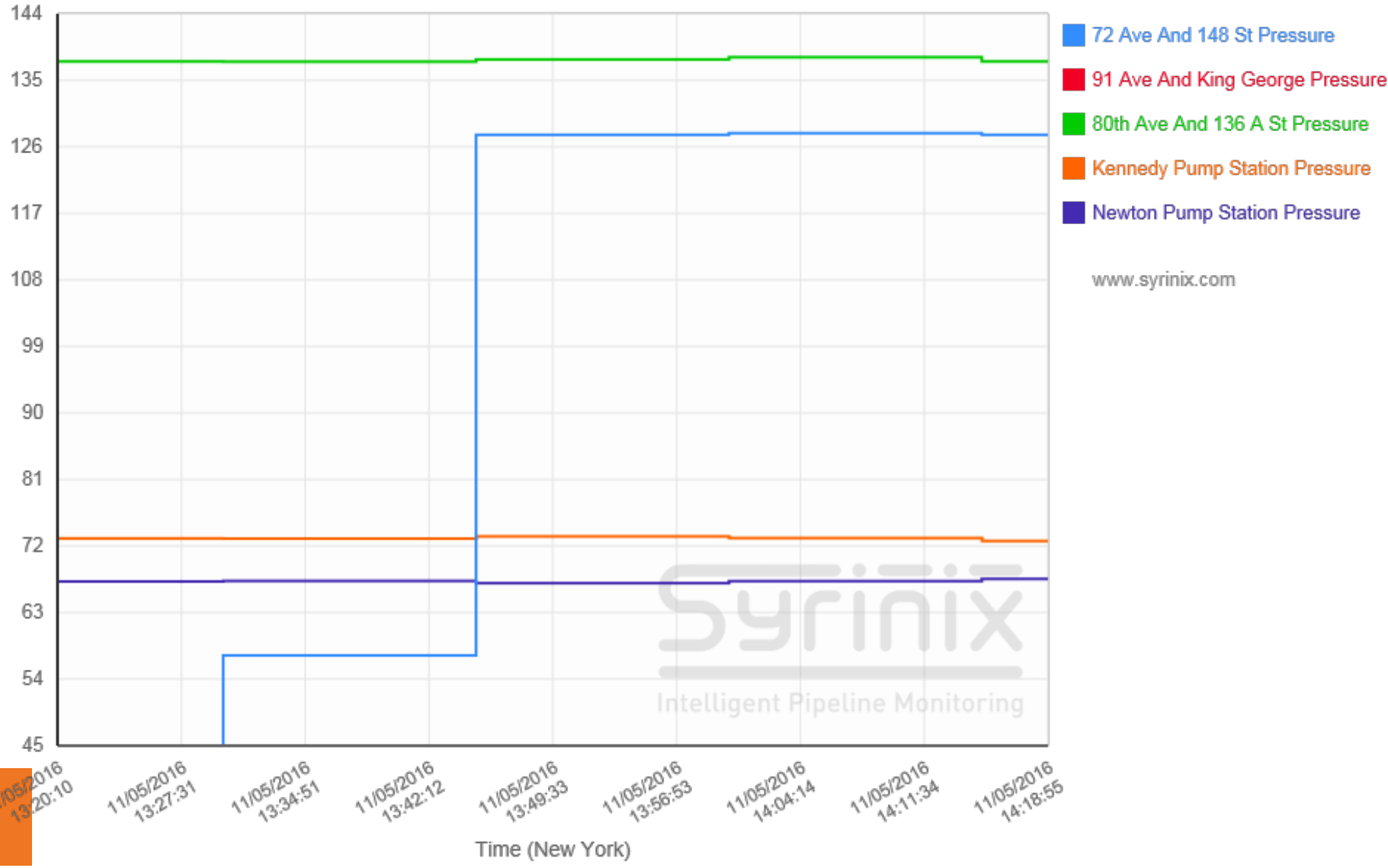


February 12, 2016 – Site B and C

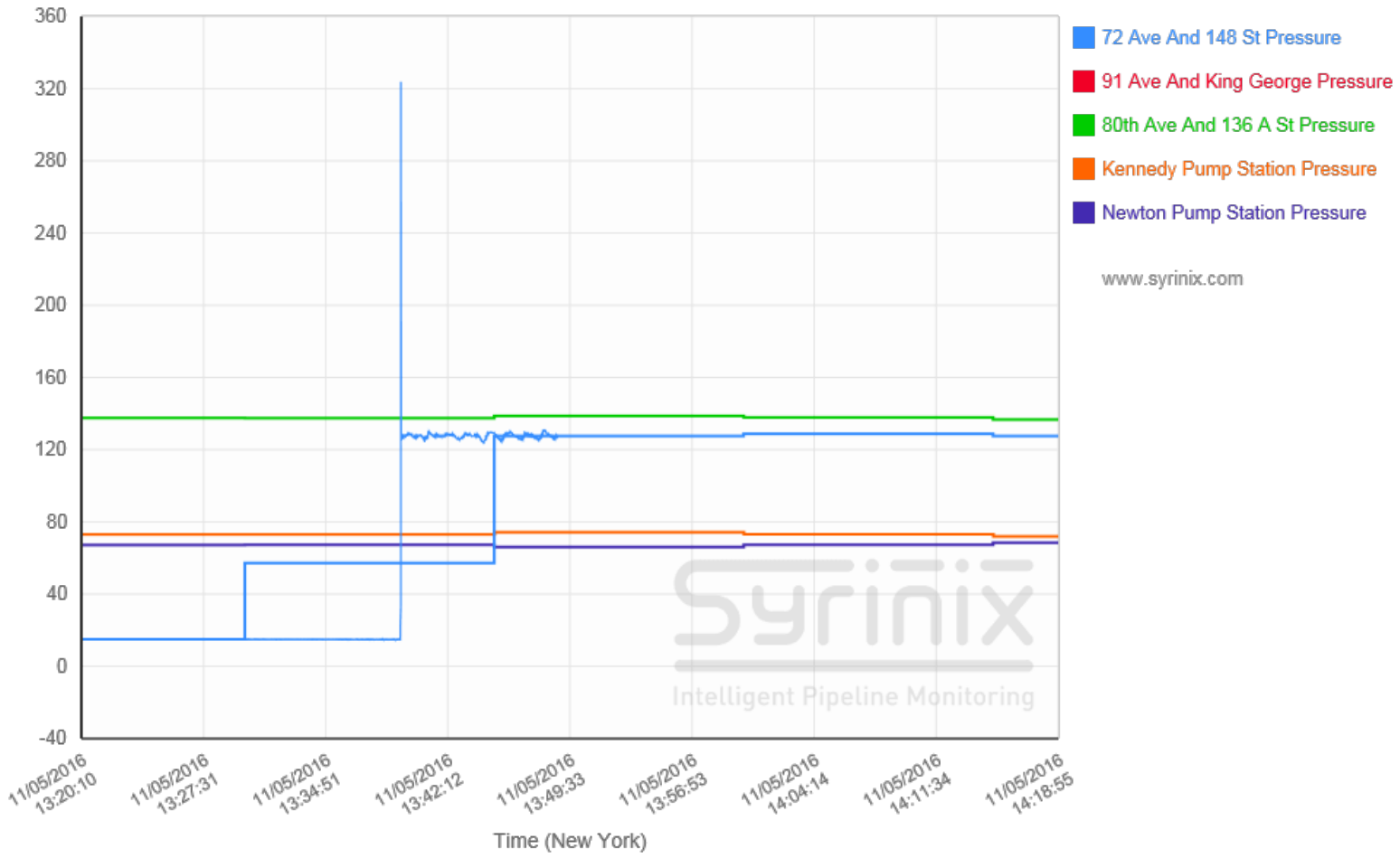


Time elapsed from start of event: 8.42 minutes
40 PSI pressure range

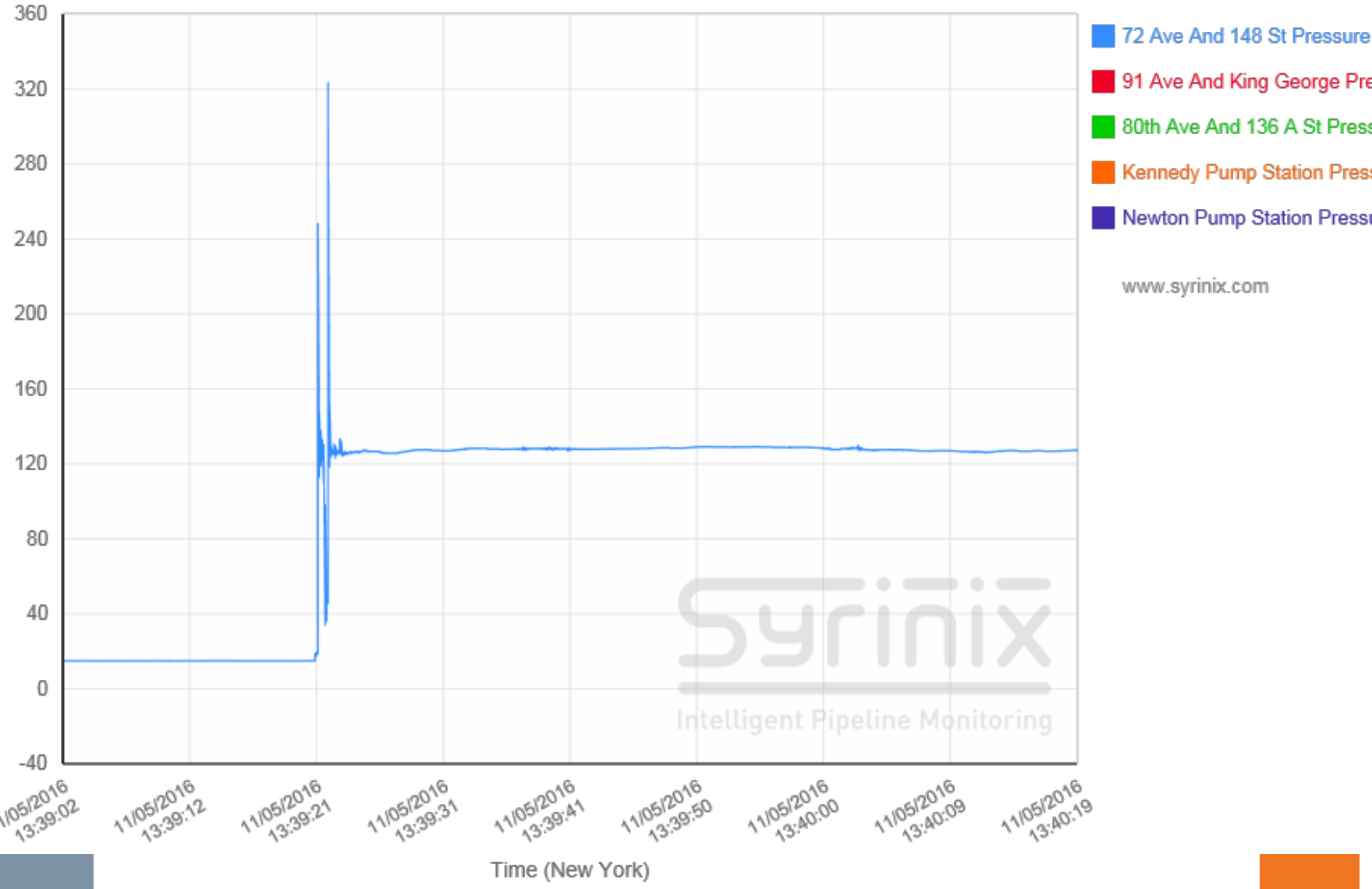
Pump start up: 5 minute sample data

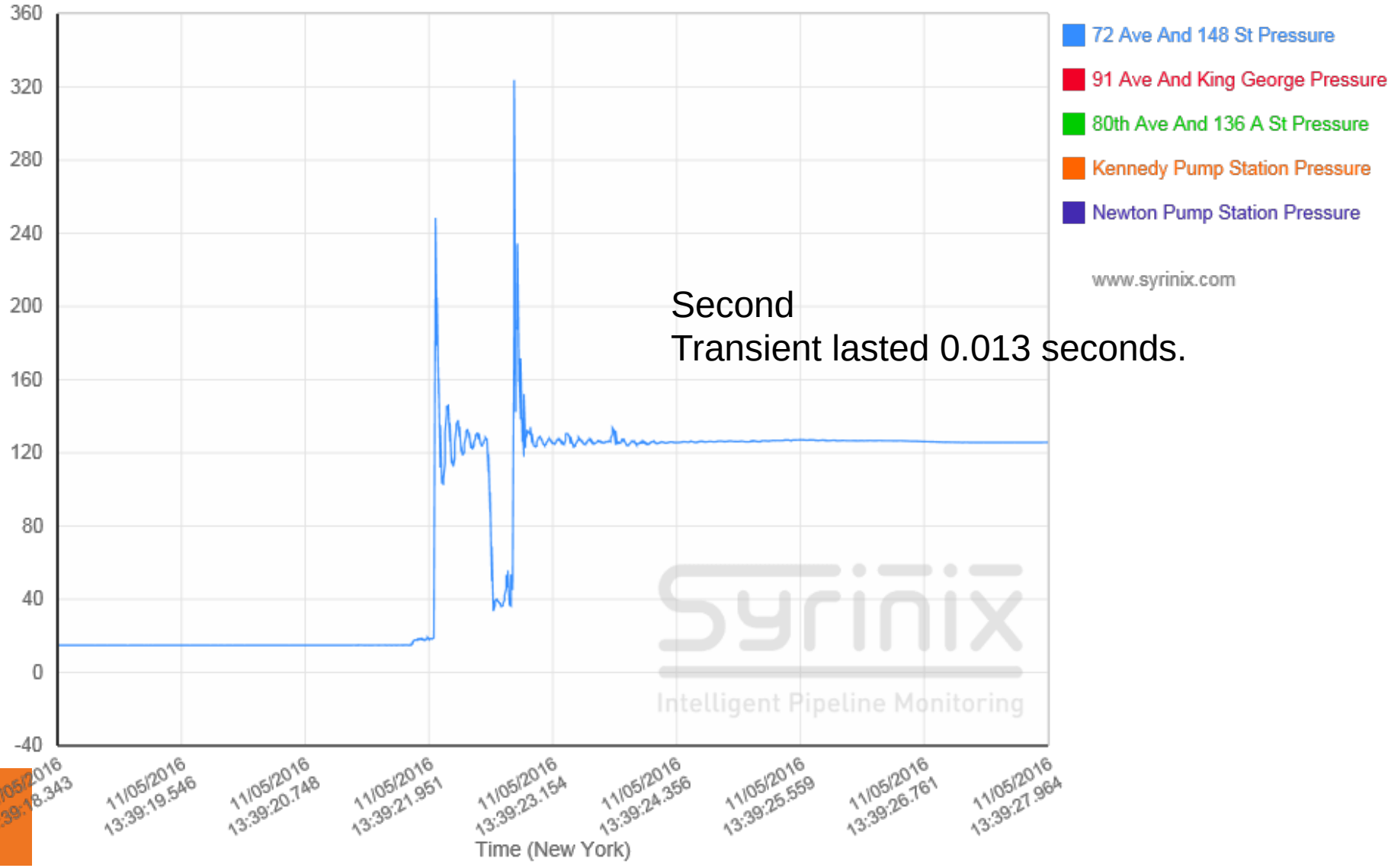


Add high sample monitoring data



Drill down into the data:




360
320
280
240
200
160
120
80
40
0
-40
11/05/2016 13:39:18.343
11/05/2016 13:39:19.546
11/05/2016 13:39:20.748
11/05/2016 13:39:21.951
11/05/2016 13:39:23.154
11/05/2016 13:39:24.356
11/05/2016 13:39:25.559
11/05/2016 13:39:26.761
11/05/2016 13:39:27.964
Time (New York)
72 Ave And 148 St Pressure
91 Ave And King George Pressure
80th Ave And 136 A St Pressure
Kennedy Pump Station Pressure
Newton Pump Station Pressure
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Second
Transient lasted 0.013 seconds.
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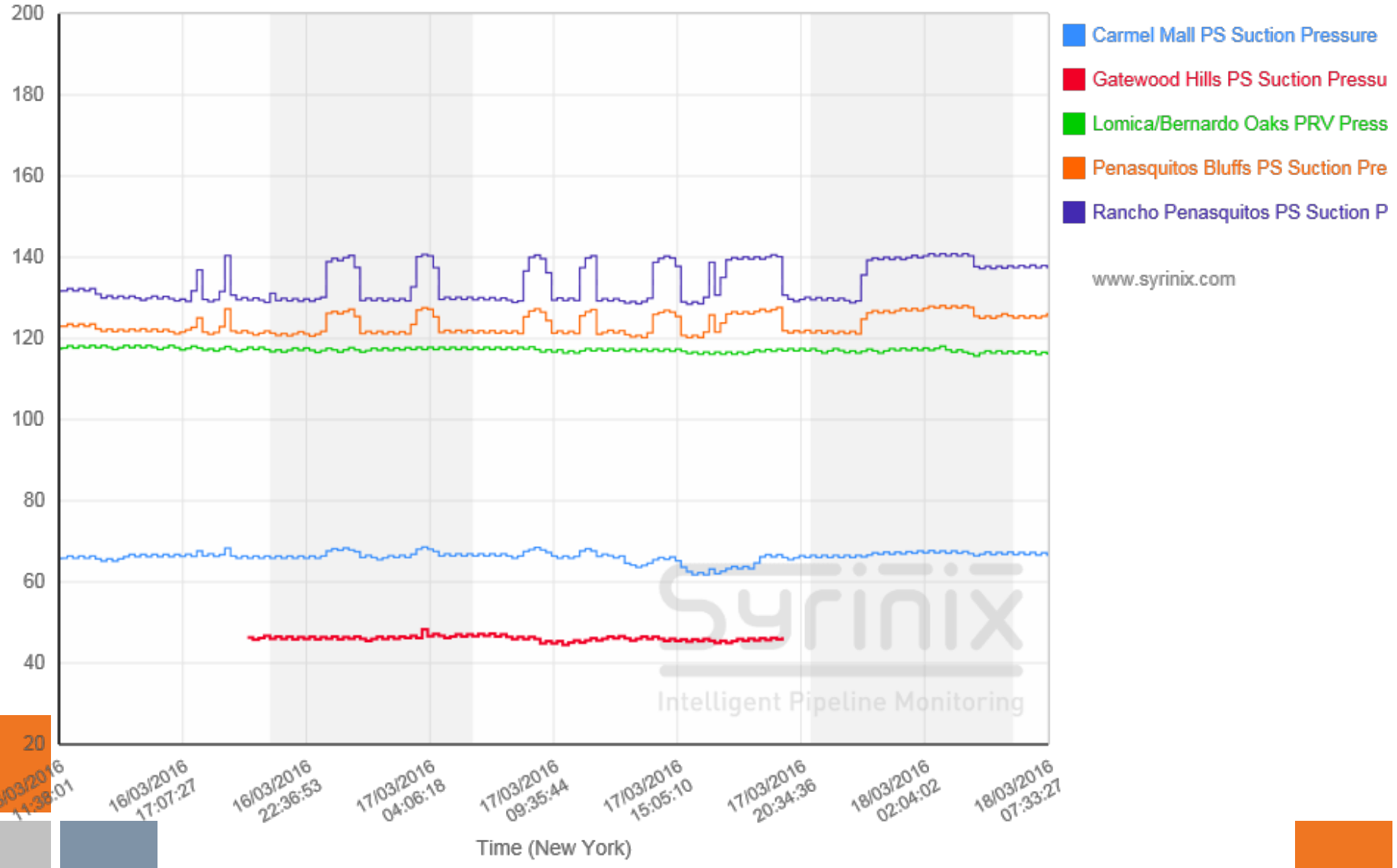
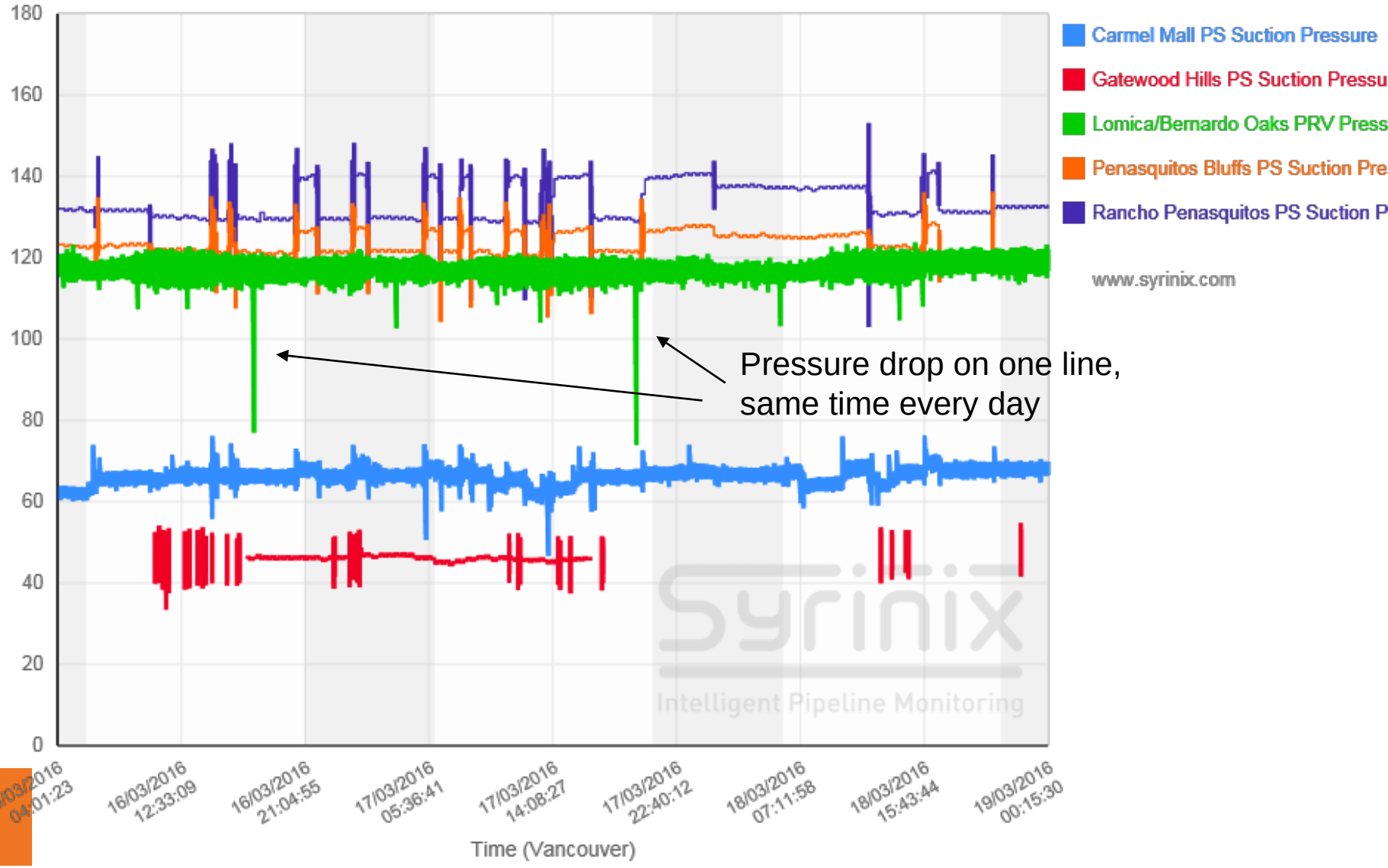
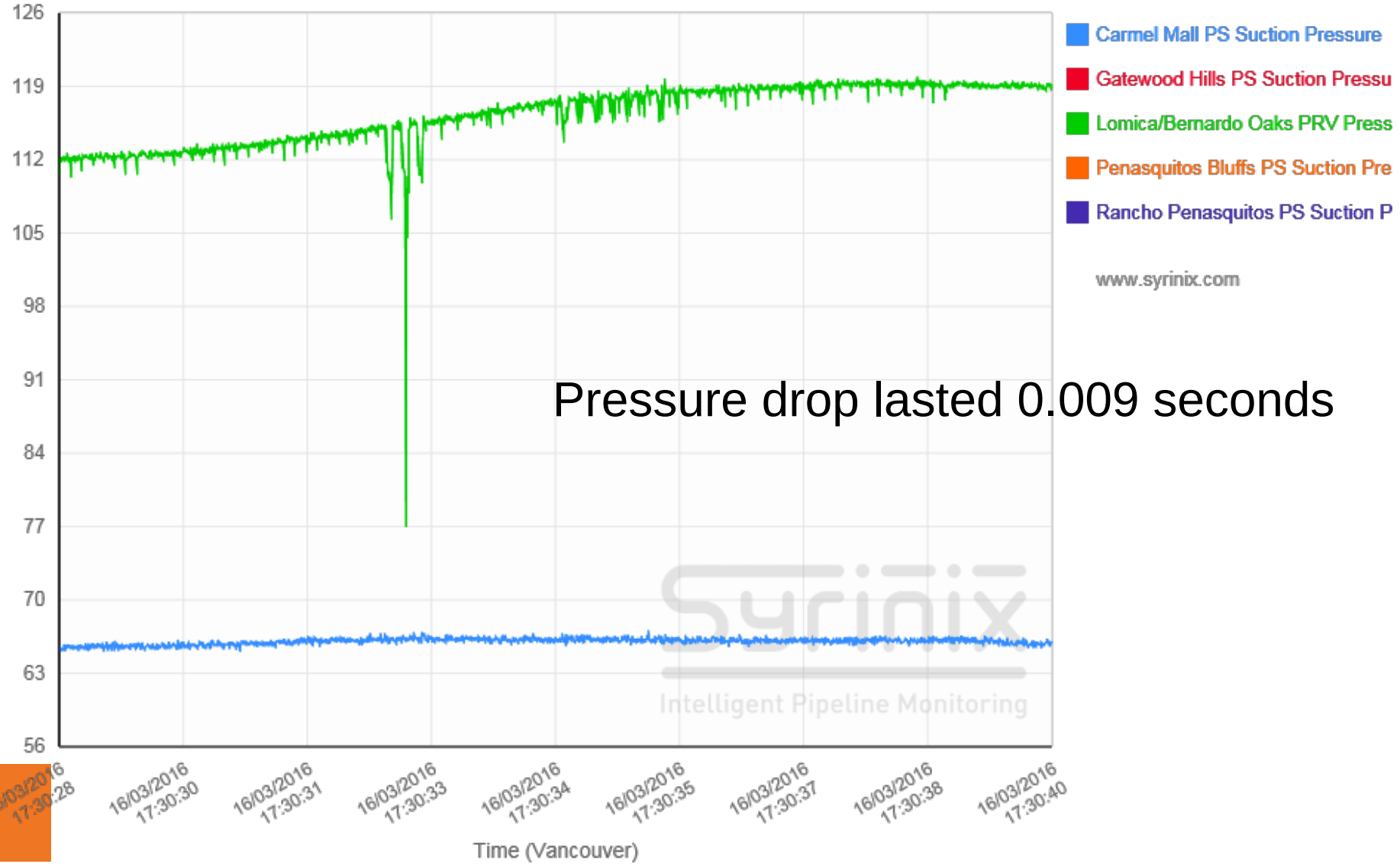
Assessing risk on several transmission mains



Adding high sample data




126
119
112
105
98
91
84
77
70
63
56
16/03/2016 17:30:28
16/03/2016 17:30:30
16/03/2016 17:30:31
16/03/2016 17:30:33
16/03/2016 17:30:34
16/03/2016 17:30:35
16/03/2016 17:30:37
16/03/2016 17:30:38
16/03/2016 17:30:40
Time (Vancouver)
Carmel Mall PS Suction Pressure
Gatewood Hills PS Suction Pressu
Lomica/Bernardo Oaks PRV Press
Penasquitos Bluffs PS Suction Pre
Rancho Penasquitos PS Suction P
www.syrinix.com
Pressure drop lasted 0.009 seconds
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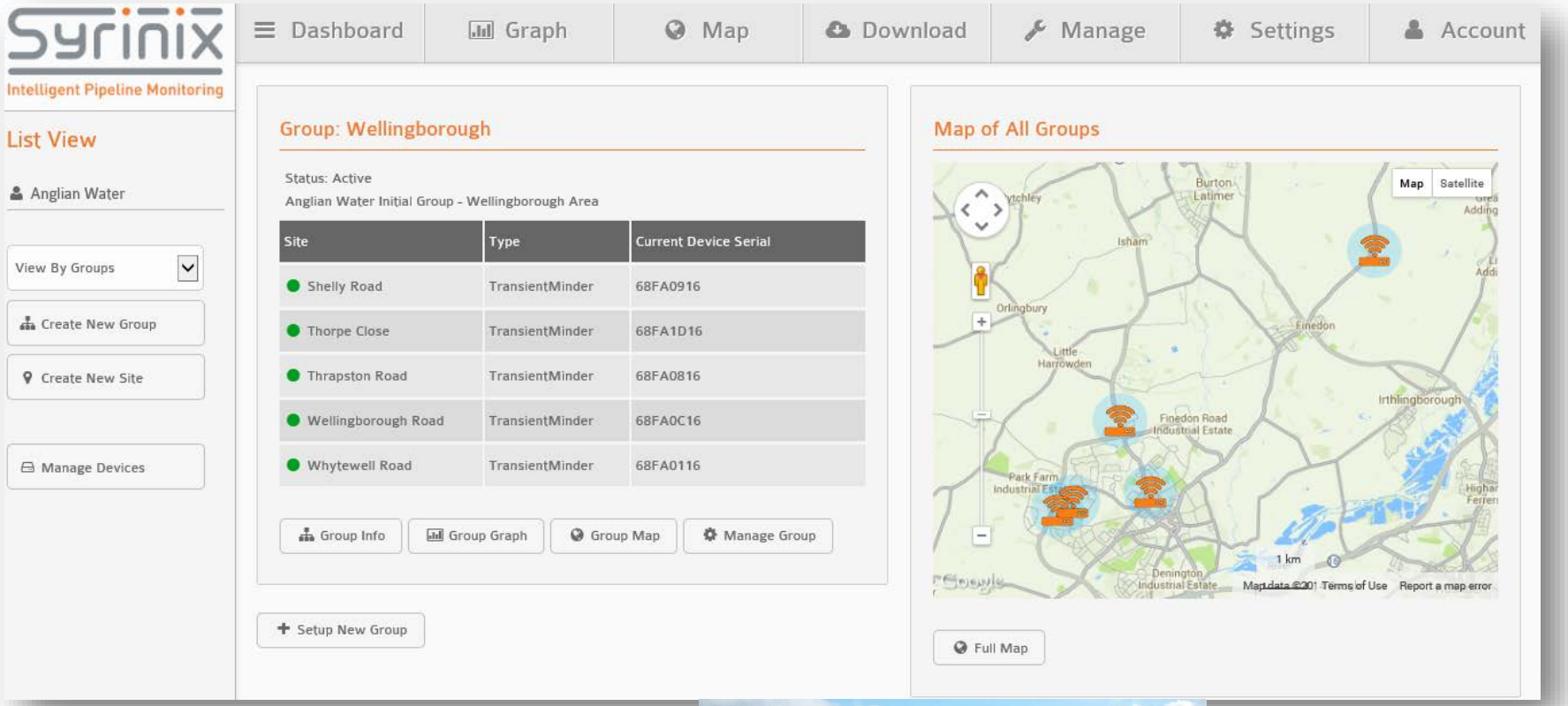
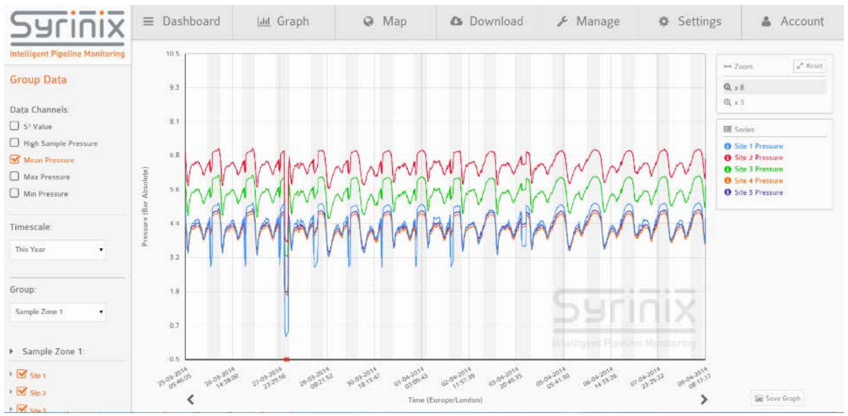
Leak Reduction

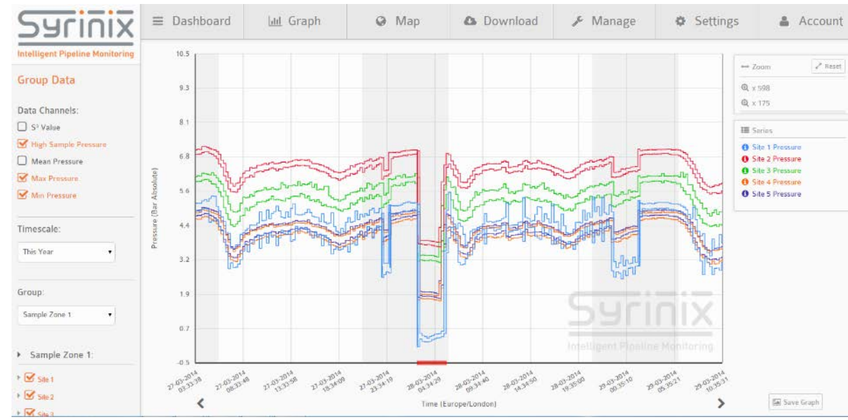


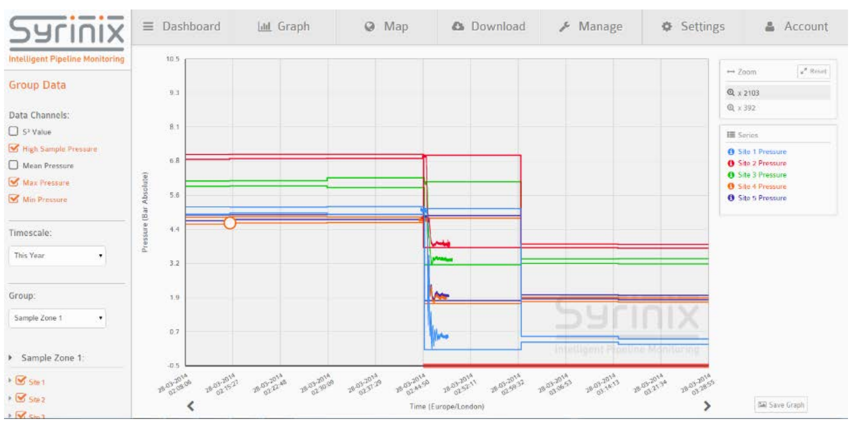
Inlet valve on reservoir suspected of causing damaging transients but current logging equipment not providing detailed data

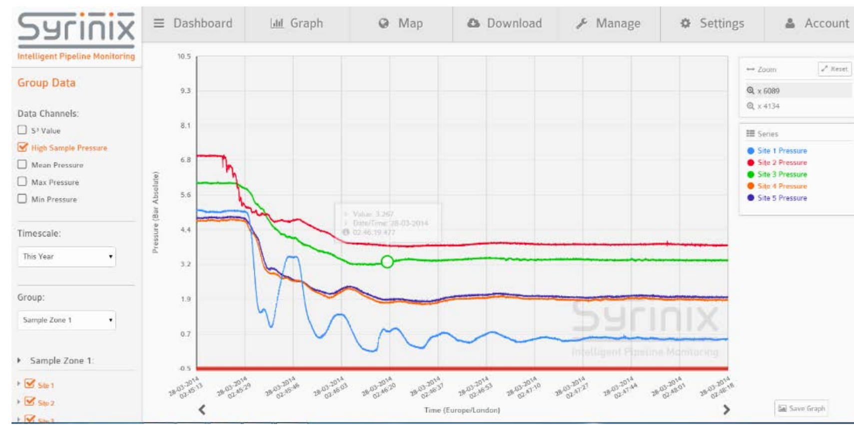
Town of 40,000 people.
Units approx. 8 miles apart

Results at your desktop using RADAR



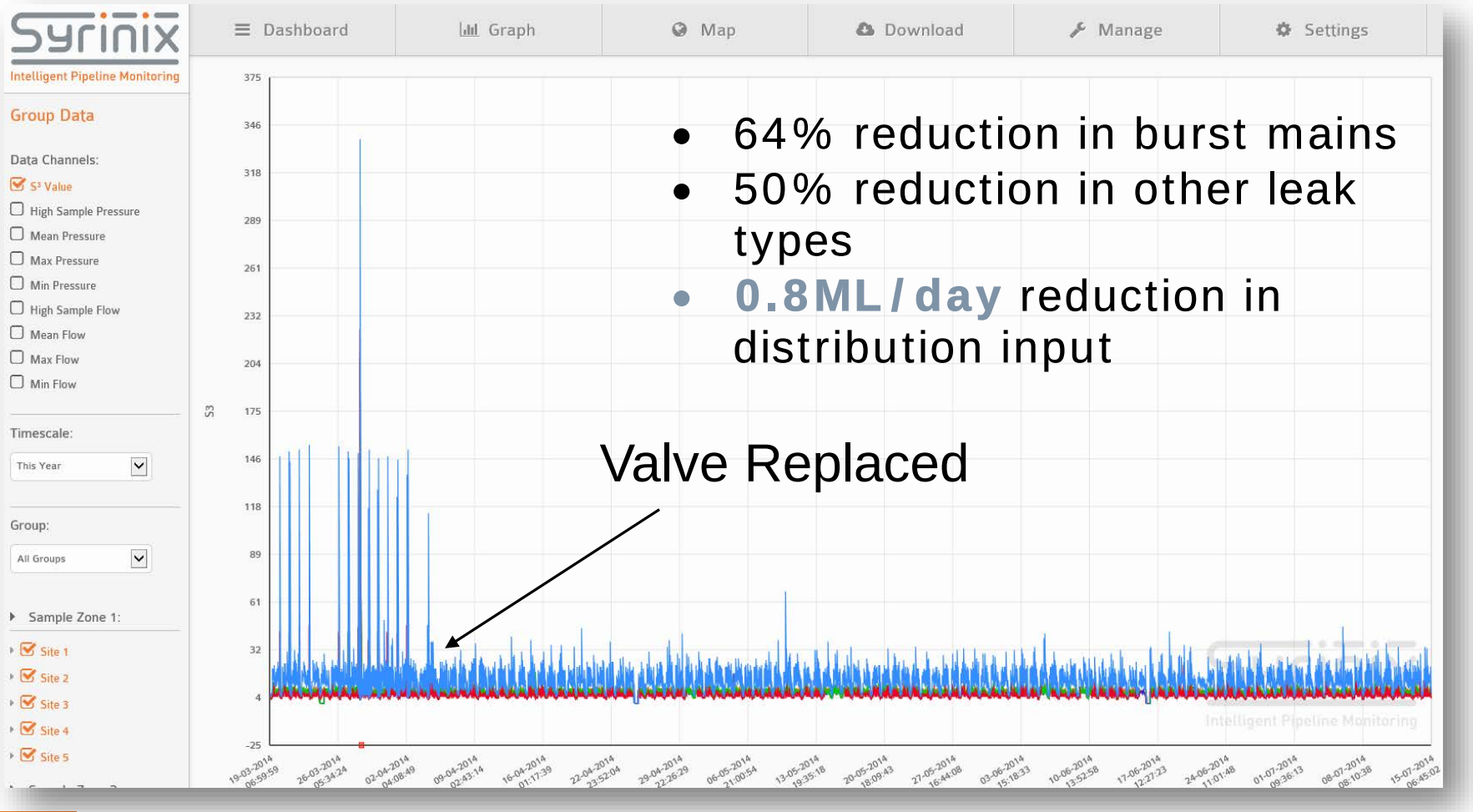






Web based presentation and analysis of data

Network calming works!



- 64% reduction in burst mains
- 50% reduction in other leak types
- **0.8ML/day** reduction in distribution input

Valve Replaced

chart shows why replacing a valve was justified

Benefits of transient monitoring and network calming

- **Increased asset life**
- Reduced capital costs
- **Reduced O&M costs**
- Reduce Non revenue water
- Reduce Break/leak frequency
- **Improved Water Quality**

Increased network knowledge provides current, relevant information to actively assist in making better strategic decisions.
Immediate and future cost saving.
Replaced valve and reduced leaks and bursts in network

Conclusions

- **Transients**
  - They do occur on your systems
  - You can detect them with high sample monitoring
  - If you know they are there, and what is causing them, you can do something about it…..
- **Reducing or Removing Transients**
  - Reduces leakage and breaks
  - Extends life of your infrastructure
  - Reduces operational costs
  - Reduces water loss
  - Allows you to focus resources elsewhere

SMART Systems

Can be cost effective

Can be Useful

Can be Selective/ appropriate

And can tell you what is going to break before its too late.

And tells you where to focus your time, energy and resources…and money

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Questions?

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