

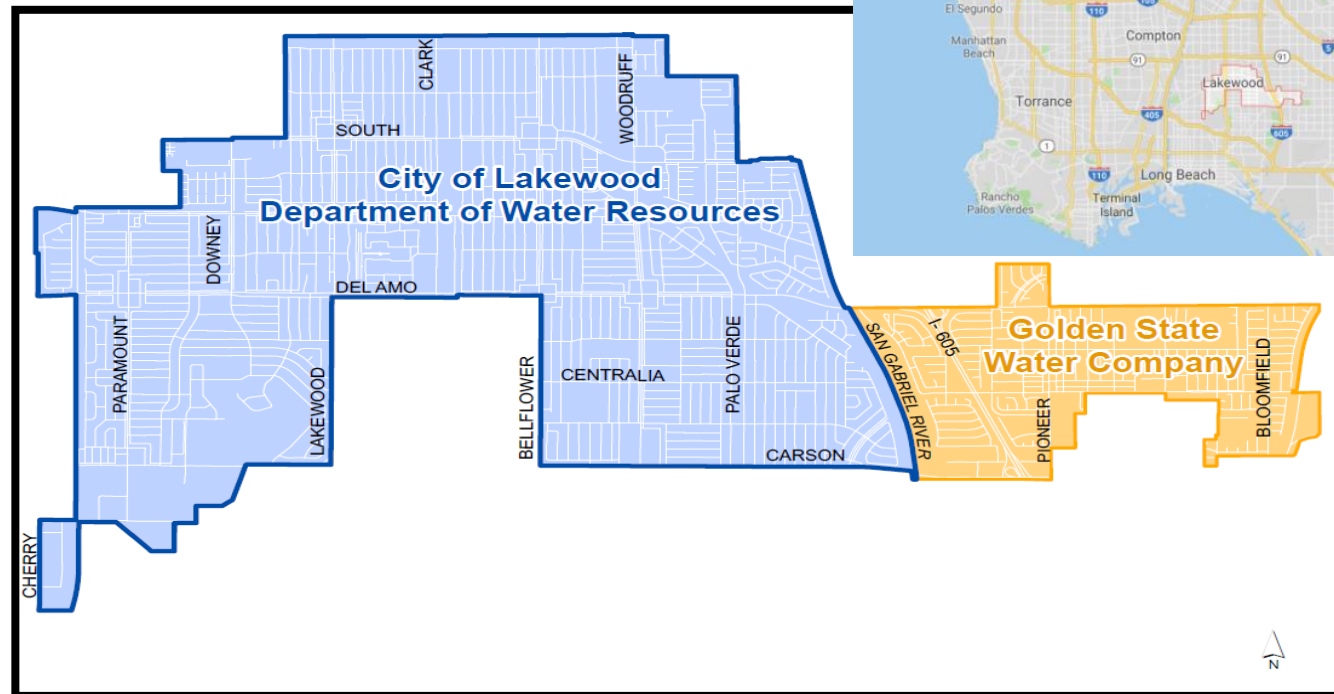
# ***Leak Detection, Conservation, and Customer Engagement Using AMI/Smart System***

Jason Wen, PhD, PE  
Michael Santillan  
Derwin Dy, PE





# *City of Lakewood, California*

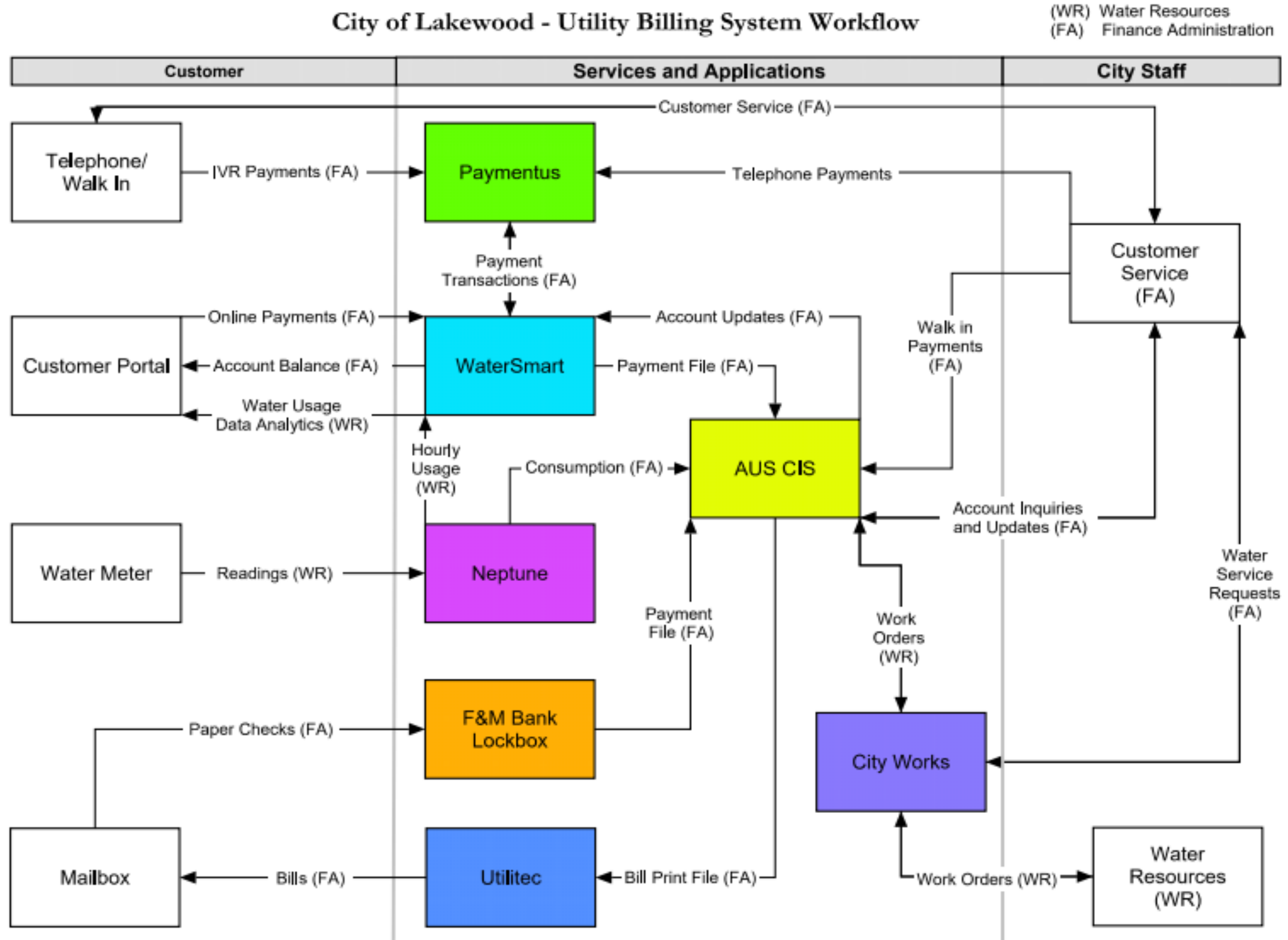


- 100% groundwater from 10 wells
  - 3 water storage facilities (13 MG)
  - 3 booster stations (15 pumps)
  - 5 Emergency Inter-connections
- 
- 180 miles of water mains (4" to 27")
  - 20,300 meter service connections to ~60,000 population
  - Demand - 12 MGD or 11,000 GPM
  - Annual Production - 7,000 AF + 2,200 AF (Exported)

## *Smart Water System .....*

- **Smart Meters:** AMI System - 100% replacement (20,300)
- **Pipeline Assessment:** AI/ML to use historical leak data to predict when & where the future breaks would occur and prioritize pipeline replacement
- **Active Leak Monitoring:** Acoustic Sensors to monitor small breaks from deep transmission main
- **Distribution Sensors** – Transient pressure monitoring
- **Pump Control Optimization:** Pressure and energy control platform to improve efficiency and extend useful life of infrastructures, and reduce pipeline breaks and leaks

# Technology Platforms



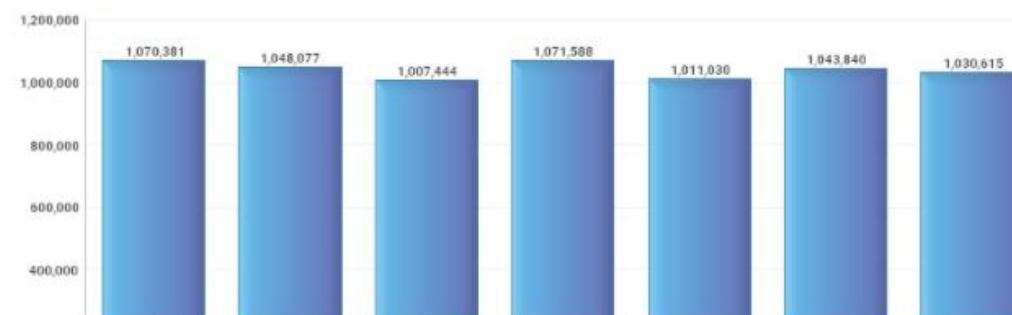


## Endpoint Summary Review

7-Day Summary as of : 08/27/2020

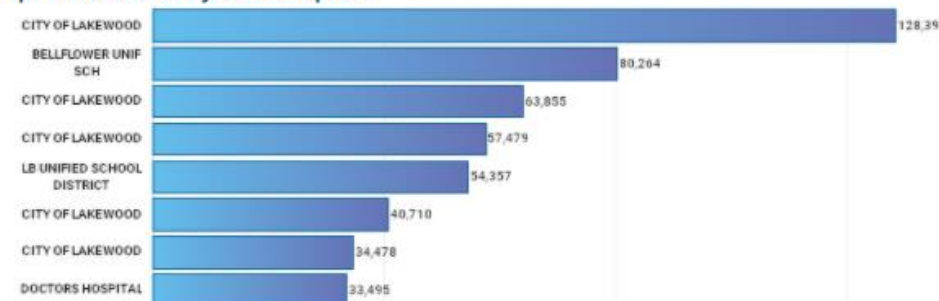
### System Consumption

[Detail Report >>](#)

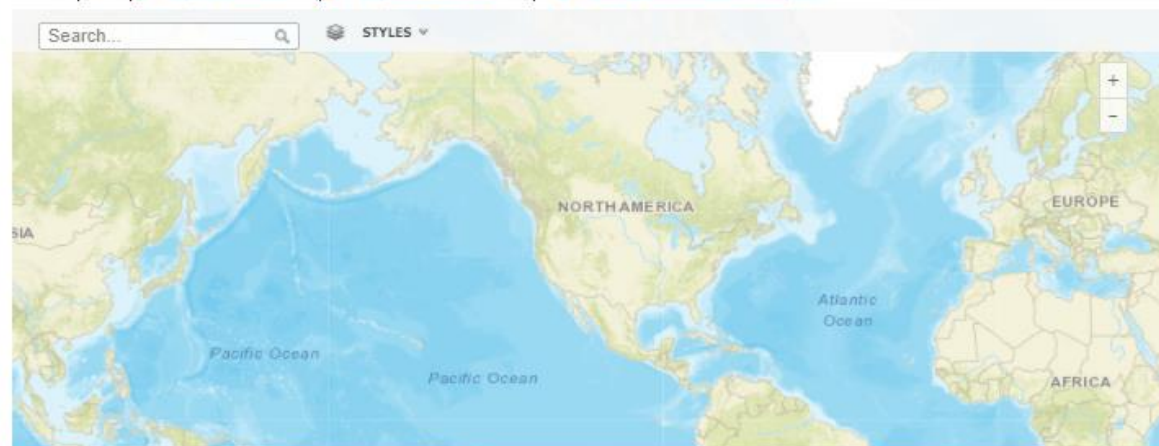


### Top 10 Accounts by Consumption

[Detail Report >>](#)



[All](#)
[Top 10 Accounts](#)
[Major Reverse Flow](#)
[Critical Continuous Consumption](#)



## System Snapshot

Incomplete

0

Readings

Received

19,488

via AMI

Critical

888

Continuous Consumption

Major

4

Reverse Flow

Normal

15

Gateway





# *Neptune AMI System*

- Meter Readings: <2% re-read
- Gateway Status
- Continuous/Intermittent Consumption
- Reverse Flow
- Top consumption accounts
- Hourly live (1-day old) data
- Re-read by AMI system
- .....

## City of Lakewood

### Accounts

 SFR	19,237
 Other	3,841
 Commercial	977

### Data Status

All files on time

Most recent bi-monthly read

Sep 2, 2020

Most recent AMI Interval

Sep 13, 2020 11:00 PM

## Analytics

INFO

### Consumption

375.9 MG in Period 2020-4

Compared to previous period ▲ 25%

Compared to one year ago ▼ 12%

TOTAL MG BY READING PERIOD



### Leak Detection

Detected in the last year **17,893**

Leaks alerted in the last year **3,829**

ENGAGEMENT WITH ALERTS



### Tier Consumption

3.2% of SFR accounts within Tier 1 in Period 2020-4

Compared to previous period ▼ 28%

Compared to one year ago ▼ 9.6%

% ACCOUNTS WITHIN TIER 1



## Engagement

INFO

### Mailings

 Active Recipients **0**

### STARTING SOON

### Group Messenger

0 messages sent in past year

Messages delivered **90,812**

Open rate of emails **44%**

MESSAGE RECIPIENTS



### Customer Intelligence

Profile Updates **1,803**

Email Addresses **13,722**

NUMBER OF OCCUPANTS



### Portal Registrations

697 in past 90 days

Registered Accounts since program start **11,537**

Total % among eligible accounts **48.0%**

### Portal Visits

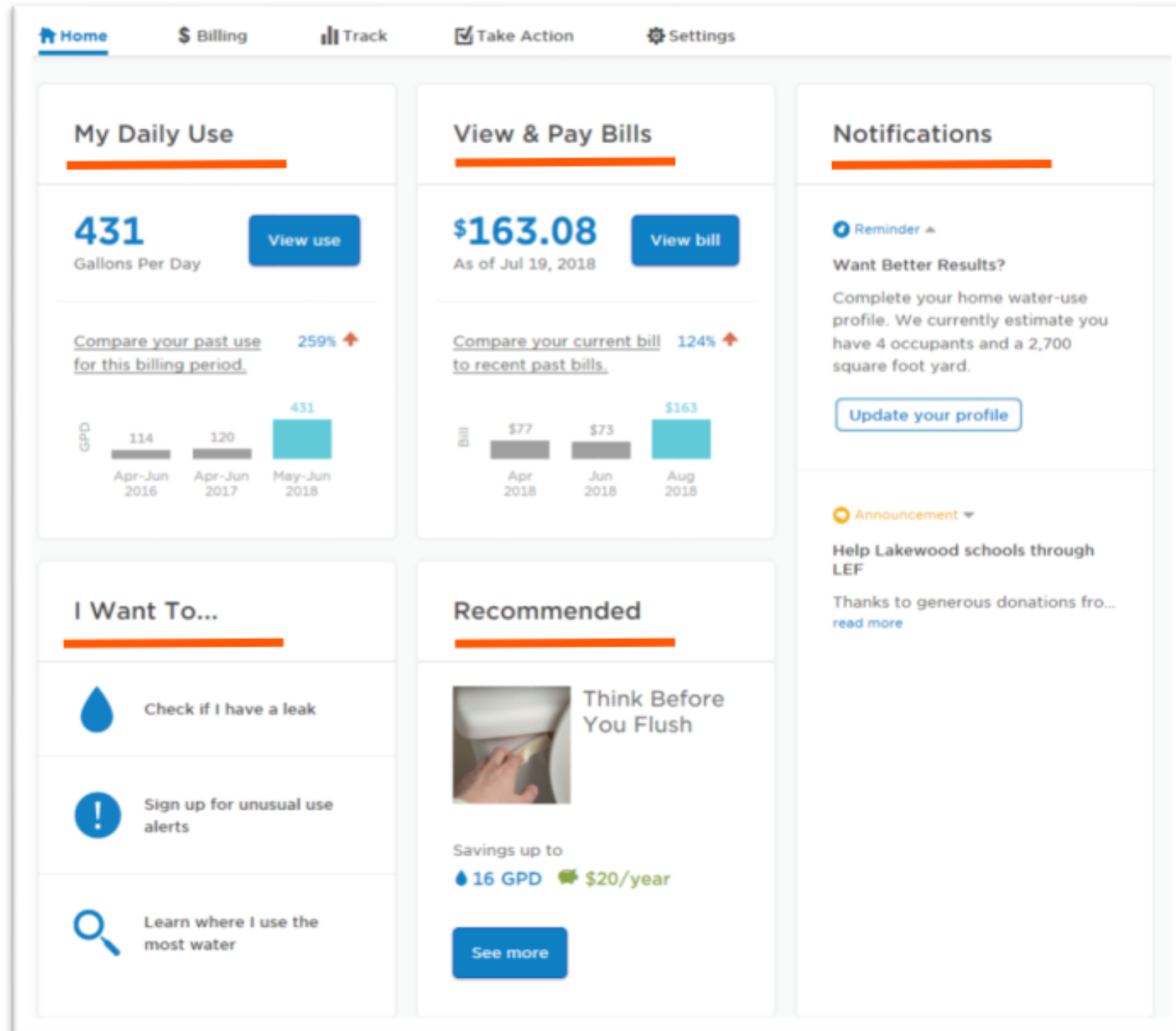
27,372 in past 90 days

 Desktop visits **64%**

 Mobile visits **36%**



## Learn to Navigate New Online Portal



My Daily Use – Log on daily to find out how much gallons of water was used. Compare that to what was used the previous two years.

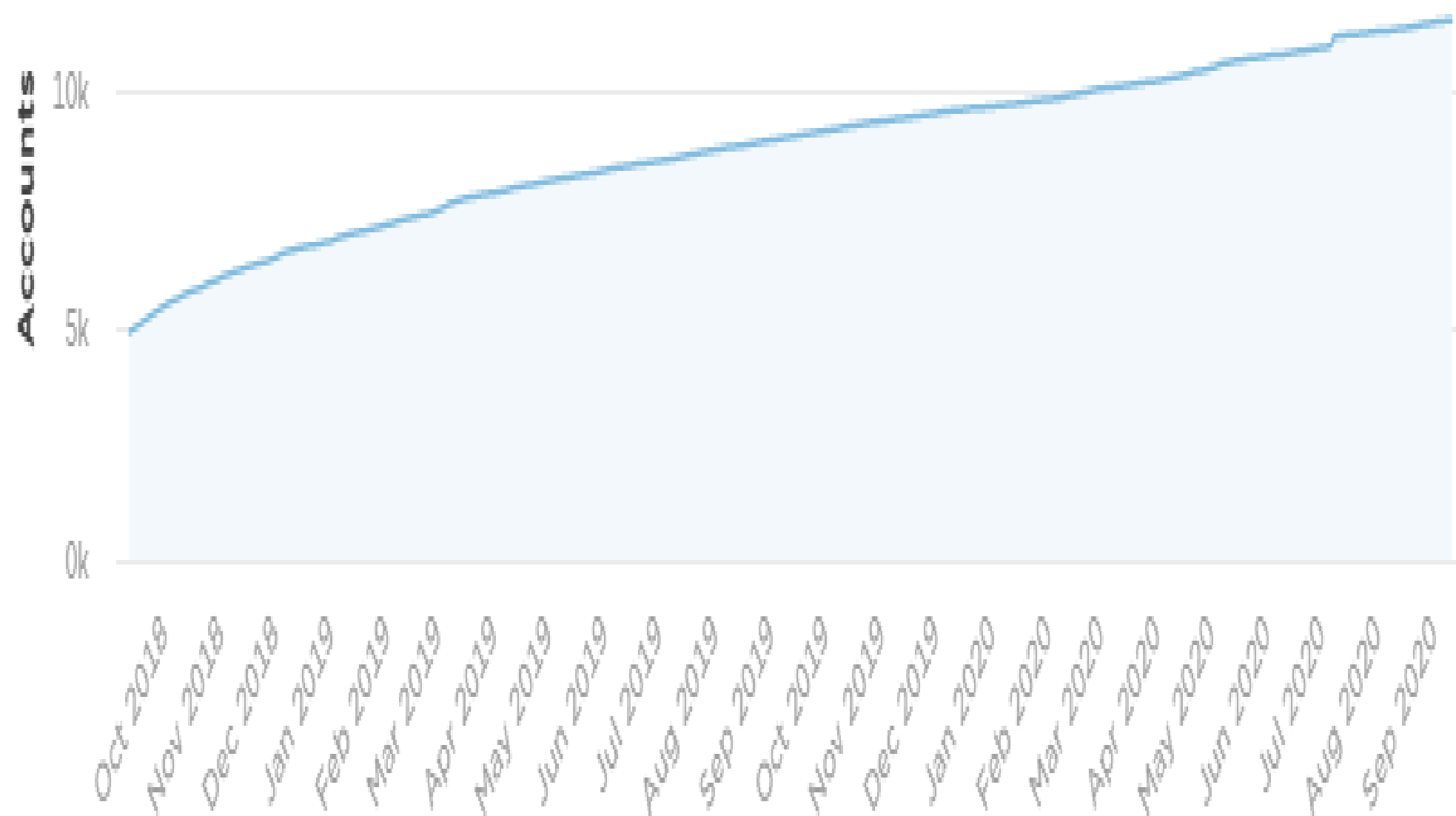
View & Pay Bills – With one click, pay your water and trash bill online. And, compare your current bill to your previous two bills.

Notifications – Look here to get updated information about the City and water use information.

I Want To... - Trouble shoot and check if you have a leak, sign up for unusual water use alerts (*this way no there's no need to log on daily to know if your water use has changed*), and learn where you might use water most and get advice how to save water in your home.

Recommended – Look here to get general water conservation advice and turn those savings into dollars.

# Customer Engagement



Registered Accounts ⓘ

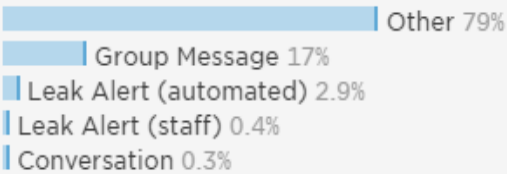
SEE ALL

# 11,528

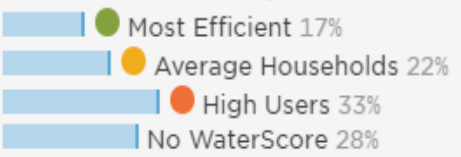
707 in the past 90 days

## BREAKDOWN OF REGISTRANTS

### Source of Registrants



### WaterScore of Registrants



### Tier of SFR Registrants



# WaterSmart Portal

- Data – Info – knowledge – Management tool
- Alert and remarkably reduce internal leaks
- Enhance customer involvement
- Hourly data provide more information
- More efficient customer services

## Portal Registrations

697 in past 90 days

Registered Accounts  
since program start

11,537

Total %  
among eligible accounts

48.0%

## Portal Visits

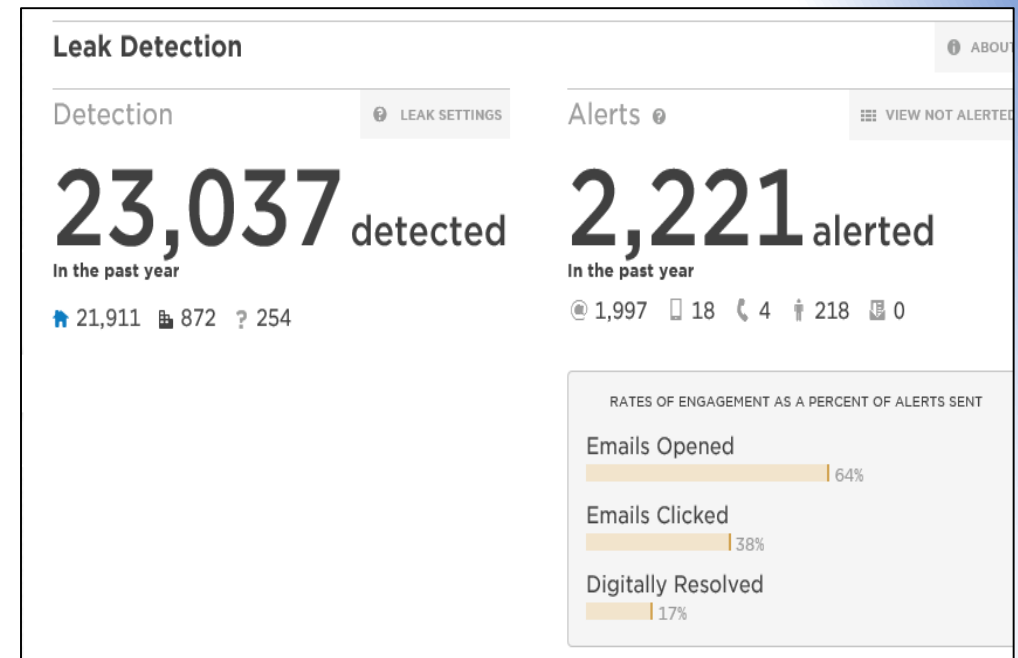
27,372 in past 90 days

Desktop  
visits

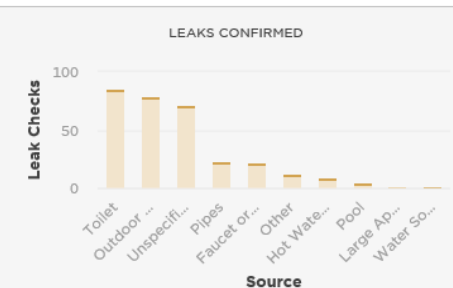
64%

Mobile  
visits

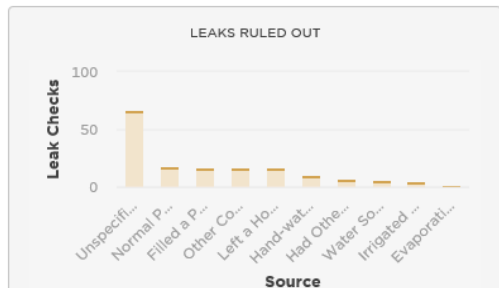
36%



### Leak Explanations



Of the leaks found using the Leak Investigation and Diagnosis tool in the FATHOM Portal, the most common explanation was Toilet, which accounts for 28% of leaks confirmed since May 29, 2018.



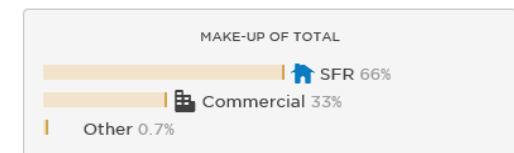
Of the leaks ruled out using the Leak Investigation and Diagnosis tool in the FATHOM Portal, the most common explanation was Unspecified, which accounts for 44% of leaks ruled out since May 29, 2018.

### Total Open Leak Rate

**4,441** GPH

estimated rate of open leaks

This represents current active leaks among eligible AMI accounts.





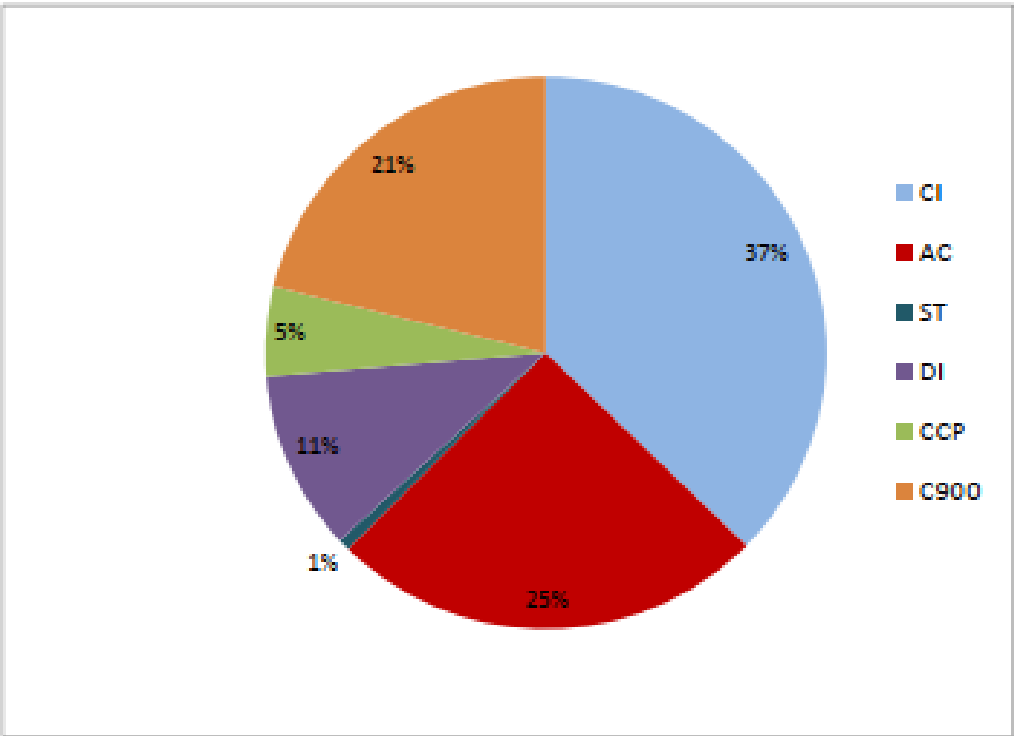
*Pipeline Condition  
Assessment  
(AI/ML by Fracta)*

Transmission and Distribution Mains in the Water Mains

Pipe Length		
Type	(ft)	%
CI	353,758	37.31%
AC	238,322	25.14%
ST	6,124	0.65%
DI	99,924	10.54%
CCP	49,574	5.23%
C900	200,379	21.14%

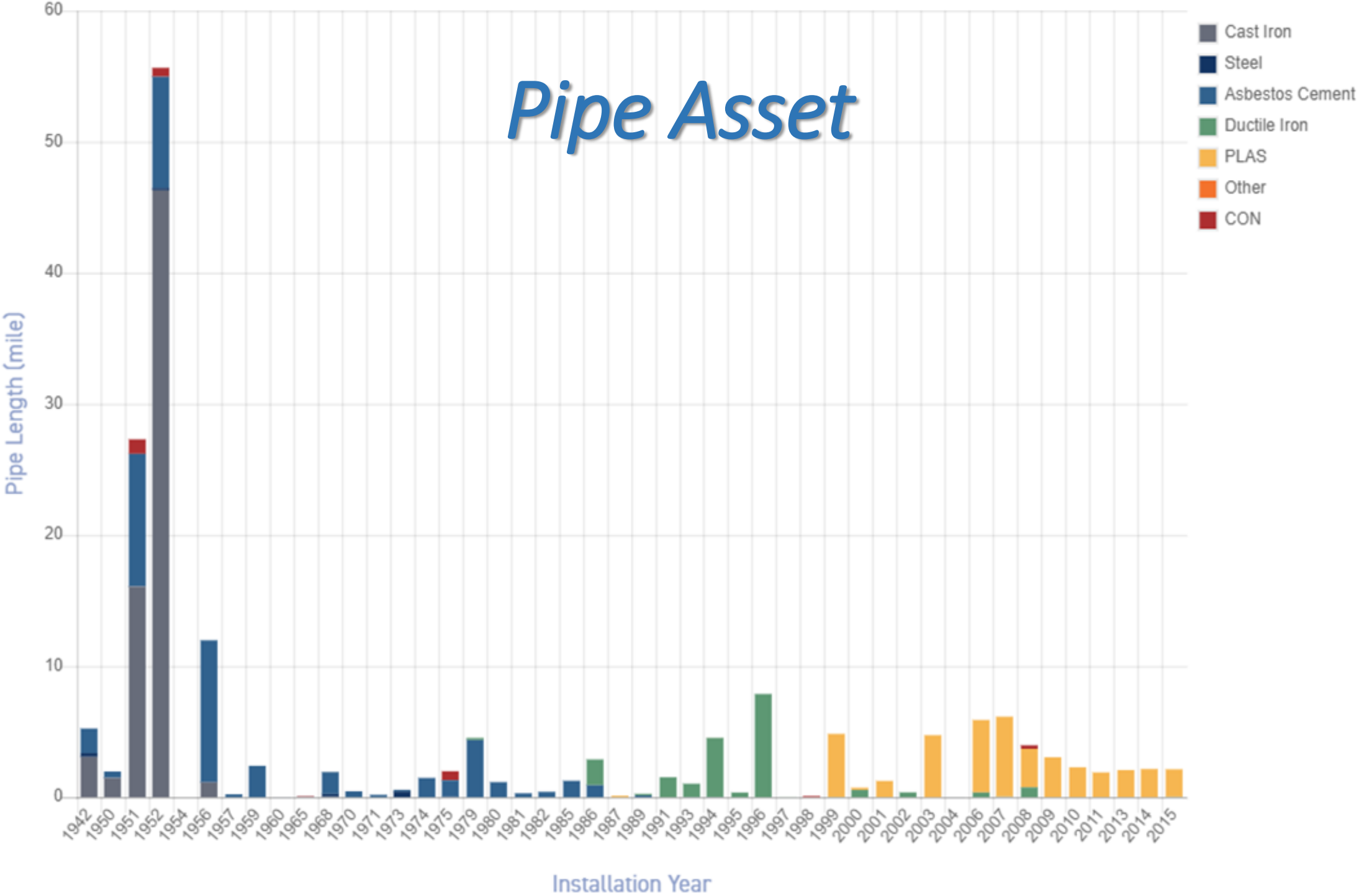
Transmission and Distribution Mains in the Water Mains

Pipe Diameter		
(inches)	Length (ft)	% of Total Length
4	153,190	16.2%
6	204,846	21.6%
8	402,968	42.5%
10	40,110	4.2%
12	79,650	8.4%
14	3,597	0.4%
16	24,457	2.6%
18	3,354	0.4%
20	18,102	1.9%
24	1,850	0.2%
27	15,956	1.7%
Total	948,080	100.0%



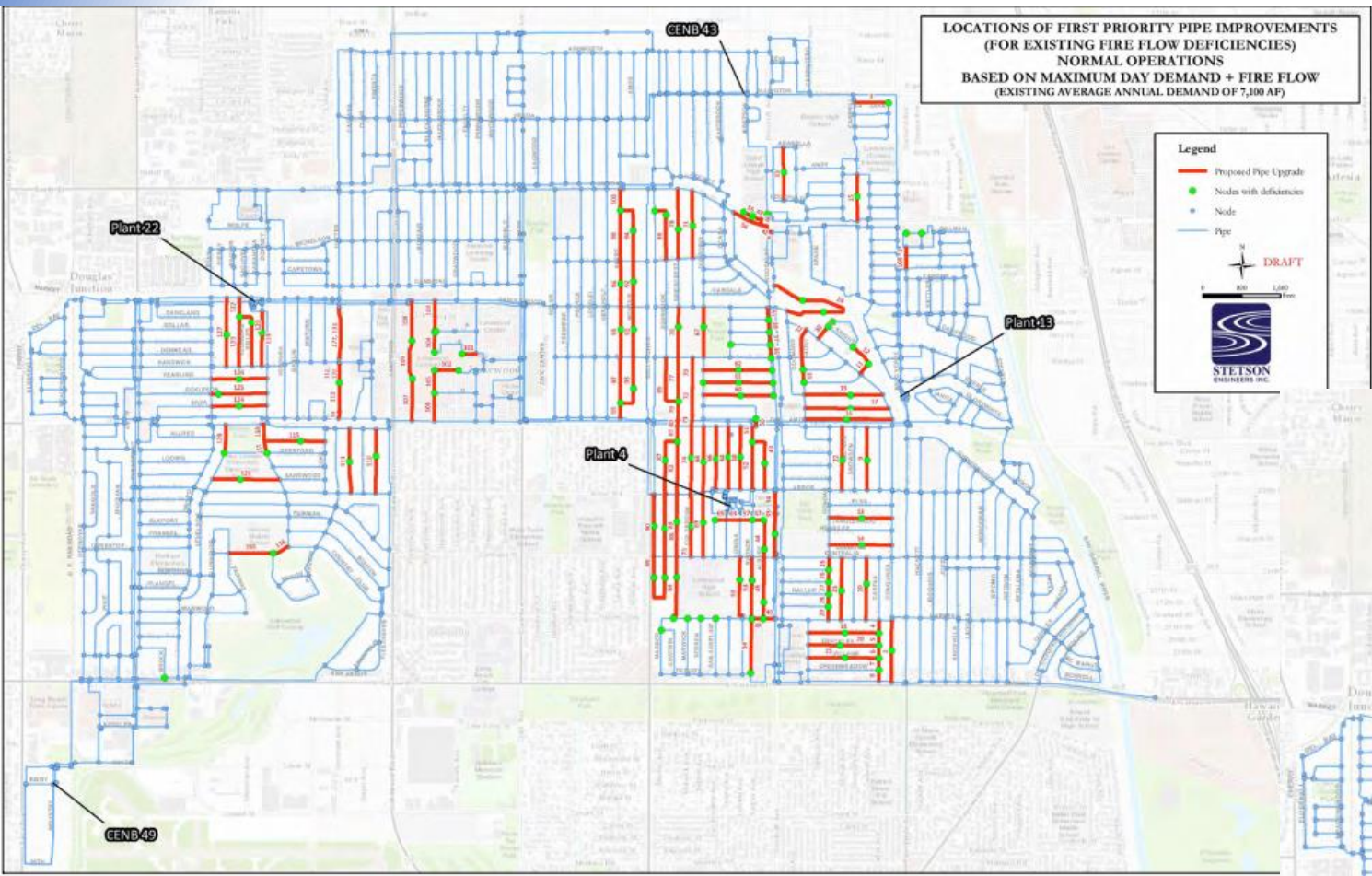
Summary of Pipe Age by Pipe Size in Length (Feet)

Pipe Diameter (inches)	Before 1950	1950's	1960's	1970's	1980's	1990's	2000's	2010's	Unknown	Total
4	5,782	146,122	0	1,286	0	0	0	0	0	153,190
6	9,035	117,862	5,427	38,015	12,588	21,864	0	0	54	204,846
8	11,397	143,689	3,037	6,079	2,265	62,553	126,699	42,158	5,091	402,968
10	1,324	36,426	166	679	0	1,515	0	0	0	40,110
12	4,133	43,667	1,202	3,525	0	11,206	1,842	0	14,075	79,650
14	0	3,551	0	46	0	0	0	0	0	3,597
16	1,286	16,450	0	4,520	0	0	0	0	2,201	24,457
18	0	2,896	0	0	0	0	0	0	458	3,354
20	0	17,358	0	427	0	0	316	0	0	18,102
24	0	1,634	0	215	0	0	0	0	0	1,850
27	2,605	10,792	0	0	0	2,559	0	0	0	15,956
Total	35,563	540,448	9,831	54,793	14,854	99,697	128,857	42,158	21,879	948,080
%	3.8%	57.0%	1.0%	5.8%	1.6%	10.5%	13.6%	4.4%	2.3%	100.0%

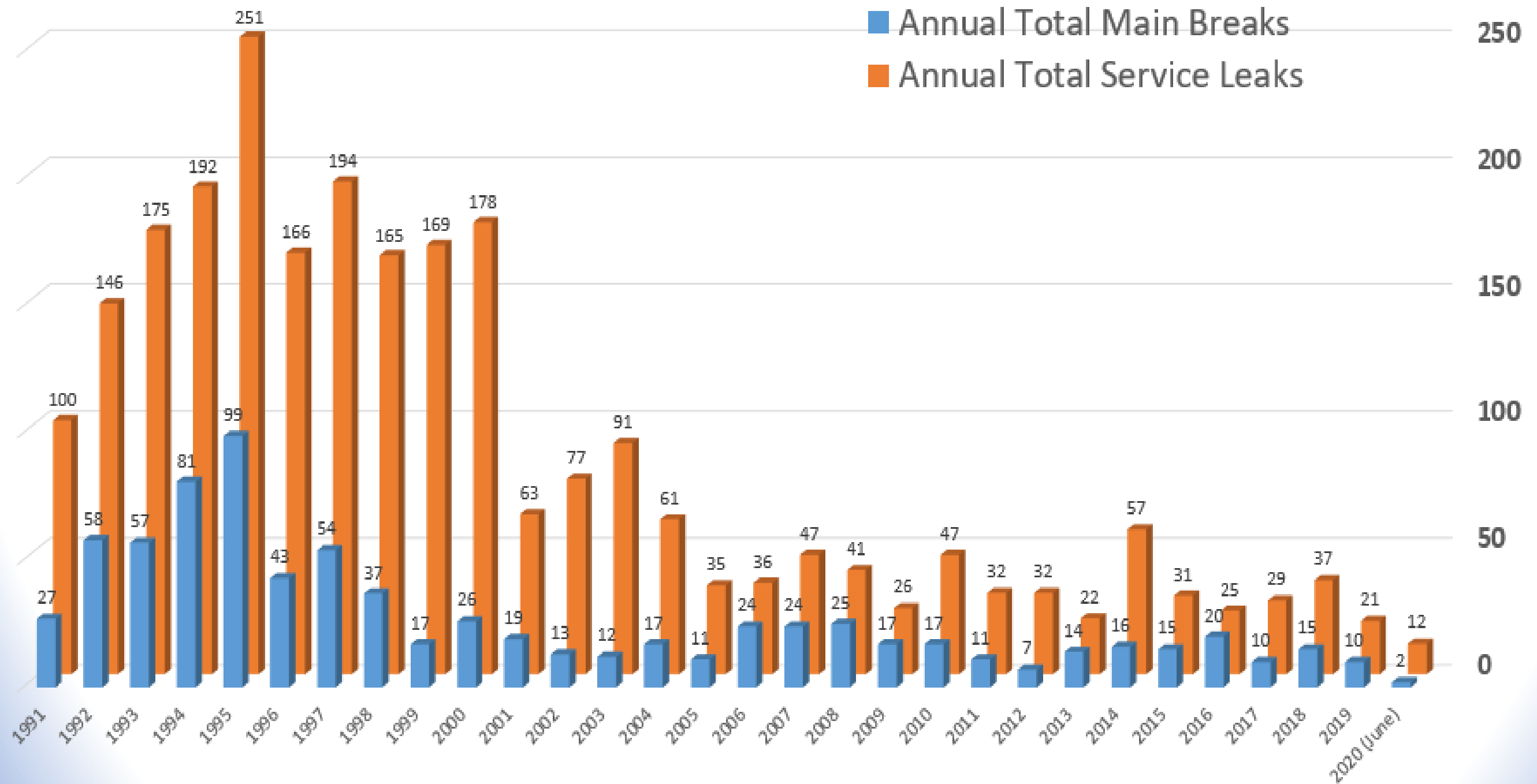




# Hydraulic Model

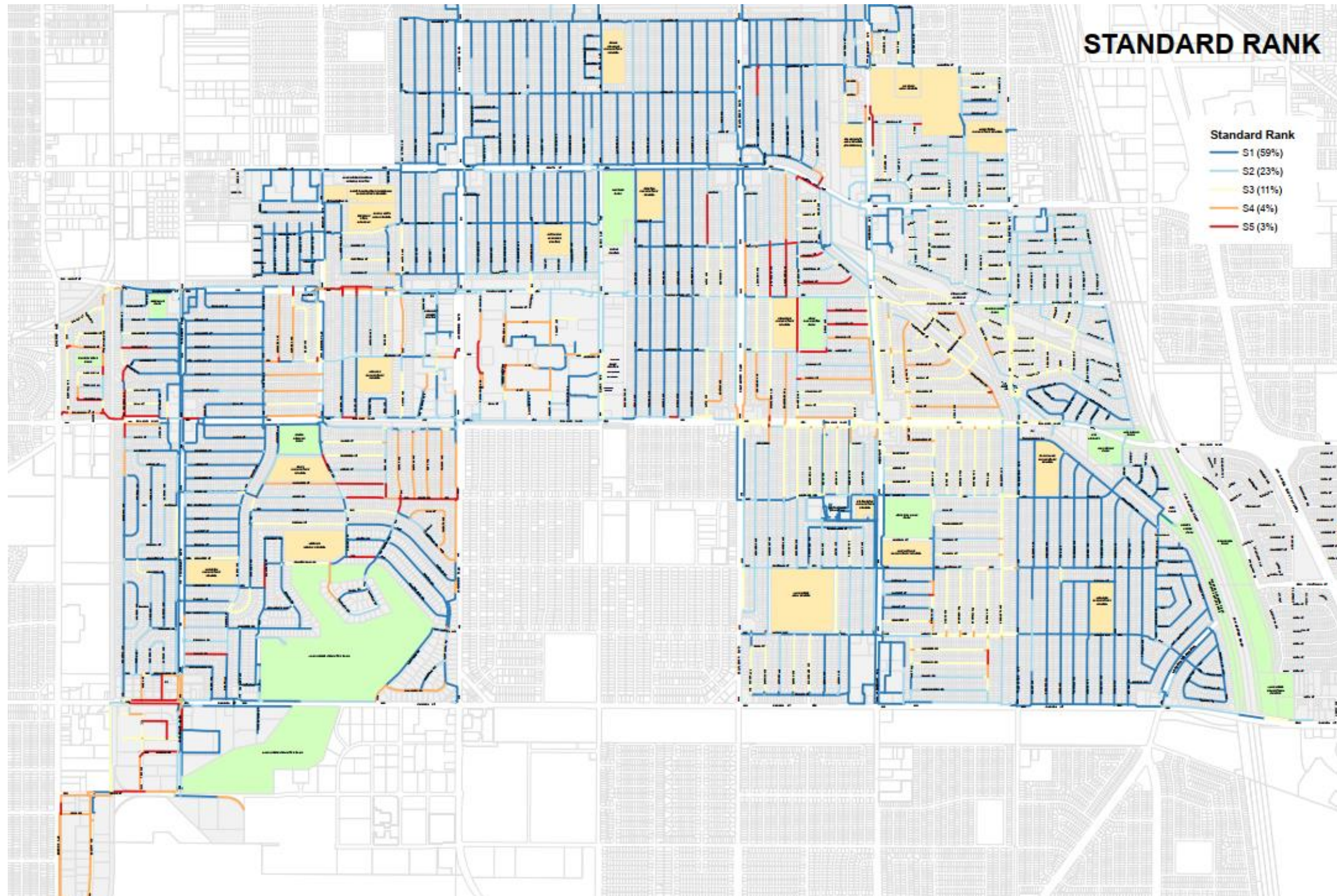


# Main & Service Leaks



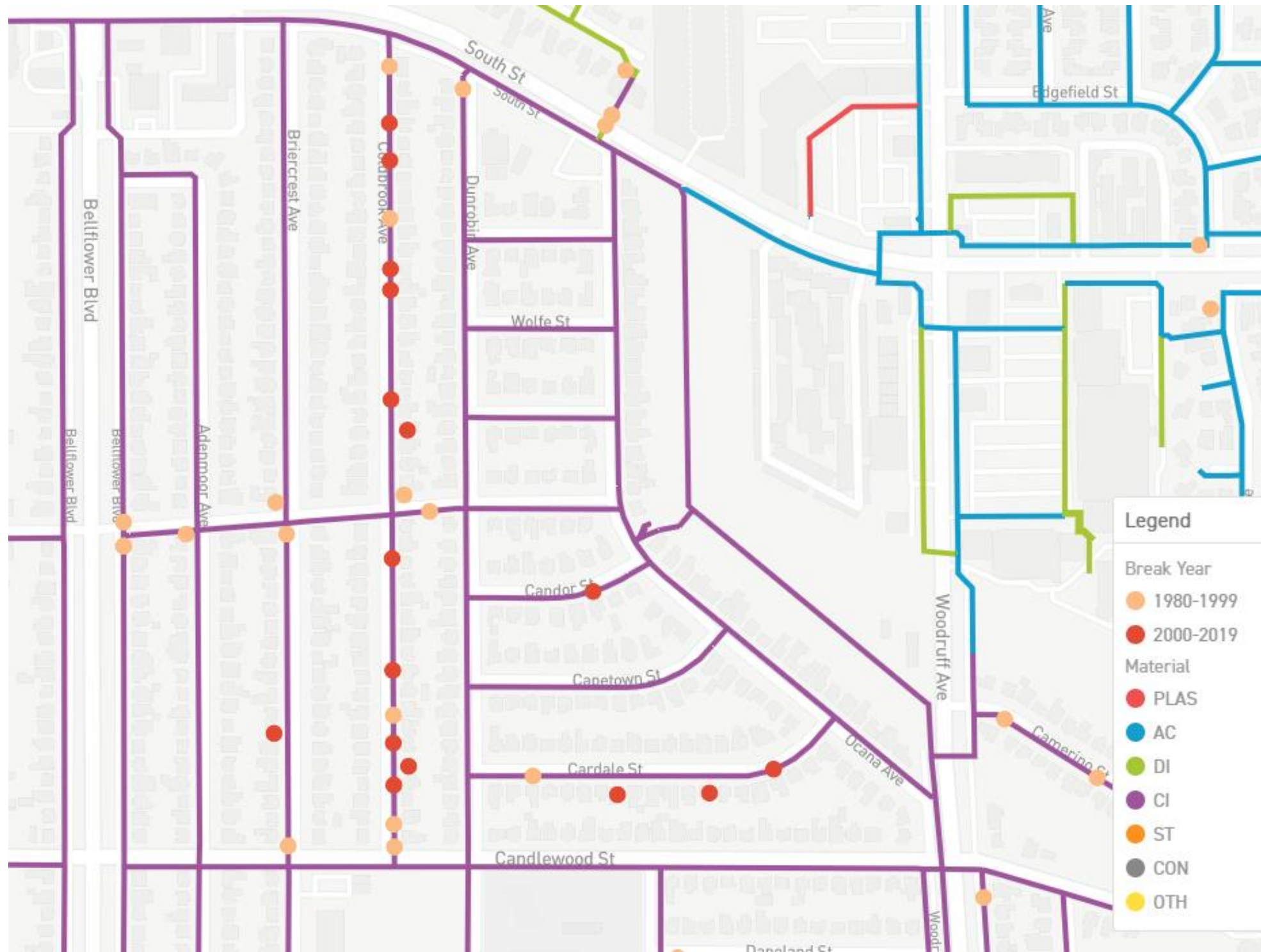


# LOF Analysis by Fracta





# *Breaks vs. Pipe Materials*



# *Breaks vs. Years*





# *Active Monitoring*

Echologics DS System





# Echologics DS System

Cityworks Mueller Systems - Mi.Net

File Edit View Favorites Tools Help

MUNIS Dashboard LEN Google Maps Login MUNIS Suggested Sites Web Slice Gallery HomeHome-

0 New Meter Alerts 0 New Network Alerts 849 Open POI Detected Tasks:

## Mi.Net Mueller Systems Smart Meter Infrastructure Version 5.7

Home Water Network Infrastructure Account Management Alerts Tools Billing

Mi.Nodes Echo Monitoring

Home » Water » Echo Monitoring

Selection: 0 selected items Mode: Layout:

The map displays a street grid in Lakewood, Colorado, with various landmarks and infrastructure. Key locations include Lakewood Center Mall, Costco, Home Depot, and Lakewood City Hall. The map is overlaid with a network of blue lines representing water infrastructure. Numerous yellow warning icons (triangles with exclamation marks) are placed along these lines, indicating potential issues or alerts. A legend at the bottom left identifies 'POI' (Point of Interest) and 'Closed POI'.

POI Closed POI

City of Lakewood Department of Water Resources

Golden State Water Company



# ***“DEEP” - LEAKS***







Home

Water

Network Infrastructure

Account Management

Alerts

Tools

Billing

## Water

No Water Meters Found.

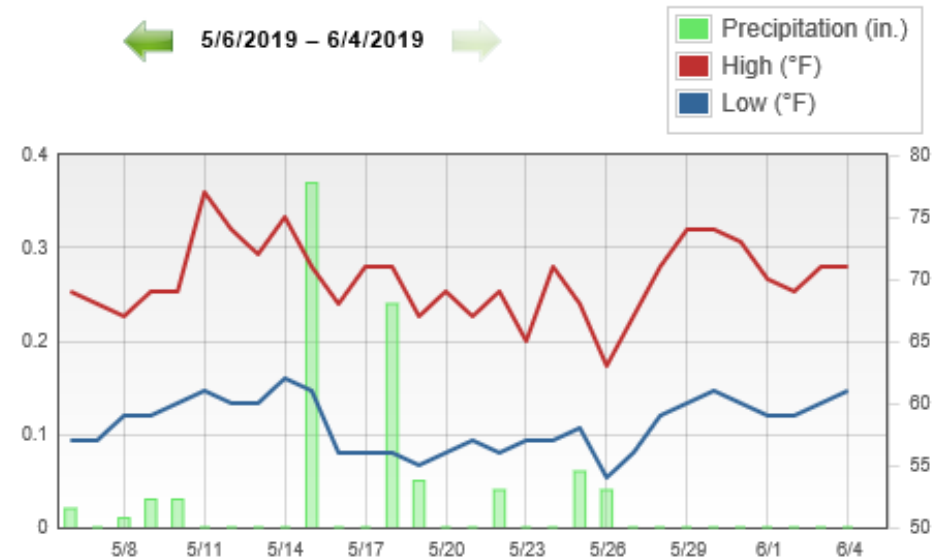
[Import Customer Data](#)

[Install Mi.Nodes](#)

[Install Generic Meters](#)

## Weather

5/6/2019 – 6/4/2019



## Echo Monitoring

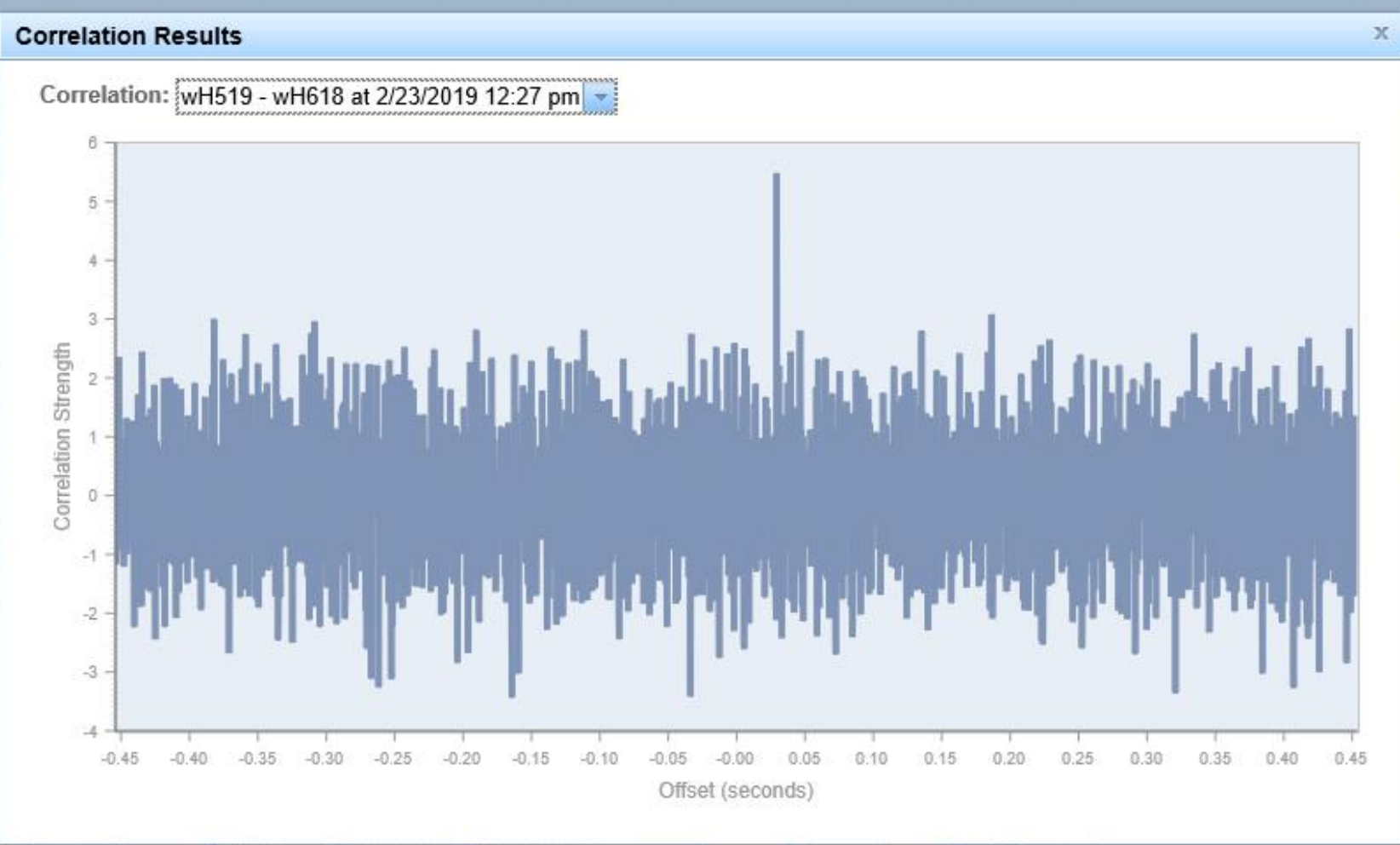
### System Metrics:

850  
POI

93%  
Reported  
Today

26  
Correlations  
Today

[View Echo Monitoring](#)



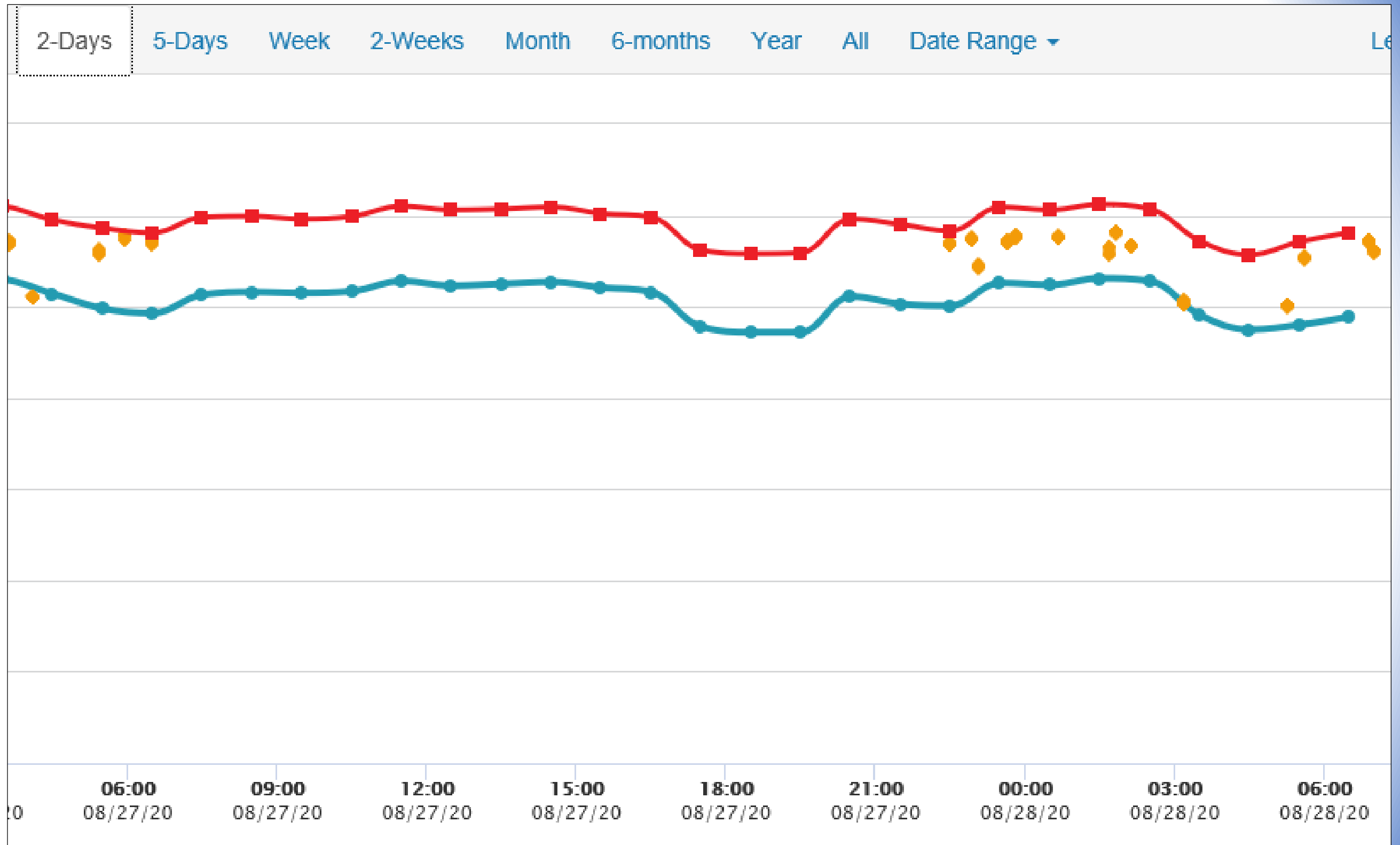


# *Acoustic Sensors*

- Pilot for major commercial area
- Distribution line in the pilot area is larger and deeper
- Identify minor leaks early and prevent disaster situation
- No surprise ... yet

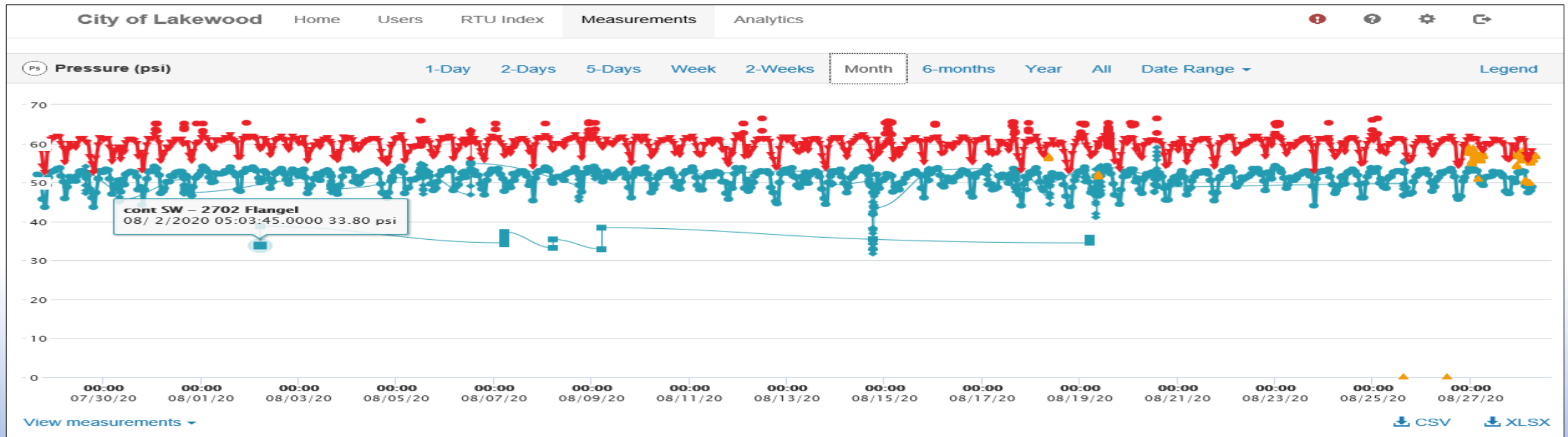
# *Distribution Pressure Sensors (Mueller)*

# Distribution Pressure



# *Distribution Pressure*

- Catch minor break earlier and respond main break faster
- Transient pressure observations
- Smooth system pressure to prevent breaks and leaks

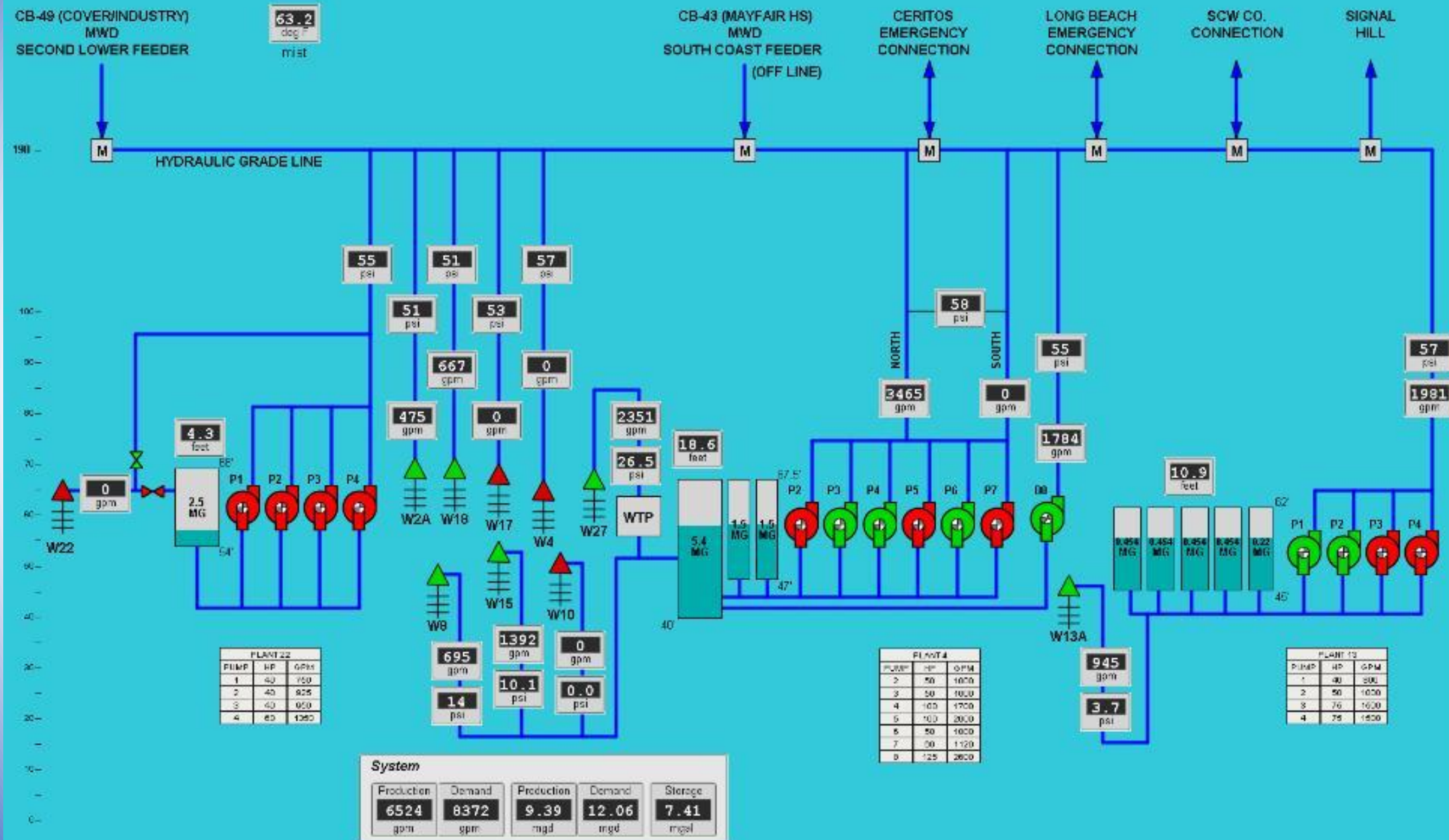


# Pump Control and Optimization

**SCADA Improvement**



## Hydraulic



### Overviews

[Map](#)  
[Hydraulic Network](#)  
[Pump Control](#)

### Wells

[Well 2A](#)  
[Well 4](#)  
[Well 6](#)  
[Well 8](#)  
[Well 10](#)  
[Well 13A](#)  
[Well 15](#)  
[Well 17](#)  
[Well 18](#)  
[Well 22](#)  
[Well 27](#)

### Plants

[Plant 4](#)  
[Booster 8](#)  
[Plant 13](#)  
[Plant 22](#)  
[Plant 27](#)

### Irrigation

[Bolivar](#)

### Alarms

[Alarm Journal](#)

### Log In

guest

Mon 06/10/19 07:20:14

# Central Pressure Control

Command Alarm Overview Well Plant Trend Data Report Admin Doc Windows Help

## Pump Control

Sequence Control							24 Hour Trend
Pump	Flow Cap.	Status	Available	Control Mode	Delay After Start	Delay After Stop	
Booster 8	2000	On	Available	System	120	120	
Plant 04 P4	1700	On	Available	System	120	120	
Plant 13 P1	800	On	Available	System	120	120	
Plant 04 P6	1000	On	Available	System	120	120	
Well 18	660	Off	Unavailable	System	120	120	
Well 02A	470	On	Available	System	120	120	
Plant 04 P3	1000	Off	Available	System	120	120	
Plant 04 P2	1000	Off	Available	System	120	120	
Plant 13 P2	1000	Off	Available	System	120	120	
Plant 04 P7	1100	Off	Available	System	120	120	
Well 22	800	Off	Unavailable	System	720	120	
Plant 04 P5	2000	Off	Available	System	120	120	
Well 17	900	Off	Unavailable	System	120	120	
Well 04	550	Off	Unavailable	System	120	120	
Plant 13 P3	1500	Off	Unavailable	System	120	120	
Plant 13 P4	1500	Off	Unavailable	System	120	120	
Plant 22 P1	0	Off	Unavailable	Local	60	60	
Plant 22 P2	0	Off	Unavailable	Local	60	60	
Plant 22 P3	0	Off	Unavailable	Local	60	60	
Plant 22 P4	0	Off	Unavailable	Local	60	60	

Command History	
Date/Time	Command
06/05/19 07:58:59	Started Plant 04 P3
06/05/19 06:06:31	Started Plant 04 P7
06/05/19 05:04:48	Started Plant 13 P2
06/05/19 05:02:47	Started Plant 04 P2
06/05/19 05:00:48	Started Plant 04 P3
06/05/19 04:08:09	Started Well 02A
06/05/19 04:03:04	Started Well 18
06/05/19 04:00:39	Started Plant 04 P6
06/05/19 01:51:01	Stopped Plant 04 P6
06/04/19 23:52:44	Stopped Well 18
06/04/19 23:19:07	Stopped Plant 04 P3
06/04/19 22:41:15	Stopped Plant 04 P2
06/04/19 20:03:58	Started Well 18
06/04/19 19:27:16	Started Plant 04 P2
06/04/19 18:22:27	Started Plant 04 P3
06/04/19 15:38:47	Started Plant 04 P6
06/04/19 10:14:59	Started Well 18
06/04/19 05:05:56	Started Plant 13 P2
06/04/19 05:01:50	Started Plant 04 P7
06/04/19 04:05:52	Started Plant 04 P2
06/04/19 04:03:07	Started Well 02A
06/04/19 01:43:58	Stopped Plant 04 P2
06/03/19 22:44:13	Stopped Plant 04 P7
06/03/19 19:59:47	Started Plant 13 P2
06/03/19 07:38:57	Started Plant 04 P7
06/03/19 05:05:35	Started Plant 13 P2
06/03/19 05:02:00	Started Plant 04 P7
06/03/19 04:10:07	Started Plant 04 P2
06/03/19 04:02:27	Started Plant 13 P1
06/02/19 22:54:09	Stopped Plant 13 P1
06/02/19 22:39:38	Stopped Plant 04 P2
06/02/19 20:01:41	Started Plant 04 P2
06/02/19 06:49:39	Stopped Plant 04 P2
06/02/19 05:09:33	Started Plant 04 P2
06/02/19 05:03:14	Started Plant 13 P1
06/02/19 05:01:14	Started Well 02A
06/02/19 01:39:21	Stopped Well 02A

Pressure Selection		
Site	Pressure	Use
Booster 8	56.3 psi	ON
Well 02A	53.0 psi	OFF
Well 04	56.5 psi	OFF
Well 17	54.6 psi	OFF
Well 18	51.7 psi	OFF
Well 22	57.0 psi	OFF
Plant 04 N	58.4 psi	OFF
Plant 04 S	60.9 psi	OFF
Plant 13	56.6 psi	OFF

Change Sequence

**Stage Control**

Stage Pump

Stage Timer  sec

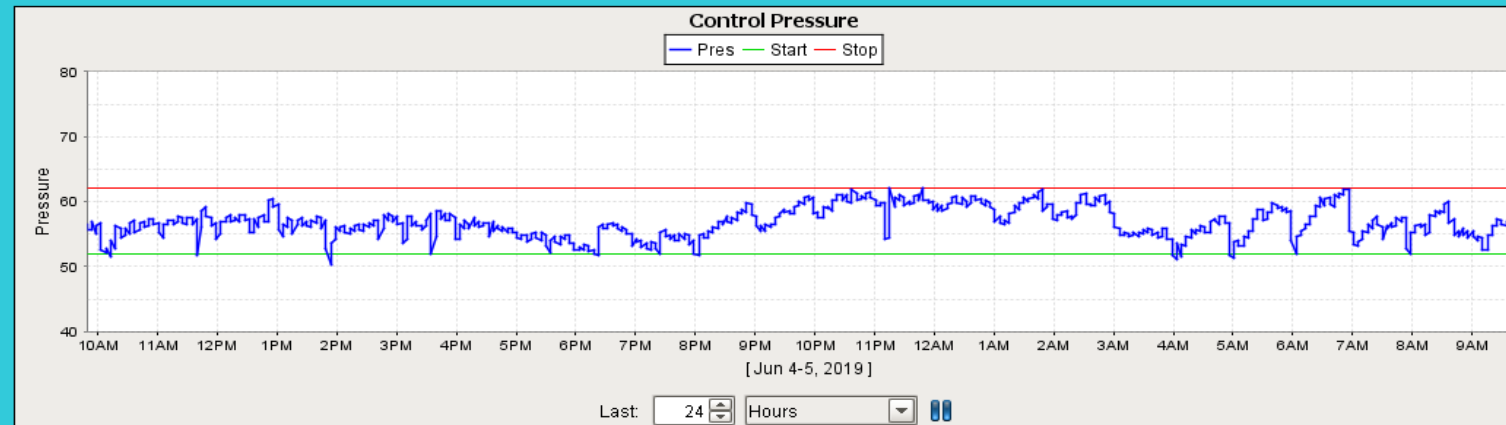
Stop Pressure  psi

Start Pressure  psi

Pressure  psi

Demand  gpm

Started Plant 04 P3 07:58



[Overviews](#)

[Map](#)

[Hydraulic](#)

[Network](#)

[Pump Control](#)

[Wells](#)

[Well 2A](#)

[Well 4](#)

[Well 6](#)

[Well 8](#)

[Well 10](#)

[Well 13A](#)

[Well 15](#)

[Well 17](#)

[Well 18](#)

[Well 22](#)

[Well 27](#)

[Plants](#)

[Plant 4](#)

[Booster 8](#)

[Plant 13](#)

[Plant 22](#)

[Plant 27](#)

[Irrigation](#)

[Bolivar](#)

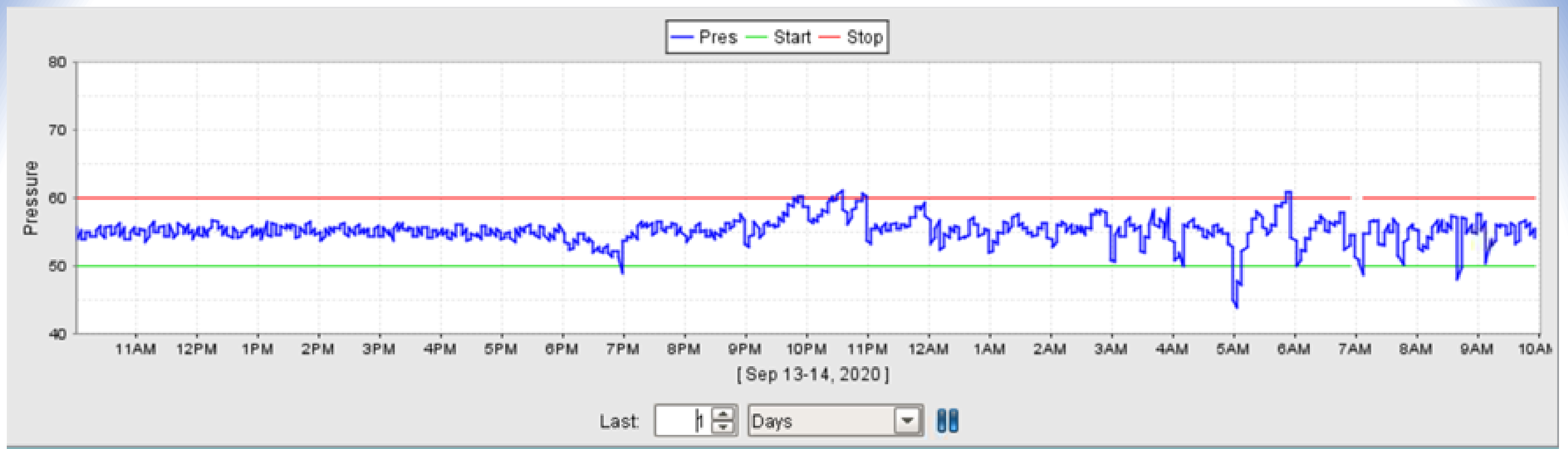
[Alarms](#)

[Alarm Journal](#)

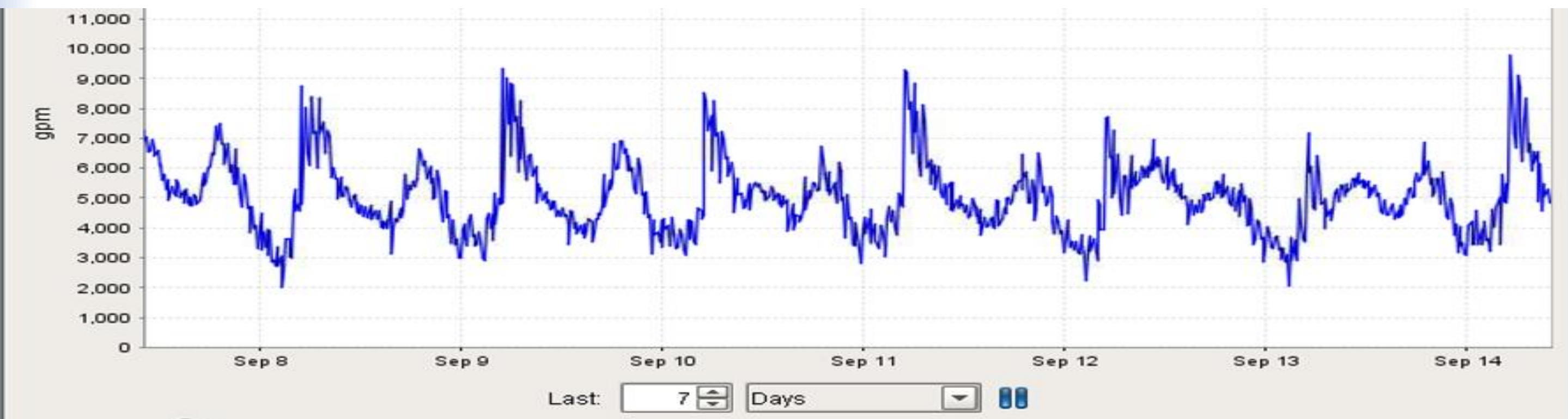
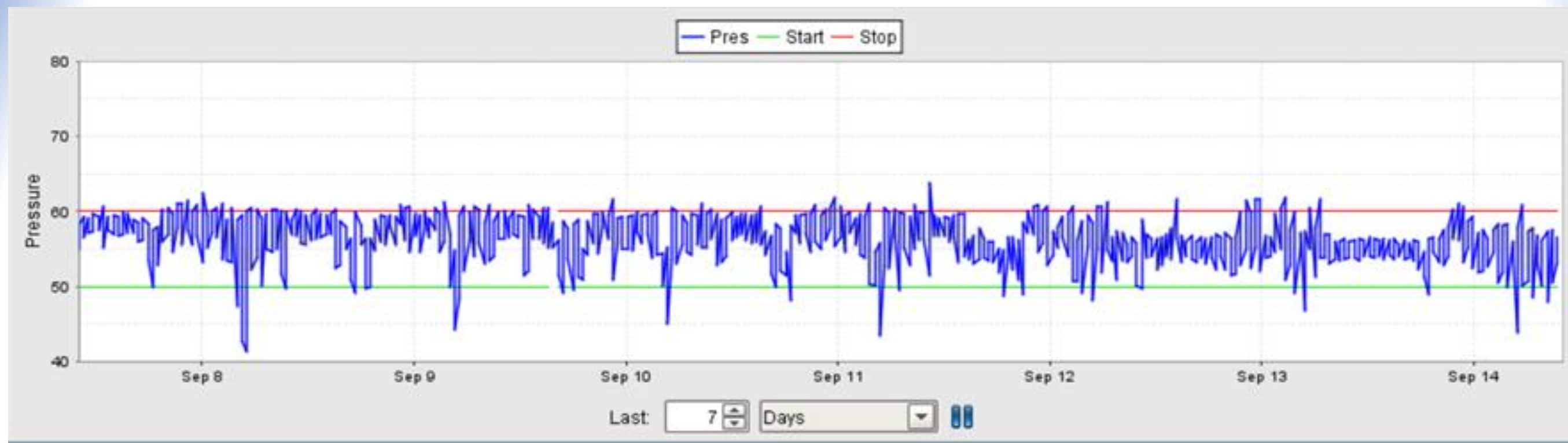
[Log In](#)

guest

Wed 06/05/19 09:48:59







# *Central Pressure Control*

- Ease of arranging well and pump sequence by matching the demand at various levels
- Better utilizing VFD pumps
- Smooth pressure peaks and reduce leaks
- Preschedule pump sequences to save energy
- Pressure control to reduce leaks and enhance conservation
- Utilize demand data from AMI to schedule the supply configuration and capital project

# Efficiency Standards TIMING

**2018**



Begin  
standard  
development

**2022**



Adopt  
standards, PMs,  
and method

**2023**



Suppliers  
calculate  
objectives

**2025**



Suppliers  
reach  
objectives





# AWWA Free Water Audit Software: Water Balance

WAS v5.0

American Water Works Association.

Water Audit Report for: CITY OF LAKEWOOD (1910239)

Reporting Year: 2019

1/2019 - 12/2019

Data Validity Score: 80

Own Sources (Adjusted for known errors)  9,852.290	System Input 9,852.290	Water Exported 3,245.430	Billed Water Exported				Revenue Water 3,245.430
		Authorized Consumption  6,468.420	Billed Authorized Consumption  6,459.340	Billed Metered Consumption (water exported is removed)  6,459.340	Revenue Water  6,459.340		
				Billed Unmetered Consumption  0.000			
			Unbilled Authorized Consumption  9.080	Unbilled Metered Consumption  0.000	Non-Revenue Water (NRW)  147.520		
				Unbilled Unmetered Consumption  9.080			
		Water Supplied  6,606.860	Apparent Losses 48.854	Unauthorized Consumption  16.517			
				Customer Metering Inaccuracies  16.189			
				Systematic Data Handling Errors  16.148			
			Water Losses 138.440	Real Losses 89.586	Leakage on Transmission and/or Distribution Mains Not broken down		
					Leakage and Overflows at Utility's Storage Tanks Not broken down		
Leakage on Service Connections Not broken down							
Water Imported  0.000							

# Summary

- **Significantly enhance customer services and relations**
  - Maximizing reading success rate and billing accuracy
  - Identify and alert potential customer-side leaks
  - Proactive customer communication and issue resolution
  - Provide tools to utility staff to better assist customers
  - Improving communication and responsiveness to customers
- **Use more technology being more efficient and cost-effective**
  - Automation to manage increasing labor cost
  - Revenue recovery and control water loss
  - Increase data availability/accuracy to improve reporting
  - Optimize future CIP investment
  - TOU rate possible to reflect cost of services
- **Integration and visualization of technology platforms to be smarter**
  - Identify and visualize issues timely from on-going platforms
  - Improve understanding of system operations
  - Reduce breaks and leaks through pressure management
  - Smooth pressure variation to extend pipeline life
  - Data-driven management for annual CIP budget\$!



# Thank You!

**Jason Wen**

**[jwen@lakewoodcity.org](mailto:jwen@lakewoodcity.org)**

## QUESTIONS?