ALLIANCE FOR WATER EFFICIENCY

WATER EFFICIENCY & CONSERVATION SYMPOSIUM 2025

AUGUST 6-8, 2025 | CHICAGO, IL

The Disillusion of Progress: Case Study in Reducing Water Loss and Demand

Room 300 2:15 PM – 3:10 PM

This session is brought to you by

Gold-Level Sponsor

MOEN

SMART WATER NETWORK

WATER EFFICIENCY & CONSERVATION SYMPOSIUM

Introducing the Carbon Balance to the AWWA Free Water Audit Software

Drew Blackwell

Director of Water Efficiency, Cavanaugh & Associates (NC)

CAVANAUGH

WATER EFFICIENCY & CONSERVATION SYMPOSIUM

AWWA M36 Approach

- ***Every*** water system experiences water loss.
- Establishing a baseline of validated water audit data is the anchor of a ***successful*** water loss strategy.
- The IWA/AWWA methodology provides a path to building and progressing your***water loss program***.

BASELINE

Annual Water Balance

- Annual AWWA water audit
- Apparent & Real Loss volumes
- Level 1 validation

TECHNICAL ANALYSIS

Loss Profiling & Uncertainty

- Advanced Validation
- Apparent Loss Profile
- Real Loss Profile

ECONOMIC ANALYSIS

Cost-Benefit & Targets

- Costs of losses
- Costs of intervention strategies
- Program design

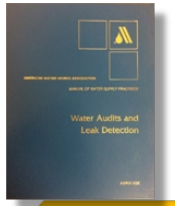
COST-EFFECTIVE

Intervention

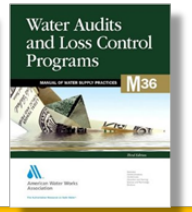
- Leakage Management
- Revenue Protection

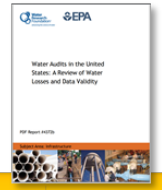
Evolution of Industry Standards

M36 1st Ed.

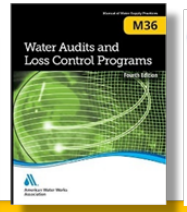


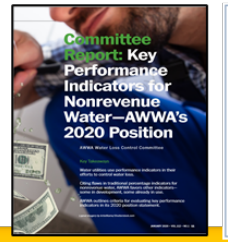
M36 3rd Ed.

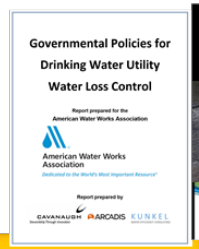




M36 4th Ed.







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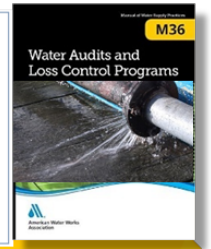

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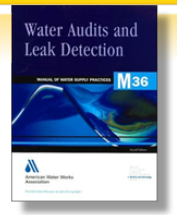
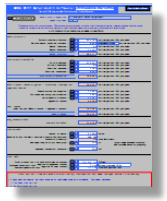
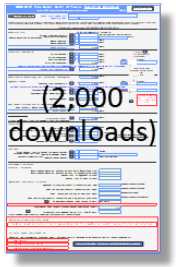


M36 2nd Ed.

AWWA Audit Software v1



AWWA Audit Software v4



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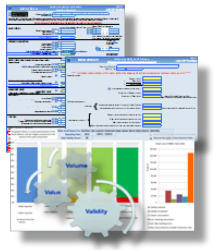
AWWA Audit Software v5



NORTH AMERICAN WATER LOSS 2015

Georgia

NORTH AMERICAN WATER LOSS 2017

California

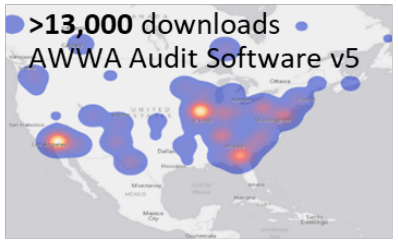
NORTH AMERICAN WATER LOSS 2019

Tennessee

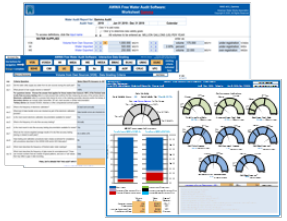
AWWA Audit Software v6

NORTH AMERICAN WATER LOSS 2021

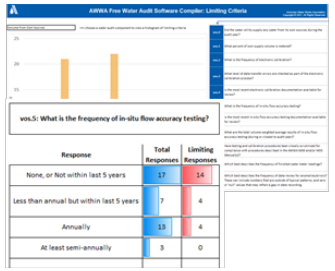
Texas



>13,000 downloads
AWWA Audit Software v5

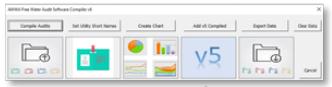


~3,000 downloads to date



AWWA Compiler v4, v5

WRF Real Loss Component Analysis Model

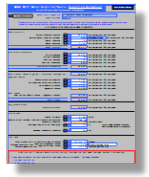


AWWA Compiler v6.0

WATER EFFICIENCY & CONSERVATION SYMPOSIUM

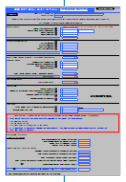
Focus on the AWWA Free Water Audit Software

FWAS v1
(200)



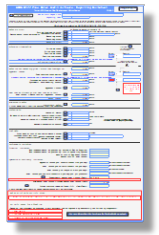
MG volumes only
Data grading:
either 'measured'
or 'estimated'

FWAS v2 – v3



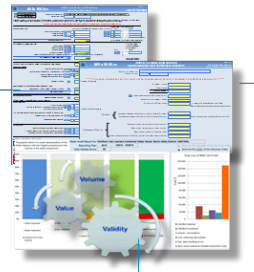
Megaliters added
Two financial performance indicators added (cost of real and apparent losses)
Acre-ft added
Example audits included
Two default values
Data checks / instant feedback added

FWAS v4
(2,000)



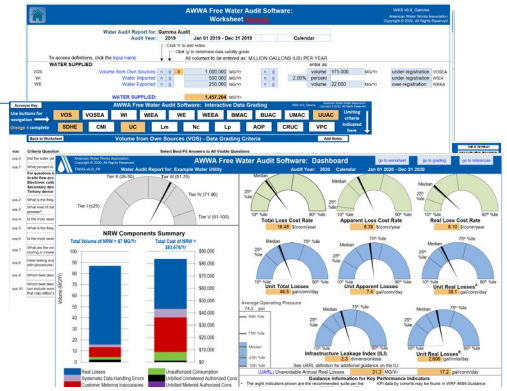
Data grading matrix (1-10)
Service connection diagram
French language version available

FWAS v5
(13,000)

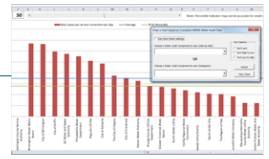


Separate data input/output tabs
Dashboard
Volume weighted data grading
Comments page
Meter error adjustment for all water supplied components

FWAS v6



AWWA Compiler developed for large audit sets



IWA/AWWA Water Balance

AWWA Free Water Audit Software
Water Balance
VOLUME in MG/Yr

FWAS v6.1

American Water Works Association.
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Water Audit Report for: Example audit
Audit Year: 2024 — Jan 01 2024 - Dec 31 2024
Data Validity Tier: Tier III (51-70)

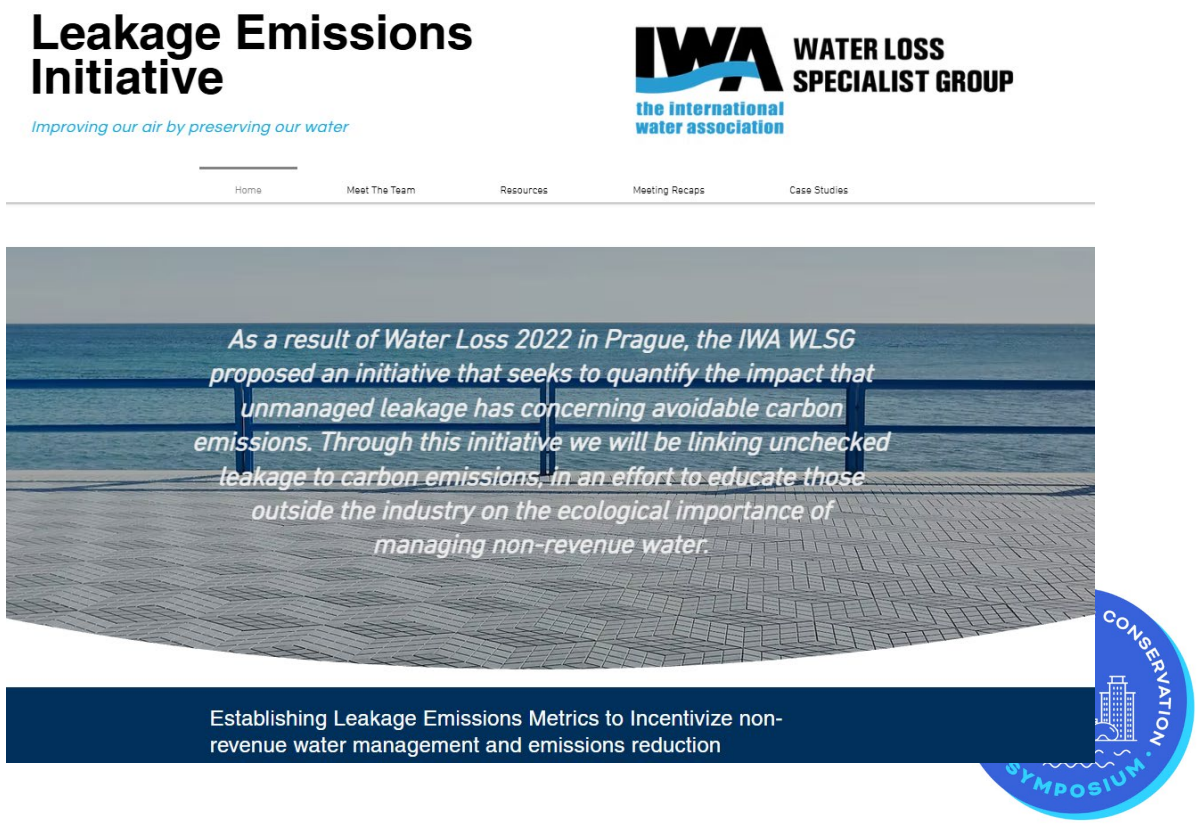
Volume from Own Sources (VOS) (corrected for known errors) 11,111.111	System Input Volume 18,253.968	Water Exported (WE) (corrected for known errors) 485.437	Billed Water Exported			Revenue Water (Exported) 485.437
		Water Supplied 17,768.531	Authorized Consumption 9,037.000	Billed Authorized Consumption 9,010.000	Billed Metered Consumption (BMAC) (water exported is removed) 9,000.000	Revenue Water 9,010.000
					Billed Unmetered Consumption (BUAC) 10.000	
				Unbilled Authorized Consumption 27.000	Unbilled Metered Consumption (UMAC) 12.000	Non-Revenue Water (NRW) 8,758.531
					Unbilled Unmetered Consumption (UUAC) 15.000	
			Water Losses 8,731.531	Apparent Losses 238.362	Systematic Data Handling Errors (SDHE) 22.525	
					Customer Metering Inaccuracies (CMI) 193.312	
					Unauthorized Consumption (UC) 22.525	
Water Imported (WI) (corrected for known errors) 7,142.857				Real Losses 8,493.170	Target Leakage Reduction 6,000.000	
					Leakage Level After Reduction 2,493.170	

Leakage Management Strategies:

Four Pillars of Leakage Management

Who invited Carbon to the party?

www.leigroup.org



Carbon dating Version 6.1

April 2022

- *Water Loss 2022, Prague, CZ. IWA WLSG proposed initiative to quantify the impact that unmanaged leakage has concerning avoidable carbon emissions.*

October 2022

- *Inaugural meeting of the Leakage Emissions Initiative*

April 2023

- *LEI White Paper published with agreed upon methodology for calculating carbon emissions as a result of leakage*

2024

- *Carbon Balance published with IWA Standard Water Balance*

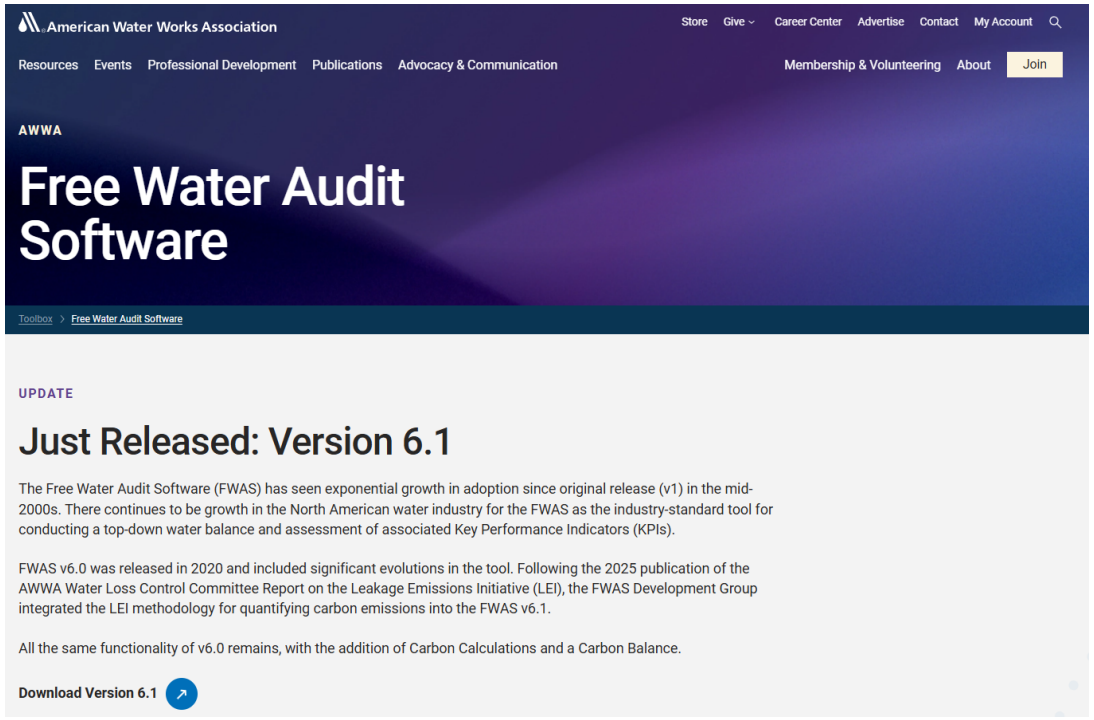
April 2025

- *AWWA publishes Water Loss Control Committee's Leakage Emissions Initiative Report*

June 2025

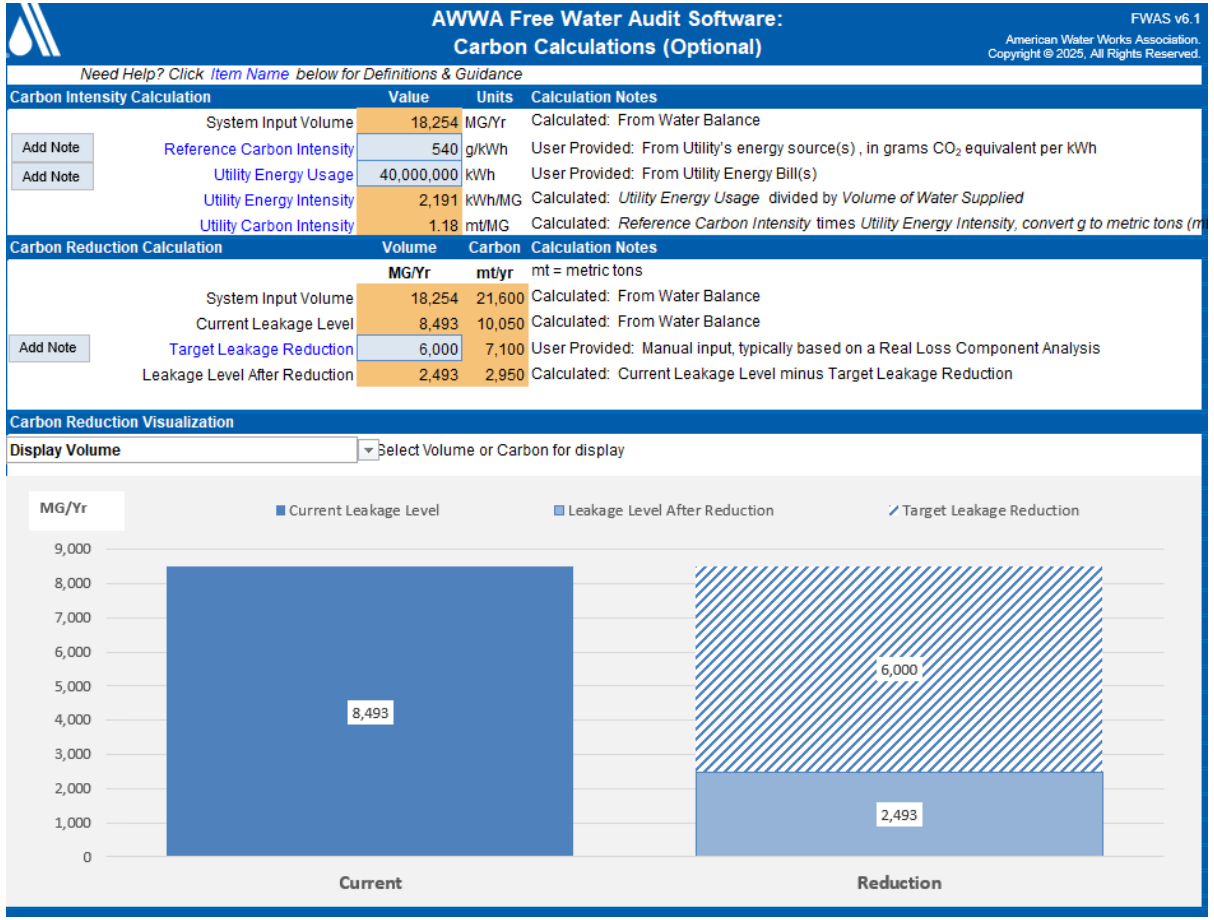
- *Carbon Balance and Calculations are integrated into Version 6.1 of the AWWA Free Water Audit Software*

Introducing the AWWA Free Water Audit Software – Version 6.1



- Version 6.1 integrates the Leakage Emissions Initiative methodology for quantifying carbon emissions

Introducing the AWWA Free Water Audit Software – Version 6.1



AWWA Free Water Audit Software: Carbon Calculations (Optional)

FWAS v6.1

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Need Help? Click Item Name below for Definitions & Guidance

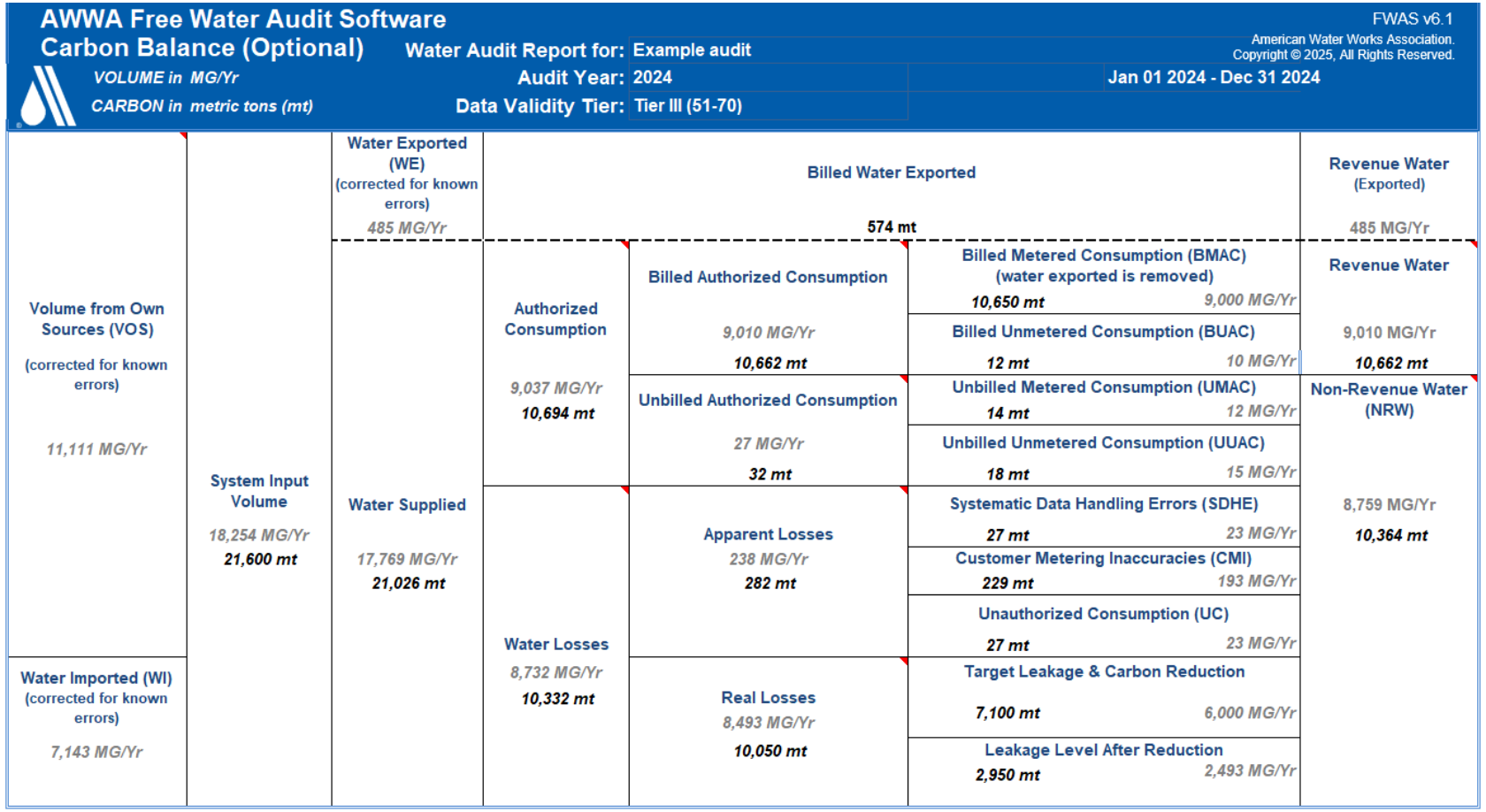
Carbon Intensity Calculation		Value	Units	Calculation Notes
	System Input Volume	18,254	MG/Yr	Calculated: From Water Balance
Add Note	Reference Carbon Intensity	540	g/kWh	User Provided: From Utility's energy source(s) , in grams CO_2 equivalent per kWh
Add Note	Utility Energy Usage	40,000,000	kWh	User Provided: From Utility Energy Bill(s)
	Utility Energy Intensity	2,191	kWh/MG	Calculated: *Utility Energy Usage* divided by *Volume of Water Supplied*
	Utility Carbon Intensity	1.18	mt/MG	Calculated: *Reference Carbon Intensity* times *Utility Energy Intensity, convert g to metric tons (m*

Carbon Reduction Calculation		Volume	Carbon	Calculation Notes
		MG/Yr	mt/yr	mt = metric tons
	System Input Volume	18,254	21,600	Calculated: From Water Balance
	Current Leakage Level	8,493	10,050	Calculated: From Water Balance
Add Note	Target Leakage Reduction	6,000	7,100	User Provided: Manual input, typically based on a Real Loss Component Analysis
	Leakage Level After Reduction	2,493	2,950	Calculated: Current Leakage Level minus Target Leakage Reduction

Carbon Reduction Visualization

Display Volume — Select Volume or Carbon for display

Introducing the AWWA Free Water Audit Software – Version 6.1



Summary

- **Water Loss Control Framework**
  - Based on AWWA M36 and IWA/AWWA methodology
  - Structured approach: Baseline Audit → Technical Analysis → Economic Evaluation → Cost-Effective Intervention
- **Industry Evolution**
  - Emphasis on validated data and sustainability
  - Water loss now linked to climate impact
- **Water Balance**
  - Mass balance
  - Accounts for all volumes of water
  - Accuracy matters
- **Leakage Management Strategies**
  - Pressure Management
  - Speed & Quality of Repairs
  - Active Leakage Control
  - Asset Management & Renewal
- **Carbon Emissions Integration**
  - AWWA Free Water Audit Software v6.1 now includes carbon emissions calculations
  - Developed through the Leakage Emissions Initiative (LEI)
  - Aligns with IWA Standard Water Balance

Prompts Questions:

1. What metric(s) are you using to track improvement in water loss?
2. Have you quantified Carbon emissions associated with distribution system leakage? If so, what are you doing with it?
3. Where are you in your Demand Management Program? Is GPCD going up/down?

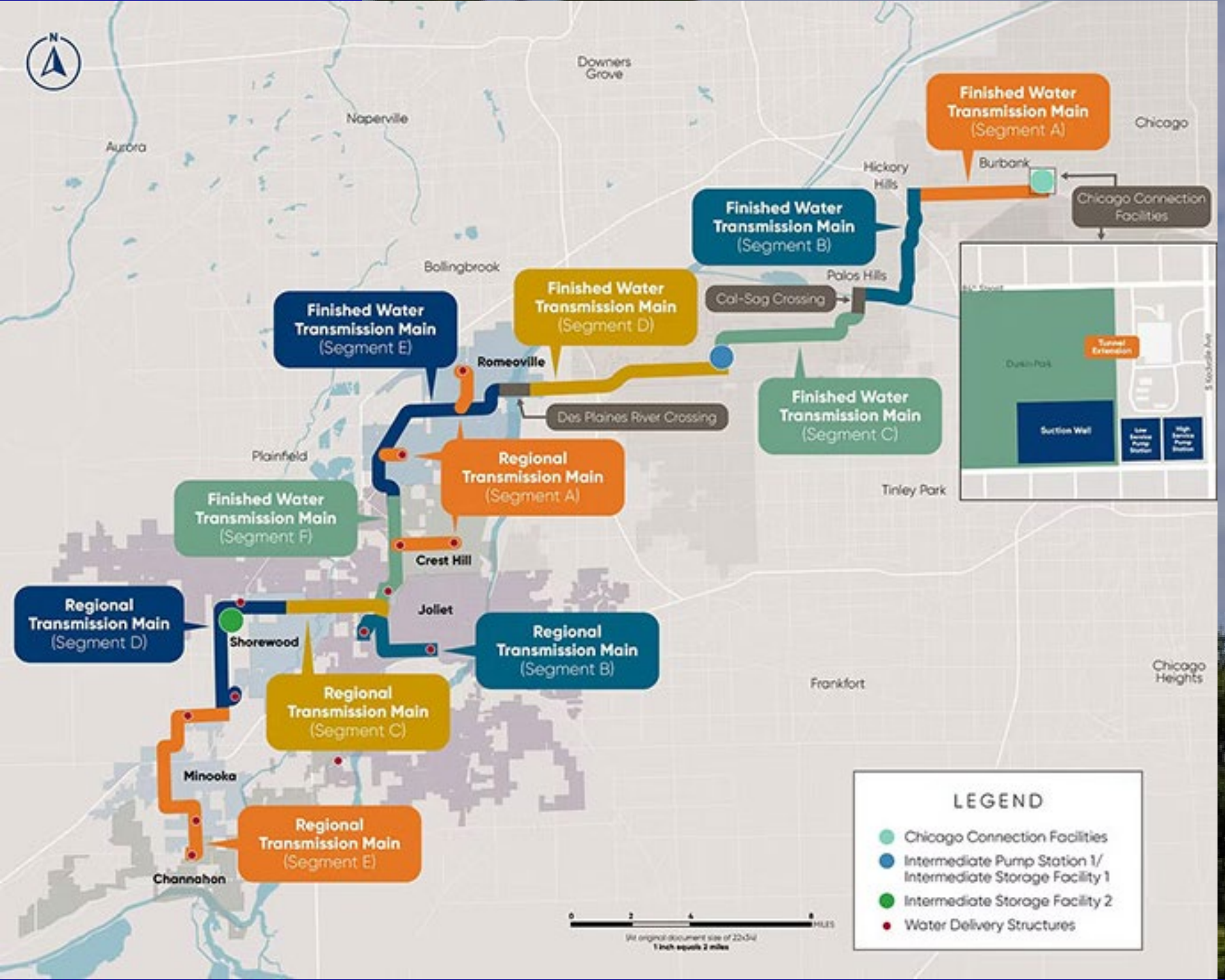
The Disillusion of Progress: Case Study in Reducing Water Loss *and* Demand

Will Jernigan, P.E.

Chief Operations Officer, Cavanaugh & Associates

CAVANAUGH

WATER EFFICIENCY & CONSERVATION SYMPOSIUM


Downers Grove
Naperville
Aurora
Chicago
Burbank
Hickory Hills
Finished Water Transmission Main (Segment A)
Chicago Connection Facilities
Finished Water Transmission Main (Segment B)
Palos Hills
Cal-Sag Crossing
Bolingbrook
Finished Water Transmission Main (Segment D)
Finished Water Transmission Main (Segment E)
Romeoville
Des Plaines River Crossing
Finished Water Transmission Main (Segment C)
Plainfield
Regional Transmission Main (Segment A)
Tinley Park
Finished Water Transmission Main (Segment F)
Crest Hill
Joliet
Regional Transmission Main (Segment D)
Shorewood
Regional Transmission Main (Segment B)
Frankfort
Chicago Heights
Regional Transmission Main (Segment C)
Minooka
Regional Transmission Main (Segment E)
Channahon
Tunnel Extension
Dukin Park
Suction Well
Low Service Pump Station
High Service Pump Station
LEGEND
Chicago Connection Facilities
Intermediate Pump Station 1/ Intermediate Storage Facility 1
Intermediate Storage Facility 2
Water Delivery Structures
0 2 4 8 MILES
1 inch equals 2 miles

JOLIET

NRW Program Highlights to Date

2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024

Annual Leak Detection Survey – Entire System

Water Main Replacements
~10% of the total 700 miles

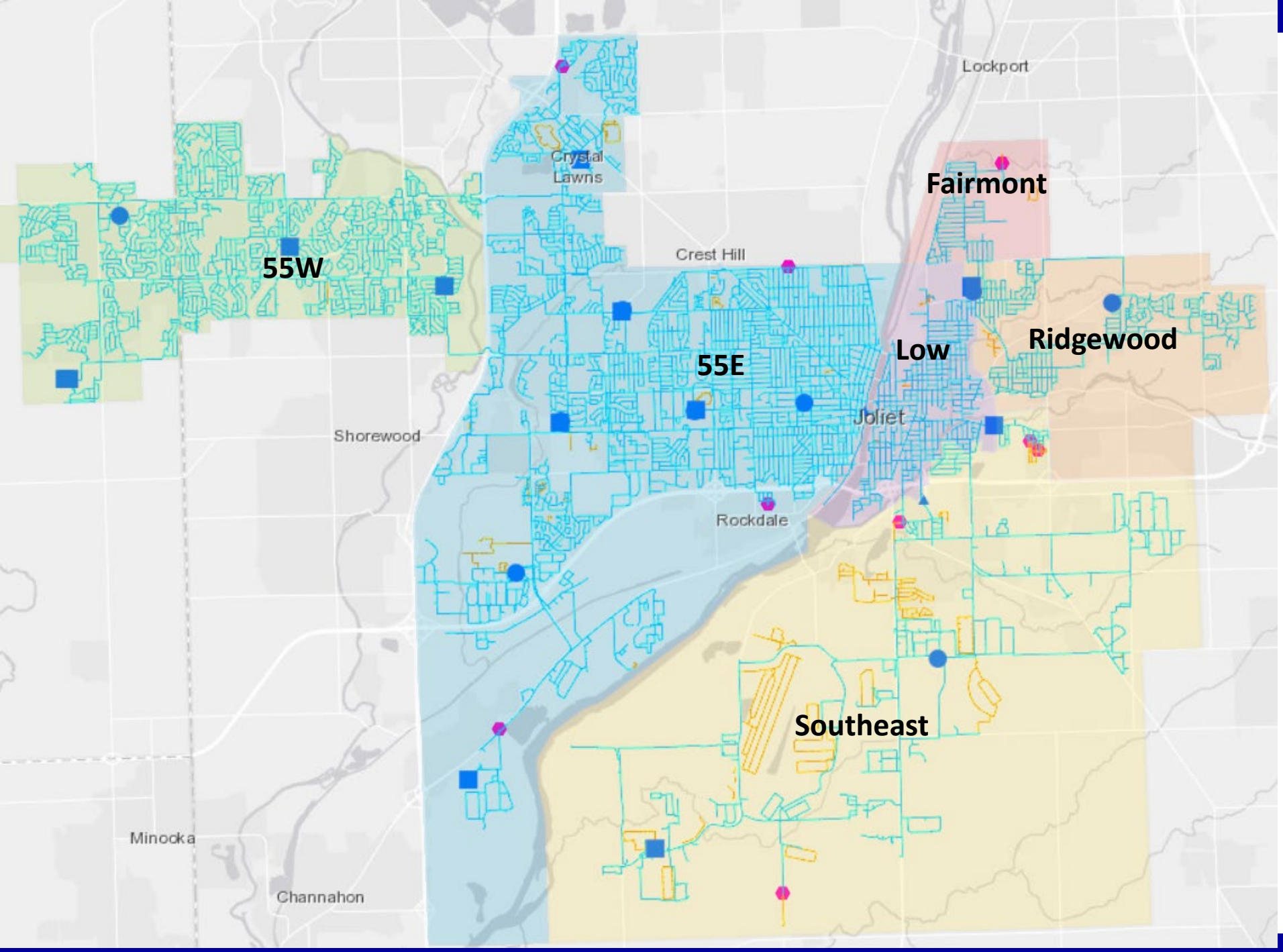
Annual Meter Testing – Supply, Export, Large Customers

Small Meter Replacements
~20% of the total 50,000 meters

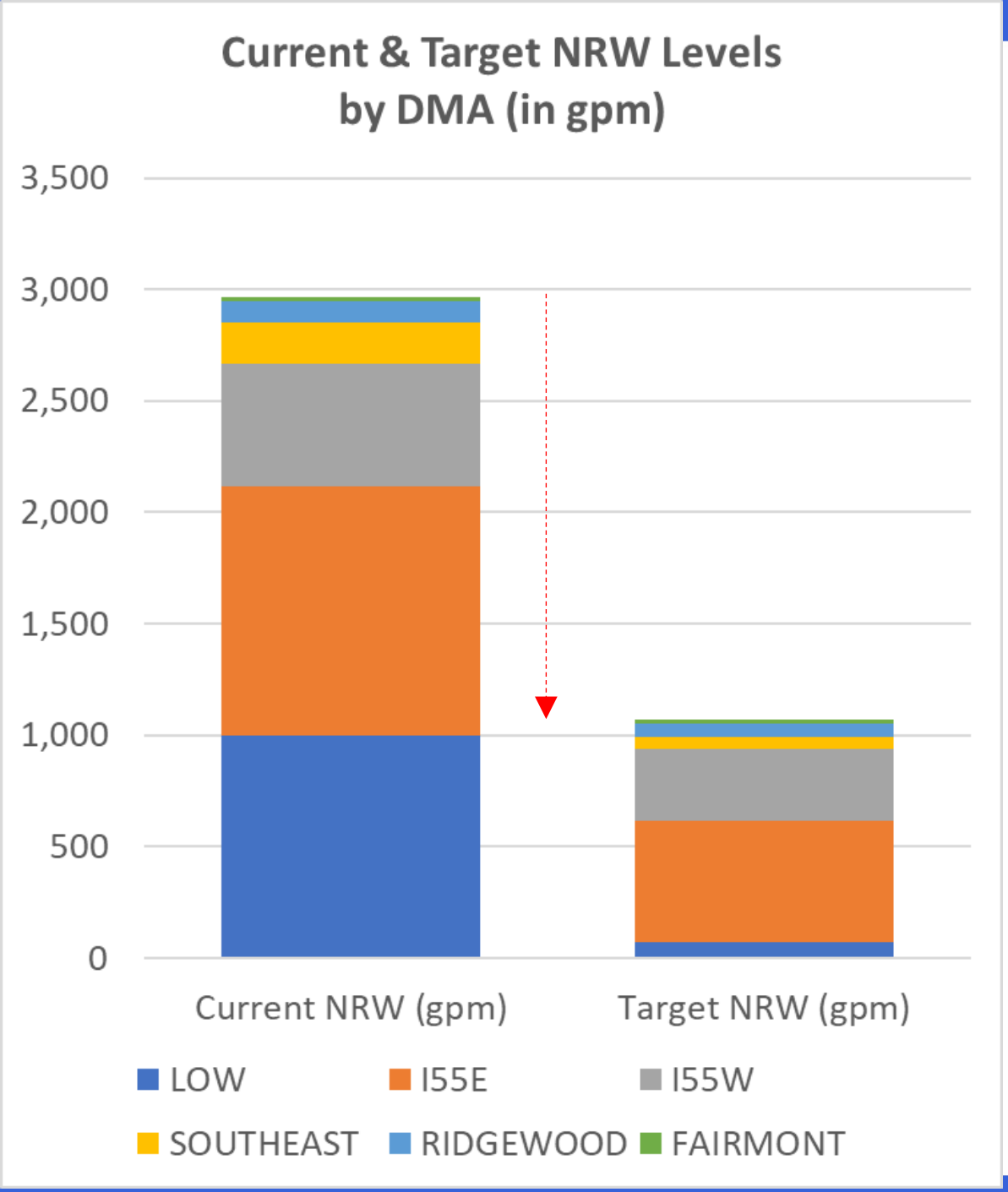
Select Large Meter Replacements

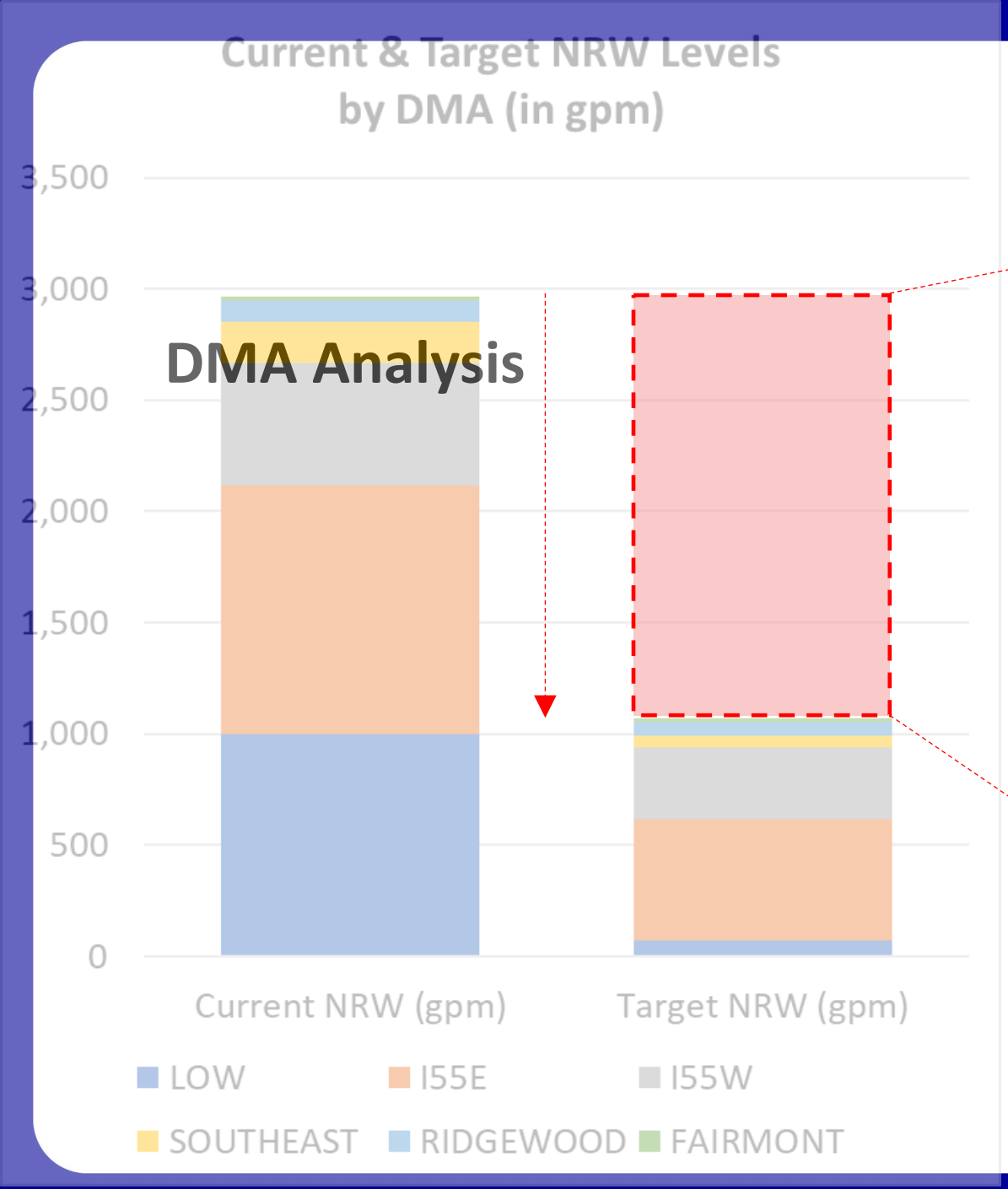
Formal Validation
2024 Water Audit

Dividing 700-mile network into 6 Zones

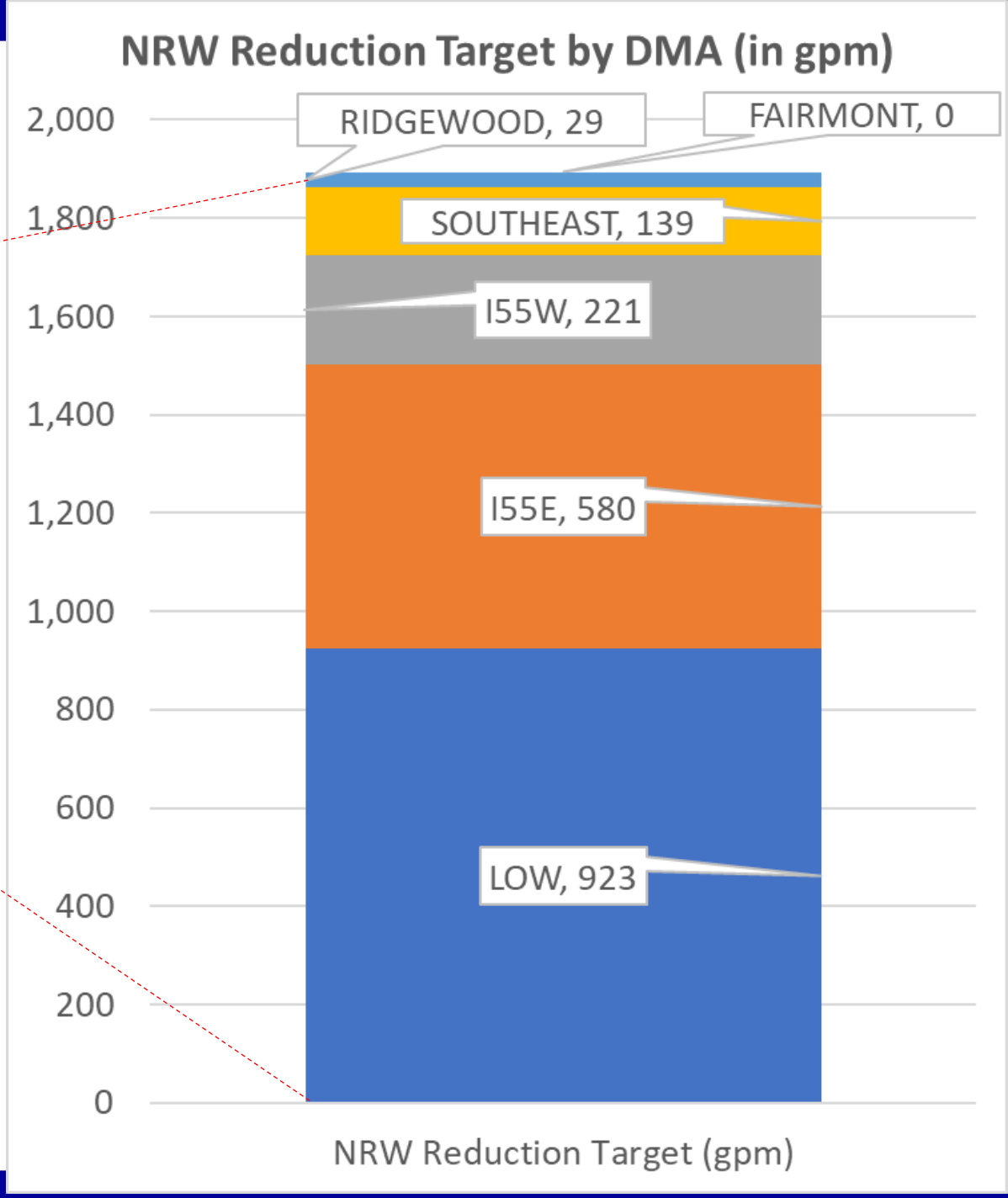


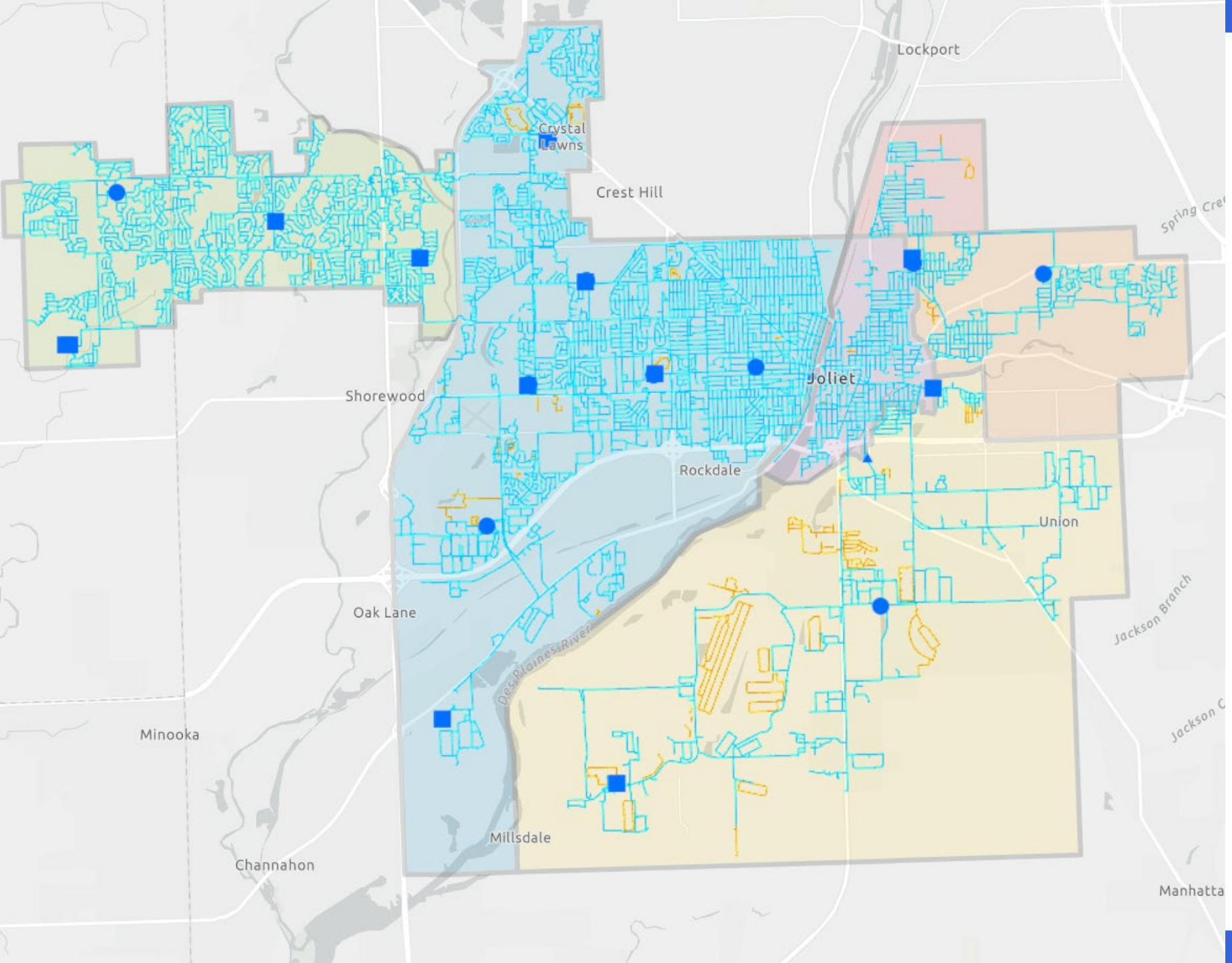
Established District Metered Areas (DMAs), aka "Zones"

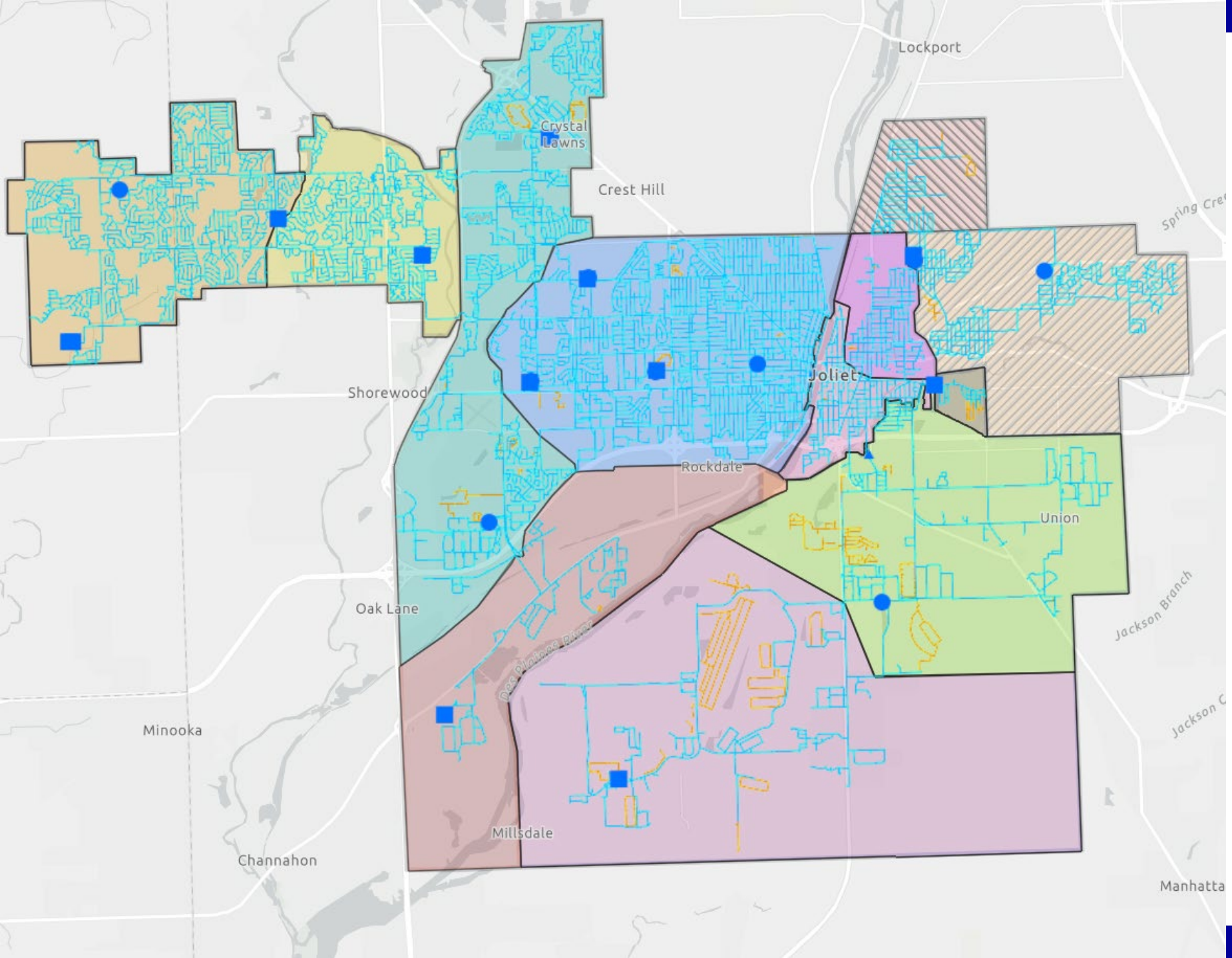

Current & Target NRW Levels by DMA (in gpm)
3,500
3,000
2,500
2,000
1,500
1,000
500
0
Current NRW (gpm)
Target NRW (gpm)
LOW
I55E
I55W
SOUTHEAST
RIDGEWOOD
FAIRMONT



DMA Analysis

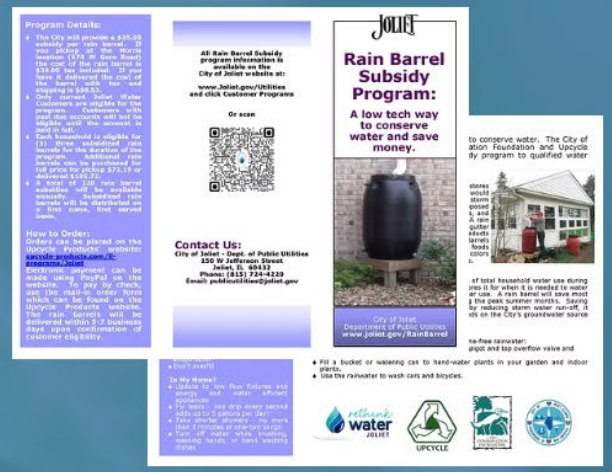



Lockport
Crystal Lawns
Crest Hill
Spring Cre
Joliet
Shorewood
Rockdale
Union
Oak Lane
Des Plaines River
Jackson Branch
Jackson C
Minooka
Millsdale
Channahon
Manhatta



Zone Enhancements

Conservation Programs

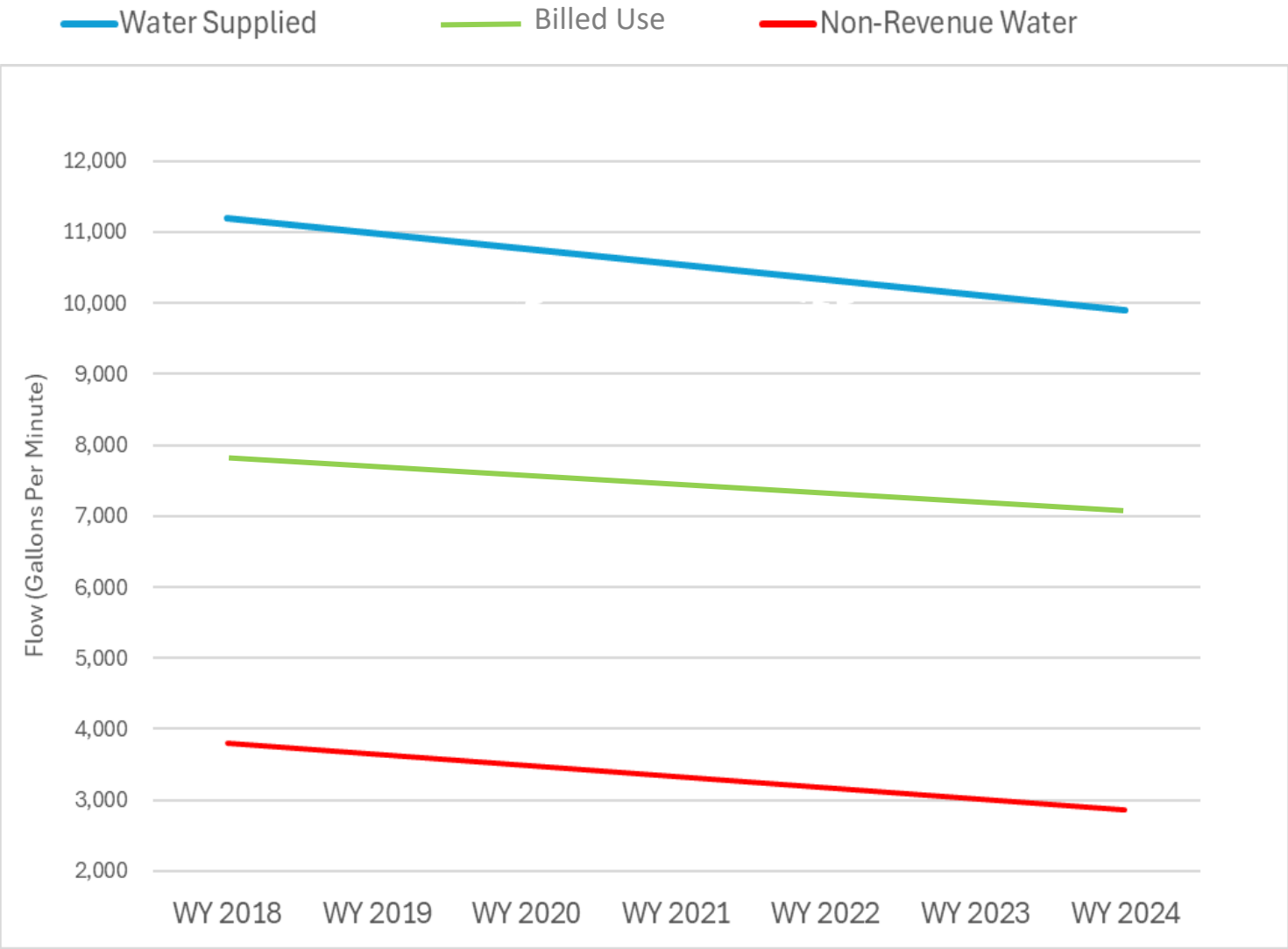


Rain Barrel Subsidy Program

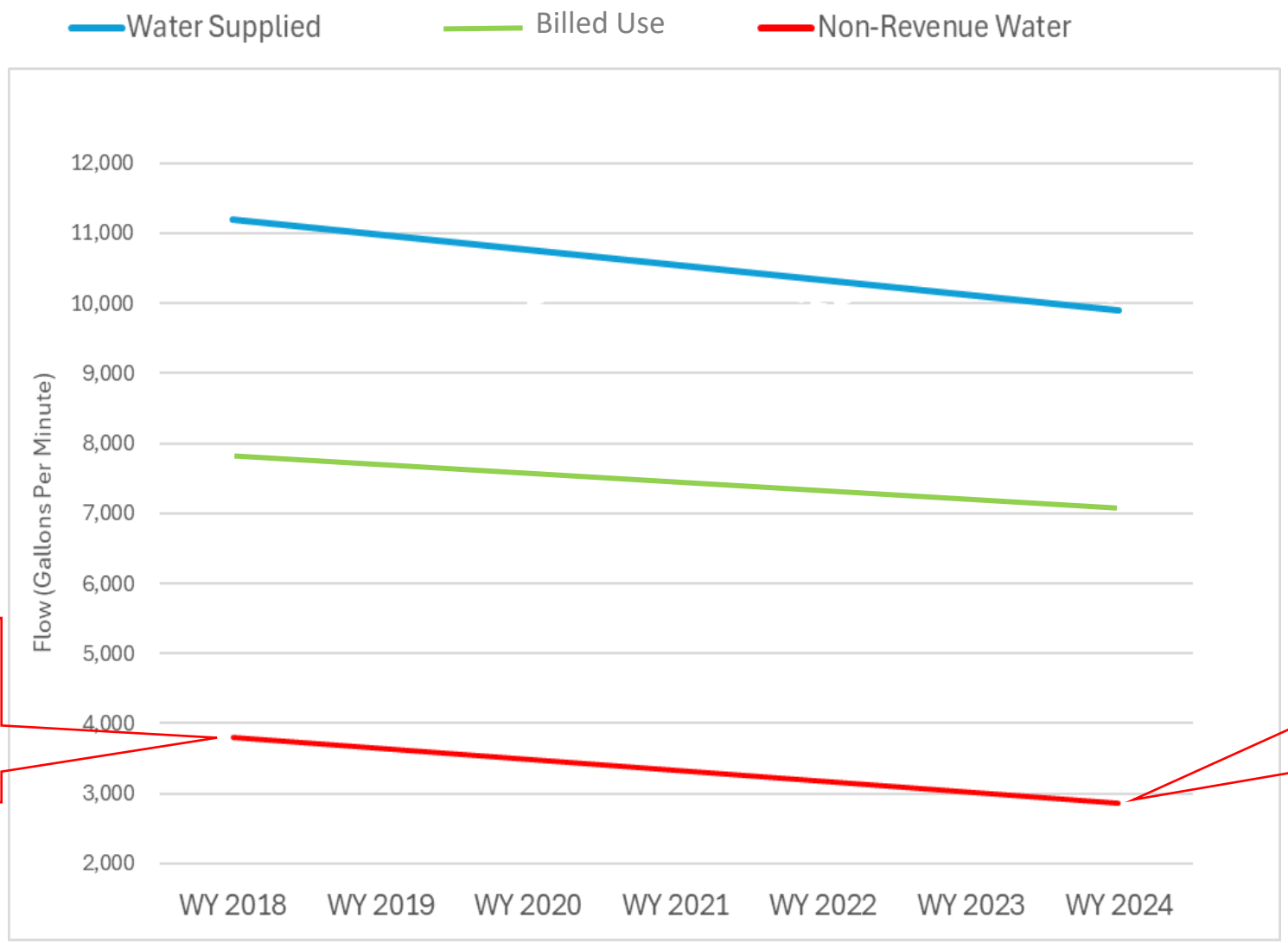
Low Flow Toilet Rebate Program

WATER EFFICIENCY & CONSERVATION SYMPOSIUM

HISTORICAL **TRENDS**



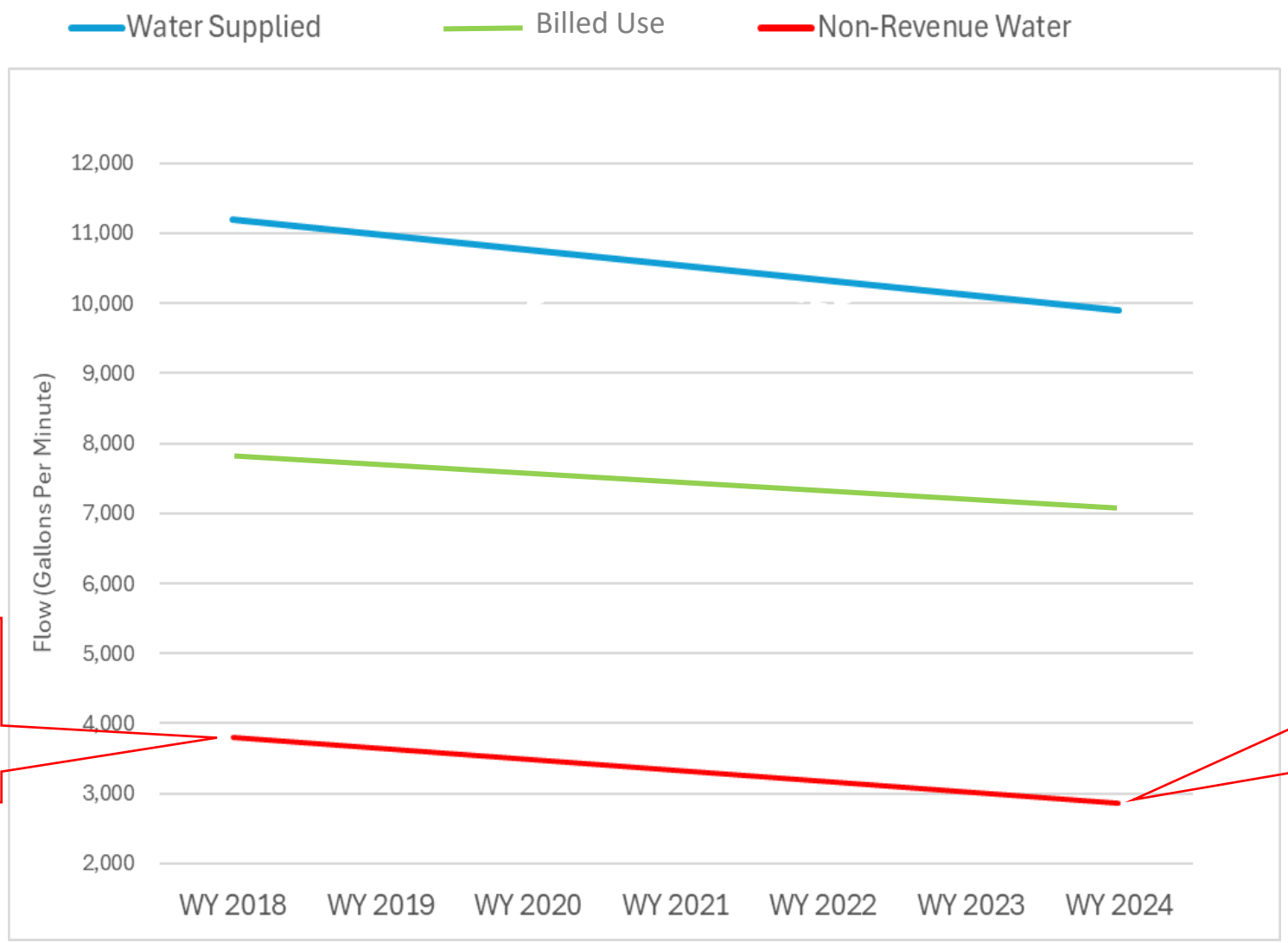
HISTORICAL **TRENDS**



Water Year 2018
NRW ~ 4,000 GPM

Water Year 2024
NRW ~ 3,000 GPM

HISTORICAL **TRENDS**

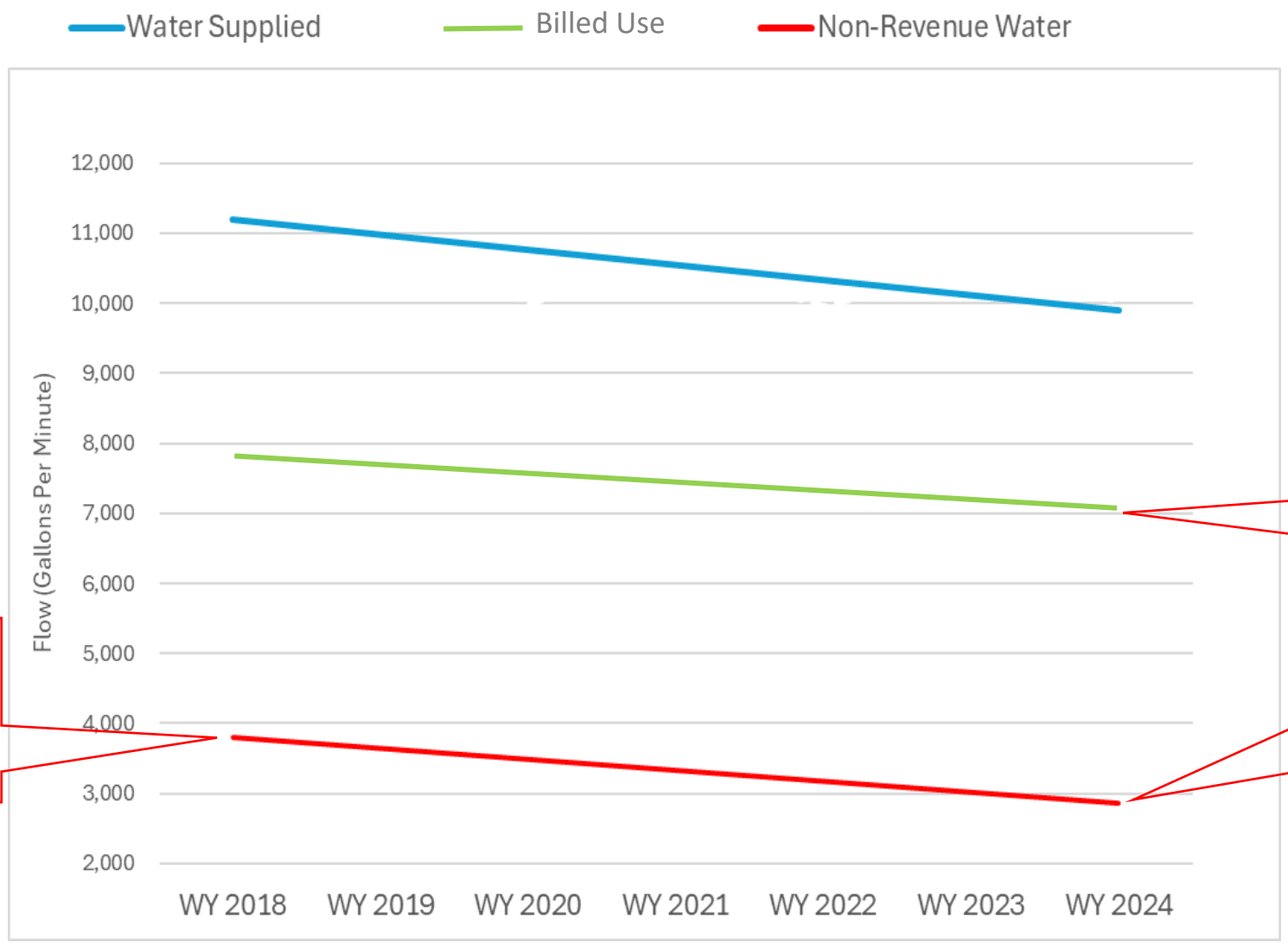


Water Year 2018
NRW ~ 4,000 GPM

Water Year 2024
NRW ~ 3,000 GPM

6-Year Reduction
NRW ~ 1,000 GPM

HISTORICAL **TRENDS**



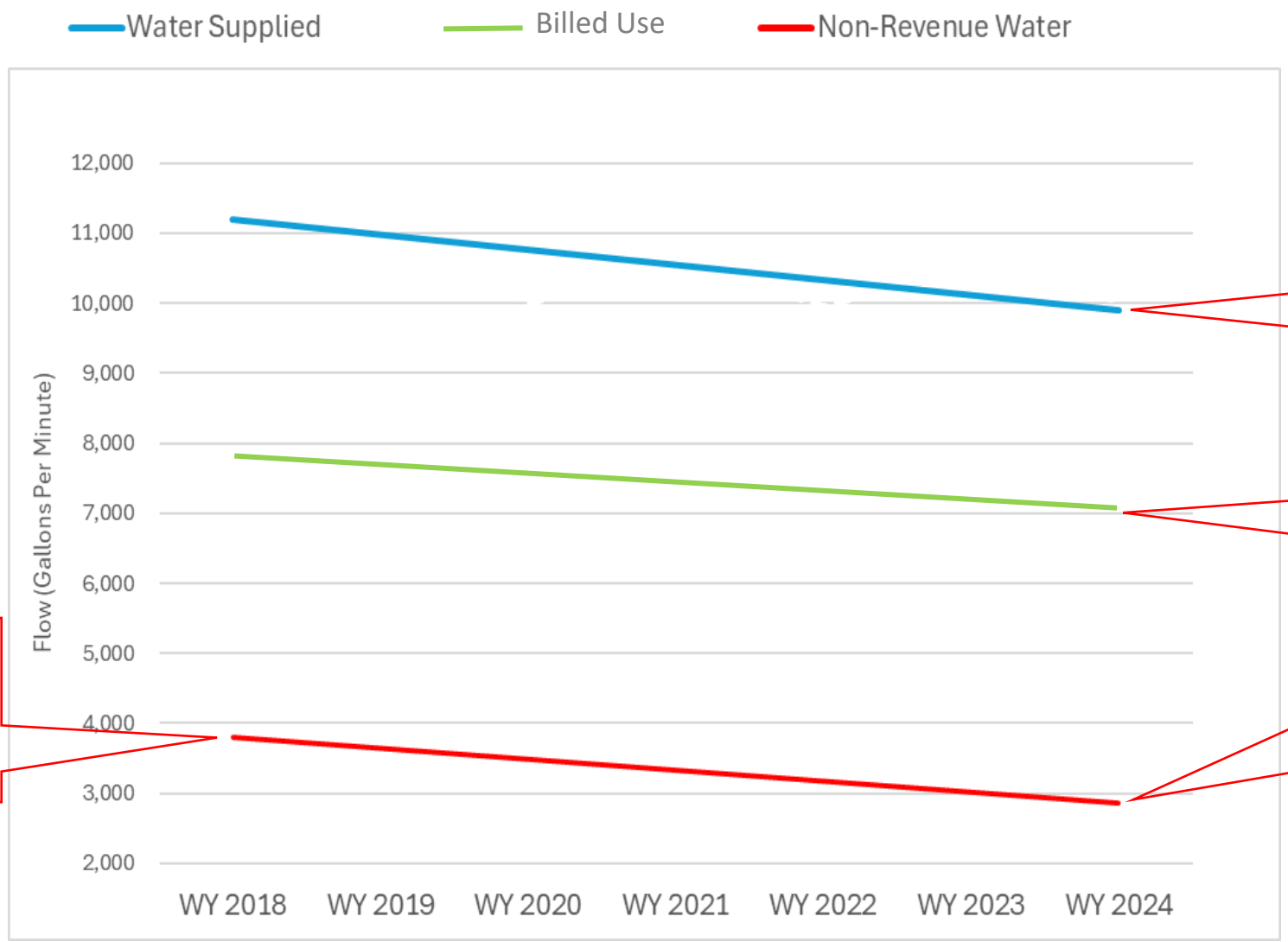
Successful Customer-Side Conservation

Water Year 2018
NRW ~ 4,000 GPM

Water Year 2024
NRW ~ 3,000 GPM

6-Year Reduction
NRW ~ 1,000 GPM

HISTORICAL **TRENDS**



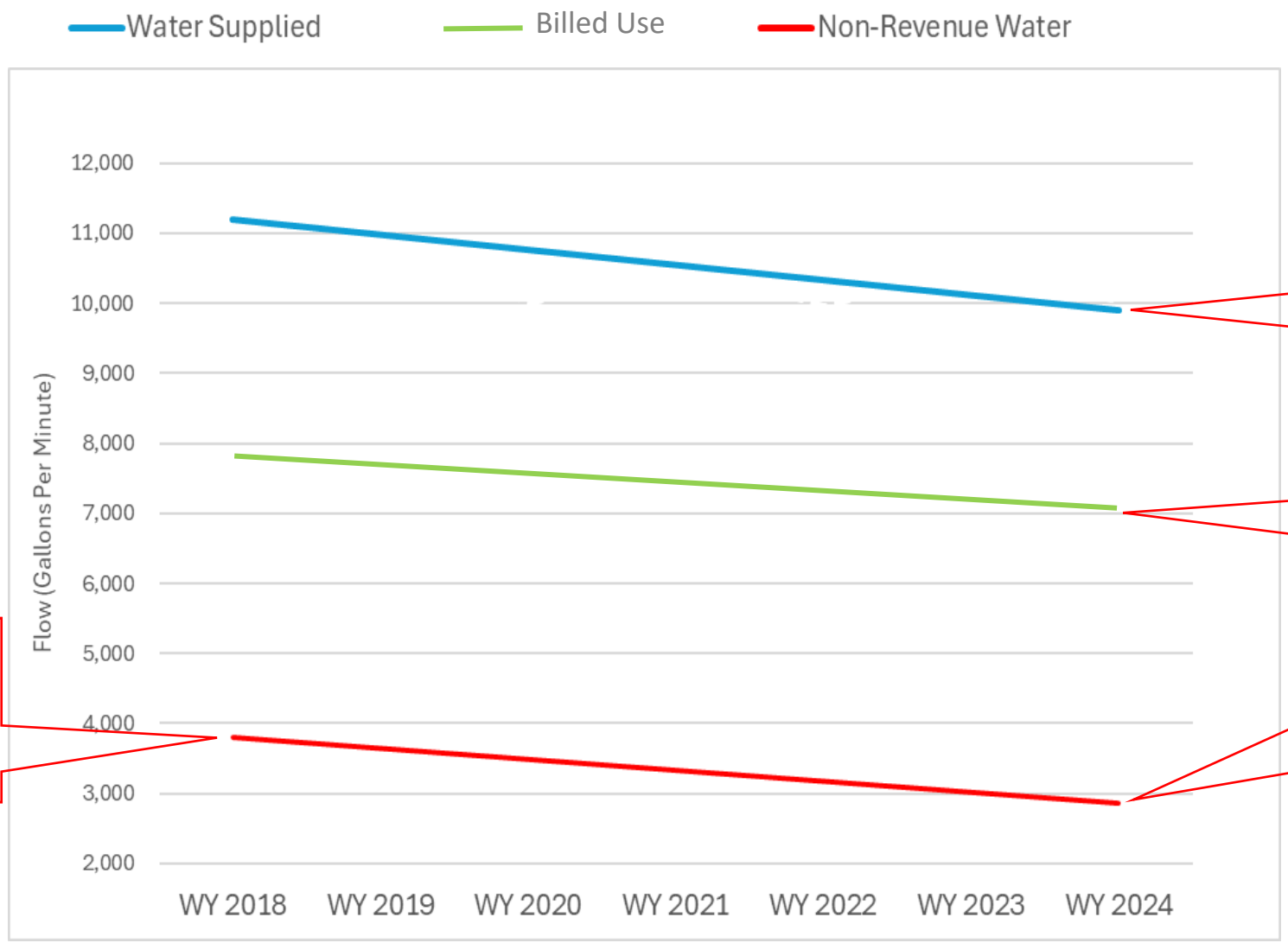
Supply Reduction

Successful Customer-Side Conservation

Water Year 2018
NRW ~ 4,000 GPM

Water Year 2024
NRW ~ 3,000 GPM

6-Year Reduction
NRW ~ 1,000 GPM



Supply Reduction

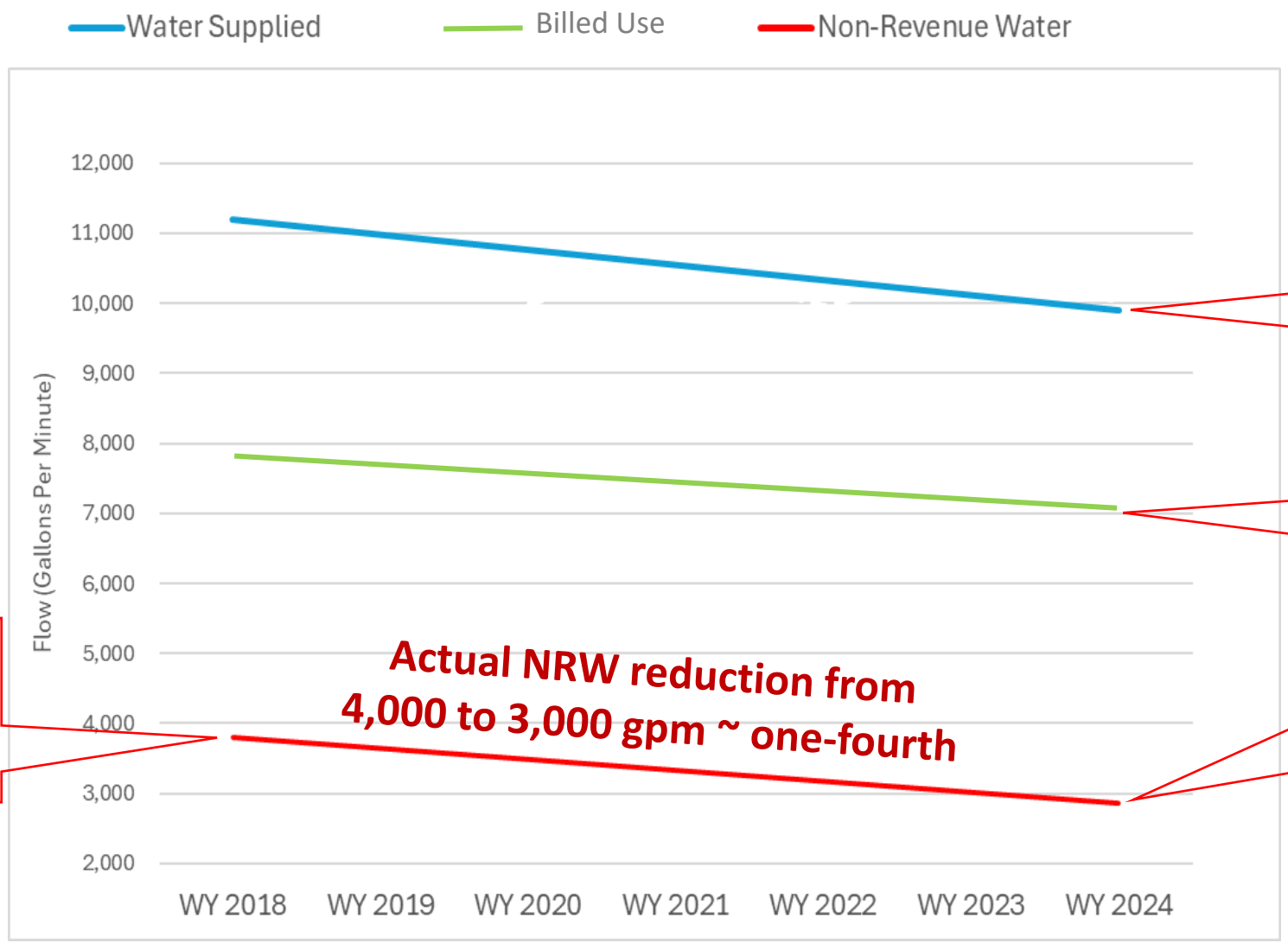
Successful Customer-Side Conservation

Water Year 2018
NRW ~ 4,000 GPM
NRW ~ 35%

Water Year 2024
NRW ~ 3,000 GPM
NRW ~ 29%

6-Year Reduction
NRW ~ 1,000 GPM
NRW ~ 6%

HISTORICAL **TRENDS**



Supply Reduction

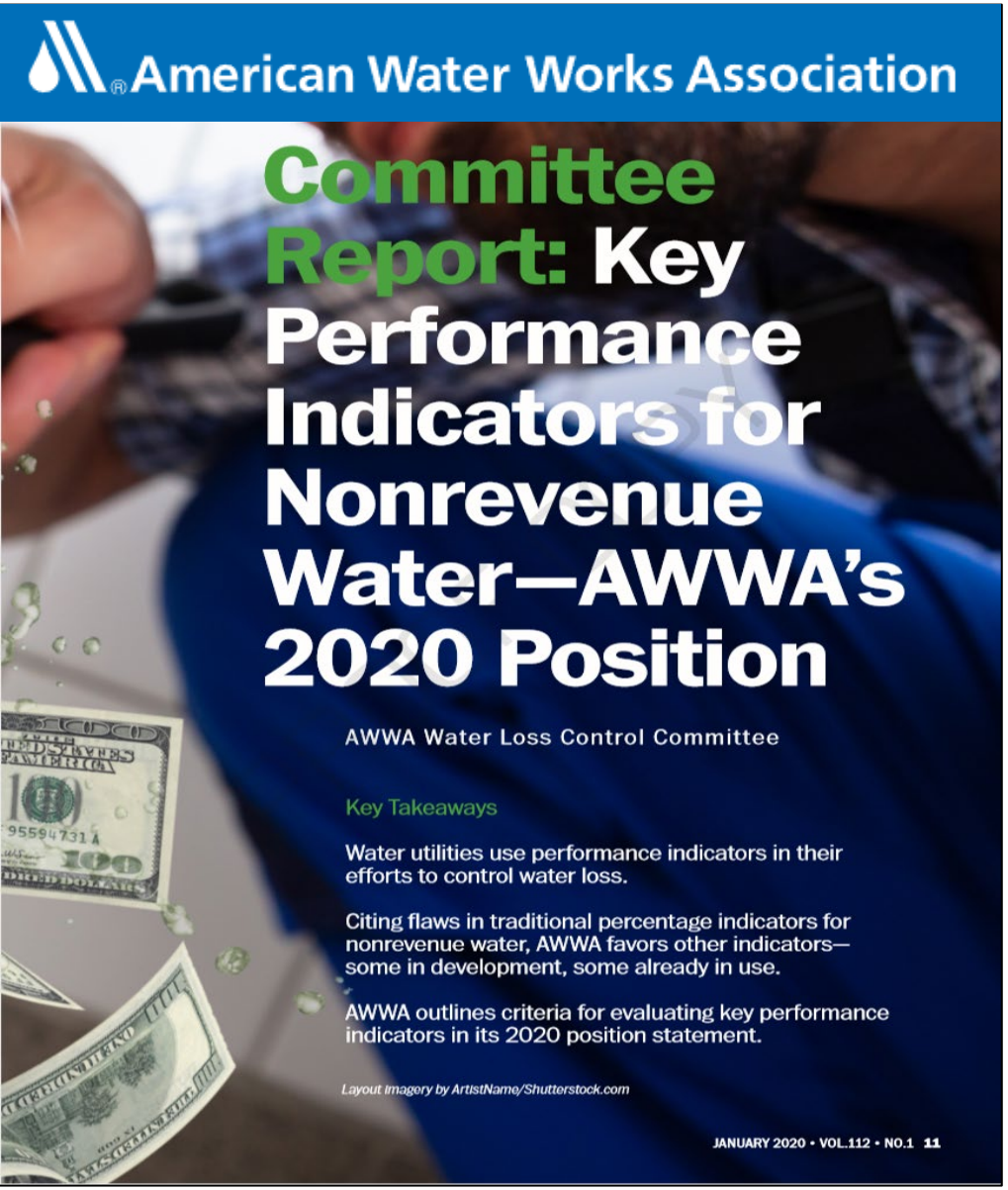
Successful Customer-Side Conservation

Water Year 2018
NRW ~ 4,000 GPM
NRW ~ 35%

Water Year 2024
NRW ~ 3,000 GPM
NRW ~ 29%

6-Year Reduction
NRW ~ 1,000 GPM
NRW ~ 6%

https://www.awwa.org/resource/water-loss-control/#technical


American Water Works Association

Committee Report: Key Performance Indicators for Nonrevenue Water—AWWA's 2020 Position

AWWA Water Loss Control Committee

Key Takeaways

Water utilities use performance indicators in their efforts to control water loss.

Citing flaws in traditional percentage indicators for nonrevenue water, AWWA favors other indicators—some in development, some already in use.

AWWA outlines criteria for evaluating key performance indicators in its 2020 position statement.

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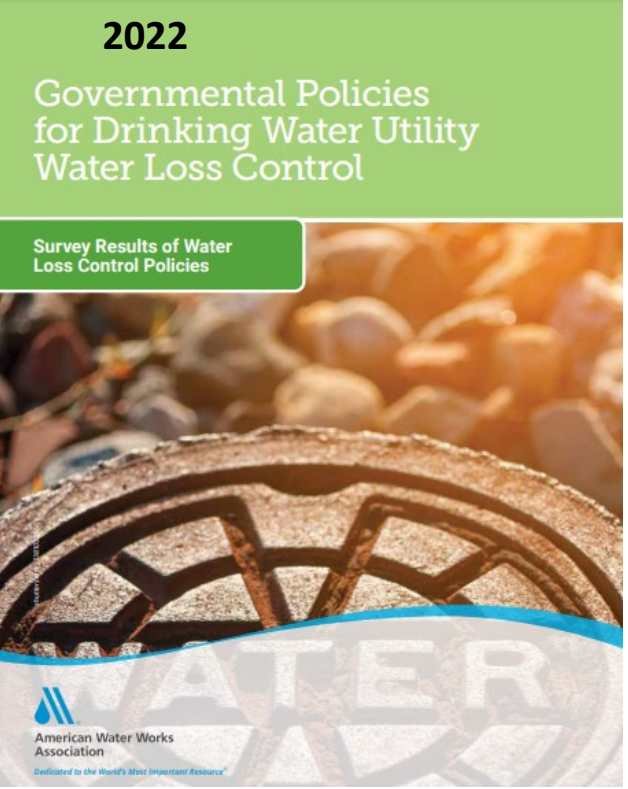
AWWA recommends AGAINST the use of "Percent NRW"

It is a moving target

It penalizes conservation

AWWA recommends:

Loss in gallons/connection/day	(typ. range 20-100)
Leakage Index	(typ. range 1-5)



Fully Adopted AWWA Recommendations

Partially Adopted AWWA Recommendations

Not Following AWWA Recommendations

Prompt Questions:

1. Your experience with tracking changes in water loss concurrent with changes in customer demand?
2. What factors should be considered if Illinois, or any other State/Regulatory body, were to eliminate “Water Loss %” or “NRW %” as a regulatory metric?

Thank you!

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