Water Loss in Texas:
How Much Water is Being Lost and
How Communities are Approaching Solutions

Moderator: Jennifer Walker
National Wildlife Federation

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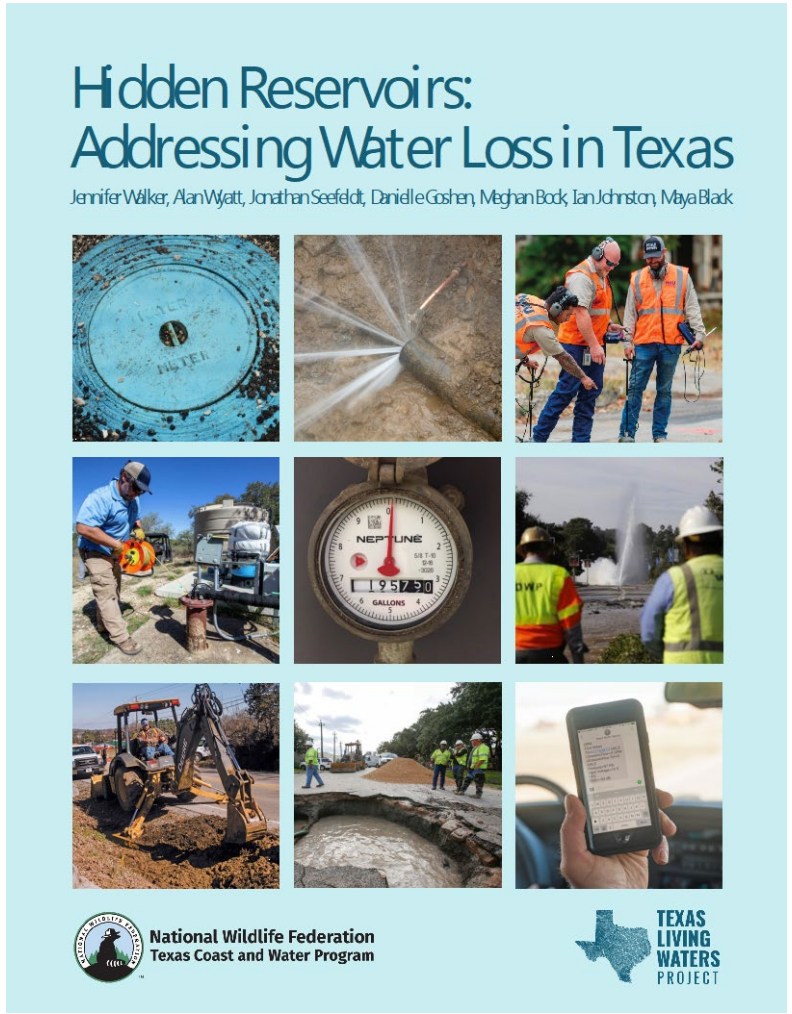
San Antonio Water System

Water Loss in Texas: How Much Water is Being Lost and How Communities are Approaching Solutions



Hidden Reservoirs: Quantifying Water Loss In Texas

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13th Annual Central Texas Water Conservation Symposium
San Antonio, Texas

February 22, 2023

Presentation Outline

1) Introduction

2) Methodology

3) Findings

- Current Water Loss
- Potential For Water Loss Reduction
- Comparative Cost Effectiveness

4) Recommendations

5) Follow-up

1. Introduction

- **Purpose:** To raise awareness on the current level of water losses in Texas, the potential for, and the favorable economics for water loss reduction, and increase the use of water loss reduction as a Water Management Strategy.
- **Project Team:** National Wildlife Federation ‘s Texas Coast and Water Program, Aiqueous, Inc. and an Independent Consultant
- **Timeline:** 2021 - 2022
- **Funding:** The Meadows Foundation and the Cynthia and George Mitchell Foundation
- **Key Collaborator:** Texas Water Development Board

2. Methodology

1. **Water Loss Audits:** Obtained water loss audits from TWDB for 2015 – 2019 (6829 audits). Determined that 2019 audits were consistent with previous years.

2. **Filtered Sample:** Filtered out potentially inaccurate 2019 audits using criteria used by TWDB and AWWA and created a Sample of the most accurate 2019 water loss audits, n = 823

3. **Water Loss by Region and Size Class (2019):** Analyzed the Sample for the components of water loss for different Regions and Size Classes, and the **total water loss, in gallons / connection / day**, for each Region (n=16) and water system Size Class (n=4).

Filtered Water Loss Audits, Texas, 2019

Acceptable Audits meet these Criteria

Available Water Loss Audits 2019	
Very Large	n= 39
Large	n= 92
Medium	n= 216
Small	n= 905
Total	n=1252

TWDB

- Positive Values for Totals of Water loss, Apparent Loss, Unreported Real Loss, Real Loss
- Customer Meter Accuracy > 90%
- Billed Metered Consumption > 1000 Gals / Connection / Month
- Infrastructure Leakage Index: 1 to 10
- Outlier Values for Population, # of Connections, Length of Mains, Connection Density, or Average Pressure

Additional Criteria

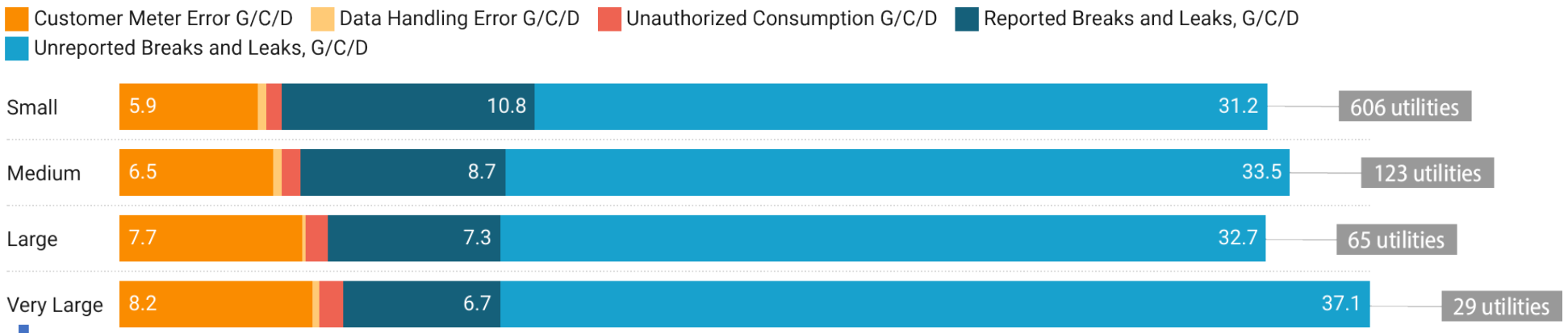
- Connection Density: 4 to 250 Connections/Mile
- Authorized Consumption: 50 to 1000 Gallons/Connection/Day
- Unit Water Loss: 5 to 200 Gallons/Connection/Day
- Water Loss Percentage > 50%
- Unit Real Loss > 3 Gallons/Connection/Day
- *Infrastructure Leakage Index: 0.5 to 15 (Expanding Criterion Above)*
- Customer Retail Unit Cost (CRUC): $500/MG to $50,000/MG sold
- Variable Production Cost (VPC): $100/MG to $20,000/MG produced
- Ratio - CRUC / VPC: 1 to 100

Filtered Sample for Analysis, 2019	
Very Large	n= 29
Large	n= 59
Medium	n=123
Small	n=606
Total	n=823

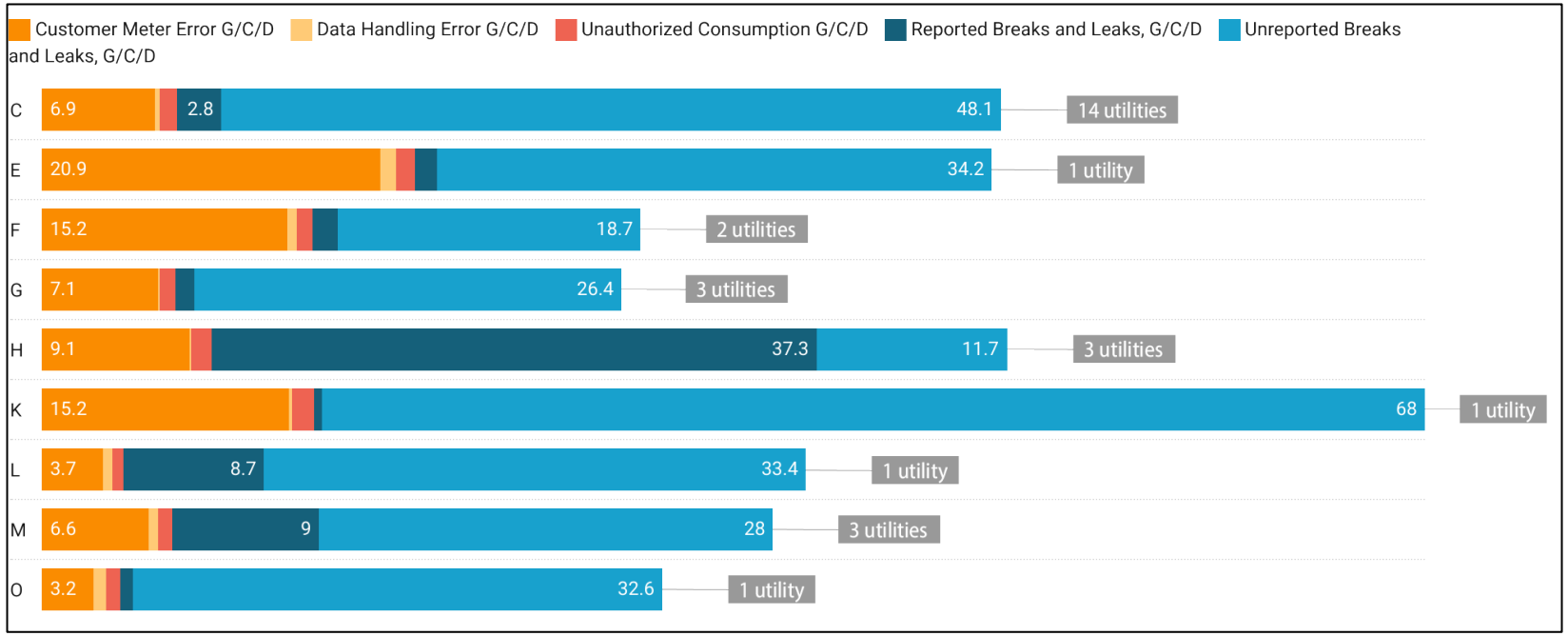
Utility Size Categories

Very Large >100,000 people
Large = 25,000 to 100,000 people
Medium = 10,000 to 25,000 people
Small = < 10,000 people

Components of Water Loss, Texas, 2019



Very Large Utilities by Region



Methodology

5. **Scale up to Statewide(2020):** Obtained data from TWDB/TCEQ on the active retail water suppliers in each Region and each Size Class for 2020, and scaled up the Sample results to “Statewide” from 823 to 4,021 retail water suppliers, using total water loss in gallons / connection / day.

6. **Statewide Analysis:** Conducted multiple analyses in each Region and in each Size Class at the Statewide (2020) level , including total and unit water losses and water loss reduction potential, for three levels of water loss performance (Average, Good Performance and Very Good Performance).

7. **Comparison of Reduction Potential** to Municipal Needs and SWP Water Loss Projects

Frontier Analysis to Assess Water Loss Performance

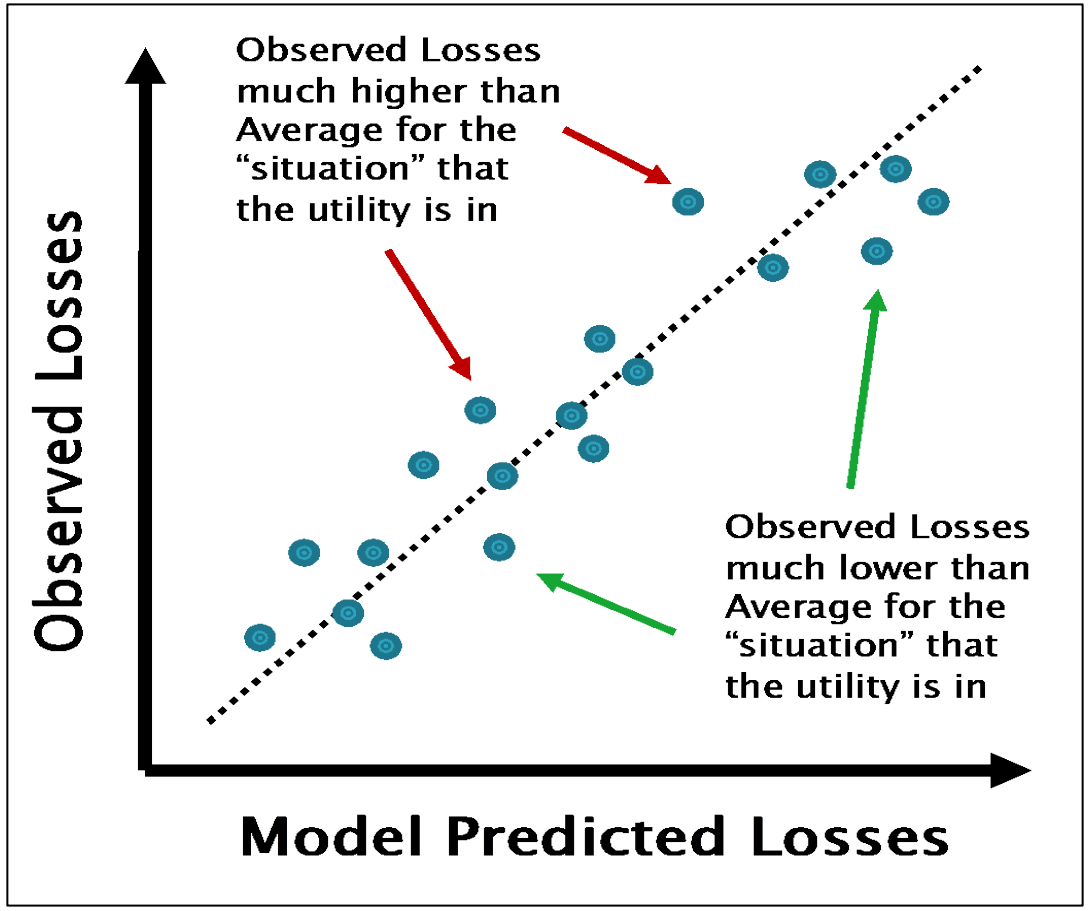
1. **Observed Water Losses:** FA starts with a database of utility attributes (mains length, connections, water use, water cost, etc) and Observed water loss for each utility.

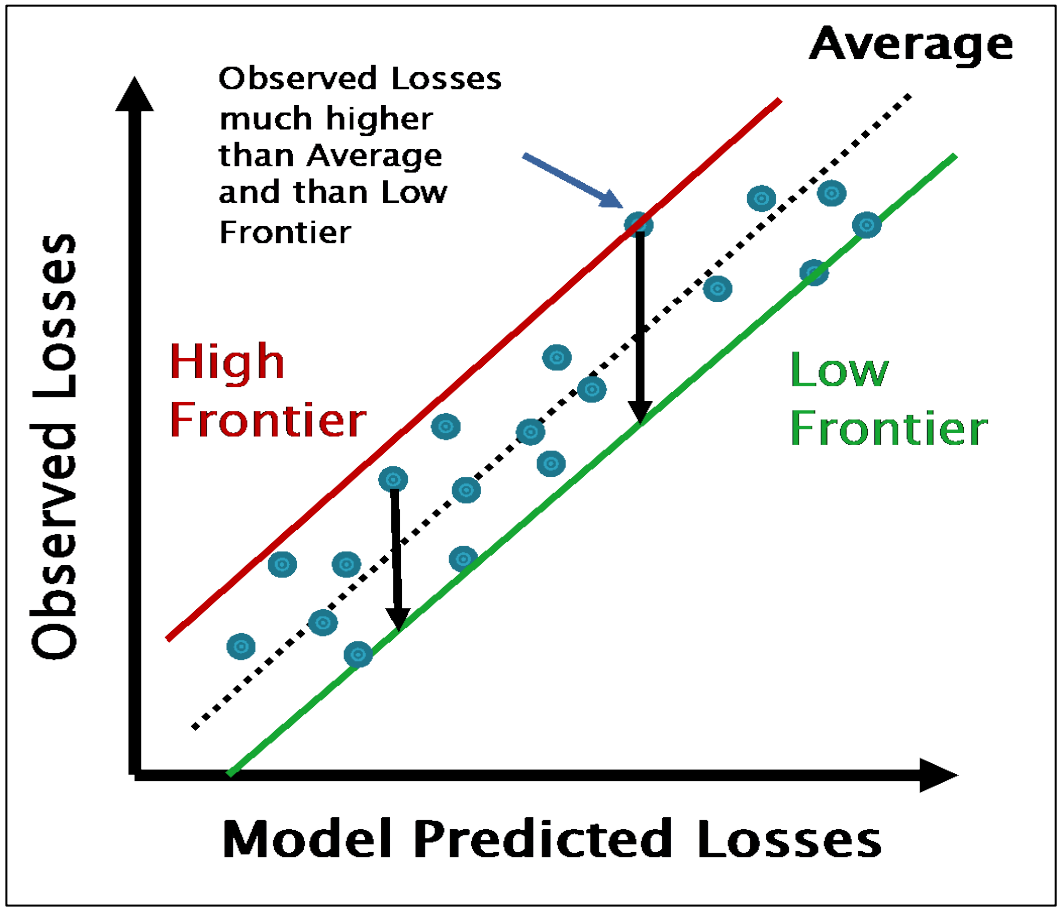
2. **Predicted Water Losses**: FA uses Multi-variate Regression Analysis to develop a mathematical formula for the average water loss performance - known as the Predicted water loss.

3. **Comparison of Observed and Predicted.** Compares the Observed water loss to the Predicted water loss, revealing good performers and poor performers

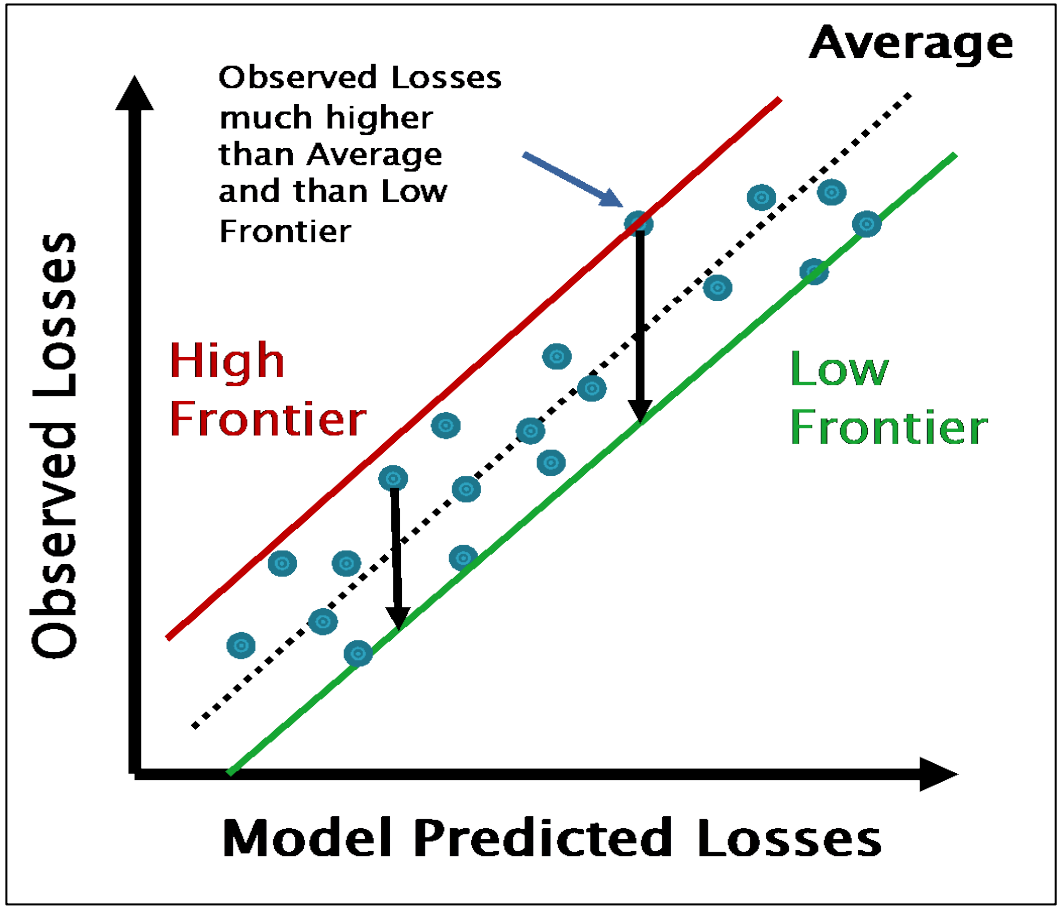
4. **Water Loss Reduction Potential:** Determines the amount of Water Loss Reduction for each utility associated with a chosen target or standard.

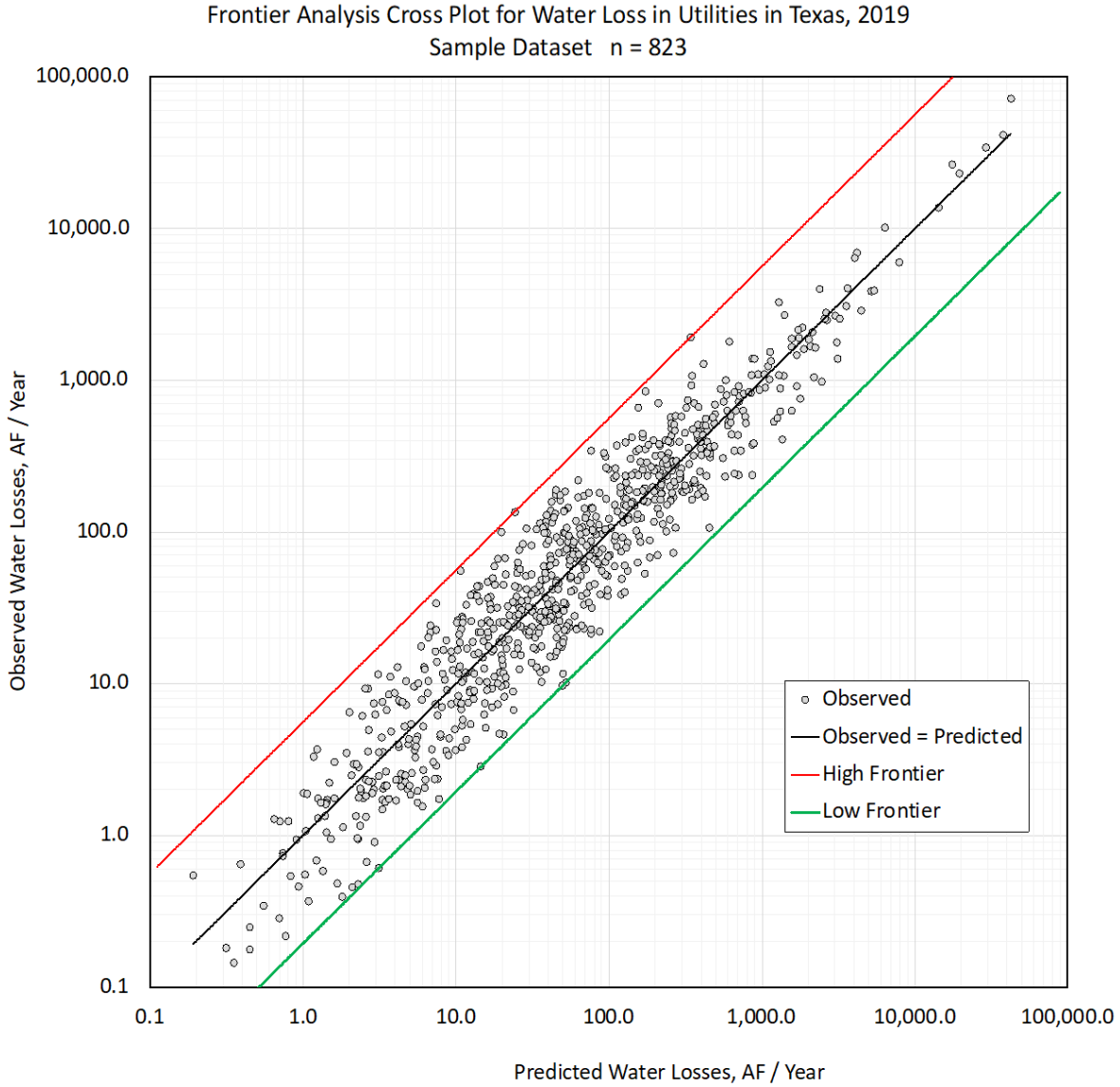
Graphical Form of Frontier Analysis





First FA Application for Water Loss in Texas





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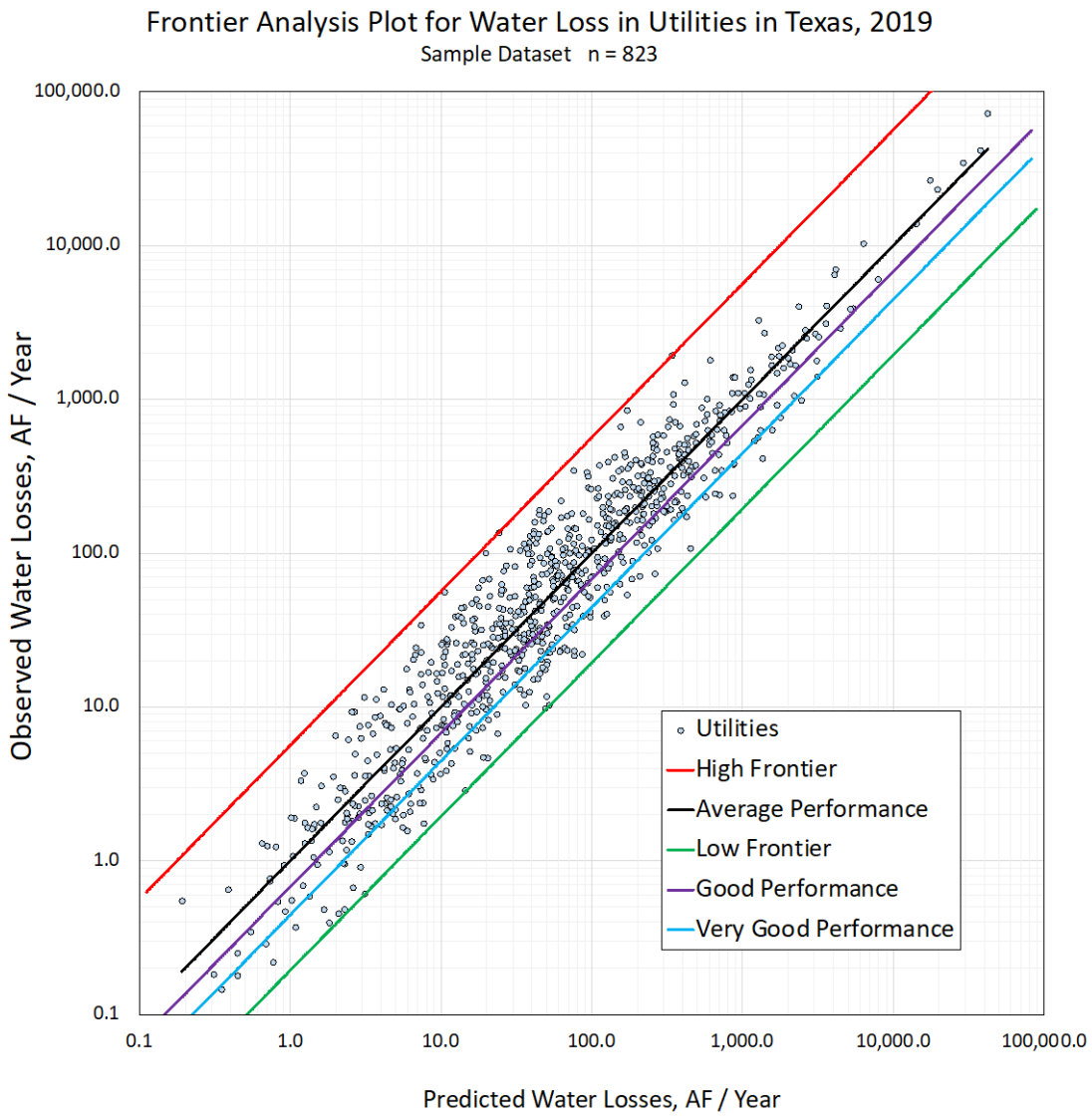


Performance Standards

High Frontier – Worst in Texas Sample

Average Performance

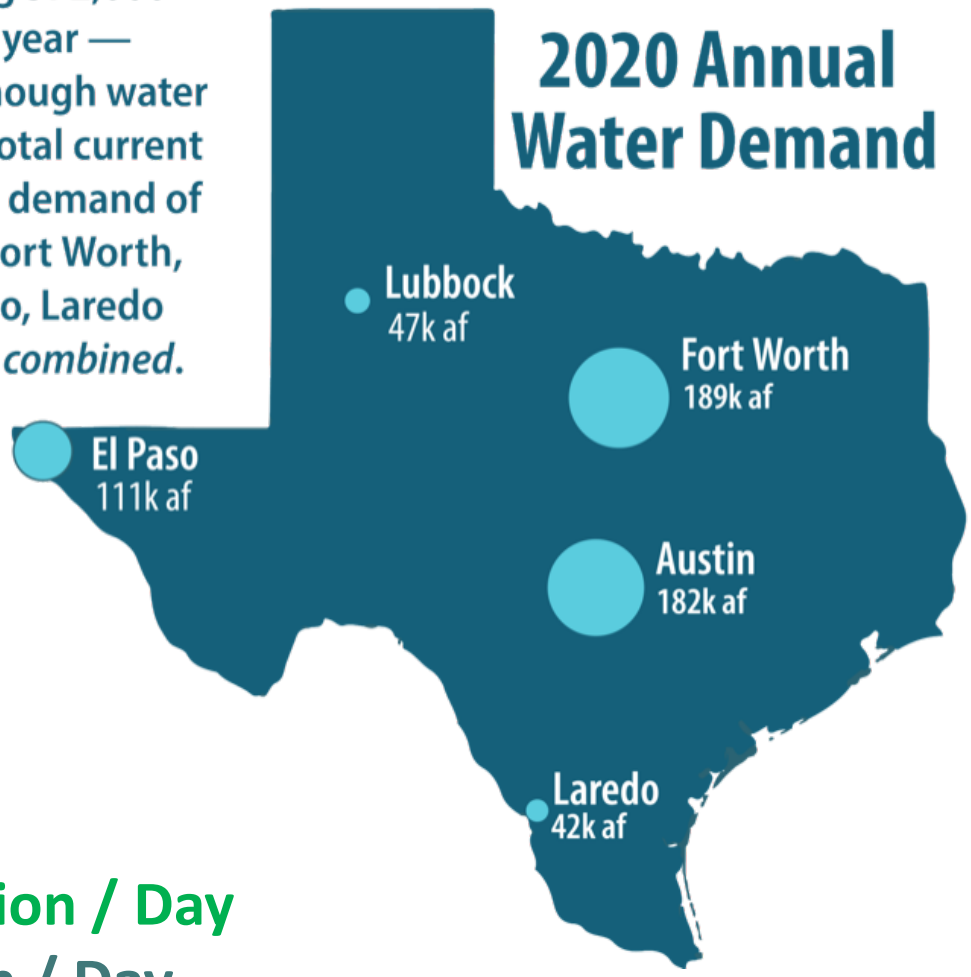
Good Performance

Very Good Performance

Low Frontier - Best in Texas Sample

3. Findings – Current Losses

Texas is losing 572,000 acre-feet per year — more than enough water to meet the total current annual water demand of the cities of Fort Worth, Austin, El Paso, Laredo and Lubbock *combined*.



2020 Average Annual Water Loss in Texas

< 572k af

51 Gallons / Connection / Day

17 Gallons / Person / Day

572,000 AF / Year

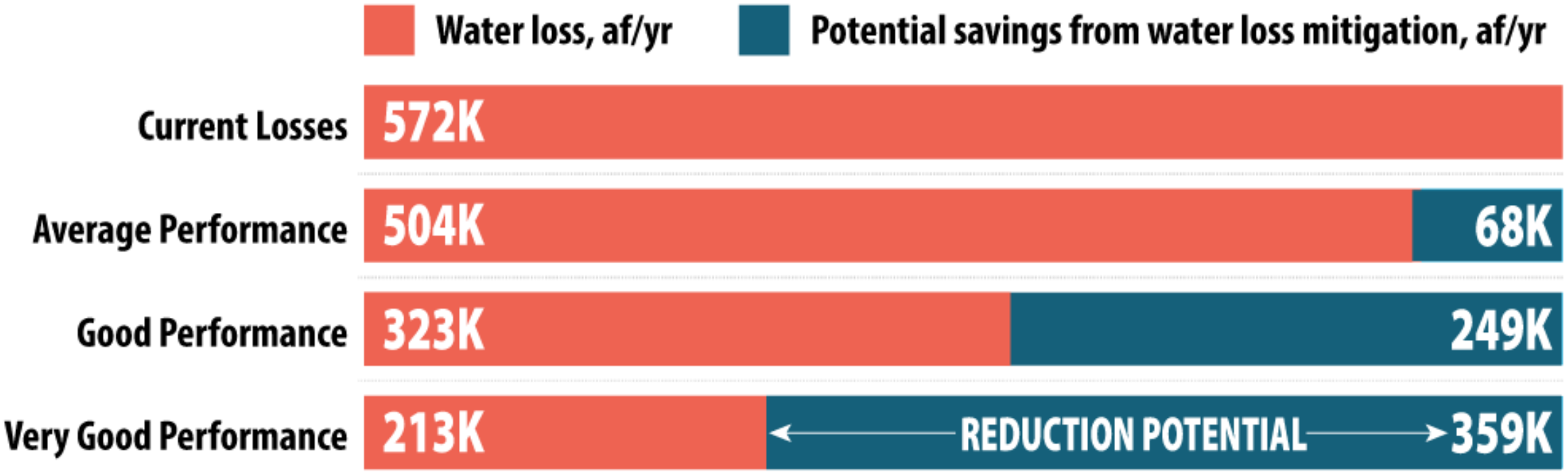
Estimated Water Loss in 2020 by Size Class

Size Category	Population Served	# of Utilities	Total Retail Population	% of Population	Total Retail Connections	% of Connections	Estimated Total Water Losses (af/yr)	% of Water Losses	Estimated Avg Water Losses (g/c/d)
Very Large	Greater than 100,000	41	14.2M	49%	4.5M	45%	277K	48%	55
Large	Between 25,000-100,000	105	5M	17%	1.8M	18%	96K	17%	47
Medium	Between 10,000-25,000	228	3.5M	12%	1.2M	12%	70K	12%	50
Small	Less than 10,000	3.6K	6.5M	22%	2.4M	24%	129K	23%	47
All		4K	29.2M		10.1M		572K		51

Table 1. Utility Attributes & Estimated Water Loss in 2020 by Size Class.

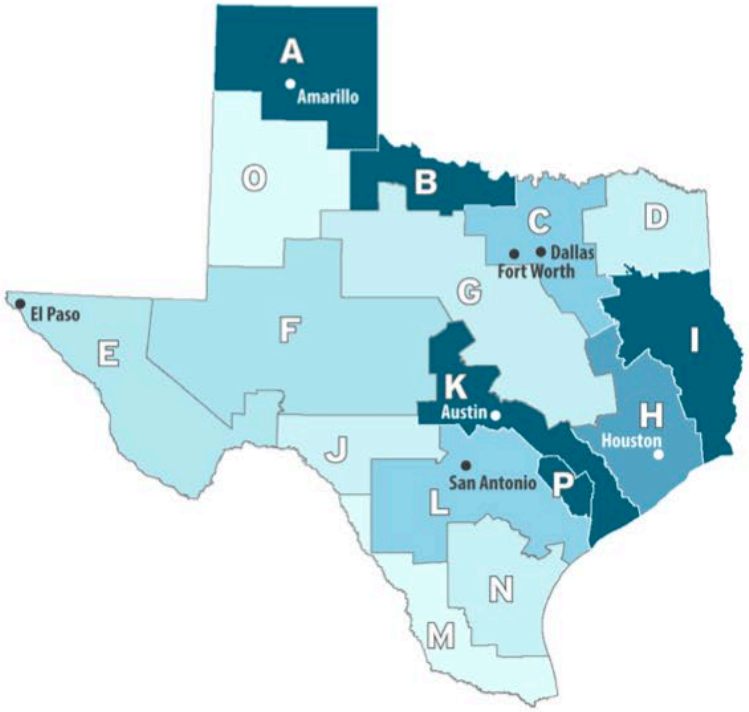
Sources for analysis: Texas Water Development Board, Water Loss Audit Data, 2019; 2022 State Water Plan; Texas Commission on Environmental Quality, 2020 Water Utility Data.

Water Loss and Reduction Potential - 2020

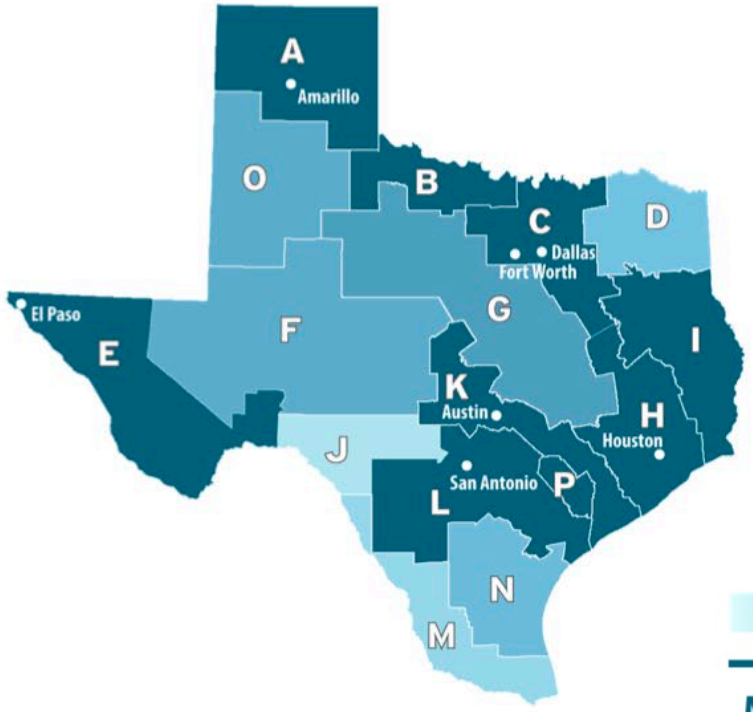


Growing Municipal Water Demand and 2020 Water Loss Reduction Potential

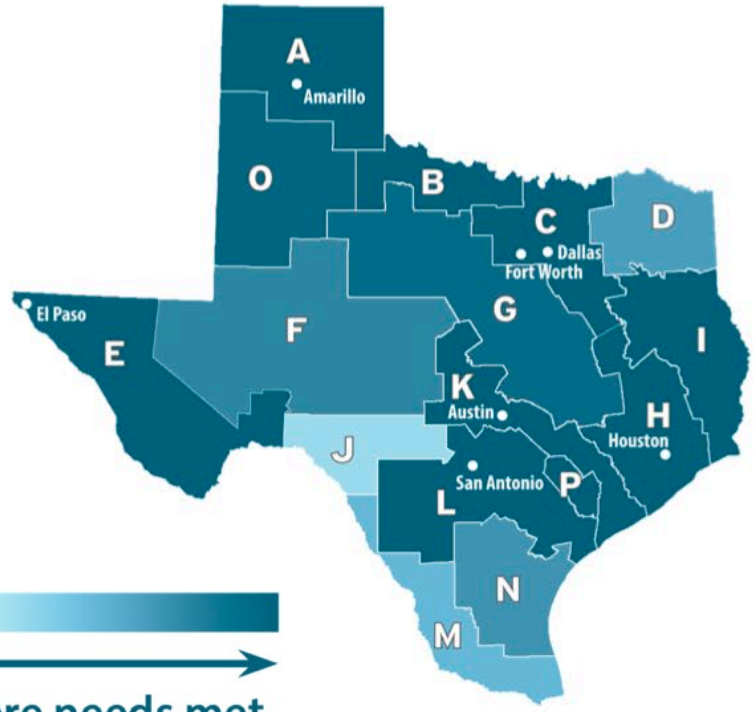
Average Performance



Good Performance



Very Good Performance



Reduction to the Good Level would cover demand growth in 9 of the 16 Regions

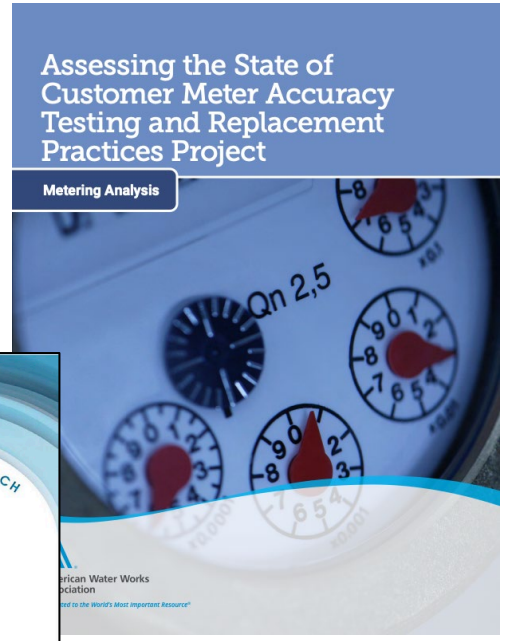
Reduction to the Very Good Level would cover demand growth in 11 of 16 Regions

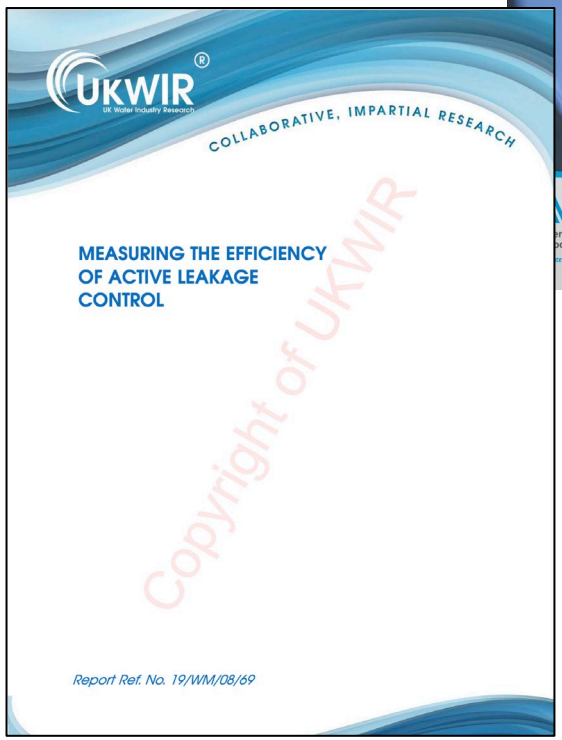
Growing Municipal Water Demand and 2020 Water Loss Reduction Potential

Utility Size	2020 Decade Municipal Needs (af/yr)	Potential Water Savings from Water Loss Reduction as a Percent of Needs			
		Supply from Water Loss WMSs	Average	Good	Very Good
Very Large	65.4K	71% *(46.4k af/yr)*	35% *(22.6k af/yr)*	>100% *(116.5k af/yr)*	>100% *(171.2k af/yr)*
Large	65.9K	8% *(5.6k af/yr)*	6% *(4.2k af/yr)*	50% *(33.2k af/yr)*	83% *(54.6k af/yr)*
Medium	37.7K	10% *(3.8k af/yr)*	29% *(11.0k af/yr)*	86% *(32.6k af/yr)*	>100% *(45.1k af/yr)*
Small	45.7K	14% *(6.6k af/yr)*	66% *(30.1k af/yr)*	>100% *(66.7k af/yr)*	>100% *(88.0k af/yr)*
Total	214.6K	29% *(62.4k af/yr)*	29% *(62.4k af/yr)*	>100% *(248.9k af/yr)*	>100% *(358.9k af/yr)*

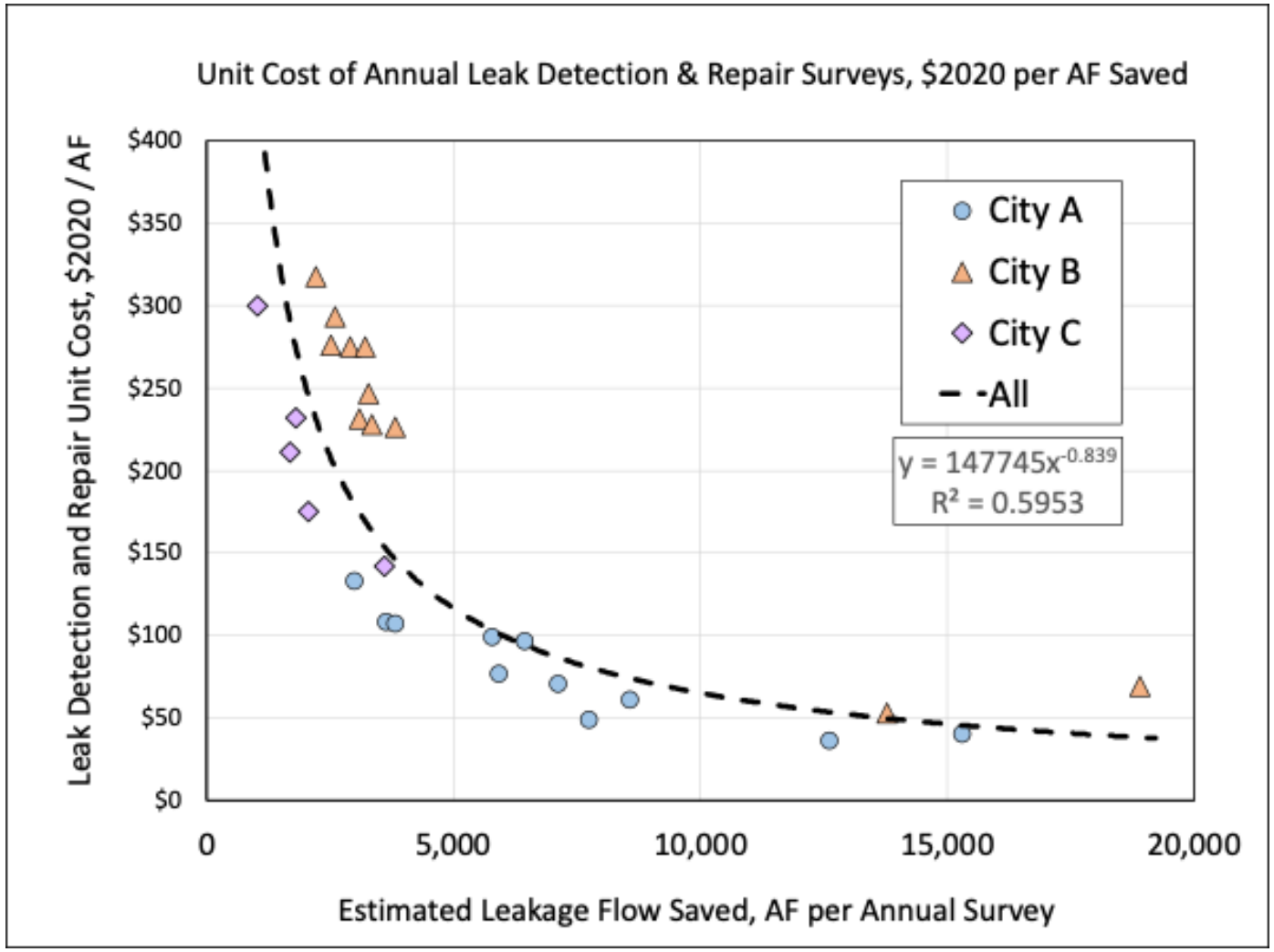
3. Cost Effectiveness - Data Sources

- Research Reports – USA (WRF), Canada (NRC), Europe (UKWIR, OFWAT, WRC, ITA), Australia (Universities – Sydney, Monash), South Africa (WRC)
- Peer-Reviewed Journal Articles (Often anonymous)
- AWWA Journal, Opflow, Manuals (costs often not provided)
- Conference Papers supplemented with Private Discussion
- Product Manufacturers
- Utility Websites, Budgets, Plans, Interviews (anonymity)
- Regulatory Documents
- RFPs and Award Notifications
- EPA Green Reserve Fund
- State Revolving Funds and other Financing Programs
- Water Loss Audits Before and After Projects
- US Military Distribution Studies and Practice Manuals
- Engineering Cost Models – Texas, Indiana, Florida, California





Leak Detection and Repair: Efficiency Indicators



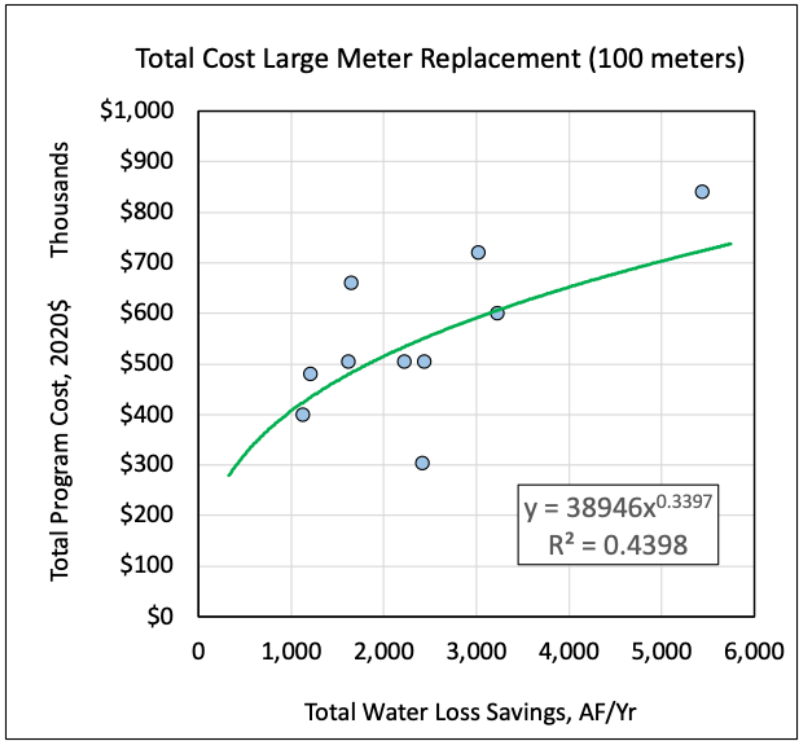
Efficiency Indicators

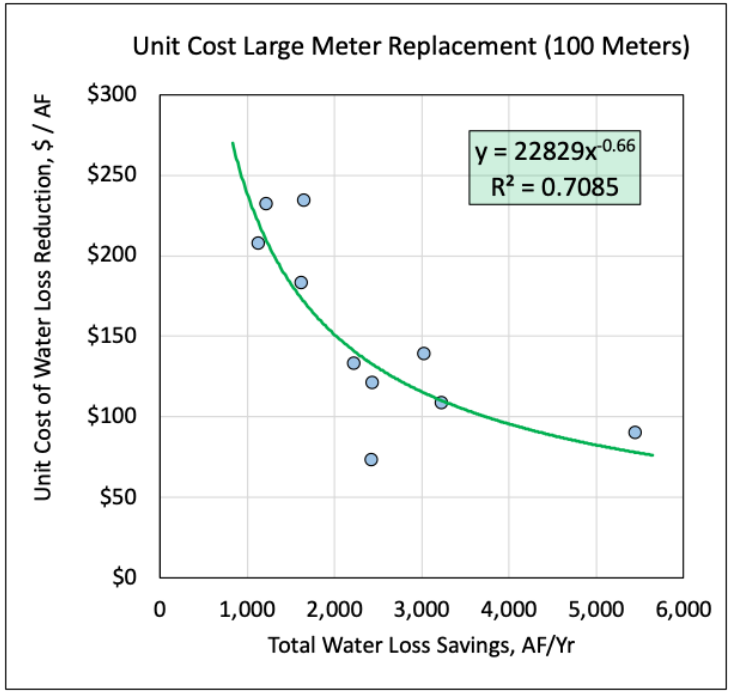
Leaks Detected / Miles Surveyed
Leaks Detected / Crew Days Used
LD&R Cost / Miles Surveyed
LD&R Cost / Leaks Detected
LD&R Cost / Leakage Reduction

Large Economies of Scale:

- Large Programs
- Many Leaks

Large Meter Testing and Replacement



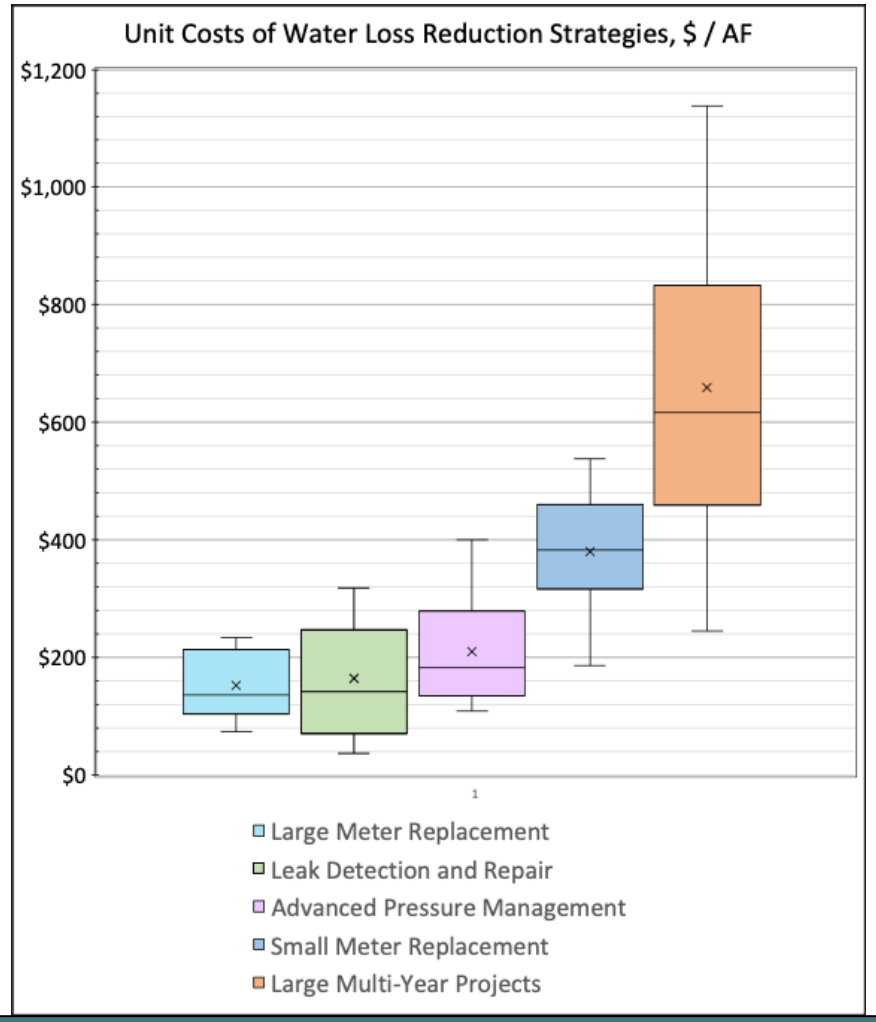


- Based on empirical data from big US cities on old large meters and cost data of meter testing and replacement.
- A Program of replacement of 100 large meters was assumed for illustrative purposes.
- MAJOR economies of Scale

Comparison to Other Water Management Strategies

Water Loss Reduction Project data was collected and analyzed to determine a cost per AF reduced and compared to cost data on recommended water supply and conservation projects in the 2022 SWP

For the most part, Water Loss Reduction is less expensive than other "sources" of water



Summary WMS Category - Supply Side Only	Number of Recommended Projects	Unit Cost (from Table 7-6)
Aquifer Storage and Recovery	153	$437
Conjunctive Use	131	$1,724
Direct Potable Reuse	18	$1,321
Groundwater Desalination	29	$920
Groundwater Wells and Related	625	$599
Indirect Reuse	550	$391
Other Direct Reuse	93	$962
Other Surface Water	1225	$744
TOTAL	**2824**	
Weighted Average Unit Cost for Supply Side WMS =		$695

Category of WMS - Demand Side	Number of Recommended Projects	Unit Cost (from Table 7-6)
Agricultural Conservation	155	$284
Industrial Conservation	141	$680
Municipal Conservation	1877	$675
TOTAL	**2173**	
Weighted Average Unit Cost for Demand Side WMS =		$406
Without Agricultural Conservation in Urban Areas, Unit Cost =		$675

Source: TWDB SWP 2022

4. Recommendations

- **Legislature:**
  - Prioritize financial assistance to utilities with high losses
  - Additional funding to TWDB for Conservation and Water Planning Staff

- **TWDB:**
  - Prioritize water loss data accuracy, transparency and accountability
  - Provide technical assistance and improve access to funding
  - Ensure those utilities receiving any financial assistance meet water loss standard, or have specific plans to do so
  - Include Water Loss Control as a distinct SWP Water Management Strategy

- **Utilities**
  - Accurately evaluate the financial impact of water losses
  - Invest in resilient infrastructure
  - Aggressively mitigate and sustain low water losses

5. Recent Developments

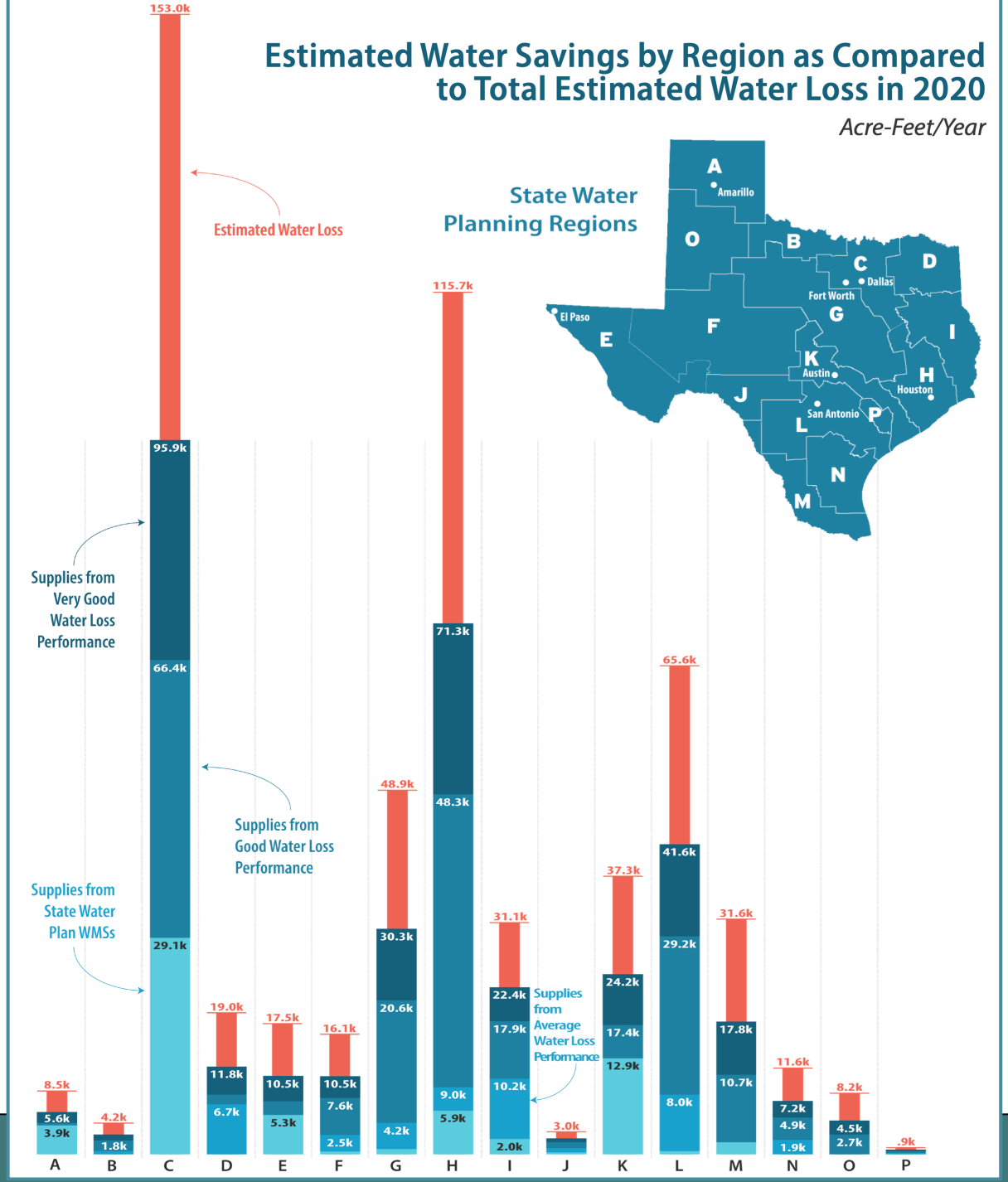
- **Legislature:**
  - Texas House Water Caucus formed – a new, bi-partisan collaborative focused on water issues
  - Discussions underway for additional investment in Texas water infrastructure, including for water loss reduction
- **TWDB:**
  - New Water Loss Audit Validation Program
  - Inclusion of Water Loss Control as a distinct SWP Water Management Strategy
  - New Water Loss Threshold
- **Utilities**
  - New water loss reduction technologies being deployed.
  - Assessment of current programs underway (SAWS case next)
- **TxAWWA** Water Loss Committee formed

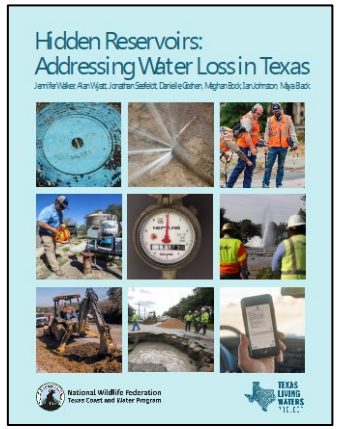
Thank You!!

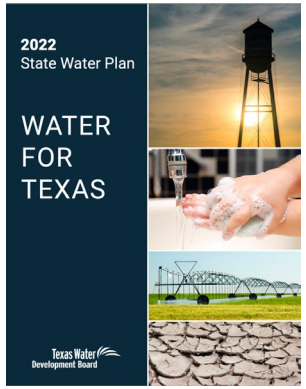
Jennifer Walker
Jonathan Seefeldt
Meghan Bock
-- -- -- -- -- -- --
Marcelo Depexe
Elvira Estruch-Juan
Amanda Fuller
Elton Goncalves
Danielle Goshen
Will Jernigan
Jonathan Kleinman
George Kunkel
Temple McKinnon
Dave Pearson
Daniel Rice
Pat Shriver
John Sutton
Gary Trachtman
Amy Talbot
TWDB
TCEQ

Estimated Water Savings by Region as Compared to Total Estimated Water Loss in 2020

Acre-Feet/Year







Water Loss in Texas:
How Much Water is Being Lost and
How Communities are Approaching Solutions

SAWS Water Loss Case Study

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Interim Manager Water Resources

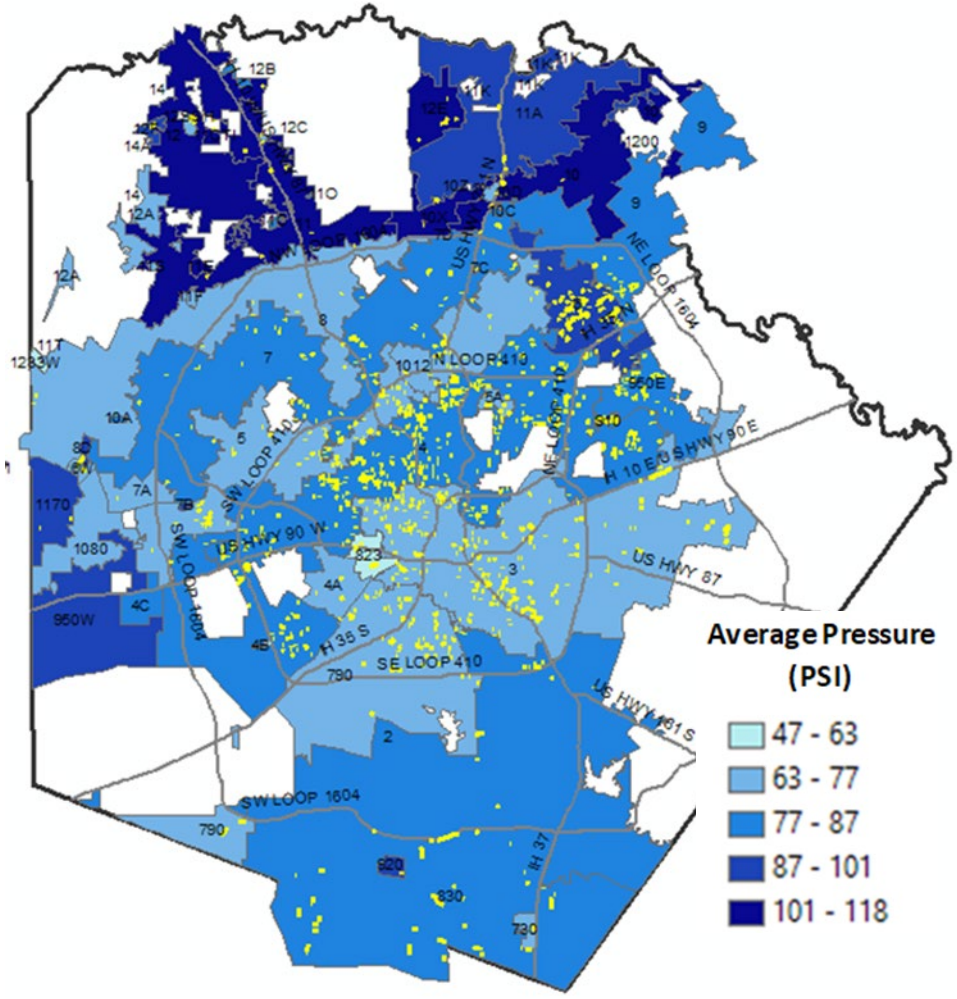
2023 Central Texas Water Conservation Symposium
February 22, 2023

San Antonio Water System

MAKING SAN ANTONIO WATERFUL

San Antonio Water System - Intro

- Municipally Owned
- Population 2.0+ M
- 850K+ Active and In-active potable connections:
  - 560,000+ Water Customers
    - ~238,000 multi-family units
- 7,600 Miles of Water Main
- ~60 Pressure Zones
- 1,700 Employees



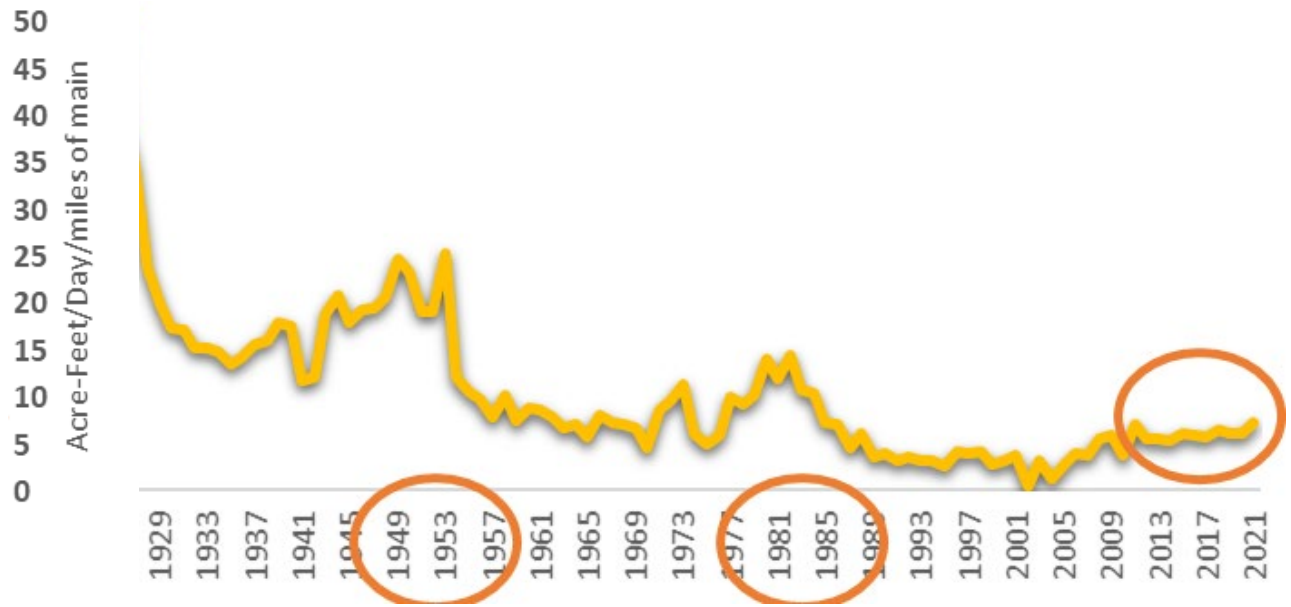
San Antonio Water System

Outline

- Quick Review of NRW
- SAWS Operation(s)
- A Decade of Intelligence
- Case study
  - Interventions
  - Case focus "Real Losses"
  - Considering Costs
- Importance of the work
- Q&A

National Statistic:

39 Billion Gallons / Day find a fate of NRW (ASCE 2021)



SAWS Water Resources:

- SAWS working on accounting for and intervening its contribution to the statistic

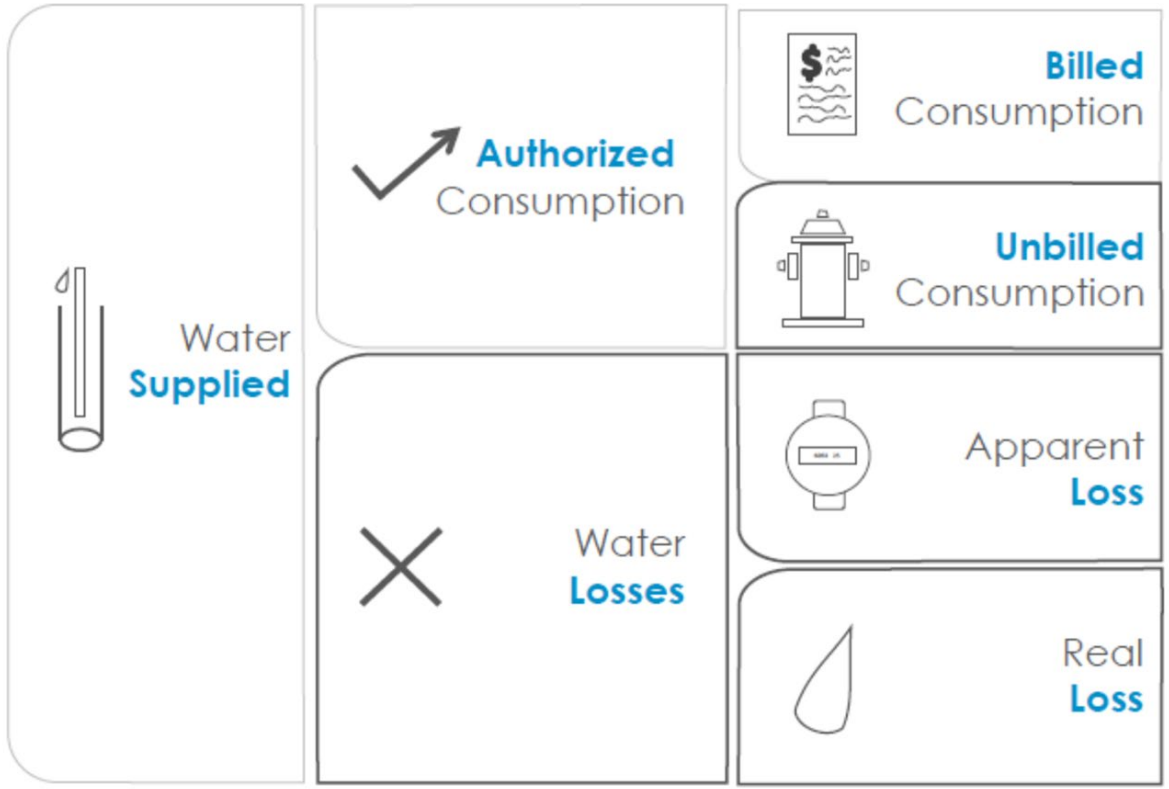
San Antonio Water System

Quick Review of Non-Revenue Water (NRW)

Common Framework and Basic Parts

- Basics of Water Balance
  - Top-down
  - Bottom up

  **Monitoring & Reporting will show a SAWS detailed one*
- NRW
  - Authorized Consumption
  - Apparent Losses
  - Real Losses



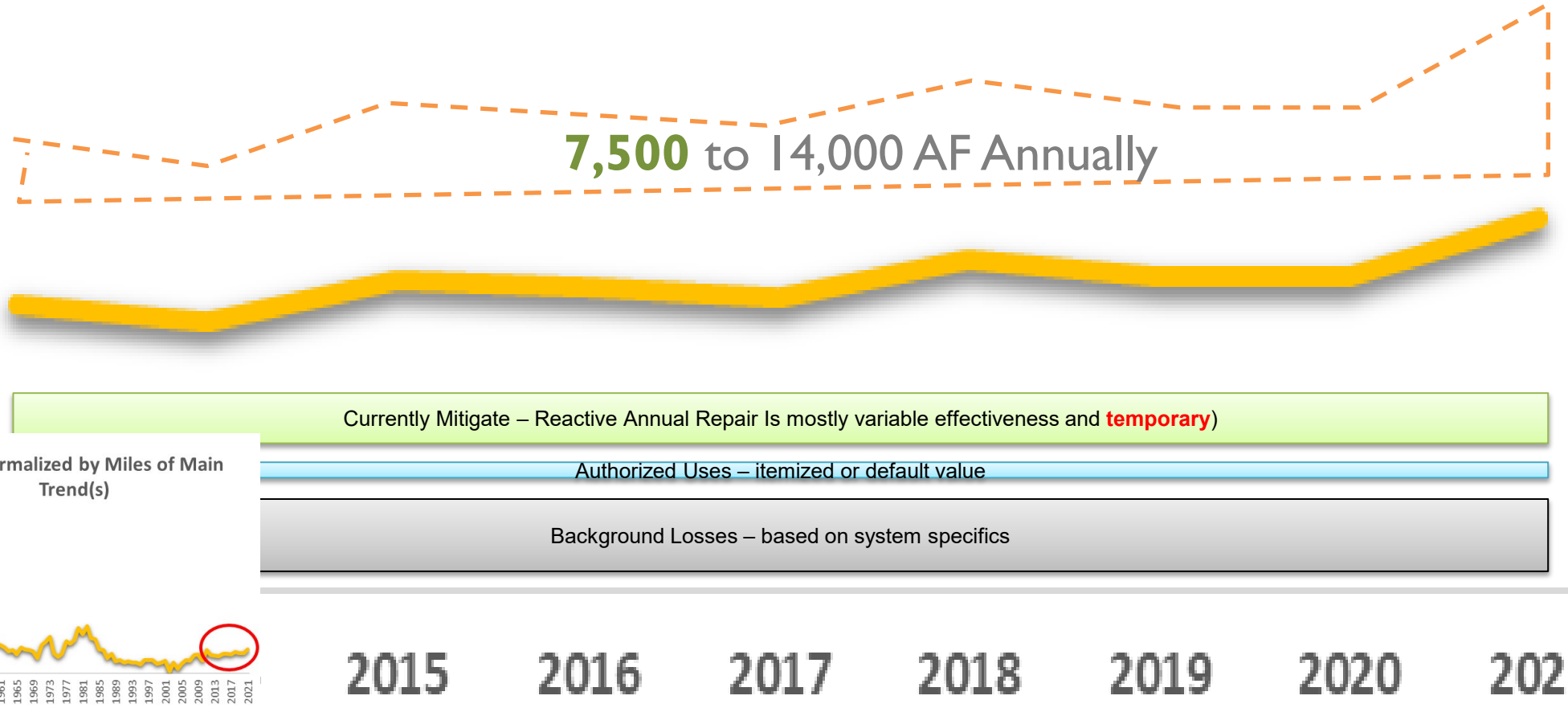
A Decade of Intelligence

SAWS Opportunities and Challenges Based on the Water Loss Control Science

- #1 Real Loss
  - Pro Active Leak Detection
  - Repair Processes and investments <a lot of variables>
- #2 System Input
  - Address correction factors
- Apparent Loss
  - Electronic meters AMI
- Other Initiatives (zones, computing AI,

SAWS Real Losses Trend 2013 to Present

Intervention Targeting – Cost Effective 7,500 AF additional annually

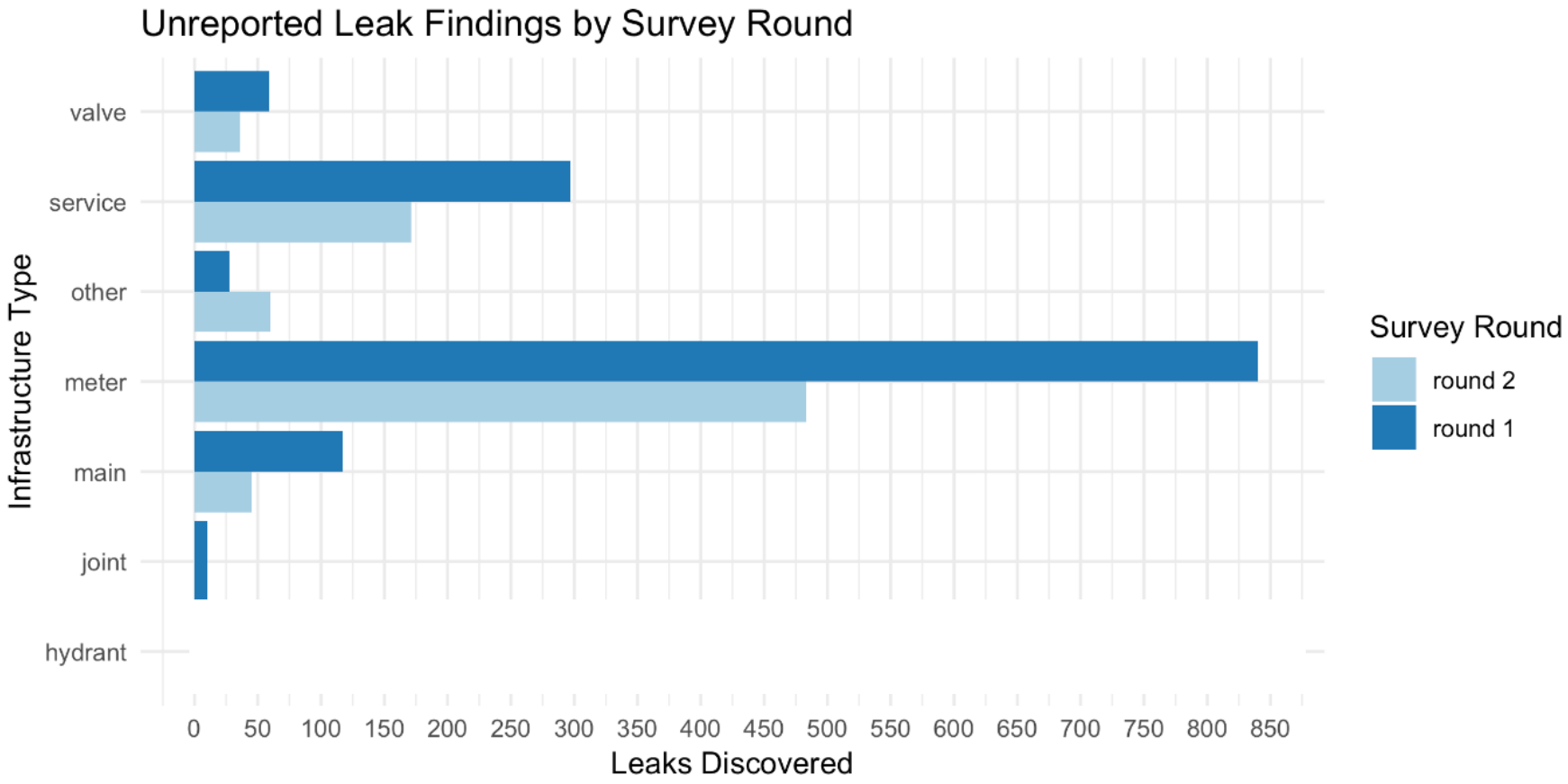


Proactive Leak Detection

Case Study Focus

- Early 90's – Walk the dog
- More systematic
  - Block Maps, known hot spots
- Mid 2010's
  - Repair funding increase
  - Entire system 2 years; twice
- Satellites
- Next… w/Water Resources

Proactive Leakage Recovery – Rate of Rise

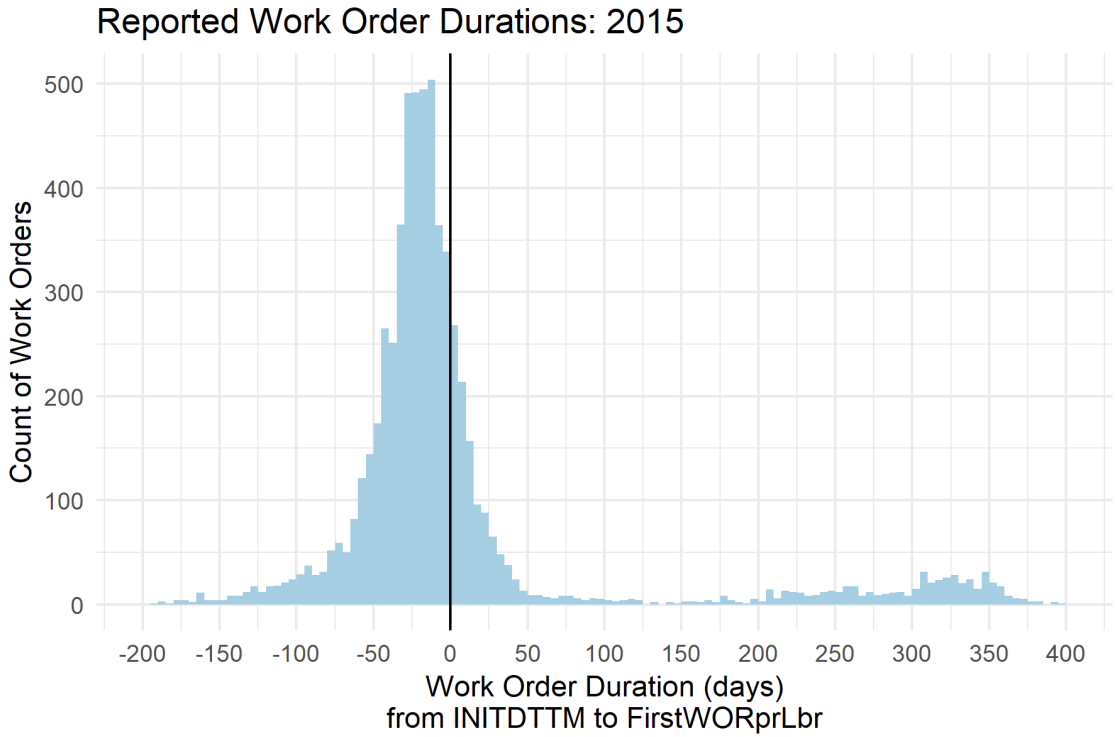


1.5 kgal leakage developed per mile per day

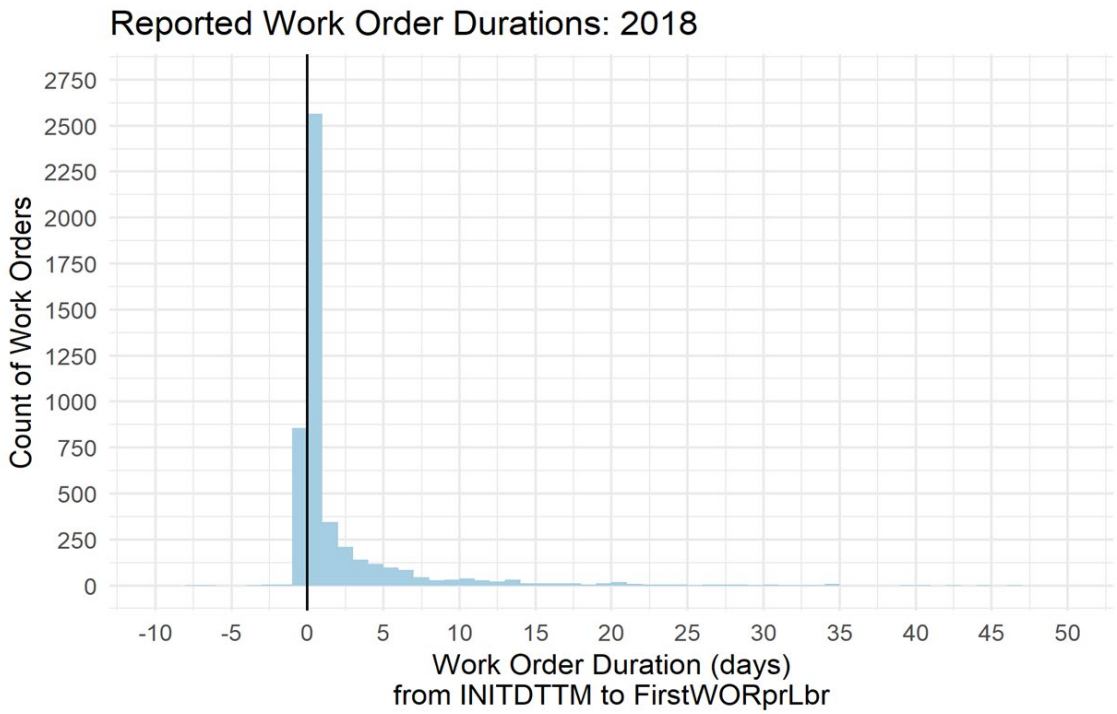
San Antonio Water System

Repair Record(s) Improvement

2015 Data

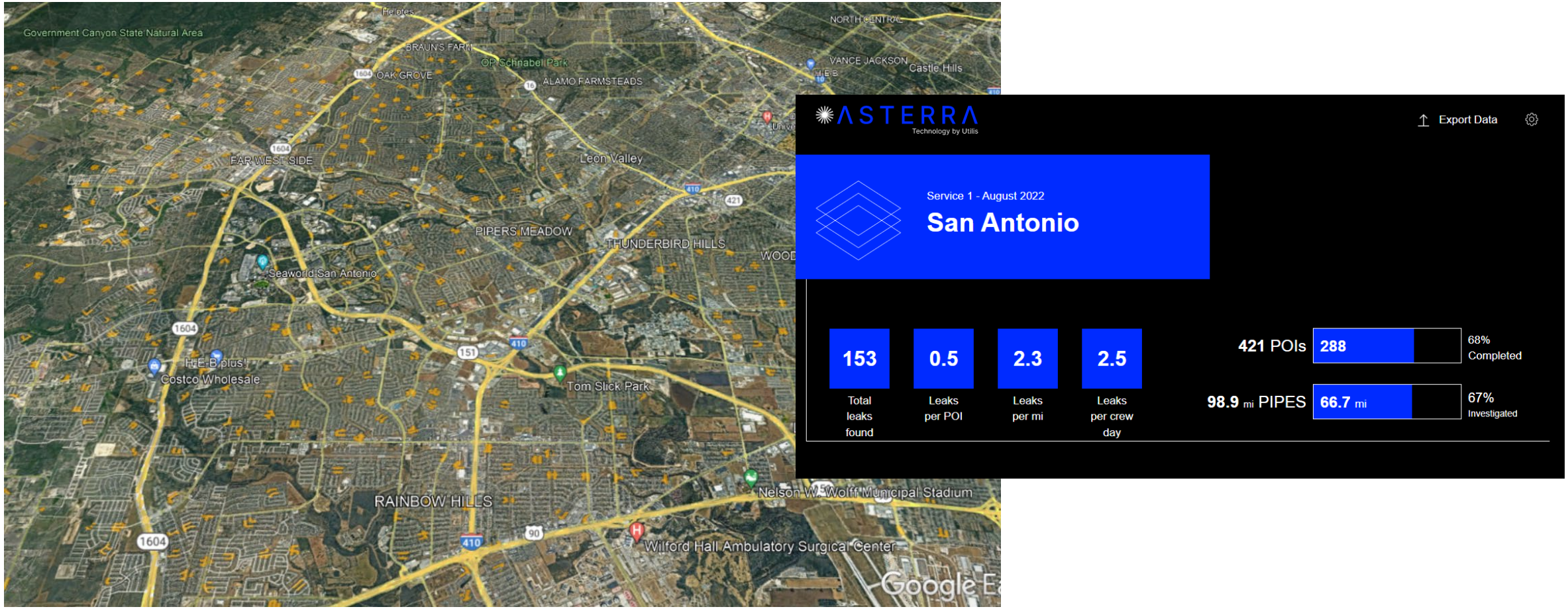


2018 Data



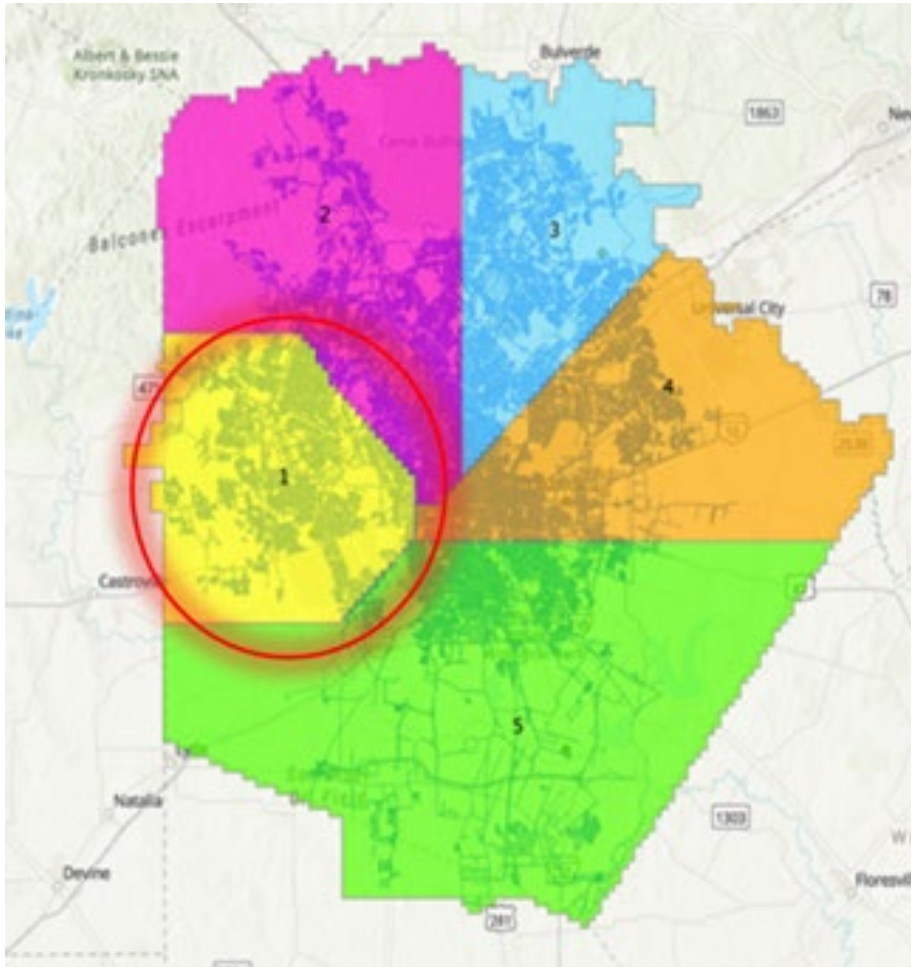
NRW Intervention Discussion

SAWS – Proactive Leak Detection



Zones

SAWS – Proactive Leak Detection



Satellite Leak Detection Validation activities:

Key – What Tools? Prioritize Field.

- Zone 1
  - August to December 2022
  - 436 POI's
- Currently Zone 2
  - Current
  - 360 POI's

San Antonio Water System

A Resiliency Strategy

Valuation Considerations are Challenging

- #1 Holds Real losses cost effectively lower (multiple tools)
- #2 Asset Management to include some production meter controls
- Data as well as AMI (electronic customer meters leveraged)

Baseline Annual 4,000K AF **$20M** – 75M Annual

Programming to nearly double AF savings???

Reactive $$ 2 X above range

GOAL:

SAWS to identify and add more proactive Intelligence and repair to improve awareness times as well as resiliency for the potable network

SAWS's Interest in Water Loss

- Efficiency Measure
- Executive Management Goal
- State Requirement
- Canary in Coalmine!
- Public Perceptions
- Saving Water & Money

Q&A

San Antonio Water System

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SAWS Water Loss Case Study

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2023 Central Texas Water Conservation Symposium
February 22, 2023

San Antonio Water System

MAKING SAN ANTONIO WATERFUL

Moderator: Jennifer Walker
National Wildlife Federation

Alan Wyatt
Independent Consultant

Patrick Shriver
San Antonio Water System

Water Loss in Texas: How Much Water is Being Lost and How Communities are Approaching Solutions

Water Loss in Texas:
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