Advanced Cost Allocation & Rate Design

Water

November 29, 2023

TODAY'S PRESENTERS

Andy Burnham

- Led over 500 studies for 200+ communities
- Authored AWWA rate-making manuals

Deb Kloeckner

- Performs cost allocation & rate design studies
- AWWA and NEWWA conference presenter

UNDERSTANDING LEARNING OBJECTIVES

A. How can you address affordability in ratemaking?

B. How can water rates promote conservation? How do you estimate elasticity of demand?

C. I want to know the current trends and emerging concepts in ratemaking.

D. I would like a better understanding of comprehensive cost allocation methods.

E. How do you determine customer class peaking factors?

F. What cost should go into fixed versus variable charges?

Write your desired learning objectives in the chat!

TODAY'S AGENDA

- Introductions
- Emerging Trends in Cost Allocation
- Traditional Approach to Water Cost Allocation

Break (11:20-11:40 AM)

- Developing Water Peaking Factors
- Sewer Cost Allocation Strategies

Lunch Break (1:00-2:00 PM)

- Fixed & Volumetric Rate Design
- Fire Protection Cost Allocation

Break (3:20-3:40 PM)

- Miscellaneous Fees & Capital Charges
- Open Forum

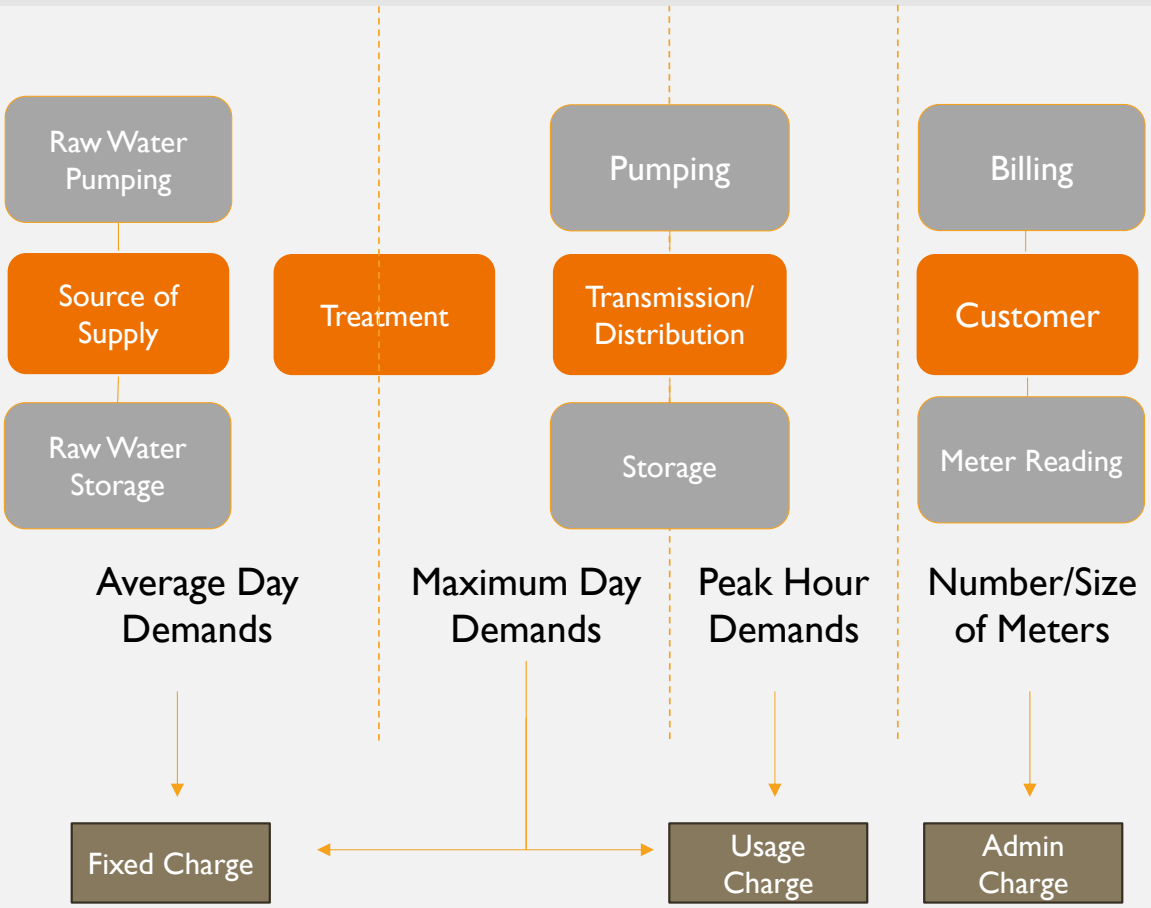
Advanced Cost Allocation & Rate Design

Water

Emerging Trends in Cost Allocation

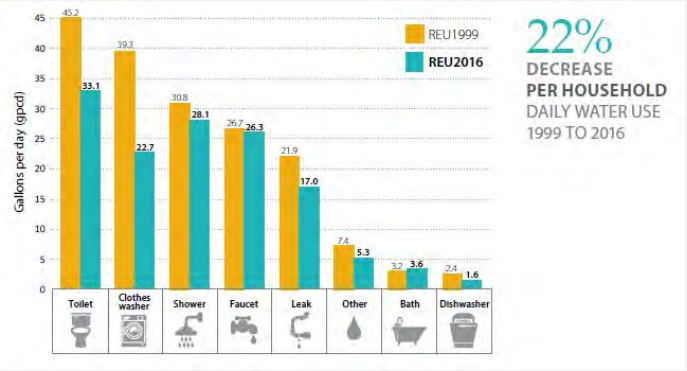
Traditional Approach to Cost Allocation

Distribute Costs by Function & Recover based on "Use" Characteristics

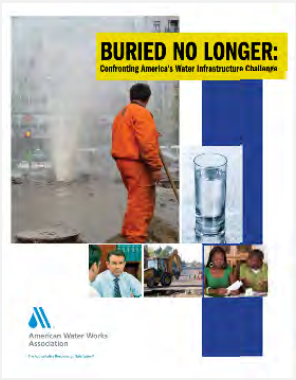


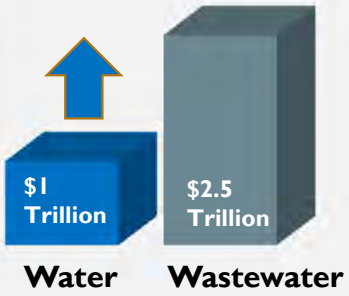
Emerging industry challenges and trends in financing

Reductions in Use / Revenue Impacts



Aging Infrastructure



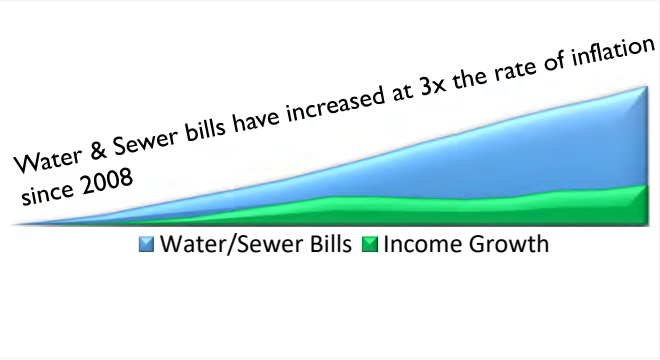


Regulatory / Resilience

PFAS, LCR, State Legislation

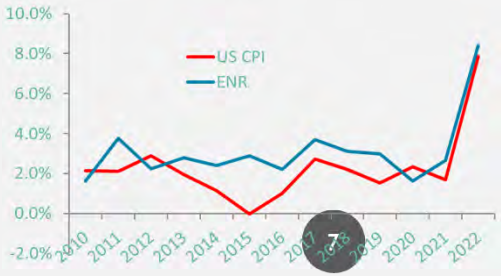
United States Environmental Protection Agency

Customer Affordability



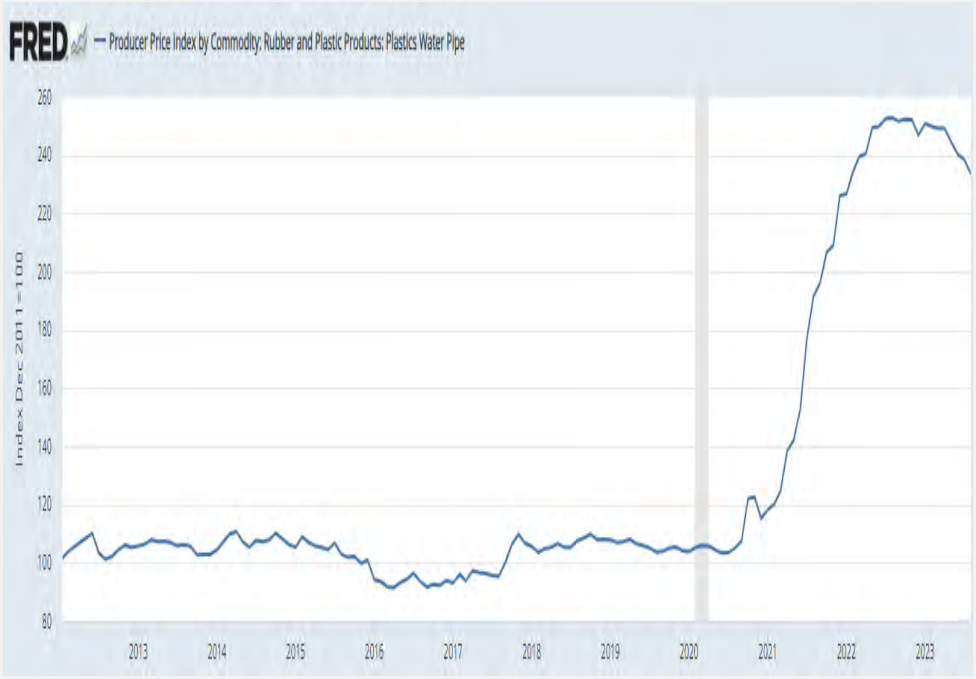
Aging Workforce

Cost Increases



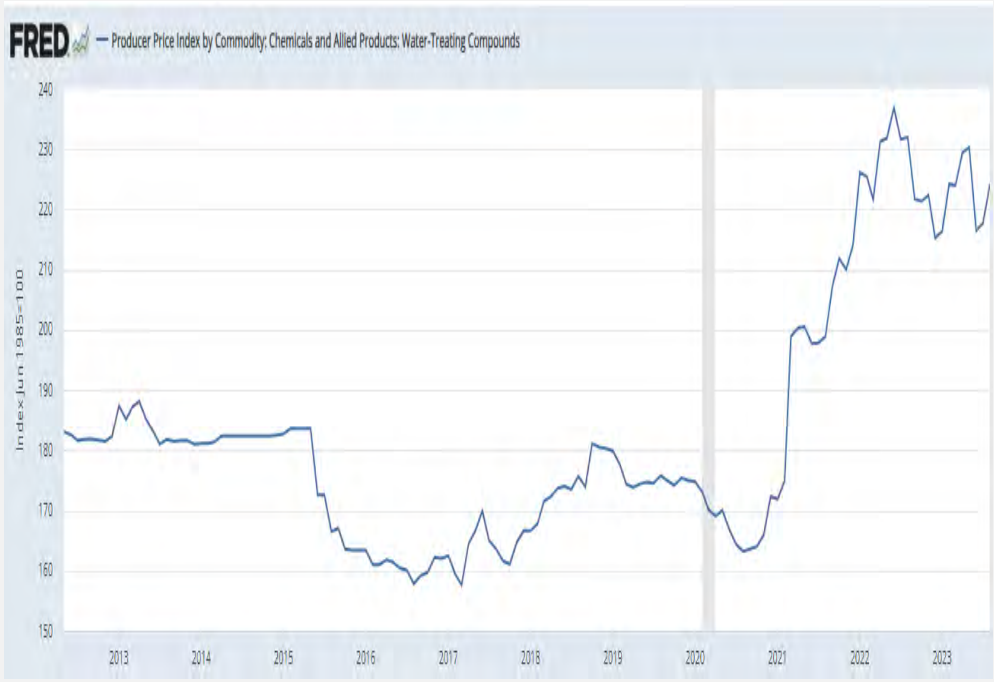
Emerging industry challenges and trends in financing

Operational Cost Inflation: 2020-2024



National Commodity Index – Plastic Water Pipe

- **Up 132% from Jan 2020 to June 2023**



National Water Treatment Chemical Index

- **Up 31% from Jan 2020 to June 2023**

Emerging industry challenges and trends in financing

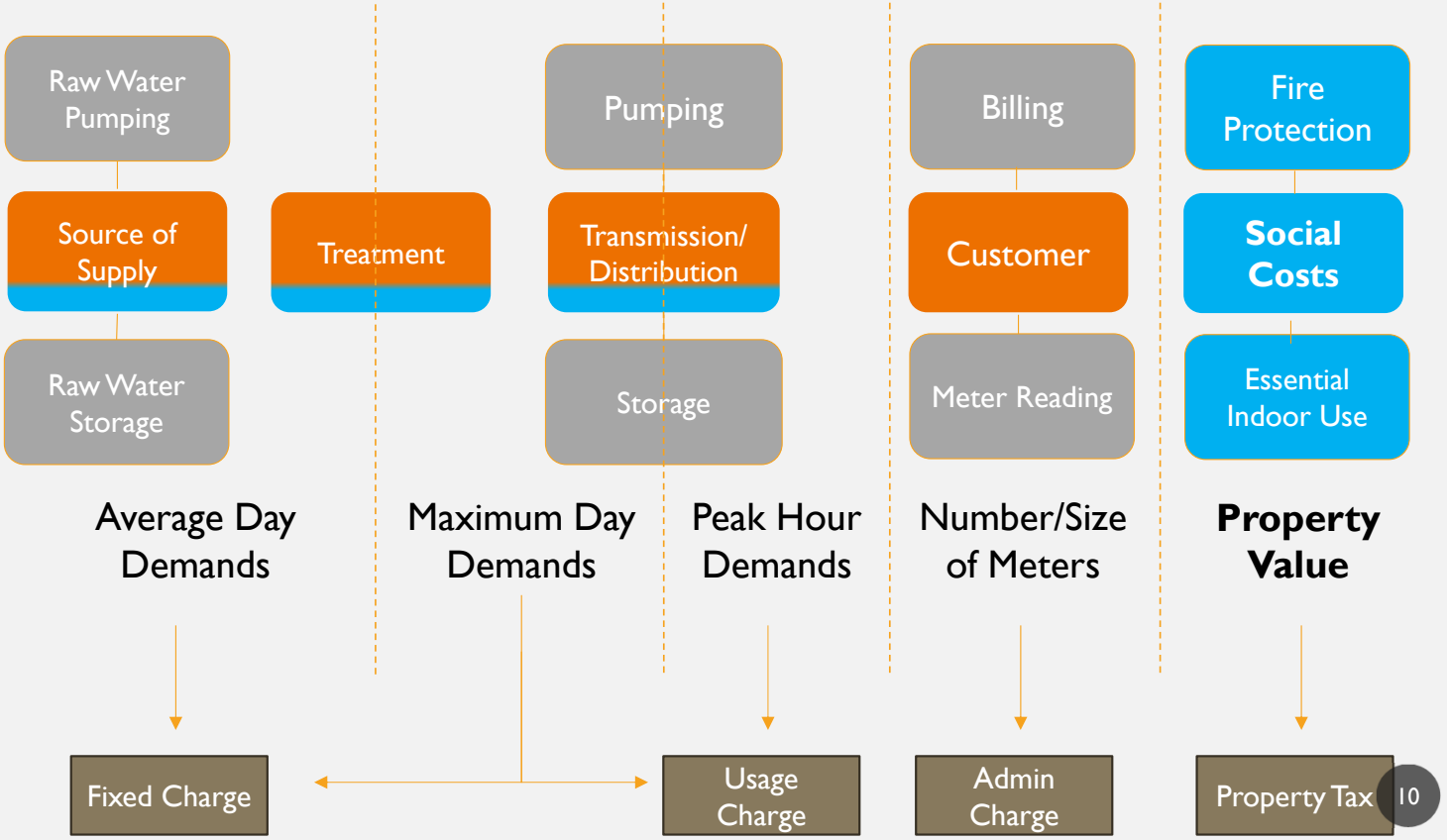
Construction Cost Inflation: 2020-2024

National Cost Index – Construction

- **General Construction - Up 33% from Jan 2020 to June 2023**
- **Industrial Construction - Up 40% from Jan 2020 to June 2023**

Thinking Outside the Box - Social Value

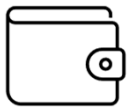
Distribute Costs by Function & Recover based on "Use" Characteristics, **with portion recovered based on social value/benefit**



COST ALLOCATION APPROACHES

Usage-Based

- Number of Bills
- Volume of Consumption
- Demand Characteristics
- Type of Customer



Revenue-Based

- Property Taxes
- Sales Tax
- Utility Rate Rider

Parcel-Based

- Lot / Building Area
- Frontage Feet

MONTREAL, QUEBEC

Property Taxes

Water tax	0,0917

BOROUG

Boroughs[4]	Tax concerning services	Tax concerning capital expenditures
Ahuntsic-Cartierville	0,0435	0,0349
Anjou	0,1250	0,0703
Côte-des-Neiges–Notre-Dame-de-Grâce	0,0413	0,0250
Lachine	0,0482	0,0389
Lachine tax per unit	$ 51.01 / unit	n. a.
LaSalle	0,0538	0,0373
L'Île-Bizard - Sainte-Geneviève	0,0819	
L'Île-Bizard sector		0,0843
Sainte-Geneviève sector		0,0841
Mercier–Hochelaga-Maisonneuve	0,0663	0,0410
Montréal-Nord	0,1348	0,0574
Outremont	0,0452	0,0343

VOLUMETRIC WATER USER FEE

NON RESIDENTIAL IMMOVABLES[5]			
0 to 1,000 m^3	1,000 to 10,000 m^3	10,000 to 100,000 m^3	more than 100,000 m^3
$ 0 / m^3	$ 0.10 / m^3	$ 0.20 / m^3	$ 0.60 / m^3

ATLANTA, GEORGIA
Sales Taxes

SUMMARY OF REVENUES AND EXPENSES

Water & Wastewater Revenue Fund

Revenues	FY21 Actuals	FY22 Adopted	FY23 Budget
Intergovernmental Revenues	$1,369,827	-	-
Charges For Services	$446,974,411	$482,250,955	$485,441,687
Investment Income	$678,792	$1,000,000	$700,000
Miscellaneous Revenues	$99,666	$80,000	$80,000
Other Financing Sources	$154,956,507	$93,925,000	$123,922,916
Total Revenues	**$604,079,203**	**$577,255,955**	**$610,144,603**

Effective October 1, 2004, a 1% Municipal sales and use tax will be collected for retail sales and use occurring in the incorporated city limits of Atlanta. The purpose of this tax is to assist with funding renovations to the water and sewer system. Some general information pertaining to the collection and remittance of this new tax follows:

The 1% City of Atlanta municipal sales and use tax will be collected on transactions where the customer takes delivery of the item being sold or an item is used within the incorporated city limits of Atlanta.

PHILADELPHIA, PENNSYLVANIA

Utility Rate Rider

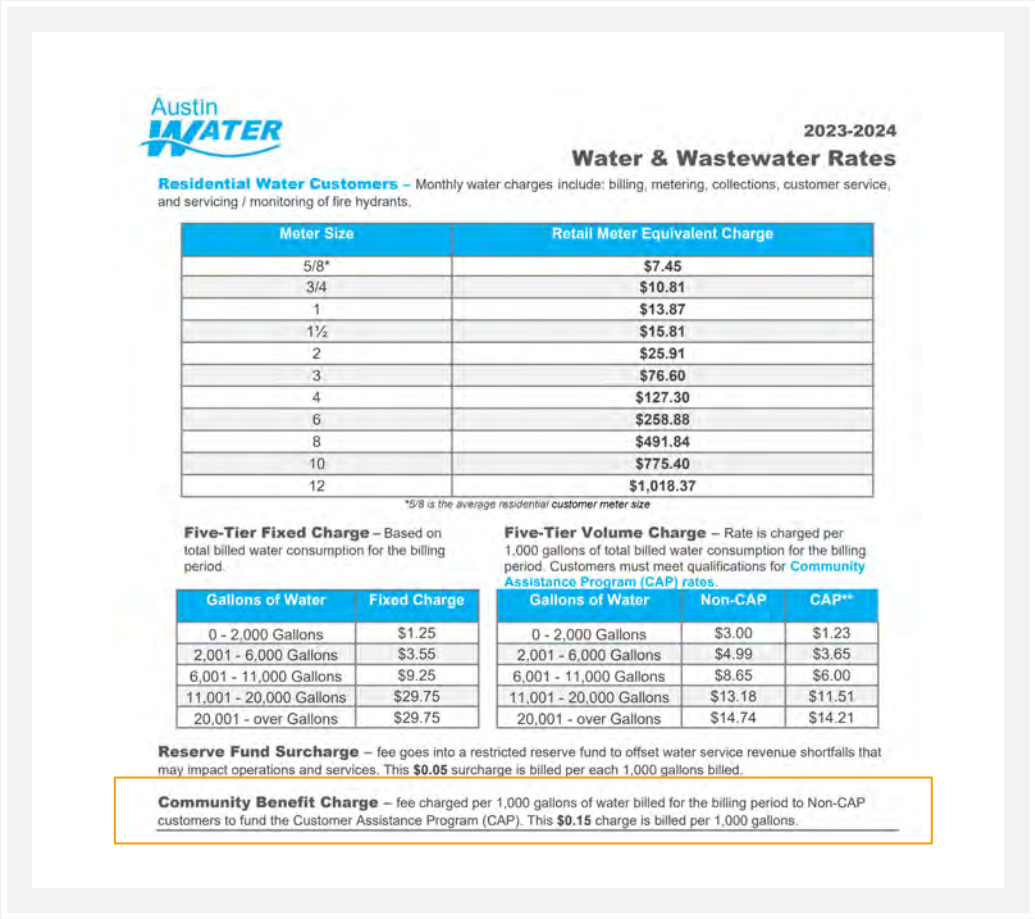
10.0 PROVISIONS FOR RECOVERY OF THE TIERED ASSISTANCE PROGRAM (TAP) COSTS

The lost revenue related to TAP (the "TAP Costs") will be recovered via a separate TAP Rate Rider Surcharge Rate (TAP-R), which would be added to the water, fire service and sewer quantity charge rate schedules. This TAP-R shall be increased or decreased for the next rate period to reflect changes in TAP costs, and will be calculated and reconciled on an annual basis in the manner set forth below.

Monthly Water Usage	Base Charge Per Mcf	TAP-R Per Mcf	Total Charge Per Mcf
First 2 Mcf (0 to 2 Mcf)	$59.32	$0.15	$59.47
Next 98 Mcf (2.1 to 100 Mcf)	53.37	0.15	53.52
Next 1,900 Mcf (100.1 to 2,000 Mcf)	41.34	0.15	41.49
Over 2,000 Mcf	40.22	0.15	40.37

AUSTIN, TEXAS

Utility Rate Rider



Austin WATER

2023-2024

Water & Wastewater Rates

Residential Water Customers – Monthly water charges include: billing, metering, collections, customer service, and servicing / monitoring of fire hydrants.

Meter Size	Retail Meter Equivalent Charge
5/8*	$7.45
3/4	$10.81
1	$13.87
1½	$15.81
2	$25.91
3	$76.60
4	$127.30
6	$258.88
8	$491.84
10	$775.40
12	$1,018.37

*5/8 is the average residential customer meter size

Five-Tier Fixed Charge – Based on total billed water consumption for the billing period.

Gallons of Water	Fixed Charge
0 - 2,000 Gallons	$1.25
2,001 - 6,000 Gallons	$3.55
6,001 - 11,000 Gallons	$9.25
11,001 - 20,000 Gallons	$29.75
20,001 - over Gallons	$29.75

Five-Tier Volume Charge – Rate is charged per 1,000 gallons of total billed water consumption for the billing period. Customers must meet qualifications for Community Assistance Program (CAP) rates.

Gallons of Water	Non-CAP	CAP**
0 - 2,000 Gallons	$3.00	$1.23
2,001 - 6,000 Gallons	$4.99	$3.65
6,001 - 11,000 Gallons	$8.65	$6.00
11,001 - 20,000 Gallons	$13.18	$11.51
20,001 - over Gallons	$14.74	$14.21

Reserve Fund Surcharge – fee goes into a restricted reserve fund to offset water service revenue shortfalls that may impact operations and services. This **$0.05** surcharge is billed per each 1,000 gallons billed.

Community Benefit Charge – fee charged per 1,000 gallons of water billed for the billing period to Non-CAP customers to fund the Customer Assistance Program (CAP). This **$0.15** charge is billed per 1,000 gallons.

CALGARY, ALBERTA

Lot Area / Building Area

Residential customers that do not have a water meter to measure the amount of water being used are billed on a flat rate.

Visit the water meter installation page to arrange to have a meter installed.

Water Utility rates for residences on a flat rate are calculated according to the square feet of actual lot area and gross building area based on the original development permit submitted to The City of Calgary Planning department. For detailed information on your flat rate calculation, please call 311.

The following 2023-2026 Water Utility rates are based on **30 days of service**, which means the amount on your bill may vary depending on the number of days you have been billed.

Water treatment and supply

	2023	2024	2025	2026
$ per thousand square feet of actual lot area*	6.1240	6.1240	6.1240	6.1240
$ per thousand square feet of gross building area*	19.0978	19.0978	19.0978	19.0978

Minimum monthly rates (for 2023-2026 is $46.17):
If the total water charge for a flat rate customer falls below the minimum monthly water rate, the customer will be charged the monthly minimum rate for water and this amount will be used to calculate the wastewater charge.

Wastewater collection and treatment

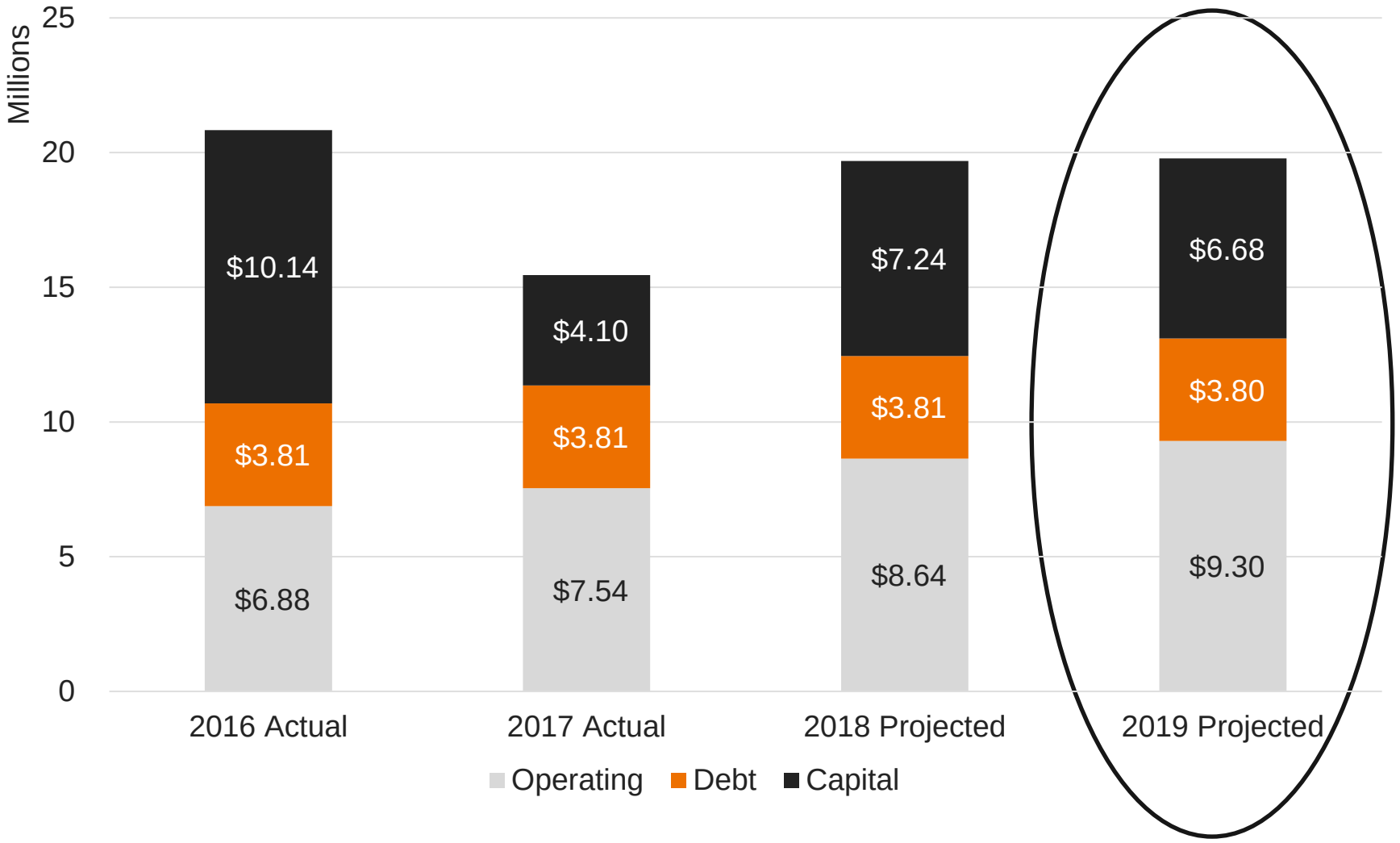
	2023	2024	2025	2026
Percentage of water charge for flat rate customers	144.46%	144.46%	144.46%	144.46%

City of Bismarck, North Dakota

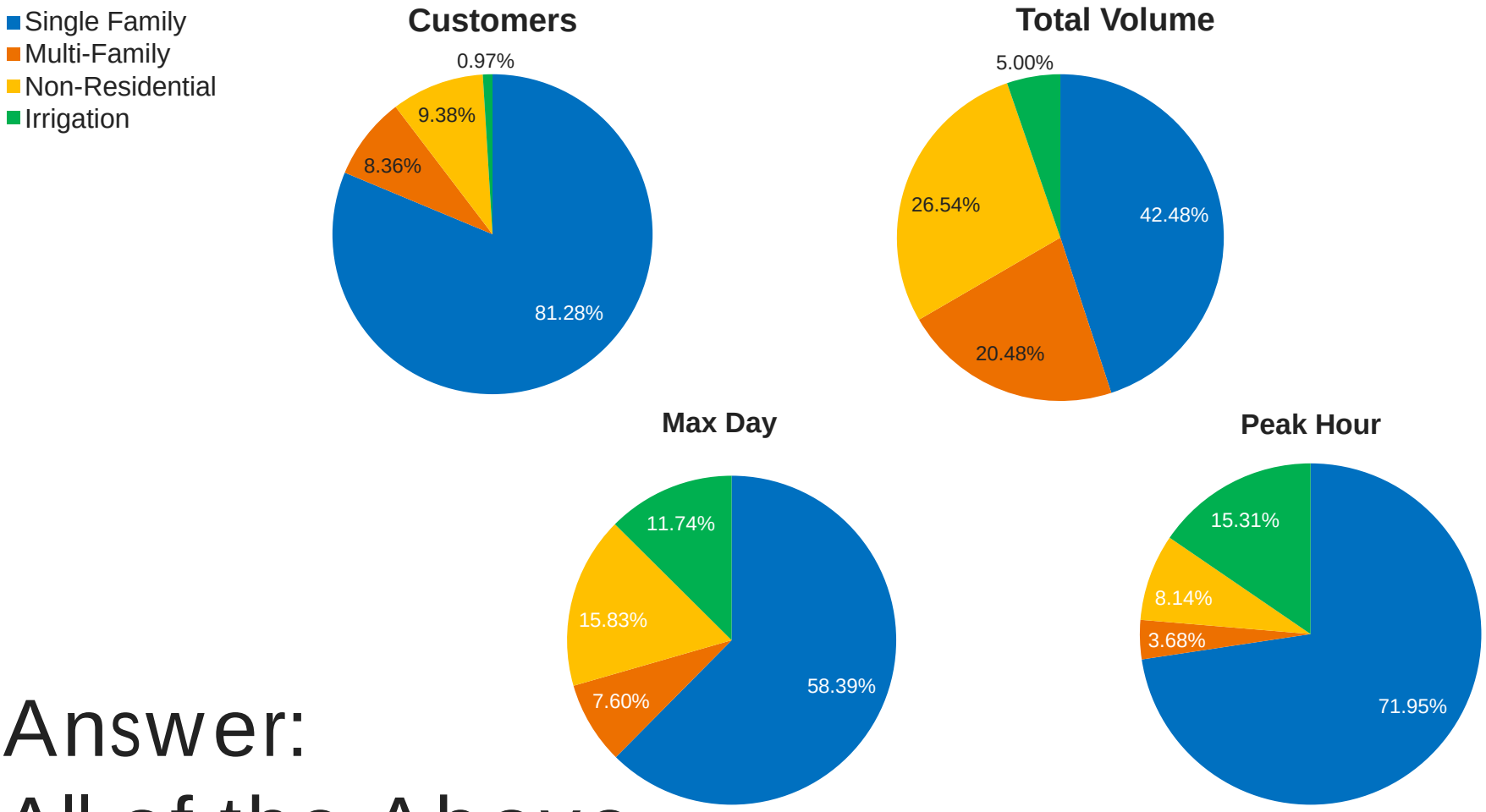
Stantec

Water System

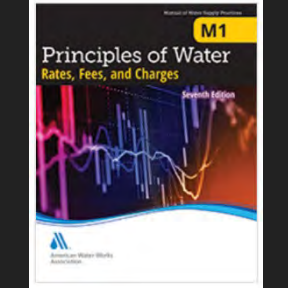
Total Annual Expenditures ($ in Millions)



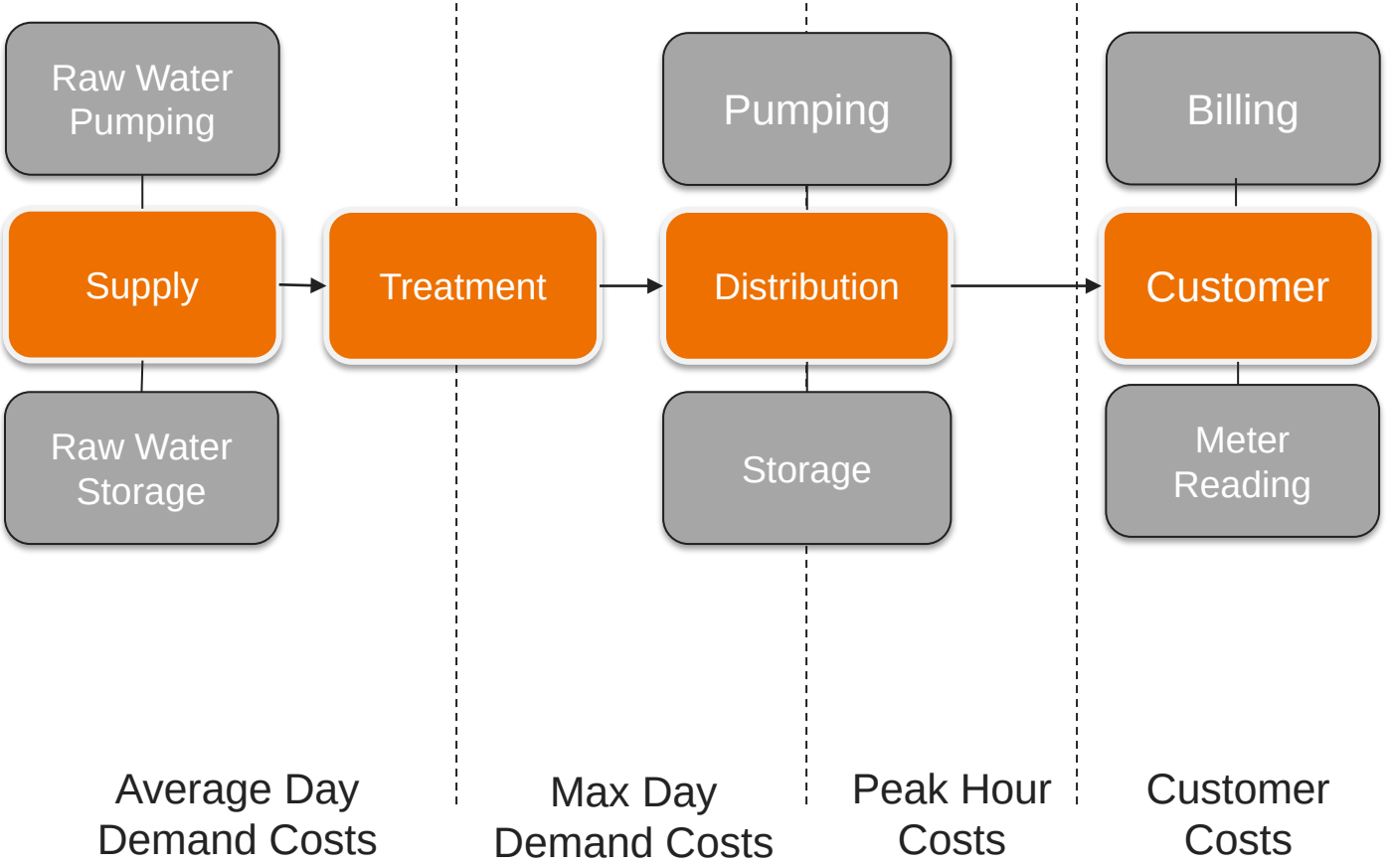
Question: How Should Costs be Allocated?



Answer:
All of the Above



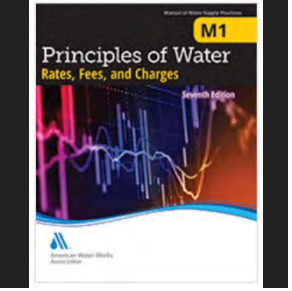
Started with a "By the Book" Process



Function costs ($ in millions) & units of service

Functions →	Supply	Treatment	Distribution	Customer	Total
2019 Cost of Service →	**$3.1**	**$6.7**	**$8.3**	**$1.7**	**$19.8**
Average/Total Demands	100%	41%	21%		**$7.7**
Maximum Day Demands		59%	30%		**$6.4**
Peak Hour Demands			49%		**$4.0**
Number of Accounts				100%	**$1.7**

Allocation of costs between average day, maximum day, and peak hour based upon ratio of observed water system demands



"Mapping" of functions to cost components

$3.1M $6.7M $8.3M $1.7M $19.8M

Raw Water Pumping

Supply

Raw Water Storage

Treatment

Pumping

Distribution

Storage

Billing

Customer

Meter Reading

Average Day Demand Costs

$7.7M

Max Day Demand Costs

$6.4M

Peak Hour Costs

$4.0M

Customer Costs

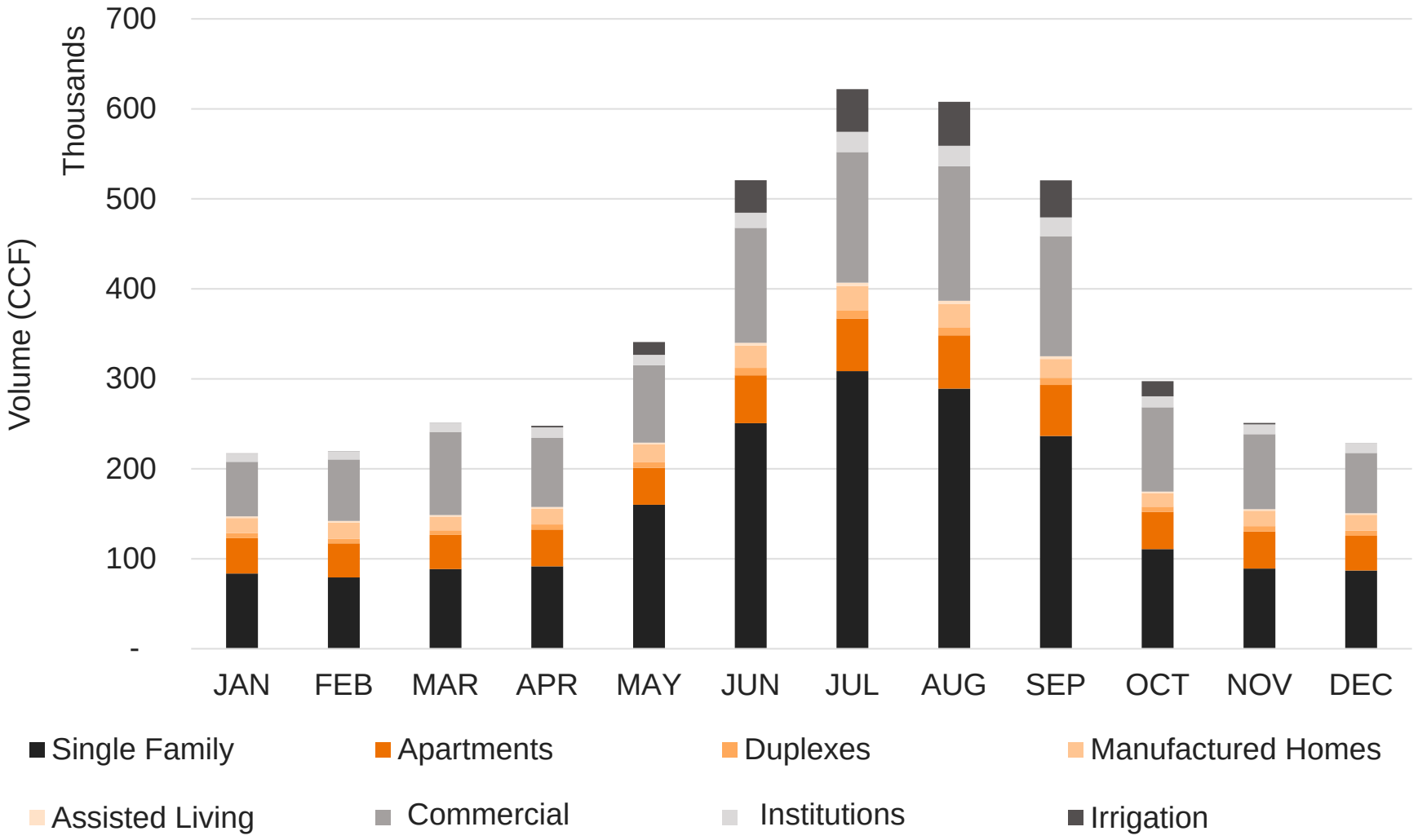
$1.7M

$19.8M

Allocating Costs to Customer Classes

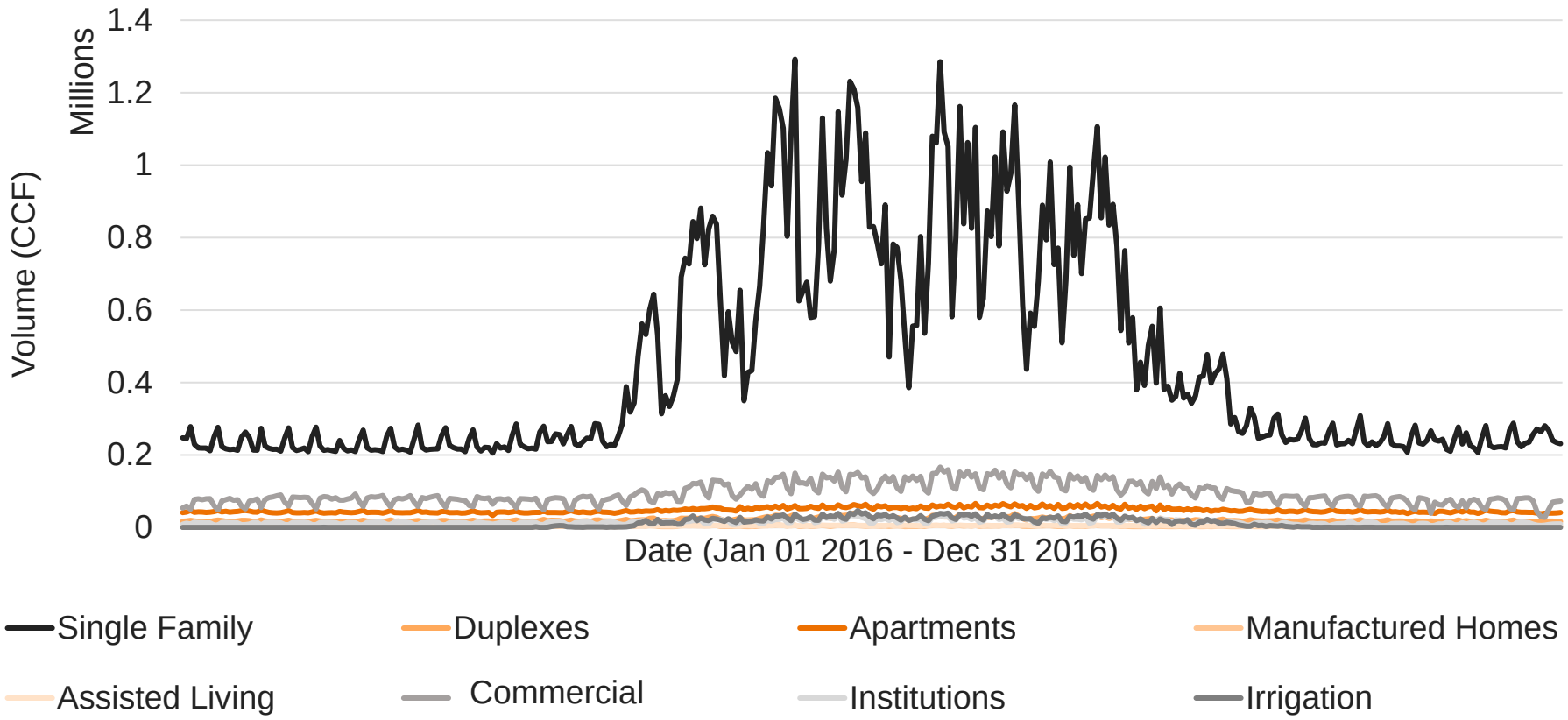
Customer Characteristics

Deep dive into 2016 monthly water use



Customer Characteristics

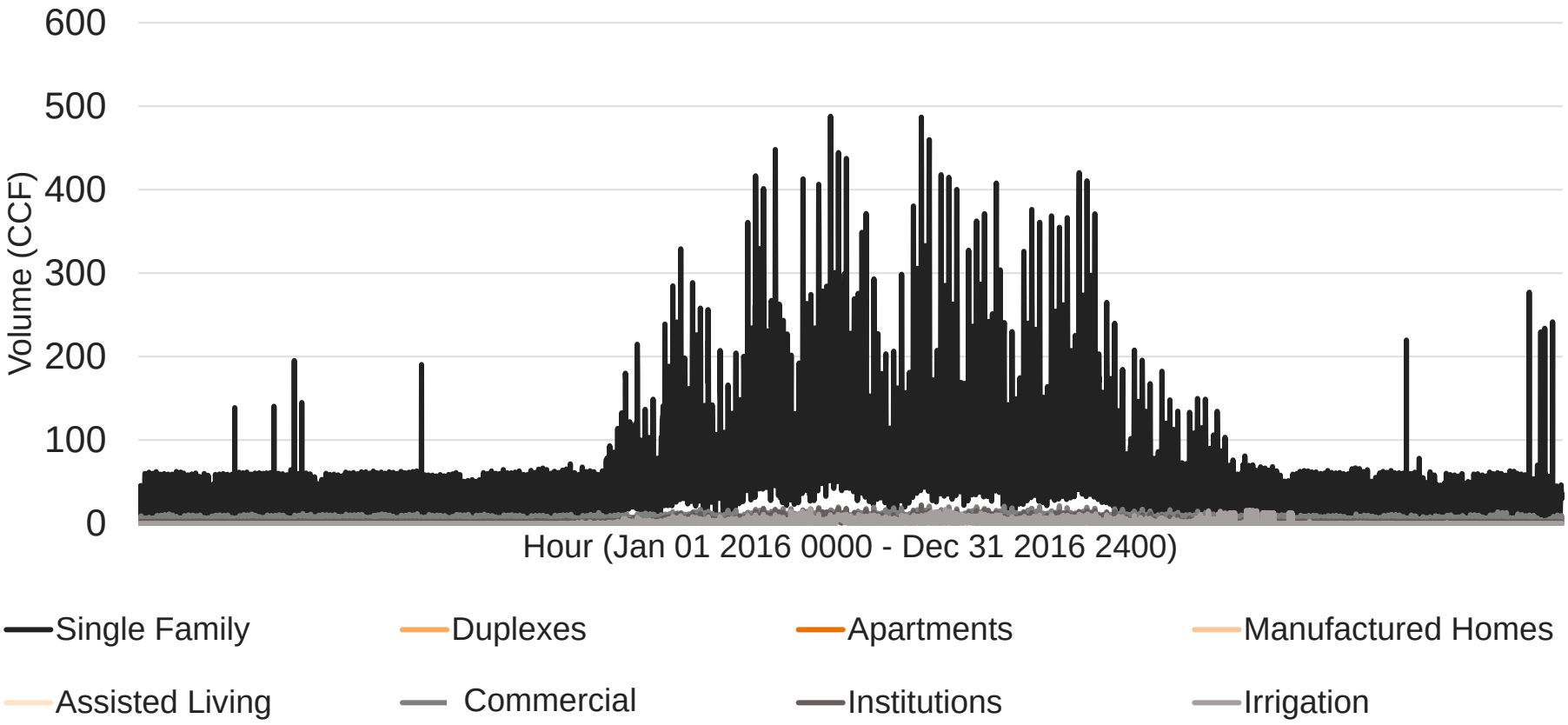
Deeper dive into customer data



7.5 million data points from the Automated Meter Infrastructure Data were used for 2016 on a **daily** basis

Customer Characteristics

REALLY deep dive into customer data



175 million data points from the Automated Meter Infrastructure Data were used for 2016 on an **hourly** basis

Summary of data evaluated (tabular)

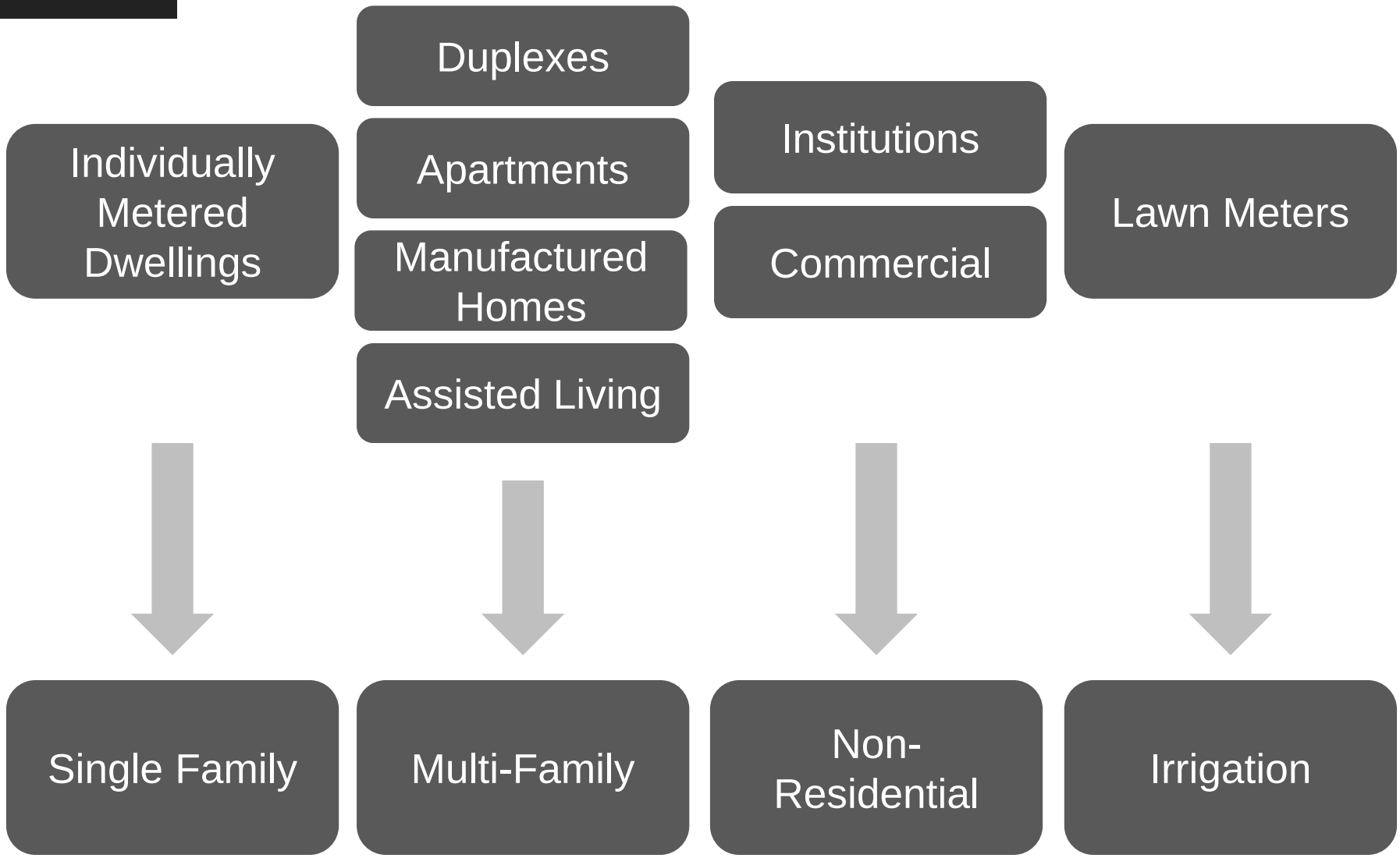
Customer Type	# of Accounts	2016 Water Use (CCF)	Peak Day Factor (Peak Day ÷ Avg Day)	Peak Hour Factor (Peak Hour ÷ Avg Hour)
Single-Family	17,306	1,964,193	2.9	9.0
Duplexes	730	84,704	1.9	3.0
Apartments	1,060	582,398	1.4	3.1
Manufactured Homes	30	251,916	1.9	2.3
Assisted Living	14	29,356	1.6	1.9
Commercial	2,066	1,121,241	1.8	3.8
Institutions	156	159,780	2.2	4.0
Irrigation	224	231,459	4.2	15.3
Lincoln	1	125,678	2.9	3.7
South Central	1	117,336	2.3	2.7

Peak day and peak hour factors presented are non-coincident and may occur during different periods.

Things to consider when establishing customer groups or classes

- Service characteristics
- Facility requirements
- Location
- Demand patterns
  - Average, maximum day, peak hour, monthly distribution
- Administrative requirements
- IT/Billing system capability
- Property uses
- Community/Stakeholder feedback

Recommended customer classes



Summary of data by customer class

Customer Class	# of Accounts	2016 Water Use (CCF)	Peak Day Factor (Peak Day ÷ Avg Day)	Peak Hour Factor (Peak Hour ÷ Avg Hour)
Single Family	17,306	1,964,193	2.9	9.0
Multi-Family	1,834	948,373	1.5	2.2
Non-Residential	2,222	1,281,021	1.8	3.0
Irrigation	224	231,459	4.2	15.3

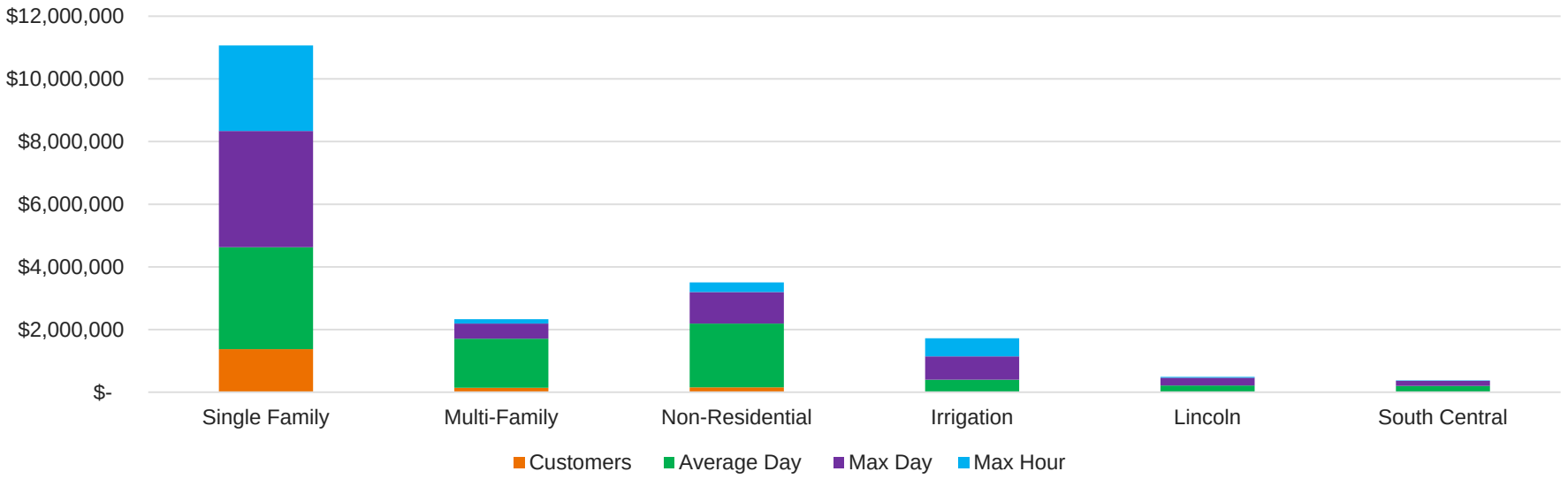
Implementation challenge: Consistent classification of same property uses with different metering configurations. Will require account auditing to identify property use in billing system and ensure equity.

Lincoln	1	125,678	2.9	3.7
South Central	1	117,336	2.3	2.7

Implementation challenge: Addressing Lincoln and South Central cost of service requirements vs. pricing per current contracts.

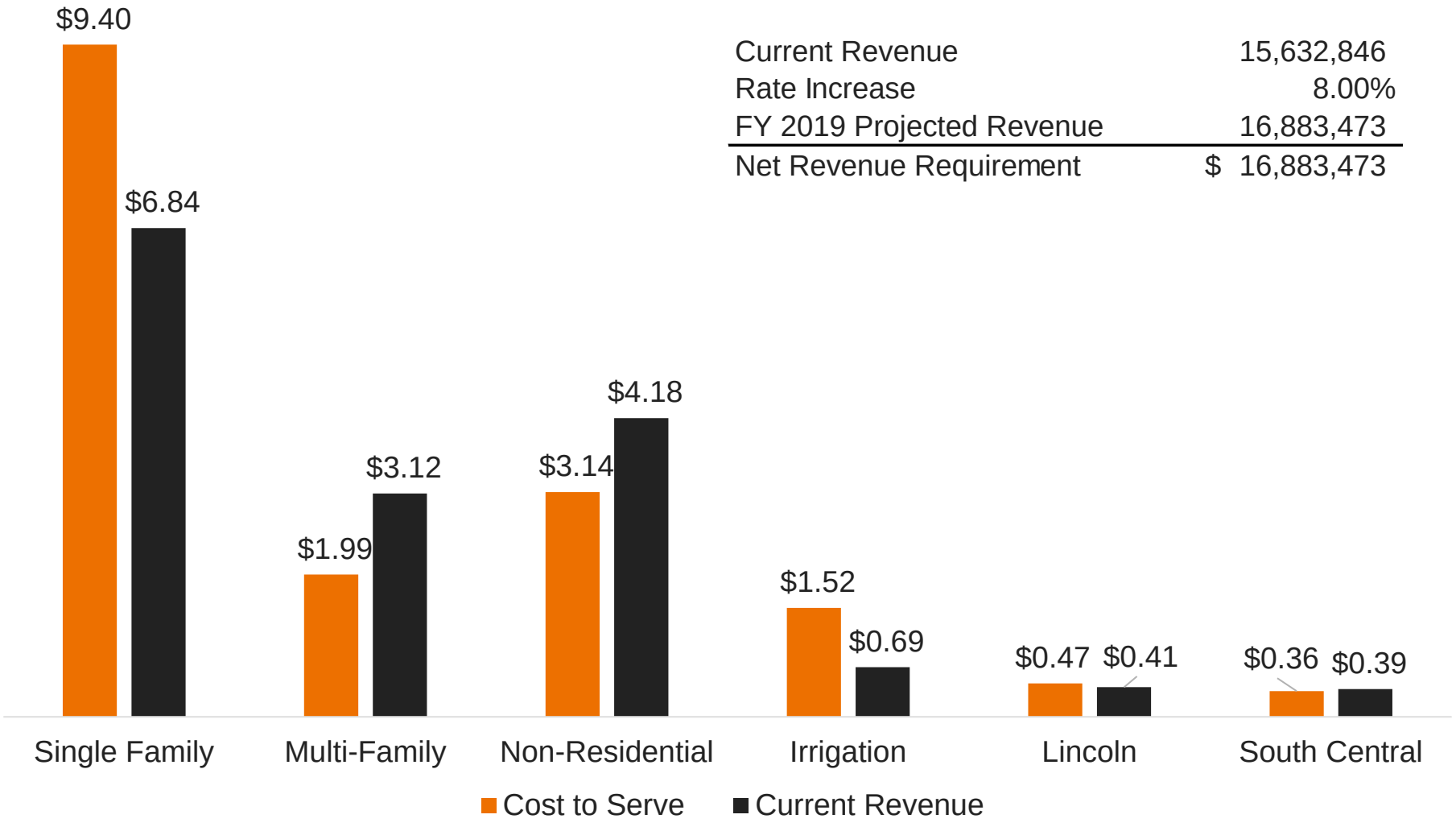
Units of service and costs by customer class

Customer Class	# of Accounts	Avg. Day Demand (CCF)	Max Day Demand Per AMI (CCF)	Peak Hour Demand per AMI (CCF)
Single Family	17,306	5,383	15,558	48,558
Multi-Family	1,834	2,598	3,923	5,612
Non-Residential	2,222	3,510	6,388	10,283
Irrigation	224	634	2,682	9,715



Cost to serve vs. current revenue ($M)

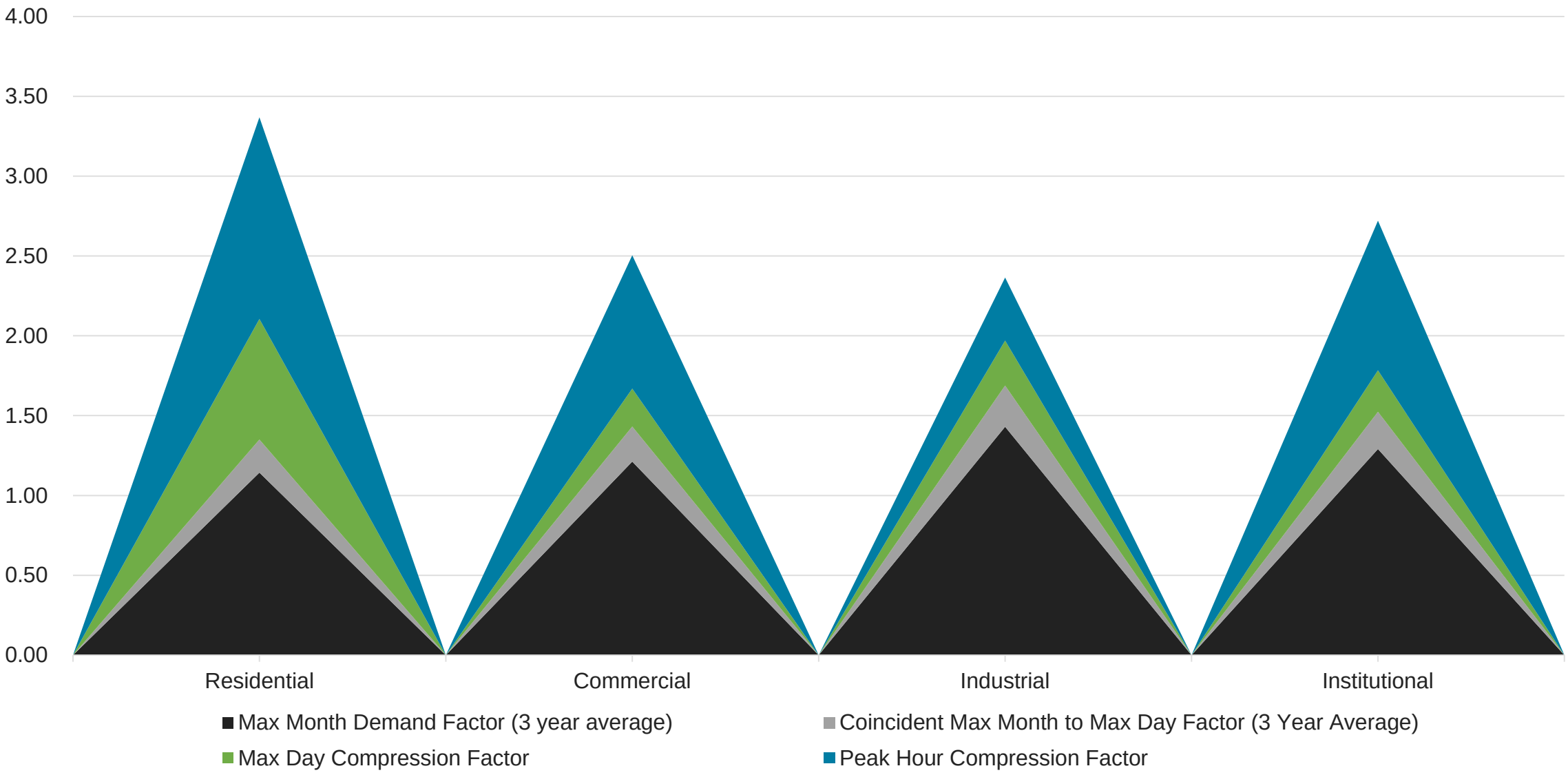
Current Revenue	15,632,846
Rate Increase	8.00%
FY 2019 Projected Revenue	16,883,473
Net Revenue Requirement	$ 16,883,473



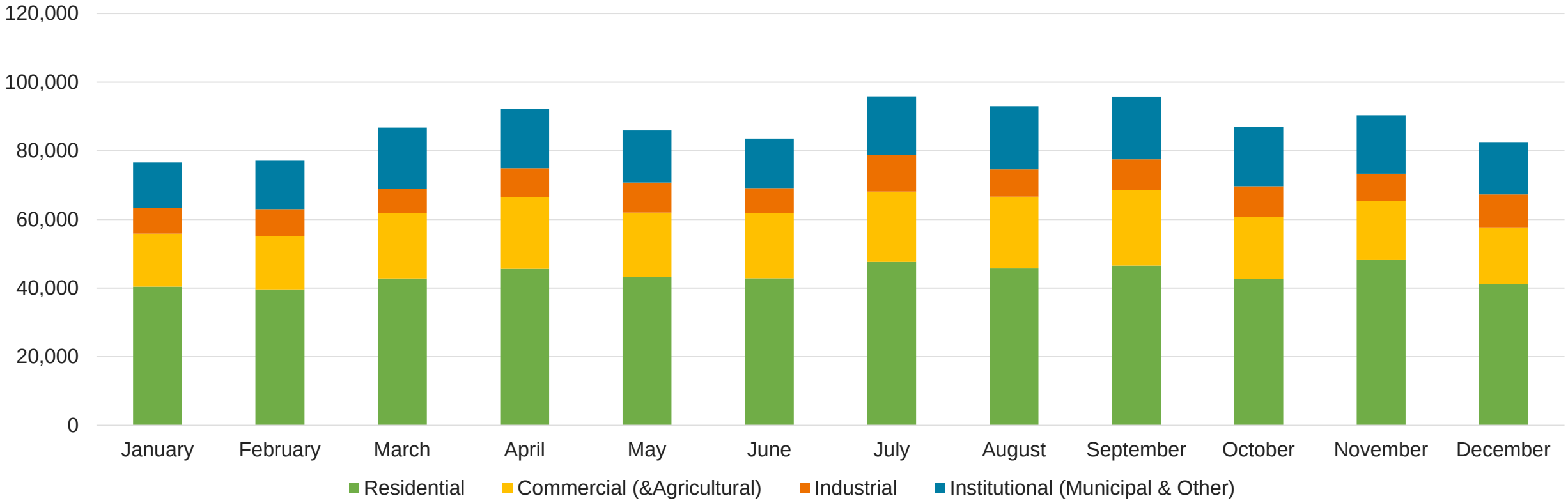
Stantec

Developing Water Peak Factors

Developing Peak Factors

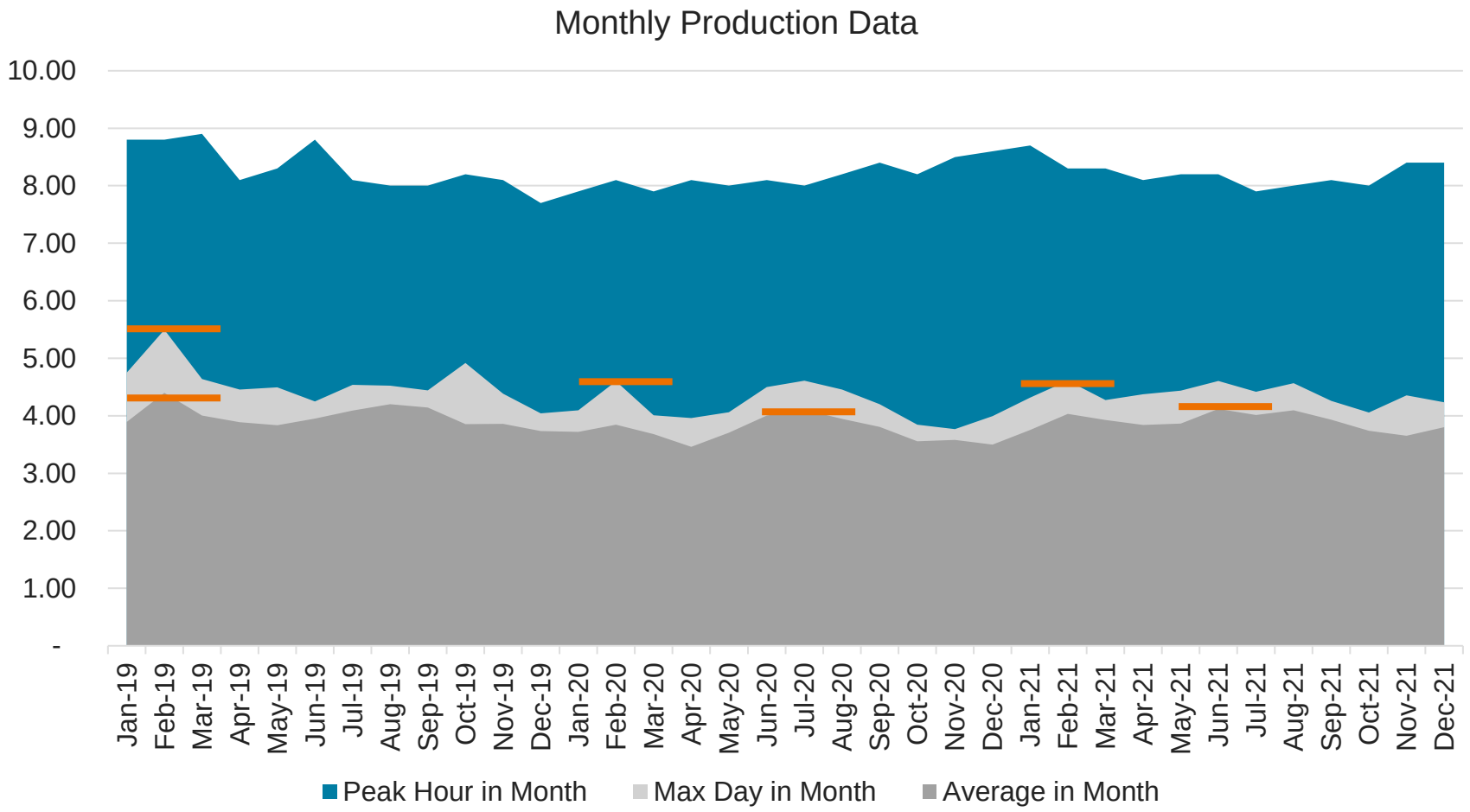


Step 1: Max Month Demand Factor



	Residential	Commercial	Industrial	Institutional
Average month	43,850	18,647	8,417	16,311
Max month	48,131	22,013	10,664	18,404
Max month ratio	1.10	1.18	1.27	1.13

Step 2: Coincident Max Day to Max Month Factor



$$\frac{\text{Max Day in Year}}{\text{Average Day}} = \text{System Max Day Factor}$$

$$\frac{\text{Peak Hour in Year}}{\text{Average Day}} = \text{System Peak Hour Factor}$$

$$\frac{\text{Max Day in Year}}{\text{Max Month in Year}} = \text{Max Day to Max Month Factor}$$

Step 3: Maximum Day Compression Factors

	Residential Base Usage	Percent	Days	Average per Day
Average Household Size	2.09			
Indoor Use per person	58.60			
Annual Usage Gallons	44,703			
Base Monthly Usage	3,725			
Sprinkling Usage	6,275	37%	7	2.61
Total	10,000	63%	3	1.88
% base				4.49
Days				7
MD Factor				**1.56**
Commercial				
Days				6
MD Factor				**1.17**
Industrial				
Days				6
MD Factor				**1.17**

Step 4: Peak Hour Compression Factors

Peak Hour Factor	Hours		
Residential and Multi Family	15	1.60	Less typical work day
Commerical	16	1.50	
Industrial	20	1.20	
Institutional	Below	1.53	

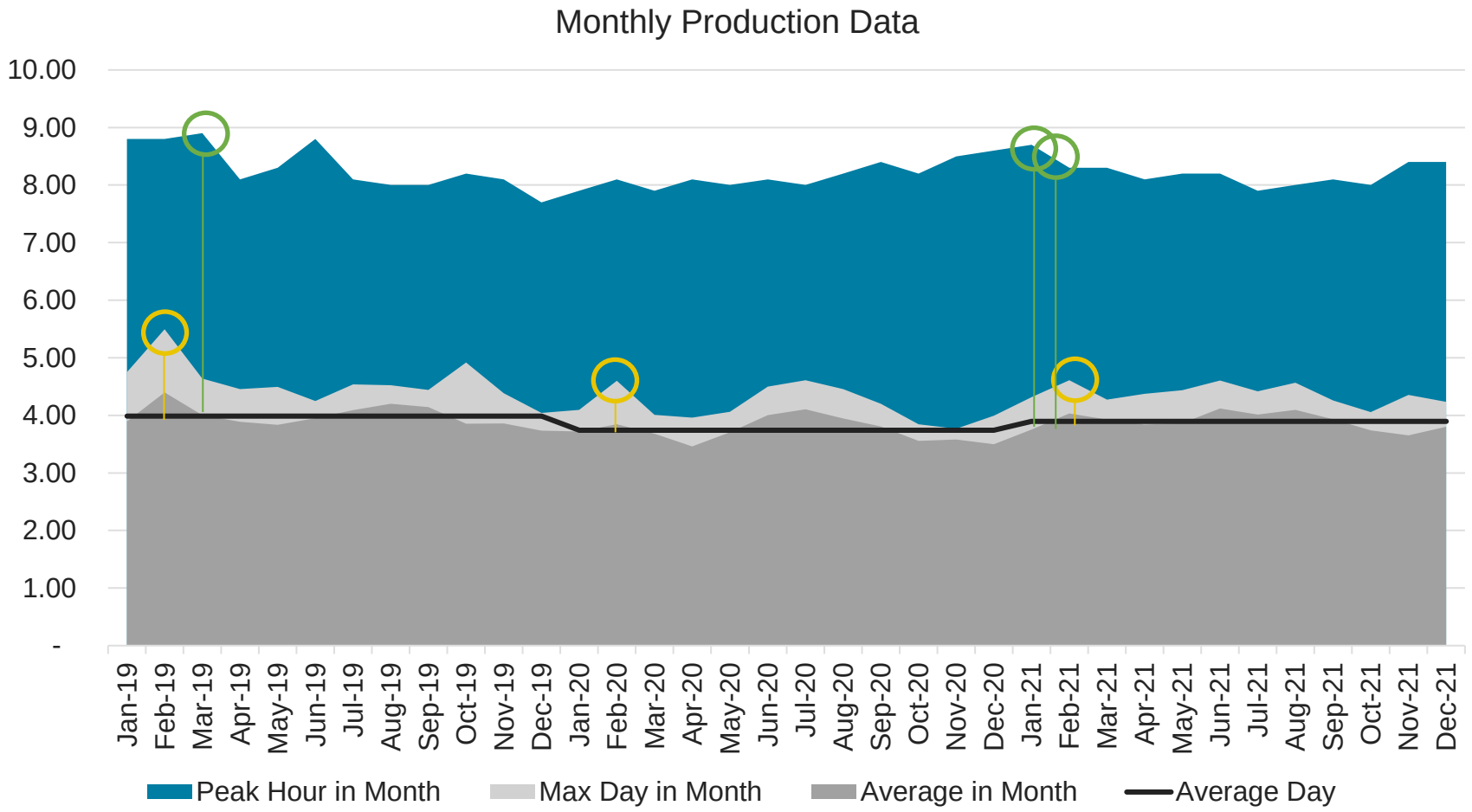
Institutional	Sales	Percent of CBU Retail	Factor	
Residential	393,622	62%	1.56	0.96
Commercial	167,384	26%	1.17	0.31
Industrial	75,560	12%	1.17	0.14
Total	636,566	100%		**1.41**

University	Percent of Sales	Peaking Factor	Weighted Average
Residential	62%	1.60	99%
Commercial	26%	1.50	39%
Industrial	12%	1.20	14%
Total			**153%**

Peak Factors by Class

Line	Base and Extra Capacity Demands by Customer Class	Residential	Commercial	Industrial	Institutional	Total
1	Test Year Annual Use (kgal)	393,622	167,384	75,560	146,421	782,987
2	Average Daily Use (MGD)	1.08	0.46	0.21	0.40	2.15
3	Non-Coincident Max Month Demand Factor (3 year average)	1.14	1.21	1.43	1.29	
4	Non-Coincident Max Month Demand (MGD) (Line 2 * Line 3)	1.23	0.56	0.30	0.52	2.60
5	Coincident Max Day to Max Month Factor (3 Year Average)	1.18	1.18	1.18	1.18	
6	Max Day Compression Factor (Schedule 8)	1.56	1.17	1.17	1.17	
7	Non-Coincident Max Day Demand (MGD) (Line 4 * Line 5 * Line 6)	2.27	0.77	0.41	0.72	4.16
8	Max Day Demand Factor (Line 7 / Line 2)	2.11	1.67	1.97	1.78	
9	Non-Coincident May Day Demand Factor (Line 7 / Line 2)	1.94				
10	Coincident Max Day Demand Factor (Schedule 6, Line 5)	1.27				
11	System MM Diversity* (Line 9 / Line 10)	1.53				
	**AWWA M1: Range for System MM Diversity For Many Utility Systems is 1.10 - 1.40*					
12	Max Hour Compression Factor (Schedule 8)	1.60	1.50	1.20	1.53	
13	Non-Coincident Max Hour Demand (Line 7 * Line 12)	3.63	1.15	0.49	1.09	6.36
14	Max Hour Demand Factor (Line 13 / Line 2)	3.37	2.50	2.36	2.72	
15	Non-Coincident Max Hour Demand Factor (Line 13 / Line 2)	2.97				
16	Coincident Max Hour Demand Factor (Schedule 6, Line 5)	2.25				
17	System MH Diversity* (Line 14 / Line 15)	1.32				
	**AWWA M1: Range for System MH Diversity For Many Utility Systems is 1.10 - 1.40*					

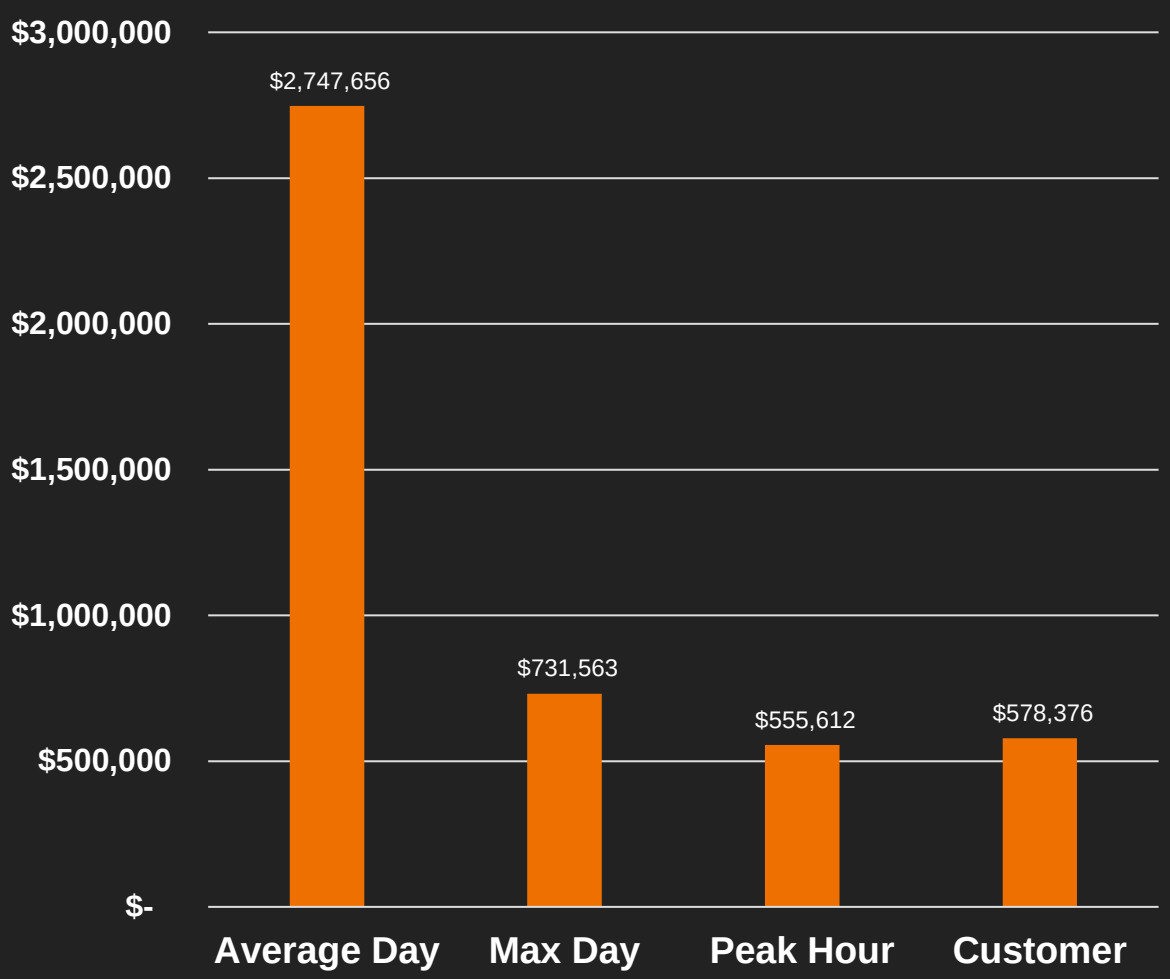
System Peak Factors – Coincident Peak



$$\frac{\text{Max Day in Year}}{\text{Average Day}} = \text{System Max Day Factor}$$

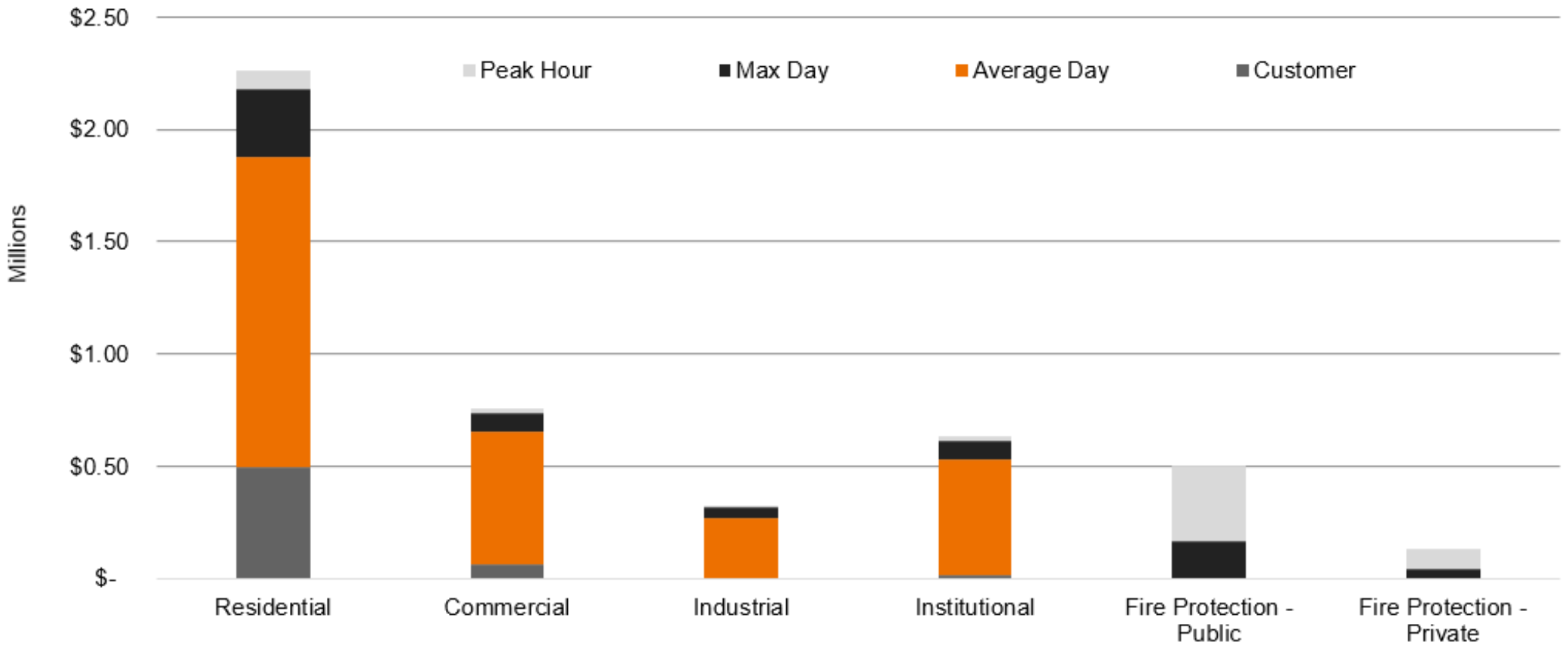
$$\frac{\text{Peak Hour in Year}}{\text{Average Day}} = \text{System Peak Hour Factor}$$

Test Year - Allocated Costs



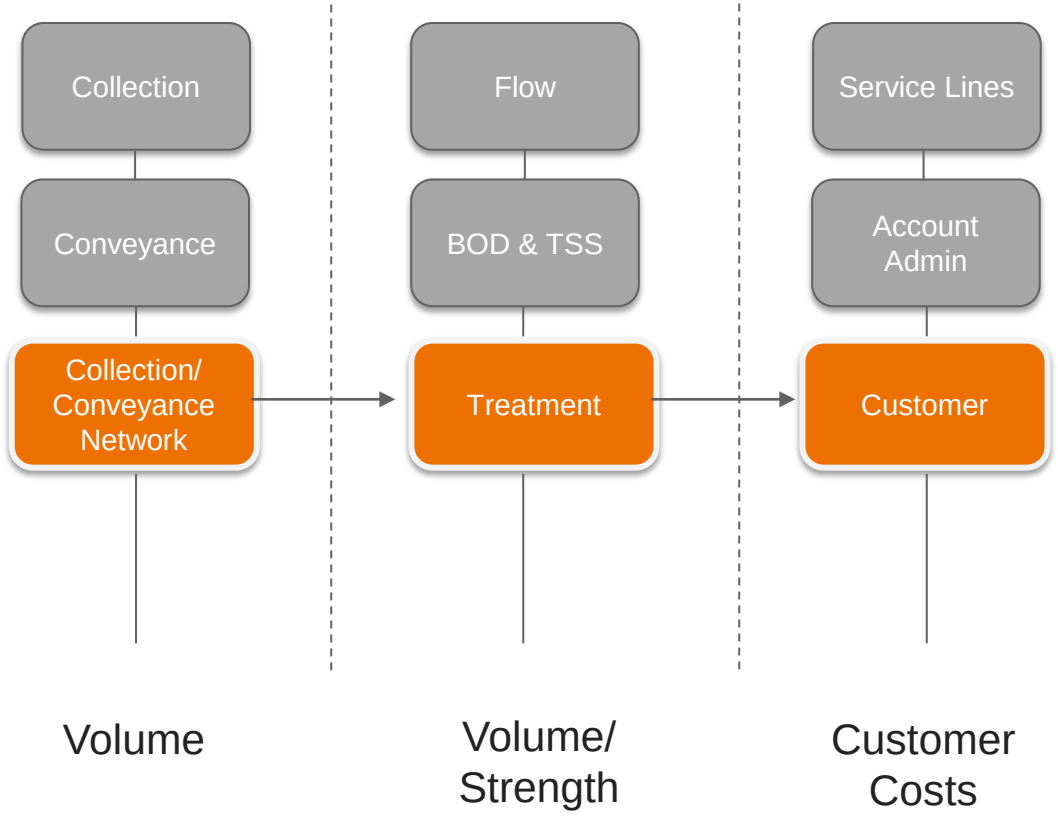
- Total $4.6M
- Allocated Costs Assigned to Customer Class based on Customer Behaviors
  - Less Non-Adjustable Revenue, $103K = $4.5M
- Monthly Billing Data
- System-wide Max Day
  - Calculated for each class using standard behaviors
  - Residential – Domestic + Irrigation
  - Others – Days of operation per week
- System-wide Peak Hour
  - Calculated for each class using standard daily behaviors
  - Hours of use per day
- Fire Protection
  - Based on required fire flow in gpm and required duration

Cost Allocation by Class



Sewer Cost of Service Overview

Start with a “By the Book” Process



Typical Strength Categories

- ✓ TSS – Total Suspended Solids
- ✓ BOD – Biological Oxygen Demand
- ✓ COD – Chemical Oxygen Demand
- ✓ FOG – Fats, Oils, Grease

Customer Classes that are over and above average municipal strength sewage

Average defined by:

- ✓ Measured Loadings at the WWTP
- ✓ Industry Standards (Metcalf & Eddy)

Premise: Allocate costs of each system component based on what it was engineered or "designed" to address.

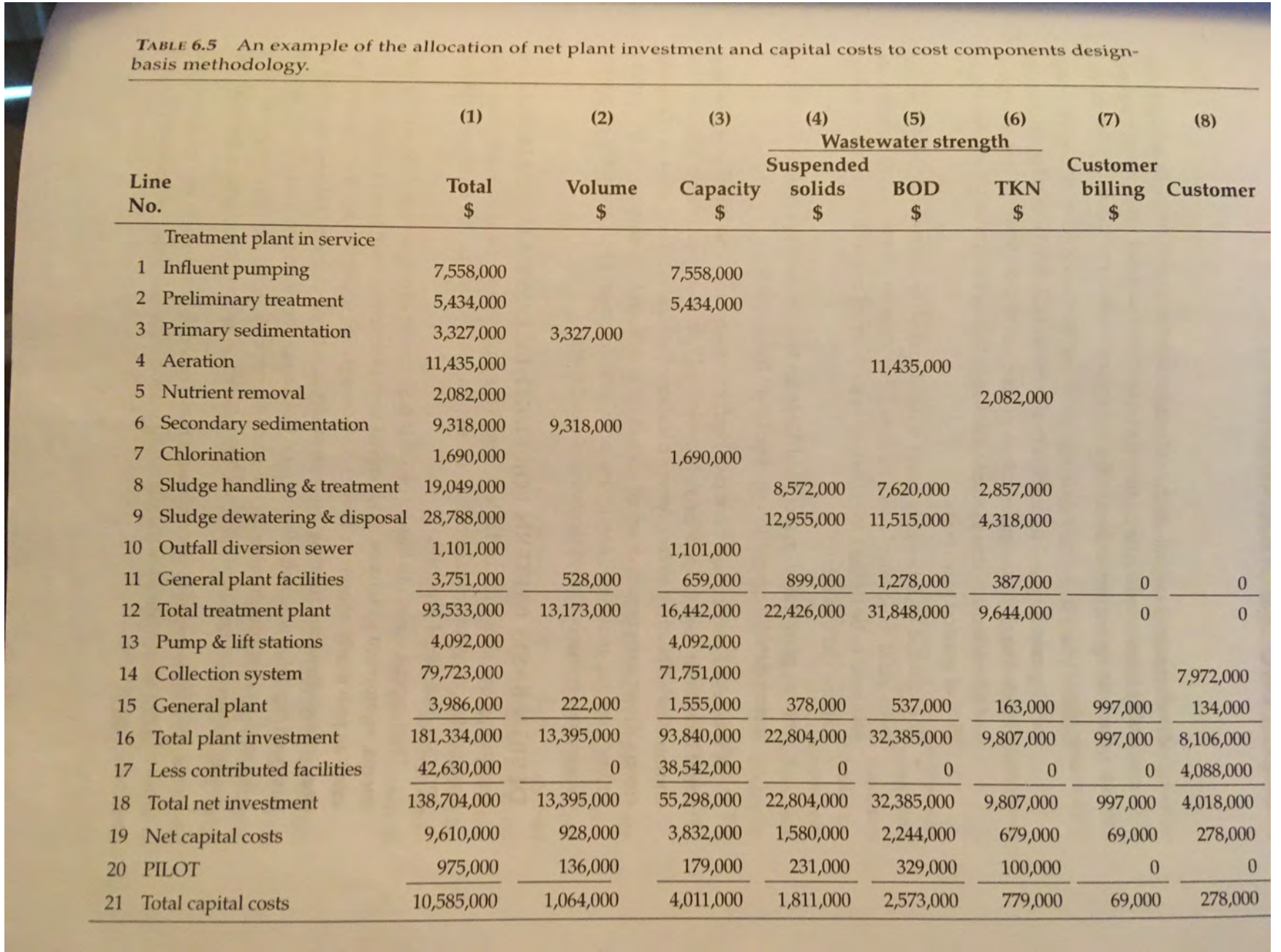


TABLE 6.5 An example of the allocation of net plant investment and capital costs to cost components design-basis methodology.

Line No.		(1) Total $	(2) Volume $	(3) Capacity $	(4) Wastewater strength Suspended solids $	(5) Wastewater strength BOD $	(6) Wastewater strength TKN $	(7) Customer billing $	(8) Customer
	Treatment plant in service								
1	Influent pumping	7,558,000		7,558,000					
2	Preliminary treatment	5,434,000		5,434,000					
3	Primary sedimentation	3,327,000	3,327,000						
4	Aeration	11,435,000				11,435,000			
5	Nutrient removal	2,082,000					2,082,000		
6	Secondary sedimentation	9,318,000	9,318,000						
7	Chlorination	1,690,000		1,690,000					
8	Sludge handling & treatment	19,049,000			8,572,000	7,620,000	2,857,000		
9	Sludge dewatering & disposal	28,788,000			12,955,000	11,515,000	4,318,000		
10	Outfall diversion sewer	1,101,000		1,101,000					
11	General plant facilities	3,751,000	528,000	659,000	899,000	1,278,000	387,000	0	0
12	Total treatment plant	93,533,000	13,173,000	16,442,000	22,426,000	31,848,000	9,644,000	0	0
13	Pump & lift stations	4,092,000		4,092,000					
14	Collection system	79,723,000		71,751,000					7,972,000
15	General plant	3,986,000	222,000	1,555,000	378,000	537,000	163,000	997,000	134,000
16	Total plant investment	181,334,000	13,395,000	93,840,000	22,804,000	32,385,000	9,807,000	997,000	8,106,000
17	Less contributed facilities	42,630,000	0	38,542,000	0	0	0	0	4,088,000
18	Total net investment	138,704,000	13,395,000	55,298,000	22,804,000	32,385,000	9,807,000	997,000	4,018,000
19	Net capital costs	9,610,000	928,000	3,832,000	1,580,000	2,244,000	679,000	69,000	278,000
20	PILOT	975,000	136,000	179,000	231,000	329,000	100,000	0	0
21	Total capital costs	10,585,000	1,064,000	4,011,000	1,811,000	2,573,000	779,000	69,000	278,000

Premise: Allocate costs of each system component based on what it is actually addressing (may be more than just what it was designed/primarily intended to do).

TABLE 6.8 An example of the allocation of net plant investment and capital costs to cost components functional cost methodology.

Line No.		(1) Total $	(2) Volume $	(3) Wastewater strength: Suspended solids $	(4) Wastewater strength: BOD $	(5) Wastewater strength: TKN $	(6) Customer billing $	(7) Customer $
	Treatment plant in service							
1	Influent pumping	7,558,000	7,558,000					
2	Preliminary treatment	5,434,000		5,434,000				
3	Primary sedimentation	3,327,000		3,327,000				
4	Aeration	11,435,000			11,435,000			
5	Nutrient removal	2,082,000				2,082,000		
6	Secondary sedimentation	9,318,000			9,318,000			
7	Chlorination	1,690,000	1,690,000					
8	Sludge handling & treatment	19,049,000		8,001,000	8,572,000	2,476,000		
9	Sludge dewatering & disposal	28,788,000		12,091,000	12,955,000	3,742,000		
10	Outfall diversion sewer	1,101,000	1,101,000					
11	General plant facilities	3,751,000	432,000	1,205,000	1,766,000	348,000	0	0
12	Total treatment plant	93,533,000	10,781,000	30,058,000	44,046,000	8,648,000	0	0
13	Pump & lift stations	4,092,000	4,092,000					
14	Collection system	79,723,000	71,751,000					7,972,000
15	General plant	3,986,000	1,460,000	507,000	742,000	146,000	997,000	134,000
16	Total plant investment	181,334,000	88,084,000	30,565,000	44,788,000	8,794,000	997,000	8,106,000
17	Less contributed facilities	42,630,000	38,542,000	0	0	0	0	4,088,000
18	Total net investment	138,704,000	49,542,000	30,565,000	44,788,000	8,794,000	997,000	4,018,000
19	Net capital costs	9,610,000	3,433,000	2,118,000	3,103,000	609,000	69,000	278,000
20	PILOT	975,000	121,000	310,000	455,000	89,000	0	0
21	Total capital costs	10,585,000	3,554,000	2,428,000	3,558,000	698,000	69,000	278,000

Sewer Customer Class Cost Allocation Examples:

1. Strength and loading sampling to support cost allocation

2. More strength and loading sampling and a peak into I&I

3. Inflow & Infiltration (I&I) allocation options

2022 Water, Wastewater and Stormwater Rate Study Recommendations

Industrial and Commercial Work Session

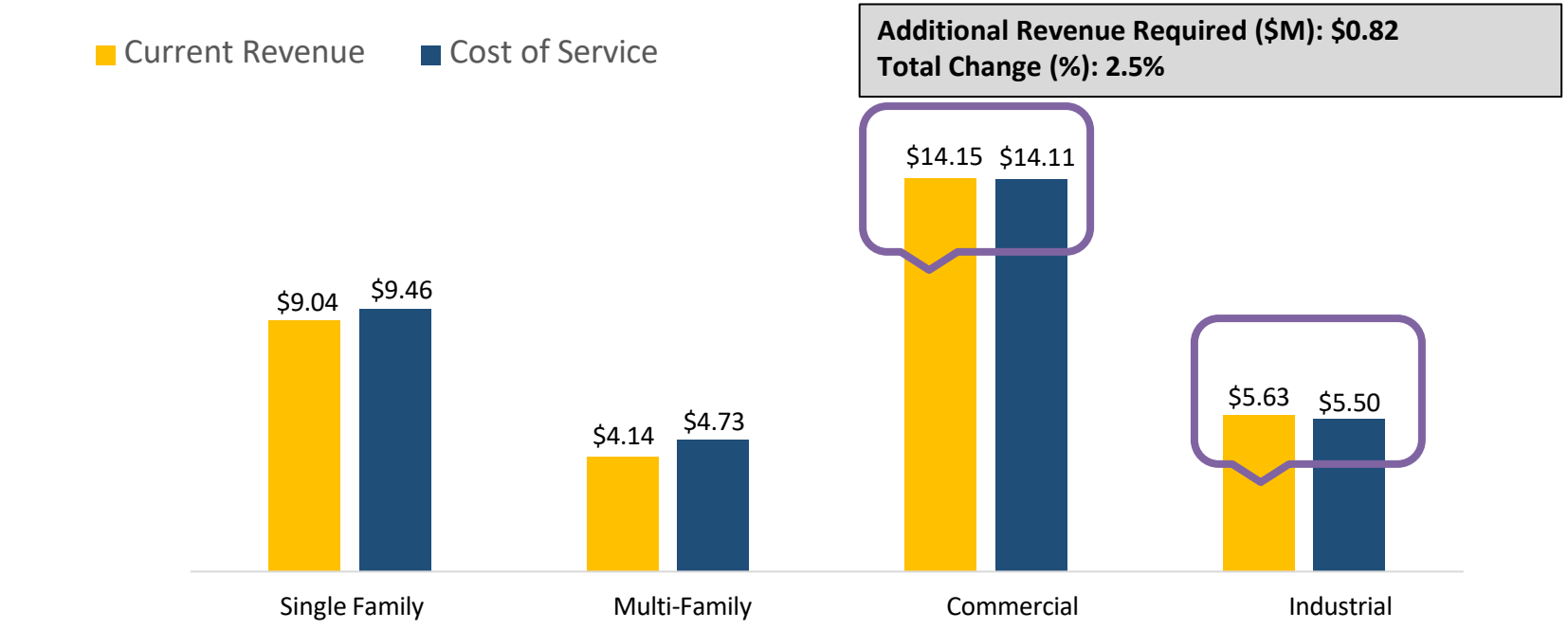
November 2022

Tempe

Wastewater COS history

- 2015 Stantec rate study increased understanding of the costs of key wastewater treatment functions
  - At the time, there was insufficient data to perform COS analysis.
  - 2.5% inflationary increase implemented for revenue sufficiency.
- Both 2017 and 2020 Stantec rate studies recommended the City preform a strength and return study to allow enhanced COS analyses.
  - Existing data for strength and usage profiles were mixed, including some outdated information.
  - The COS study recommended sampling and a literature review to update the strength database.
- The City conducted a strength and return study in 2021-2022, which looked at locally available data as well as data from published sources.
  - This year's 2022 wastewater COS study incorporated the results of that analysis.

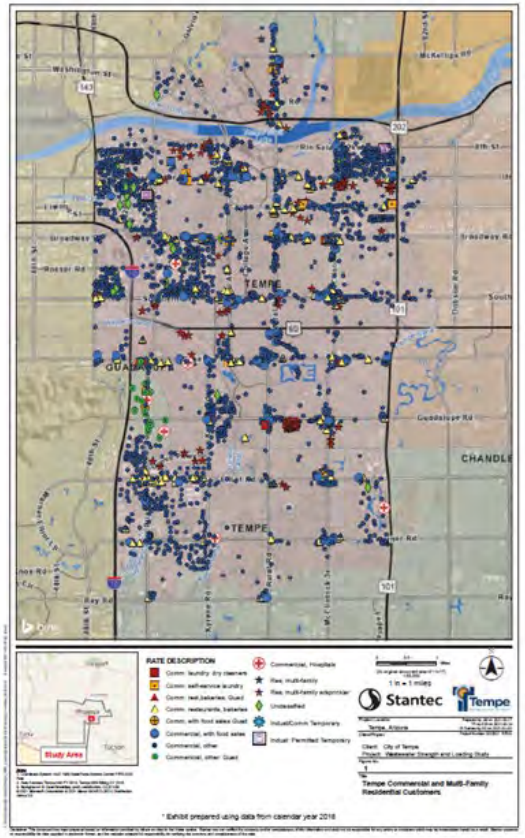
Wastewater cost allocation adjustments



	Single Family	Multi-Family	Commercial	Industrial
Change ($M):	**$0.42**	**$0.59**	**-$0.04**	**-$0.14**
Change (%):	**4.6%**	**14.2%**	**-0.3%**	**-2.4%**

While industrial customers are close to cost of service overall, specific customers will see varying effects on their bills

Wastewater Strength and Return Study - Sampling



- The City established sampling locations for various customer classifications.
- The analysis of return factors involved the selection of residential and commercial areas where aggregated water meter reading data from the customer billing database could be compiled and compared against in-pipe flow readings.

Wastewater Strength and Return Study – Residential

Figure 40 Map of Sewershed and Flow Monitoring Point for SF2

- Return factors for different single-family neighborhoods varied significantly.
- Observed near absence of outdoor use in some locations and extensive use of potable water for irrigation in other locations.

Strength and Return Study Allows Updates of Key Estimates

Table 5-4 COD Strength Loading Sampling Results Summarized by Category

Business Type	COD Average Concentration (mg/L)	COD Maximum Concentration (mg/L)	COD Minimum Concentration (mg/L)
Gas Station & Convenience Store	3,426	9,390	1,850
Grocery	2,535	11,100	641
Dine-In	2,322	5,100	406
Fast Food	1,915	3,240	1,060
Bakery	1,409	4,108	85
Self-Serve Laundry	1,115	2,280	272
Mixed Use	938	4,360	74
Residential Multi-Family	752	870	573
Residential Single Family	689	951	609
Health	652	1,600	38
Hotel	496	1,970	75

Metcalf & Eddy 1,016 mg/L

Average Residential 721 mg/L

Tempe Composite Value 630 mg/L

Table 5-5 TSS Strength Loading Sampling Results Summarized by Category

Business Type	TSS Average Concentration (mg/L)	TSS Maximum Concentration (mg/L)	TSS Minimum Concentration (mg/L)
Grocery	829	6,600	77
Mixed Use	434	2,400	11
Bakery	413	1,600	28
Self-Serve Laundry	334	1,200	56
Health	288	990	24
Residential Single Family	255	360	140
Residential Multi-Family	222	660	170
Dine-In	220	580	62
Hotel	179	860	14
Fast Food	172	500	55
Gas Station & Convenience Stores	59	79	33

Metcalf & Eddy 389 mg/L

Average Residential 238 mg/L

Tempe Composite Value 200 mg/L

- Class-based strength estimates underpin COS results for all classes
- COD and TSS results for sample locations where commercial customer types were known were compiled and compared to assumed strengths in the existing billing database
- Analysis allowed development of updated strength estimates
- Updated strength estimates also allowed for some customer class simplification
- Monitored industrial customers

Strength and Return Study Allows Updates of Key Estimates

Table 5-4 COD Strength Loading Sampling Results Summarized by Category

Business Type	COD Average Concentration (mg/L)	COD Maximum Concentration (mg/L)	COD Minimum Concentration (mg/L)
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Fast Food	1,915	3,240	1,060
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Self-Serve Laundry	1,115	2,280	272
Mixed Use	938	4,360	74
Residential Multi-Family	752	870	573
Residential Single Family	689	951	609
Health	652	1,600	38
Hotel	496	1,970	75

Metcalf & Eddy 1,016 mg/L

Average Residential 721 mg/L

Tempe Composite Value 630 mg/L

Proposed wastewater charges by classification

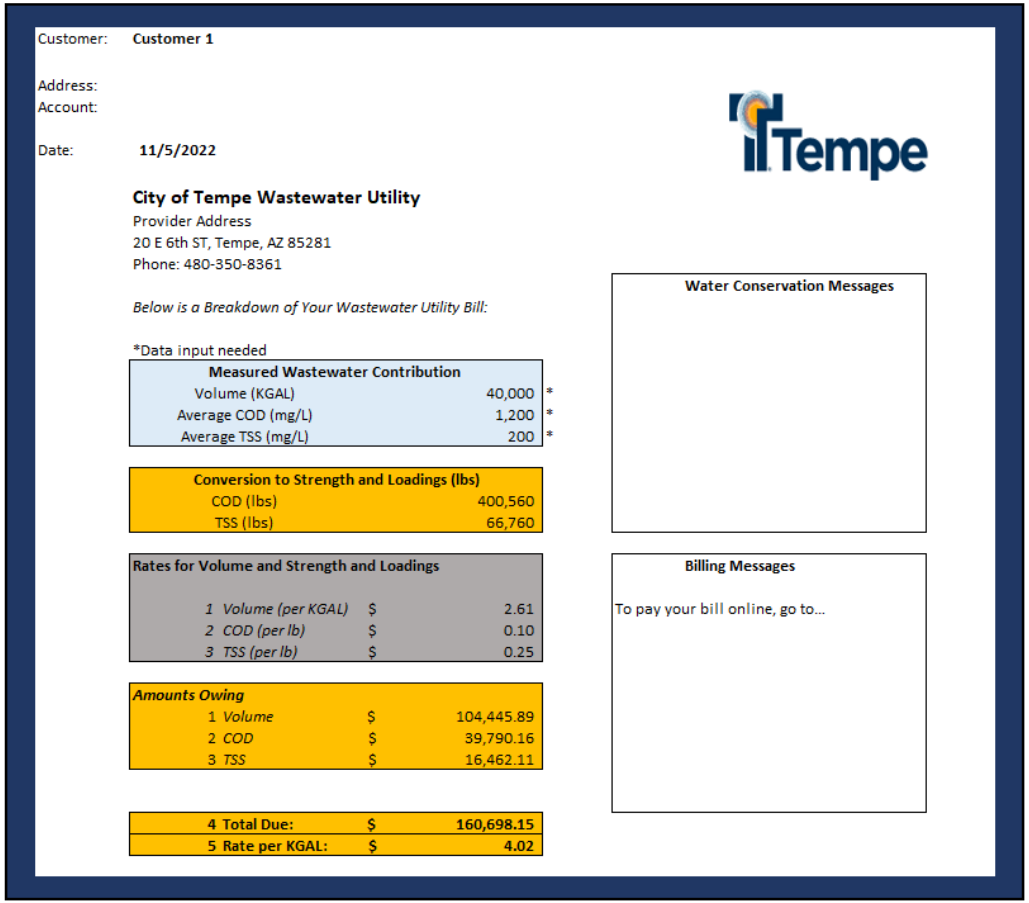
Current Classification	New Classification	Current Rate ($/1,000 gal)	Proposed Rate ($/1,000 gal)
Single Family	Single Family	$1.84	$2.12
Multi-Family	Multi-Family	$1.84	$2.39
Commercial – Self-Service Laundry	Commercial – Low	$2.82	$3.03
Commercial – Hospitals	Commercial – Low	$3.06	$3.03
Commercial – Other	Commercial – Low	$3.06	$3.03
Commercial – Food Sales	Commercial – High	$4.58	$4.44
Commercial – Restaurants/ Bakeries	Commercial – High	$7.91	$4.44
Commercial – Dry Cleaners	Commercial – High	$7.91	$4.44
Industrial	Industrial	Varies	Volume (unit cost/KGAL) – $2.61 TSS (unit cost/lb.) – $0.25 COD (unit cost/lb.) – $0.10

Wastewater Unit Costs Are Common to All Rate Classes

	Volume (per 1,000 gallons)	COD (per lb.)	TSS (per lb.)	Customer (per bill
Operating	$0.90	$0.05	$0.12	$2.83
Debt Service	$1.60	$0.05	$0.12	$0.00
Rate Funded Capital	$0.11	$0.01*	$0.01	$0.00
Total	**$2.61**	**$0.10**	**$0.25**	**$2.83**

*Values are rounded for presentation purposes

New Industrial Billing Structure - Bill sample



Customer: **Customer 1**

Address:
Account:

Date: **11/5/2022**

City of Tempe Wastewater Utility
Provider Address
20 E 6th ST, Tempe, AZ 85281
Phone: 480-350-8361

Below is a Breakdown of Your Wastewater Utility Bill:

*Data input needed

Measured Wastewater Contribution		
Volume (KGAL)	40,000	*
Average COD (mg/L)	1,200	*
Average TSS (mg/L)	200	*

Conversion to Strength and Loadings (lbs)	
COD (lbs)	400,560
TSS (lbs)	66,760

Rates for Volume and Strength and Loadings		
1 *Volume (per KGAL)*	$	2.61
2 *COD (per lb)*	$	0.10
3 *TSS (per lb)*	$	0.25

Amounts Owing		
1 *Volume*	$	104,445.89
2 *COD*	$	39,790.16
3 *TSS*	$	16,462.11

4 Total Due:	**$**	**160,698.15**
5 Rate per KGAL:	**$**	**4.02**

Water Conservation Messages

Billing Messages

To pay your bill online, go to...

Utilizing annual results for billing will simplify monthly billing and administrative processes

Examples of Impacts on Industrial Customers

	Annual Volume (1000's of gallons)	Annual COD (lbs)	Annual TSS (lbs)	Approximate Current Annual Charge	Approximate New Annual Charge*
Customer 1	100,000	2,000,000	400,000	$900,000	$560,000
Customer 2	40,000	100,000	100,000	$135,000	$140,000
Customer 3	200,000	150,000	15,000	$375,000	$540,000

*Numbers are rounded for presentation purposes

- Customer 1: Moderate flow, very high strength, → Lower new bill
- Customer 2: Relatively low flow, moderate strength → Similar new bill
- Customer 3: High flow, low strength → Increased new bill

Summary of Industrial Rate Processes and Impacts

- As a group, revenue generation from industrial customers is in line with allocated costs.
- Cost-based changes in volume and strength charges will result in variable implications for different firms based on specific volume and loading profiles.
- Lower fixed cost recovery in general results in somewhat lower meter charges for customers with large meters.
- Refinements to industrial billing procedures are being considered to keep strength estimates updated on an annual basis.
- Other non-rate related monitoring and reporting requirements may continue to be required by the City.
- The City is providing specific rate projections for industrial firms directly to monitored industries.

San Diego, CA

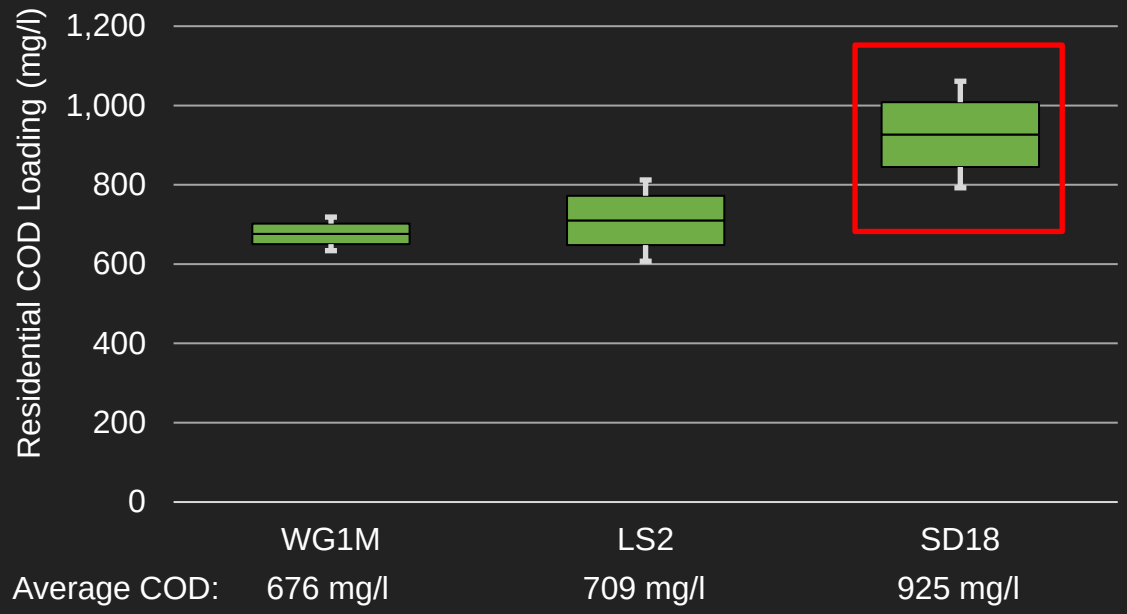
Cost of Service Analysis & Rate Design

Key Recommendations:

One of the areas (SD18) used to establish wastewater strength assumptions should be excluded, reducing the assumed strength of residential flows

Calculation of Weighted Average Residential Strength Loadings with the Addition of a New Representative Basin

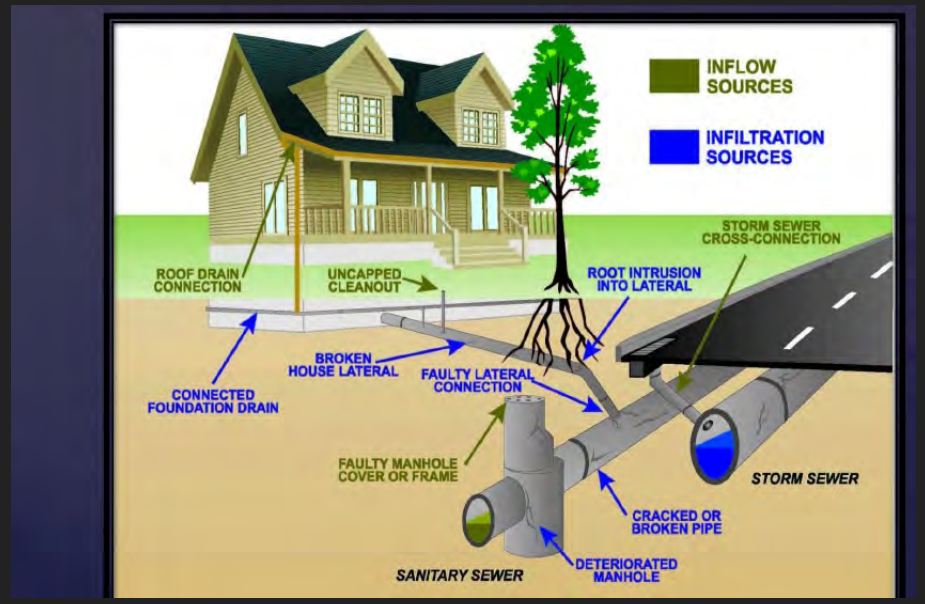
Basin	Flow MGD	COD mg/l	TSS mg/l
SD18	1.26	925	291
LS2	2.66	709	286
WG1M	0.52	676	324
New Basin	1.78	813	292
Basin	**Flow MGD**	**COD lb/day**	**TSS lb/day**
SD18	1.26	9,720	3,058
LS2	2.66	15,729	6,345
WG1M	0.52	2,932	1,405
New Basin	1.78	12,069	4,335
Total =	**6.22**	**40,449.8**	**15,142.6**
		COD Weighted Avg.	**TSS** Weighted Avg.
		779.8	**291.9**



Inflow & Infiltration

Key Recommendations:

The allocation of Inflow and Infiltration (I&I) costs based on accounts should be revised from 67% to 57% to reflect the portion of the total collection system made up of private laterals

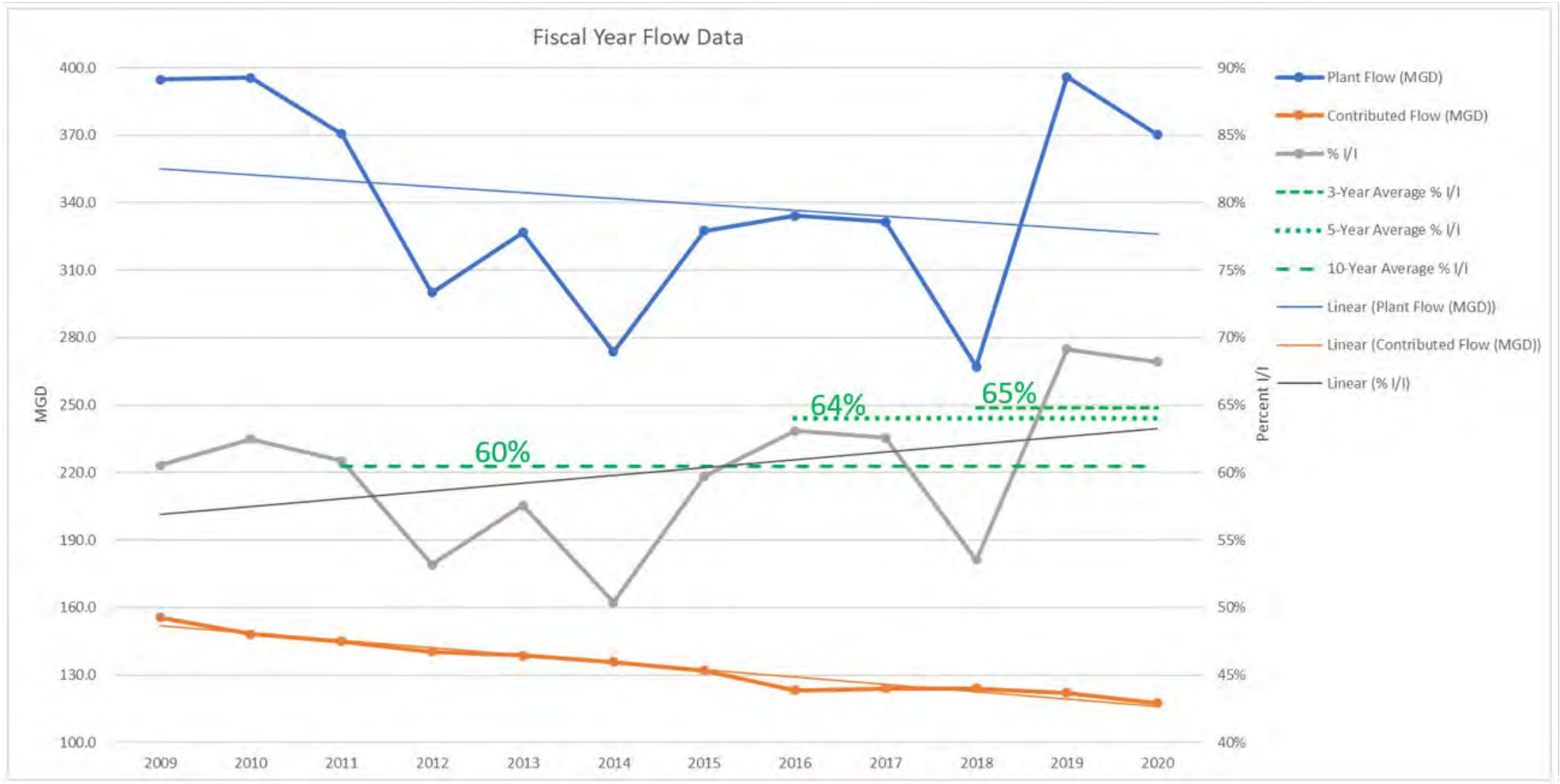


Line	Metric	Units	Calculation
1	Number of Accounts	275,378	
2	Linear Feet of Service Lateral Length per Account (estimated by City Staff/GIS)	75.51	
3	Total Estimated Linear Feet of Customer-Owned Service Laterals	20,793,793	3 = (1*2)
4	Linear Feet of City-Owned Gravity Sewers <= 8" Diameter (Provided by City Staff)	11,499,840	
5	Linear Feet of City-Owned Gravity Sewers > 8" Diameter	3,989,340	
6	Total Linear Feet of Customer Service Laterals and City-Owned Sewers	36,282,973	6 = (3+4)
7	Customer-Owned Service Laterals as a % of Total Length	57.3%	7 = (3/6)
8	(Customer-Owned Service Laterals + City-Owned Gravity Sewers <= 8" Diameter) as a % of Total	89.0%	8 = (3+4)/6
9	Mid-Point of Range	73.2%	9 = Average of 7+8
10	% of City-Owned Gravity Sewers <= 8" Diameter Assumed to be Local Collection	50.0%	10
11	Linear Feet of City-Owned Gravity Sewers <= 8" Diameter Assumed to be Local Collection	5,749,920	11 = (4*1)
12	Linear Feet of Customer-Owned Service Laterals + Assumed City Owned Local Collection Sewers <=8" Diameter	26,543,713	12 = (3+11)
13	(Customer-Owned Service Laterals + City-Owned Local Collection	73.2%	13 = (12/6)

TABLE 7.5 An example of customer classes' units of service design-basis methodology.

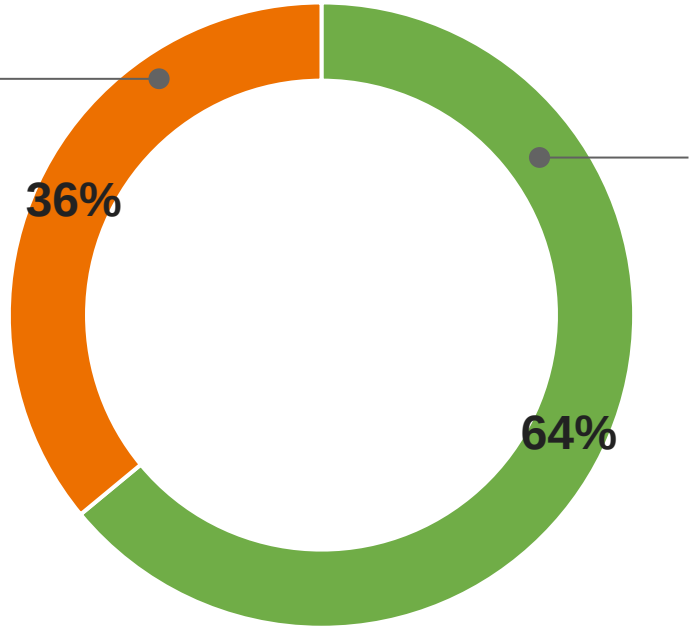
	Description	(1) Residential	(2) Commercial	(3) Industrial	(4) Surcharge	(5) Standardized strength	(6) Total
	Wastewater volume (1000 Ccf)						
1	Billed wastewater volume	4473	2761	2197		1653	11 084
2	I/I allocated 2/3 by customers	2680	282	36		106	3104
3	I/I allocated 1/3 by volume	626	387	308		231	1552
4	Total annual treated volume	7779	3430	2541	0	1990	15 740
	Wastewater capacity flowrate (Ccf/day)						
5	Estimated wastewater peaks	18 382	11 347	9029		6793	45 551
6	I/I allocated 2/3 by customers[a]	29 378	3087	391		1159	34 015
7	I/I allocated 1/3 by volume[a]	6864	4237	3371		2537	17 009
8	Total	54 624	18 671	12 791	0	10 489	96 575
	Wastewater strength (1000 pounds)						
9	Suspended solids	7930	4895	3895	5225	6187	28 131
10	BOD	6811	4204	3346	4321	3609	22 291
11	TKN	863	533	424	444	412	2676
12	I/I allocated 2/3 by customers[b]	753	79	10	0	30	872
13	I/I allocated 1/3 by volume[b]	176	109	86	0	65	436
	Customer billing units						
14	Number of bills	208 400	21 900	8328	828	24 672	264 128
15	Number of customers	52 100	5475	694	69	2056	60 394

[a]Infiltration/inflow volumes represent one-third or two-thirds of the volume, from Table 7.4 and a 4.0 peaking factor.
[b]Infiltration/inflow strengths represent one-third or two-thirds of the combined total pounds for suspended solids, BOD, and TKN, shown in Table 7.4.


Fiscal Year Flow Data
400.0
370.0
340.0
310.0
280.0
250.0
220.0
190.0
160.0
130.0
100.0
MGD
90%
85%
80%
75%
70%
65%
60%
55%
50%
45%
40%
Percent I/I
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
60%
64%
65%
Plant Flow (MGD)
Contributed Flow (MGD)
% I/I
3-Year Average % I/I
5-Year Average % I/I
10-Year Average % I/I
Linear (Plant Flow (MGD))
Linear (Contributed Flow (MGD))
Linear (% I/I)

Contributed Flow Allocated by:

- Customer Billing Data



I&I Flow Allocated by:

- Inch-Feet: Collection System
- Linear Feet: Collection System
- Inch-Feet: Collection System with Minimum 8” Line
- Inch-Feet: Laterals
- Inch-Feet: Laterals + Collection System
- Dry/Wet Weather I/I: Hybrid
- Inch-Feet: Rate Code
- Linear Feet: Rate Code
- Developed Area: Rate Code
- Total Area: Rate Code

Figure 3 - Gravity Sewers by Size and Length

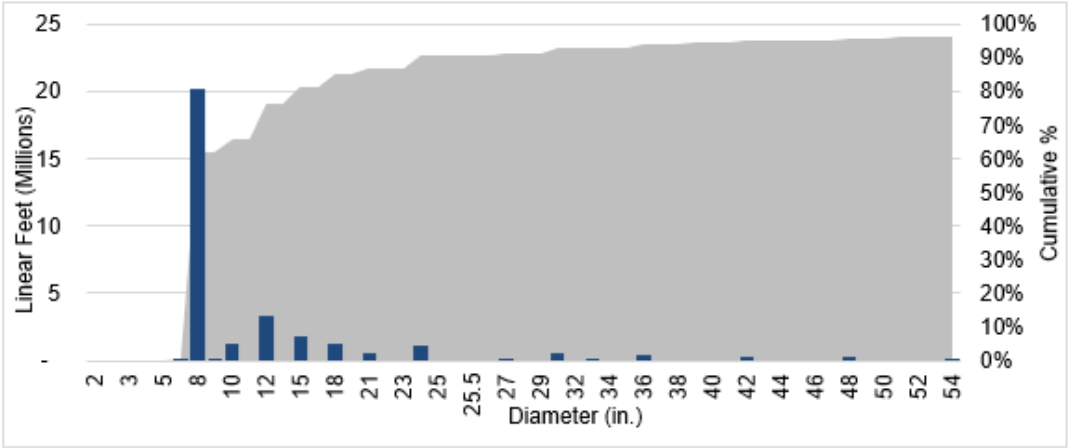


Table 1 - Approach #1 Supporting Calculation

Description	Total Inch-Feet	%	I/I Cost Allocation Basis
Small: <=8" (Sanitary Sewer Systems) <=12" (Combined Sewer Systems)	195,924,363	39%	Customer
Large: > 8" (Sanitary Sewer Systems) > 12" (Combined Sewer Systems)	302,829,158	61%	Volume
Total	498,753,521	100%	

Table 2 - Approach #2 Supporting Calculation

Description	Total Linear Feet	%	I/I Cost Allocation Basis
Small: <=8" (Sanitary Sewer Systems) <=12" (Combined Sewer Systems)	23,225,789	70%	Customer
Large: > 8" (Sanitary Sewer Systems) > 12" (Combined Sewer Systems)	9,782,176	30%	Volume
Total	33,007,965	100%	

Table 11 - Developed Area by Rate Code

Line	Description	Square Feet – Developed Footprint of Properties	Percentage
1	Residential	1,311,846,268	45%
2	Multi-Family Residential	133,762,132	5%
3	Non-Residential	1,464,518,145	50%
4	Total	2,910,126,546	

Table 13 - Total Area by Rate Code

Line	Description	Square Feet of Total Land Area	Percentage
1	Residential	5,128,008,665	58%
2	Multi-Family Residential	586,528,545	7%
3	Non-Residential	3,197,598,721	36%
4	Total	8,912,135,931	

Figure 4 - Summary of I/I Cost Allocation Approaches

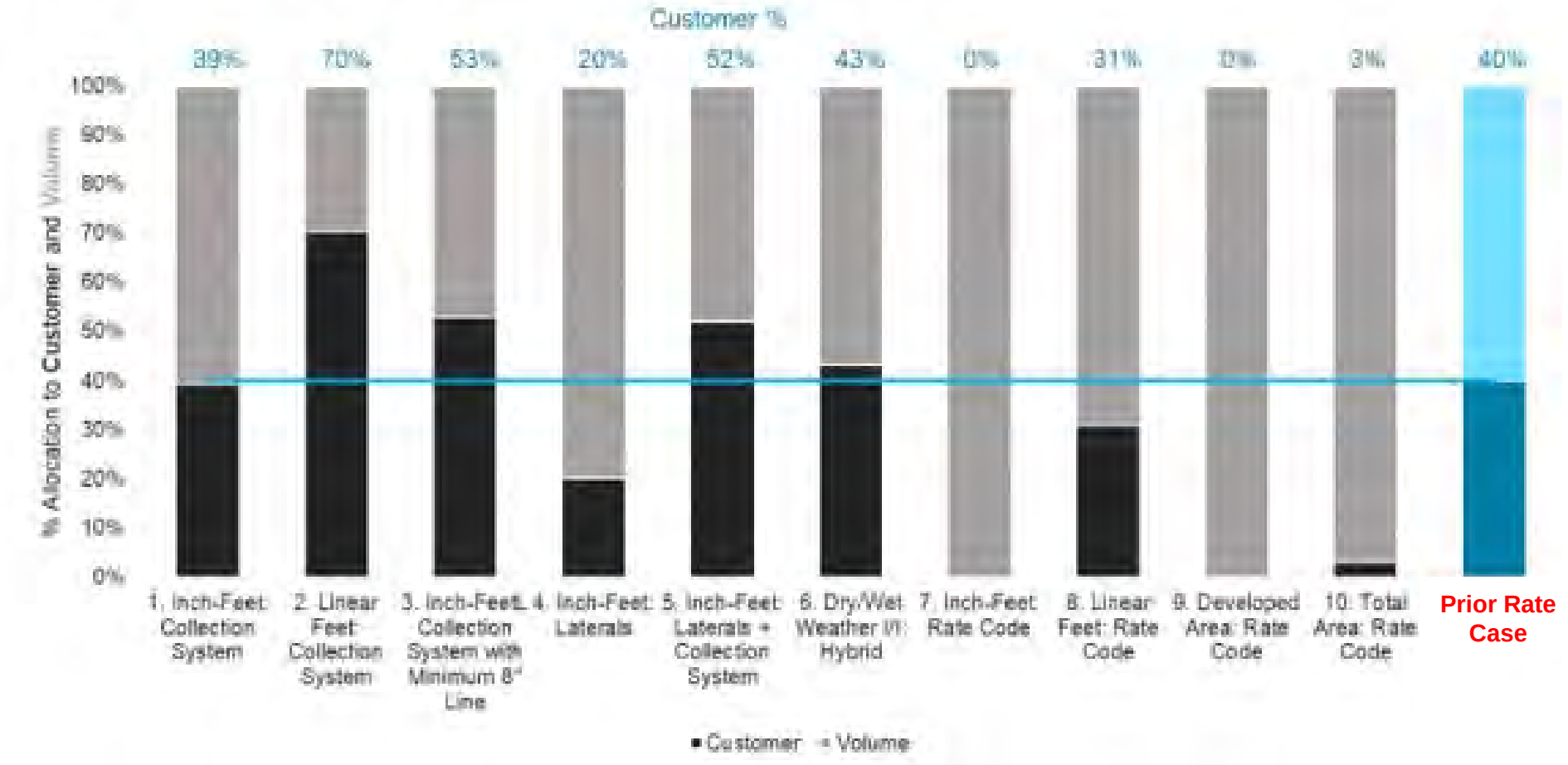
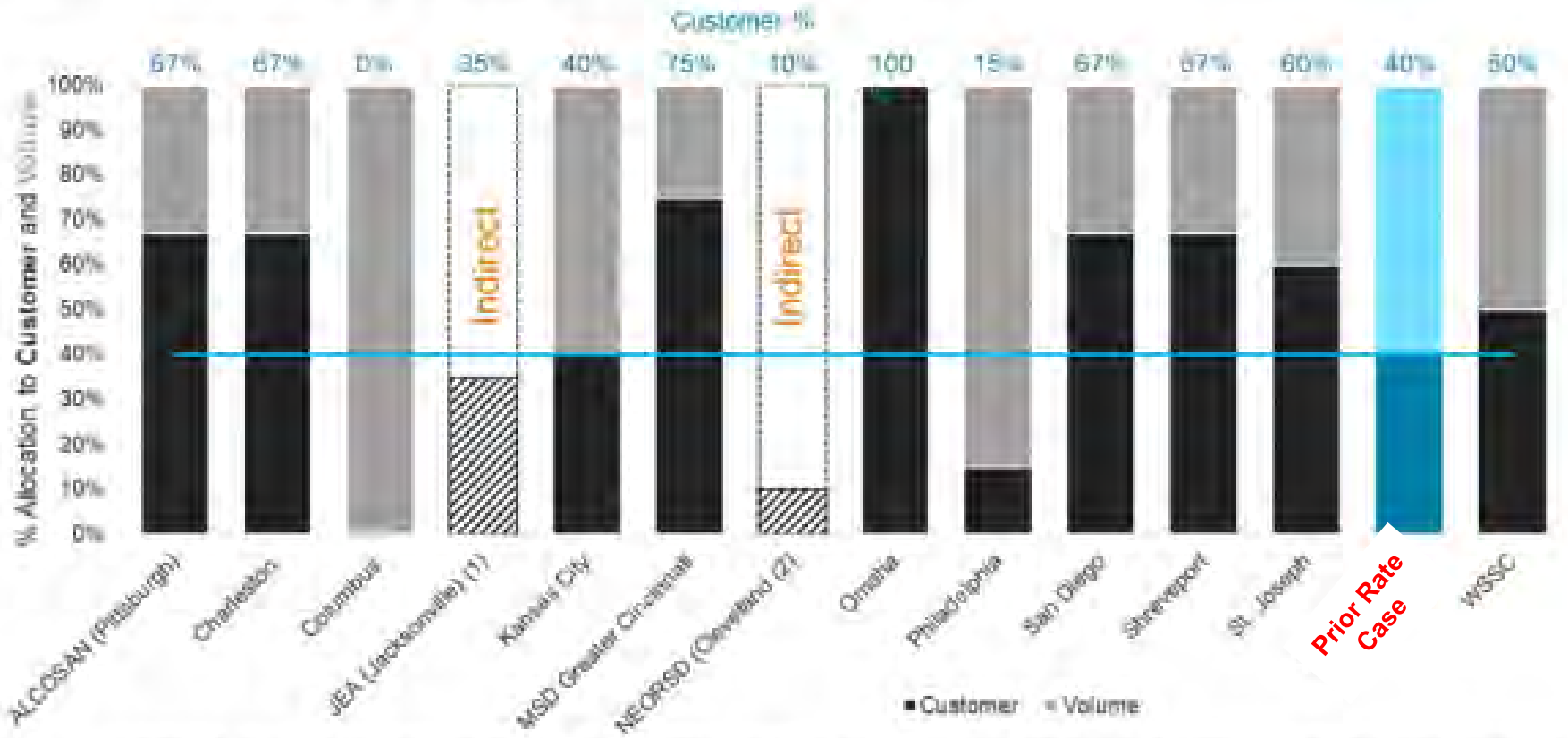


Figure 5 - Comparison of I/I Cost Allocation Percentages



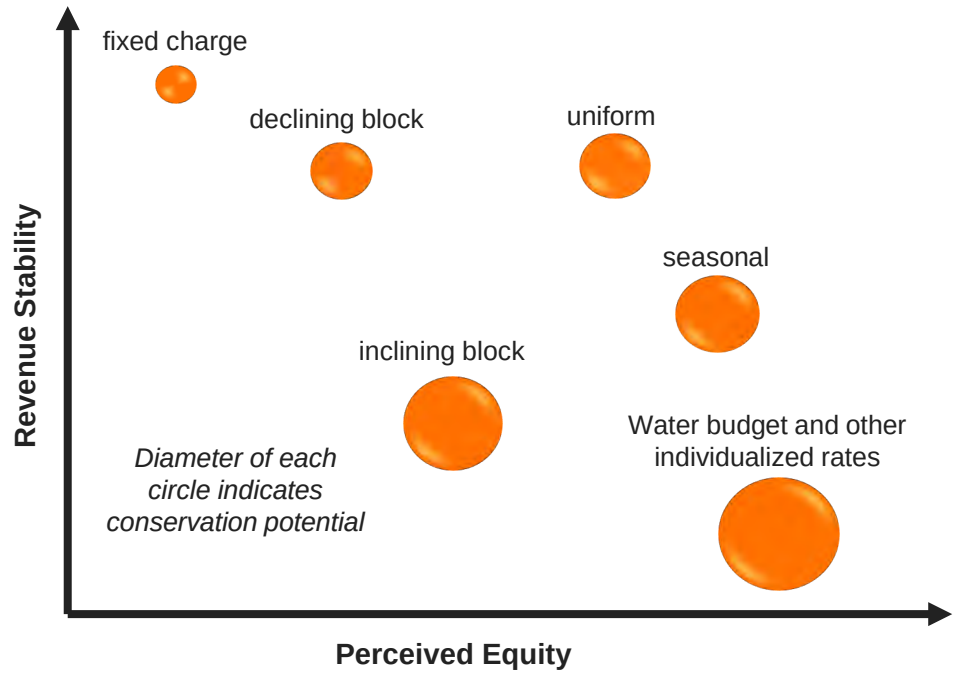
1) Reflects % of costs recovered through fixed charges in resulting rate design. The cost-of-service analysis reflects approximately 8% of costs to fixed charges.
2) Reflects the portion of costs allocated to fixed vs. volumetric charges.

Water Rate Design

All About Balance

✓**Identify structure that meets your needs:**

- Conforms to industry practice
- Meets all legal requirements
- Easy to administer/understand
- Elasticity of demand & weather
- Conservation and affordability
- Availability of data/technology
- Stakeholder input/concerns

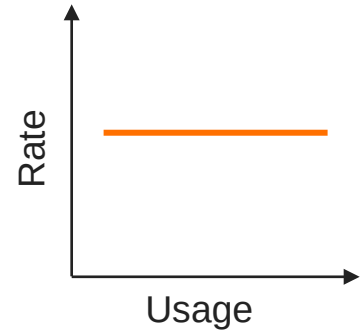


✓**Critical considerations:**

- Understanding distribution of system costs
- Integrating financial considerations
  - Reserve policies & revenue stability

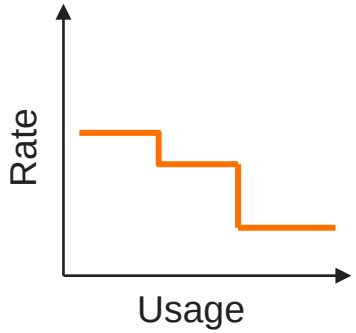
Uniform Rate Structure

- Same rate regardless of usage
- Most common rate structure for non-residential
- Simple and utilized in non-scarcity scenarios



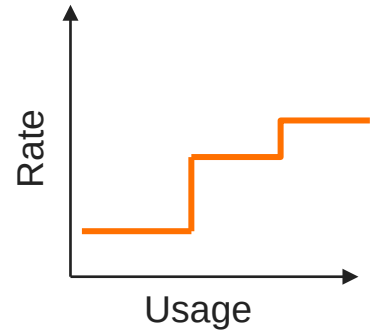
Decreasing Block Rate Structure

- Rate decreases for higher levels of usage
- Typically used to encourage economic development and minimize bills for large users
- Was a very common & successful way of creating cost-based rates within a single rate schedule



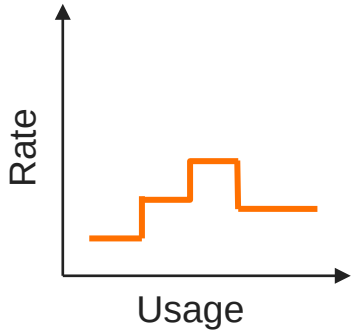
Increasing Block or “Tiered” Structure

- Rate increases for higher levels of usage
- Intended to encourage water conservation
- Now most common single-family rate structure
- Applied to single-family residential customers due to consistent usage and to irrigation-only meters
- Challenging to apply to non-residential customers



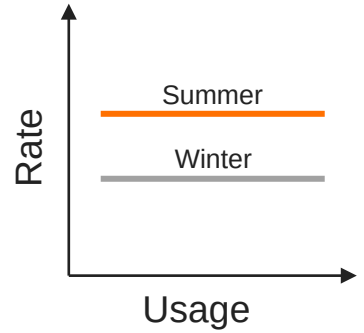
Increasing/Decreasing Structure

- Rate increases then decreases with higher usage
- Intended to provide water conservation at lower usage levels and reduced impact on larger users
- Single structure that accommodates large users



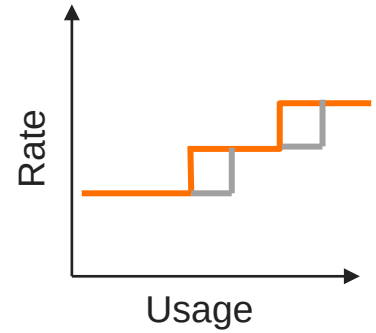
Seasonal Rate Structure

- Higher rates in peak times of year
- May be appropriate for communities with customer classes that demonstrate seasonal usage patterns or scarcity concerns
- Hard question: Why does same level of indoor use cost less in winter than summer?



Budget-Based Rates

- Individualized inclining block rate structure
- Different blocks based on usage allowance per customer, class, lot size, or other factors
- Structure used to focus higher rates on peak usage or to encourage wise use of water
- Data and resource intensive



Water & Sewerage Department
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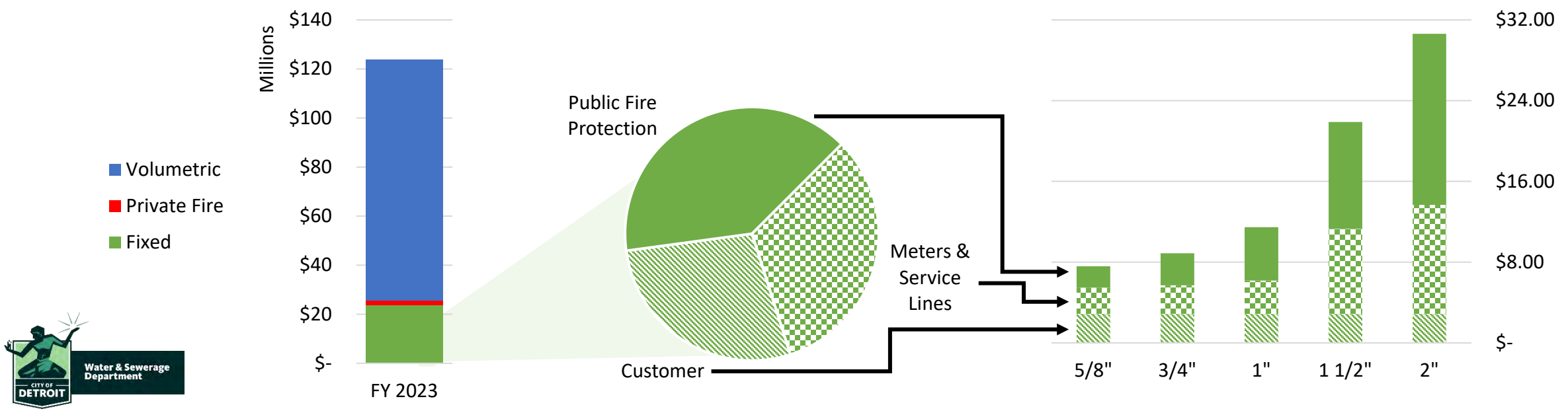
DWSD Fixed Charges

Steps to Calculating Fixed Charges

Evaluate costs to be recovered in fixed charge → Develop scaling factors by meter size → Determine bills and equivalent bills → Divide costs by equivalencies → Add together



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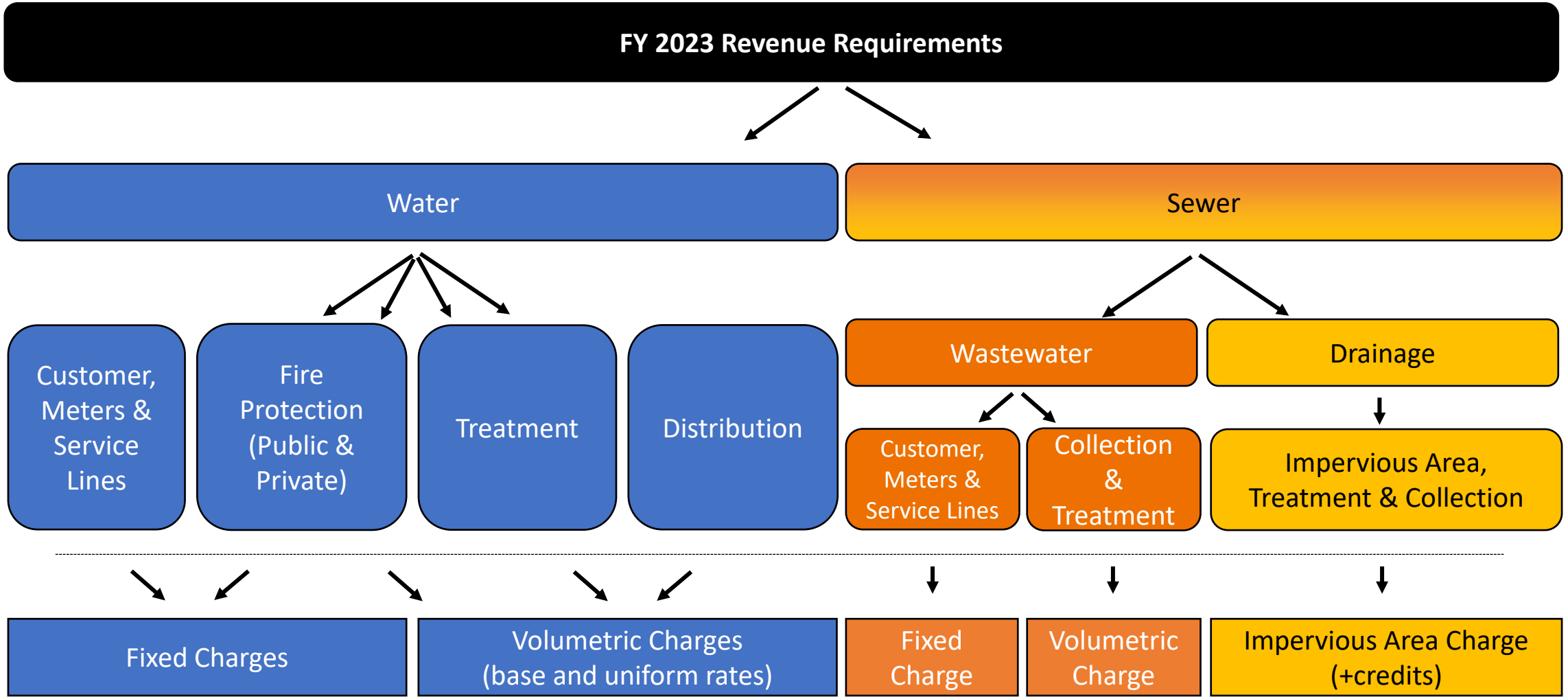
Cost Allocation & Rate Design Approach



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Evaluate Water Costs to be Recovered in Fixed Charge

Apprn.	Description	Cost Center	Cost Center Description	FY 2023 Water Expense for COSA	Allocation Factor	Allocations Treatment	Distribution	Meters & Service Lines	Customer	Fire Protection	$ Treatment	$ Distribution	$ Meters & Service Lines	$ Customer	$ Fire Protection
Operating Expenses															
Administration	1001	Chief Exec Officer	$	802,324	Weighted Internal	0.0%	76.2%	13.2%	10.7%	0.0%	$ -	$ 610,981	$ 105,882	$ 85,461	$ -
Administration	1601	BOWC	$	168,479	Weighted Internal	0.0%	76.2%	13.2%	10.7%	0.0%	$ -	$ 128,299	$ 22,234	$ 17,946	$ -
Operations	2401	Deputy Director Administration	$	1,916,474	Distribution Only	0.0%	100.0%	0.0%	0.0%	0.0%	$ -	$ 1,916,474	$ -	$ -	$ -
Operations	2411	Field Engineering	$	3,310,037	Distribution Only	0.0%	100.0%	0.0%	0.0%	0.0%	$ -	$ 3,310,037	$ -	$ -	$ -
Operations	2421	Facility Oper	$	3,961,474	Distribution Only	0.0%	100.0%	0.0%	0.0%	0.0%	$ -	$ 3,961,474	$ -	$ -	$ -
Operations	2422	Fleet Operations	$	2,418,049	Distribution Only	0.0%	100.0%	0.0%	0.0%	0.0%	$ -	$ 2,418,049	$ -	$ -	$ -
Operations	2431	Maint & Repair	$	8,232,028	Maintenance & Repair	0.0%	91.3%	0.0%	0.0%	8.7%	$ -	$ 7,518,671	$ -	$ -	$ 713,357
Operations	2432	Meter Operations	$	3,035,773	Meters & Service Lines Only	0.0%	0.0%	100.0%	0.0%	0.0%	$ -	$ -	$ 3,035,773	$ -	$ -
Operations	2435	Lead Service	$	278,500	Meters & Service Lines Only	0.0%	0.0%	100.0%	0.0%	0.0%	$ -	$ -	$ 278,500	$ -	$ -
Compliance	3101	General Counsel	$	936,948	Weighted Internal	0.0%	76.2%	13.2%	10.7%	0.0%	$ -	$ 713,499	$ 123,648	$ 99,801	$ -
Compliance	3201	Org Development	$	739,416	Weighted Internal	0.0%	76.2%	13.2%	10.7%	0.0%	$ -	$ 563,075	$ 97,580	$ 78,761	$ -
Compliance	3301	Info Technology	$	5,312,953	Weighted Internal	0.0%	76.2%	13.2%	10.7%	0.0%	$ -	$ 4,045,887	$ 701,144	$ 565,921	$ -
Compliance	3411	Compliance-Security	$	1,820,310	Weighted Internal	0.0%	76.2%	13.2%	10.7%	0.0%	$ -	$ 1,386,191	$ 240,224	$ 193,895	$ -
Compliance	3421	Compliance-Public Affairs	$	876,958	Weighted Internal	0.0%	76.2%	13.2%	10.7%	0.0%	$ -	$ 667,816	$ 115,731	$ 93,411	$ -
Finance	4001	Chief Financial Officer	$	2,003,669	Weighted Internal	0.0%	76.2%	13.2%	10.7%	0.0%	$ -	$ 1,525,821	$ 264,422	$ 213,425	$ -
Finance	4111	Finance	$	805,856	Weighted Internal	0.0%	76.2%	13.2%	10.7%	0.0%	$ -	$ 613,671	$ 106,348	$ 85,838	$ -
Finance	4121	Procurement	$	1,502,846	Weighted Internal	0.0%	76.2%	13.2%	10.7%	0.0%	$ -	$ 1,144,438	$ 198,329	$ 160,079	$ -
Finance	4131	Treasury	$	1,223,522	Weighted Internal	0.0%	76.2%	13.2%	10.7%	0.0%	$ -	$ 931,729	$ 161,467	$ 130,326	$ -
Finance	4151	Budget	$	177,237	Weighted Internal	0.0%	76.2%	13.2%	10.7%	0.0%	$ -	$ 134,969	$ 23,390	$ 18,879	$ -
Finance	4161	Billing & Collect	$	1,218,255	Customer Only	0.0%	0.0%	0.0%	100.0%	0.0%	$ -	$ -	$ -	$ 1,218,255	$ -
Finance	4170	Internal Aud	$	280,359	Weighted Internal	0.0%	76.2%	13.2%	10.7%	0.0%	$ -	$ 213,497	$ 36,999	$ 29,863	$ -
Customer Svc	5111	Customer Service	$	1,456,827	Customer Only	0.0%	0.0%	0.0%	100.0%	0.0%	$ -	$ -	$ -	$ 1,456,827	$ -
Operations	2223	Storm Drainage	$	853,344	Weighted Internal	0.0%	76.2%	13.2%	10.7%	0.0%	$ -	$ 649,833	$ 112,615	$ 90,896	$ -
			$	**43,331,639**							**$ -**	**$ 32,454,412**	**$ 5,624,285**	**$ 4,539,585**	**$ 713,357**
Non-Operating Expenses															
Non-Operating	7111	Water Pension Expense	$	21,015,700	Weighted Internal	0.0%	76.2%	13.2%	10.7%	0.0%	$ -	$ 16,003,747	$ 2,773,417	$ 2,238,536	$ -
Non-Operating	7111	Water Retail Assistance Program	$	614,460	Weighted Internal	0.0%	76.2%	13.2%	10.7%	0.0%	$ -	$ 467,919	$ 81,090	$ 65,451	$ -
			$	**21,630,160**							**$ -**	**$ 16,471,666**	**$ 2,854,507**	**$ 2,303,986**	**$ -**
GLWA Expenses															
Non-Operating	#N/A	GLWA Water Charge	$	22,985,900	Treatment Only	100.0%	0.0%	0.0%	0.0%	0.0%	$ 22,985,900	$ -	$ -	$ -	$ -
Water - Pre-Bifurcation Debt	Debt	Water Pre-Bifurcation Debt	$	33,438,800	Distribution Only	0.0%	100.0%	0.0%	0.0%	0.0%	$ -	$ 33,438,800	$ -	$ -	$ -
			$	**56,424,700**							**$ 22,985,900**	**$ 33,438,800**	**$ -**	**$ -**	**$ -**
Revenue Financed Capital															
Transfer to I&E from Revenue Fund			$	6,580,230	Distribution Only	0.0%	100.0%	0.0%	0.0%	0.0%	$ -	$ 6,580,230	$ -	$ -	$ -
			$	**6,580,230**							**$ -**	**$ 6,580,230**	**$ -**	**$ -**	**$ -**
			$	**127,966,729**							**$ 22,985,900**	**$ 88,945,108**	**$ 8,478,792**	**$ 6,843,571**	**$ 713,357**
Weighted internal allocation											*0.0%*	*76.2%*	*13.2%*	*10.7%*	*2.8%*

Water & Sewerage Department

Evaluate Water Costs to be Recovered in Fixed Charge

	Base Average Day	Extra Max Day	Extra Peak Hour	Meters & Service Lines	Customer	Fire Protection	Total
Treatment	69%	31%					**$22,985,900**
Distribution	50%	23%	27%				**$88,945,108**
Meters & Service Lines				100%			**$8,478,792**
Customer					100%		**$6,843,571**
Fire Protection						100%	**$713,357**
Total	**$60,438,125**	**$27,372,918**	**$24,119,965**	**$8,478,792**	**$6,843,571**	**$713,357**	

	Average Units	Max Day Units	Peak Hour Units
Model Units (FY 2023)	7,089.8	9,506.7	11,245.9
DWSD Coincident Peaking Ratios[1]	1.00	1.34	1.59
Calculated DWSD Fire Flow Requirements	-	794.1	2,887.7
Total with Fire Flow Requirements[2]	7,089.8	10,300.9	14,133.6
Calculated DWSD Peaking Ratios	**1.00**	**1.45**	**1.99**

(1) Peaking factors based on Black & Veatch Phase 1 Report.
(2) DWSD Fire Flow Requirements calculation shown in Schedule 9.

Water & Sewerage Department
CITY OF DETROIT

Evaluate Water Costs to be Recovered in Fixed Charge

	Base Average Day	Extra Max Day	Extra Peak Hour	Meters & Service Lines	Customer	Direct Fire Protection
Cost	$60,438,125	$27,372,918	$24,119,965	$8,478,792	$6,843,571	$713,357

Units	Mcf/day	Mcf/day	Mcf/day	Equivalent Meters/Services	Bills	Hydrants
Retail[1]	7,090	2,417	1,739	243,907	2,299,762	-
Public Fire[2]	-	743	1,959			29,948
Private Fire[2]	-	51	135	15,642	21,017	-
Total Units	**7,090**	**3,211**	**3,833**	**259,548**	**2,320,779**	**29,948**

Cost per Unit	$23.36	$8,524.63	$6,293.18	$32.67	$2.95	$23.82

Allocation to Class							**Total Class Cost**
Retail	$60,438,125	$20,603,357	$10,944,675	$7,967,815	$6,781,596	$0	**$106,735,568**
Public Fire	$0	$6,334,399	$12,328,353	$0	$0	$713,357	**$19,376,109**
Private Fire	$0	$435,162	$846,937	$510,977	$61,975	$0	**$1,855,051**

→ **$9,348,988**
50% of public fire protection costs are capital-related

Water & Sewerage Department
CITY OF DETROIT

Develop Scaling Factors for Fixed Charge Costs

Meter Equivalency	Customer	Meters & Service Lines	Public Fire Protection
5/8"	1.00	1.00	1.00
3/4"	1.00	1.09	1.50
1"	1.00	1.27	2.50
1 1/2"	1.00	3.22	5.00
2"	1.00	4.12	8.00
3"	1.00	14.92	25.50
4"	1.00	17.07	46.00
6"	1.00	26.07	140.00
8"	1.00	37.16	185.00
10"	1.00	66.58	352.25
12"	1.00	98.00	550.40
14"	1.00	144.27	880.65
16"	1.00	212.37	1,144.85

Size	Type	Max Flow Rate	Capacity Equivalency - Flow Ratios
5/8"	Positive Displacement	20	1.00
3/4"	Positive Displacement	30	1.50
1"	Positive Displacement	50	2.50
1 1/2"	Displacement / Single Jet Electronic	100	5.00
2"	Displacement / Single Jet Electronic	160	8.00
3"	Magnetic Flow	510	25.50
4"	Magnetic Flow	920	46.00
6"	Magnetic Flow	2,800	140.00
8"	Magnetic Flow	3,700	185.00
10"	Magnetic Flow	7,045	352.25
12"	Magnetic Flow	11,008	550.40
14"	Magnetic Flow	17,613	880.65
16"	Magnetic Flow	22,897	1,144.85

Size	Meter Cost	Labor Cost	ARM/MXU - 200W (Time)	Van	Pipe	Adapter	Tee	Companion Flange	Restraint Rod	Total Cost w/ Meter	Total Cost w/ 5/8" Meter	Retail Meter Equivalency - Cost w/ Meter[1]
5/8"	$59.39	$17.00	$78.00	$12.91						$167.30	$167.30	1.00
3/4"	$74.00	$17.00	$78.00	$12.91						$181.91	$167.30	1.09
1"	$104.00	$17.00	$78.00	$12.91						$211.91	$167.30	1.27
1 1/2"	$411.00	$36.36	$78.00	$12.91						$538.27	$186.66	3.22
2"	$512.00	$54.54	$104.00	$19.37						$689.91	$237.30	4.12
3"	$1,647.90	$222.88	$104.00	$51.64	$238.10	$98.17	$101.32	$32.21	$0.00	$2,496.22	$907.71	14.92
4"	$1,943.00	$222.88	$104.00	$51.64	$221.19	$125.61	$135.27	$52.47	$0.00	$2,856.06	$972.45	17.07
6"	$2,886.00	$581.76	$104.00	$103.28	$244.88	$184.44	$191.62	$65.75	$0.00	$4,361.73	$1,535.12	26.07
8"	$4,307.00	$581.76	$104.00	$206.56	$344.25	$291.49	$289.43	$91.82	$0.00	$6,216.31	$1,968.70	37.16
10"	$8,465.00	$891.52	$104.00	$206.56	$468.79	$413.40	$485.32	$103.44	$0.00	$11,138.03	$2,732.42	66.58
12"												98.00
14"												144.27
16"												212.37

(1) Equivalency for meters 10" and smaller based on actual installation and meter costs; equivalency for meters 12" and larger based on average cost increase betweem 3" - 10" meter sizes.
(2) Equivalency for meters 10" and smaller based on actual installation costs with 5/8" meter cost; equivalency for meters 12" and larger based on average cost increase between 3" - 10" meter sizes.

Water & Sewerage Department

Determine Bills and Equivalent Bills

	Customer	Meters & Service Lines	Public Fire Protection
FY 2023 Equivalent Units	191,647	243,907	367,978

Meter Equivalency	Customer	Meters & Service Lines	Public Fire Protection
5/8"	1.00	1.00	1.00
3/4"	1.00	1.09	1.50
1"	1.00	1.27	2.50
1 1/2"	1.00	3.22	5.00
2"	1.00	4.12	8.00
3"	1.00	14.92	25.50
4"	1.00	17.07	46.00
6"	1.00	26.07	140.00
8"	1.00	37.16	185.00
10"	1.00	66.58	352.25
12"	1.00	98.00	550.40
14"	1.00	144.27	880.65
16"	1.00	212.37	1,144.85

FY 2021 Meters			
5/8"	137,605	137,605	137,605
3/4"	33,579	33,579	33,579
1"	11,024	11,024	11,024
1 1/2"	2,865	2,865	2,865
2"	2,720	2,720	2,720
3"	672	672	672
4"	539	539	539
6"	269	269	269
8"	85	85	85
10"	38	38	38
12"	4	4	4
14"	0	0	0
16"	1	1	1

Water & Sewerage Department
CITY OF DETROIT

Divide Costs by Equivalencies

	Customer	Meters & Service Lines	Public Fire Protection
FY 2023 Revenue Requirement	$ 6,544,251	$ 7,688,955	$ 9,348,988
FY 2023 Equivalent Units	191,647	243,907	367,978
Charge per Equivalent per Month	$ 2.85	$ 2.63	$ 2.12

Water & Sewerage Department
CITY OF DETROIT

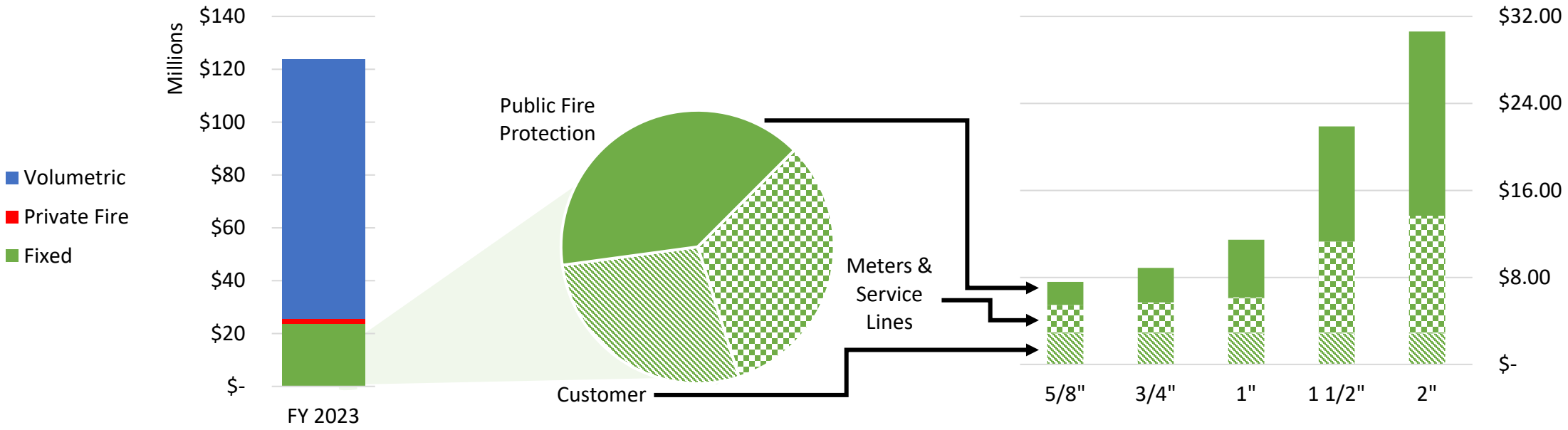
Multiply Rate by Equivalency Factor and Add Together

Meter Equivalency	Customer	Meters & Service Lines	Public Fire Protection
5/8"	1.00	1.00	1.00
3/4"	1.00	1.09	1.50
1"	1.00	1.27	2.50
1 1/2"	1.00	3.22	5.00
2"	1.00	4.12	8.00
3"	1.00	14.92	25.50
4"	1.00	17.07	46.00
6"	1.00	26.07	140.00
8"	1.00	37.16	185.00
10"	1.00	66.58	352.25
12"	1.00	98.00	550.40
14"	1.00	144.27	880.65
16"	1.00	212.37	1,144.85

Customer	Meters & Service Lines	Public Fire Protection	Proposed Meter Charge
$ 2.85	$ 2.63	$ 2.12	$ 7.59
$ 2.85	$ 2.86	$ 3.18	$ 8.88
$ 2.85	$ 3.33	$ 5.29	$ 11.47
$ 2.85	$ 8.45	$ 10.59	$ 21.88
$ 2.85	$ 10.83	$ 16.94	$ 30.62
$ 2.85	$ 39.20	$ 53.99	$ 96.03
$ 2.85	$ 44.85	$ 97.39	$ 145.08
$ 2.85	$ 68.49	$ 296.41	$ 367.74
$ 2.85	$ 97.61	$ 391.68	$ 492.14
$ 2.85	$ 174.89	$ 745.78	$ 923.52
$ 2.85	$ 257.46	$ 1,165.31	$ 1,425.61
$ 2.85	$ 378.99	$ 1,864.51	$ 2,246.35
$ 2.85	$ 557.90	$ 2,423.88	$ 2,984.63

Water Fixed Charges

Water fixed charges cover three types of costs:



1. Customer service costs allocated uniformly to all meters
2. Meter & service line costs reflect replacement costs by meter size
3. Portion of public fire protection costs (capital, debt, & GLWA expense) scaled based on hydraulic capacity

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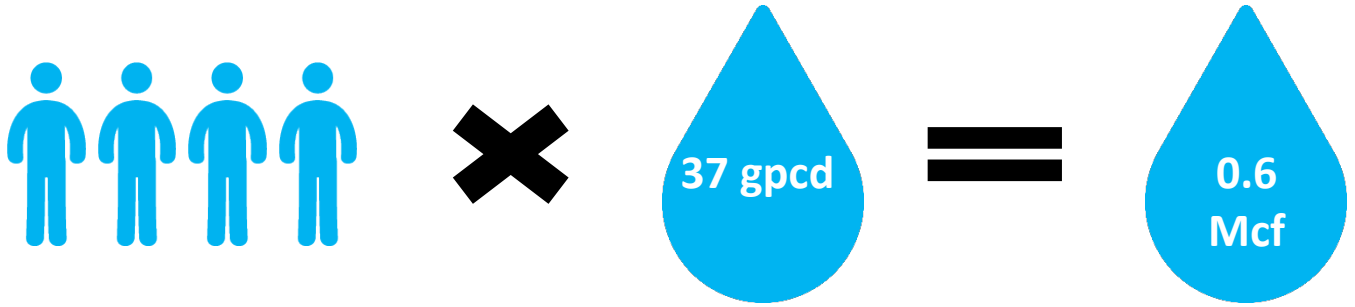
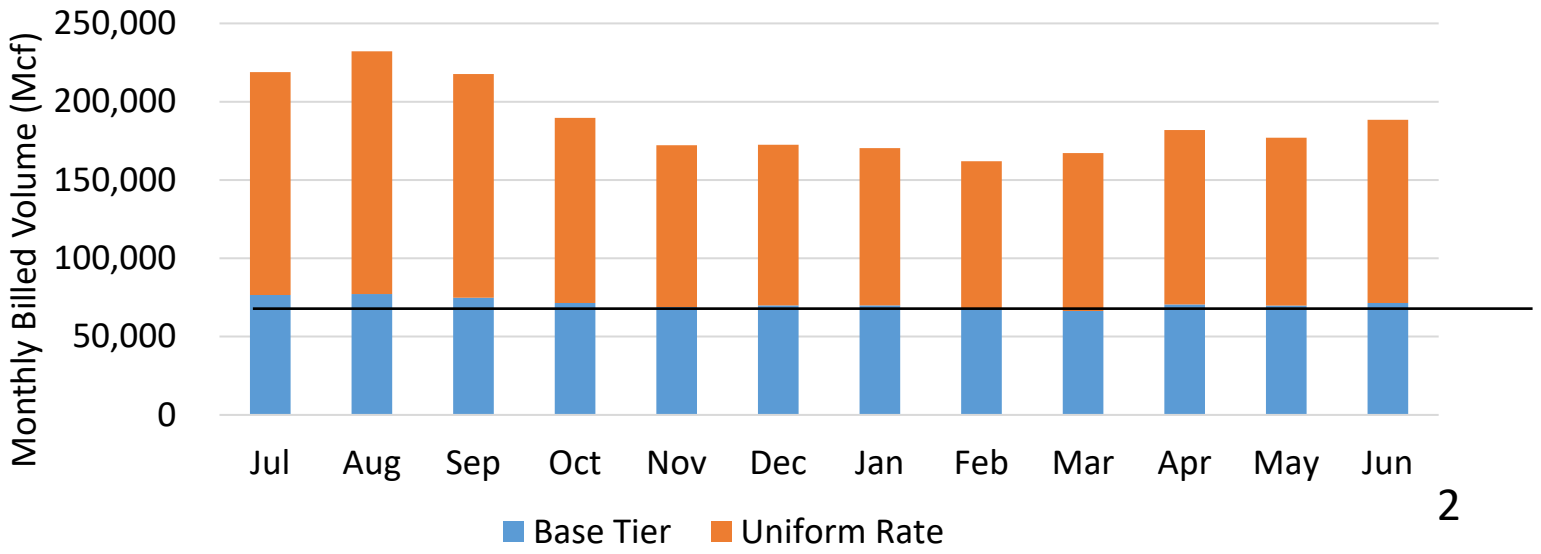
DWSD Affordability Rate Structure

Lifeline Tier Size

Base Tier Size



Amount of Water Use That Falls in Each Tier



Minimal peaking in Tier 1

Amount of water use stays very consistent throughout the year

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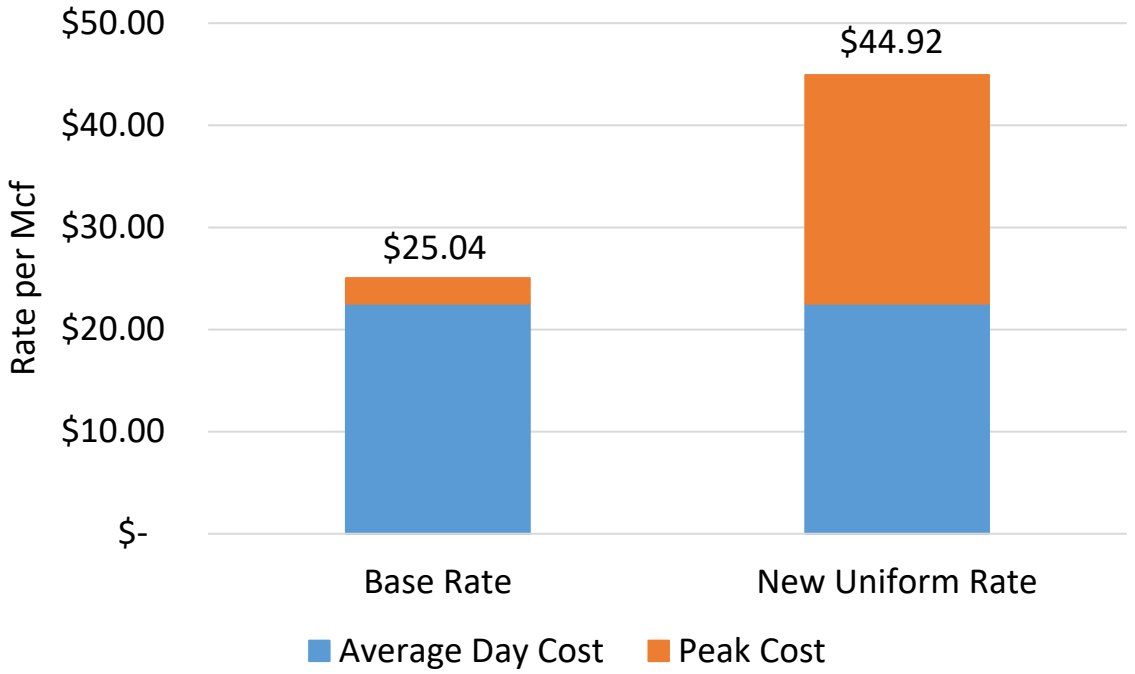
Lifeline & Uniform Tier Price

Base Rate (Lifeline Tier)

Average Day Costs ÷ Total Volume + Tier 1 Peaking Costs* ÷ Tier 1 Volume

New Uniform Rate (All Remaining Use)

Average Day Costs ÷ Total Volume + Tier 2 Peaking Costs* ÷ Tier 2 Volume



*Peaking cost allocation based on proportional change in monthly volume from lowest month to highest month of the test year

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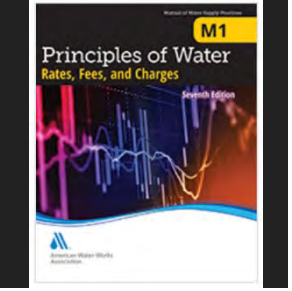
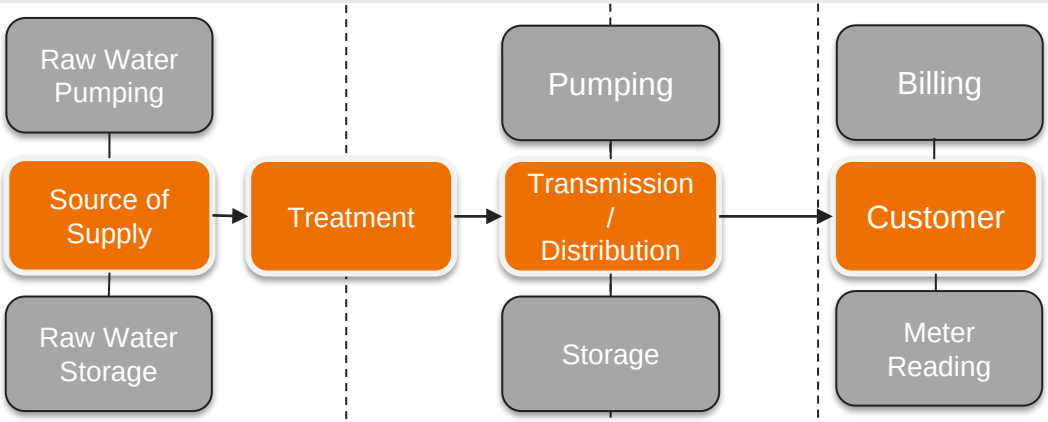
City of Tempe, Arizona

Stantec



Functionalizing System Costs

Function Costs	$0.46 M	$4.33 M	$4.69 M	$2.95 M	$14.14 M
	Average Day Demand Costs	Max Day Demand Costs	Peak Hour Costs	Customer Costs	Total
Test Year Costs	$6.99 M	$3.97 M	$1.48 M	$1.70M	$14.14 M



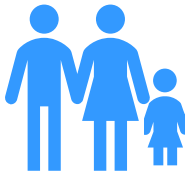
Basis of proposed water rate structure

Cost Component	Charge Type	How Charge is Applied
Customer Cost	Customer Charge	Per Bill
Average Day Cost	Base Charge (50%)	Scaled by Meter Size
Max Day Cost	Volume Charge	Per CCF of Metered Water Volume (different rates for each customer class)
Peak Hour Cost		

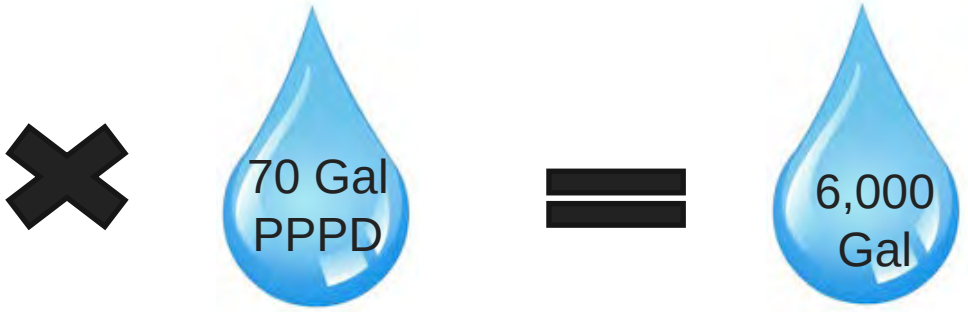
Indoor Use

Monthly Single-Family Tier Sizing (Indoor)

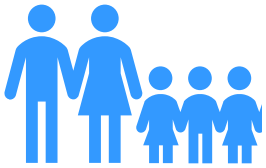
- Tier 1



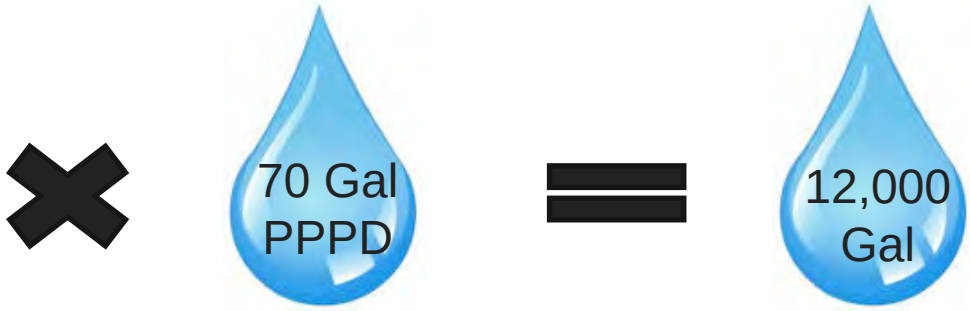
Average household:
2.63 people



- Tier 2

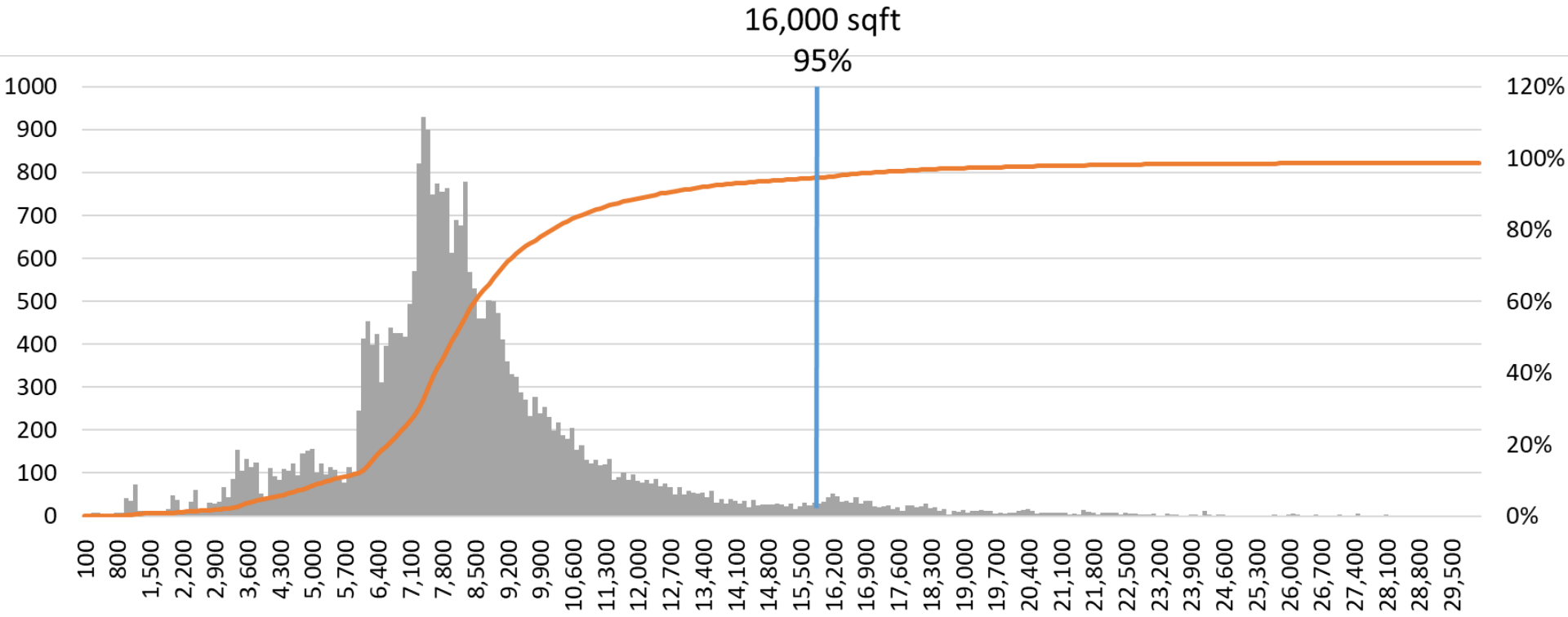


Large household:
5.26 people



Outdoor Use

Single Family Parcel Distribution

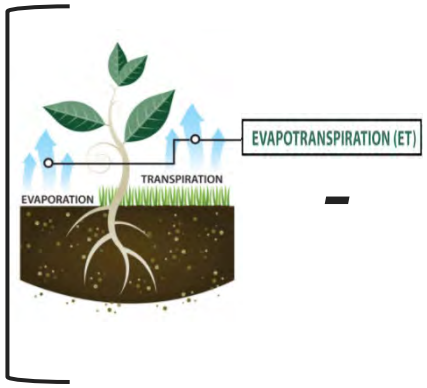


Outdoor Use

Calculating irrigation requirements for the mean parcel (8,000 ft²)

Parcel Size: 8,000
Landscape Area: 2,000

*



Evapotranspiration: 81 Inches

-

Beneficial Rainfall: 4 Inches

*

Crop Type

Irrigation System Efficiency: 70%

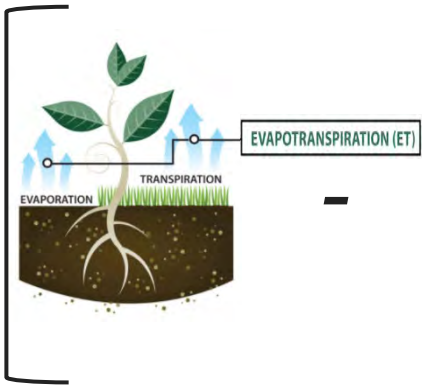
= 8,000 GAL

Outdoor Use

Calculating irrigation requirements for the 90th percentile parcel (16,000 ft²)

Parcel Size: 16,000
Landscape Area: 6,500

*



Evapotranspiration: 81 Inches

-

Beneficial Rainfall: 4 Inches

*

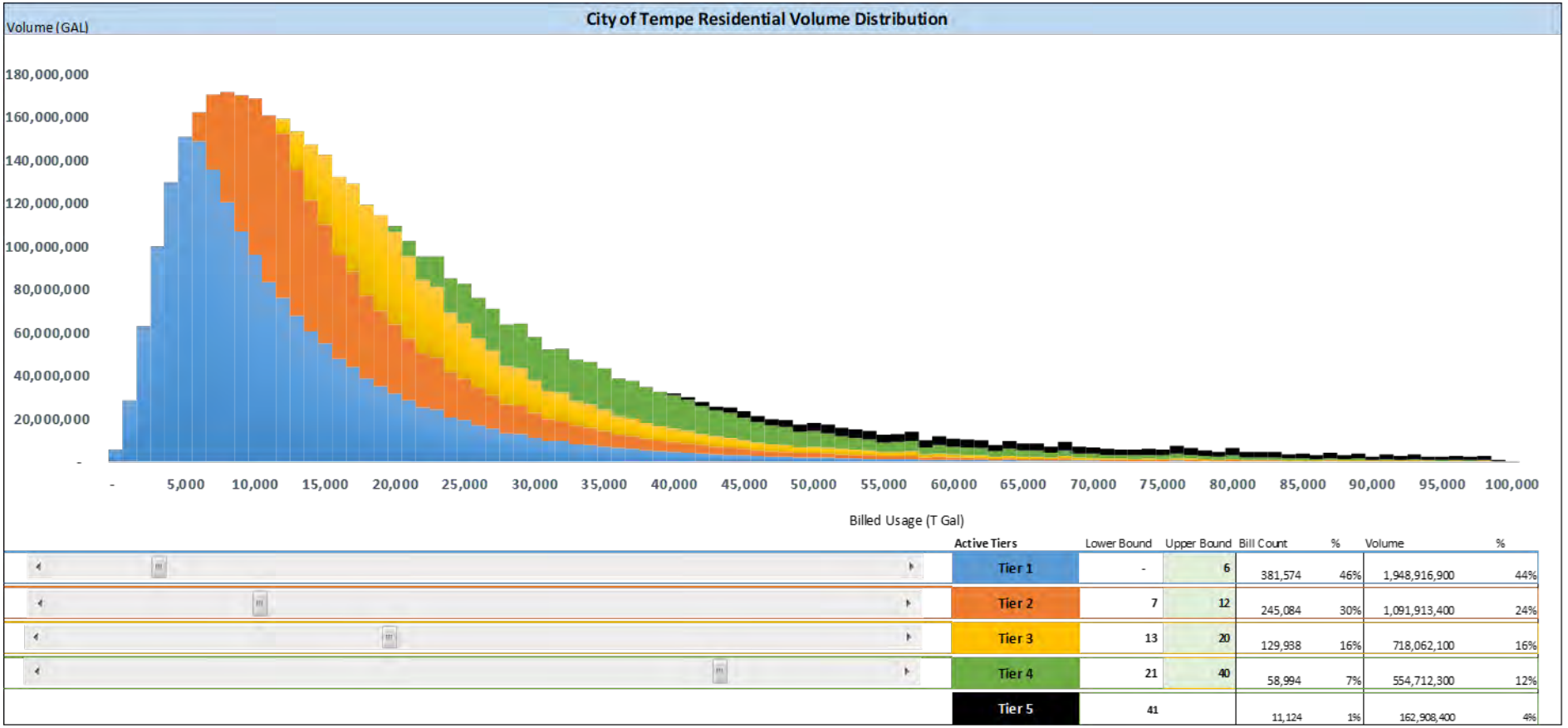
Crop Type

Irrigation System Efficiency: 70%

= 20,000 GAL

Single Family
Tiered Rates

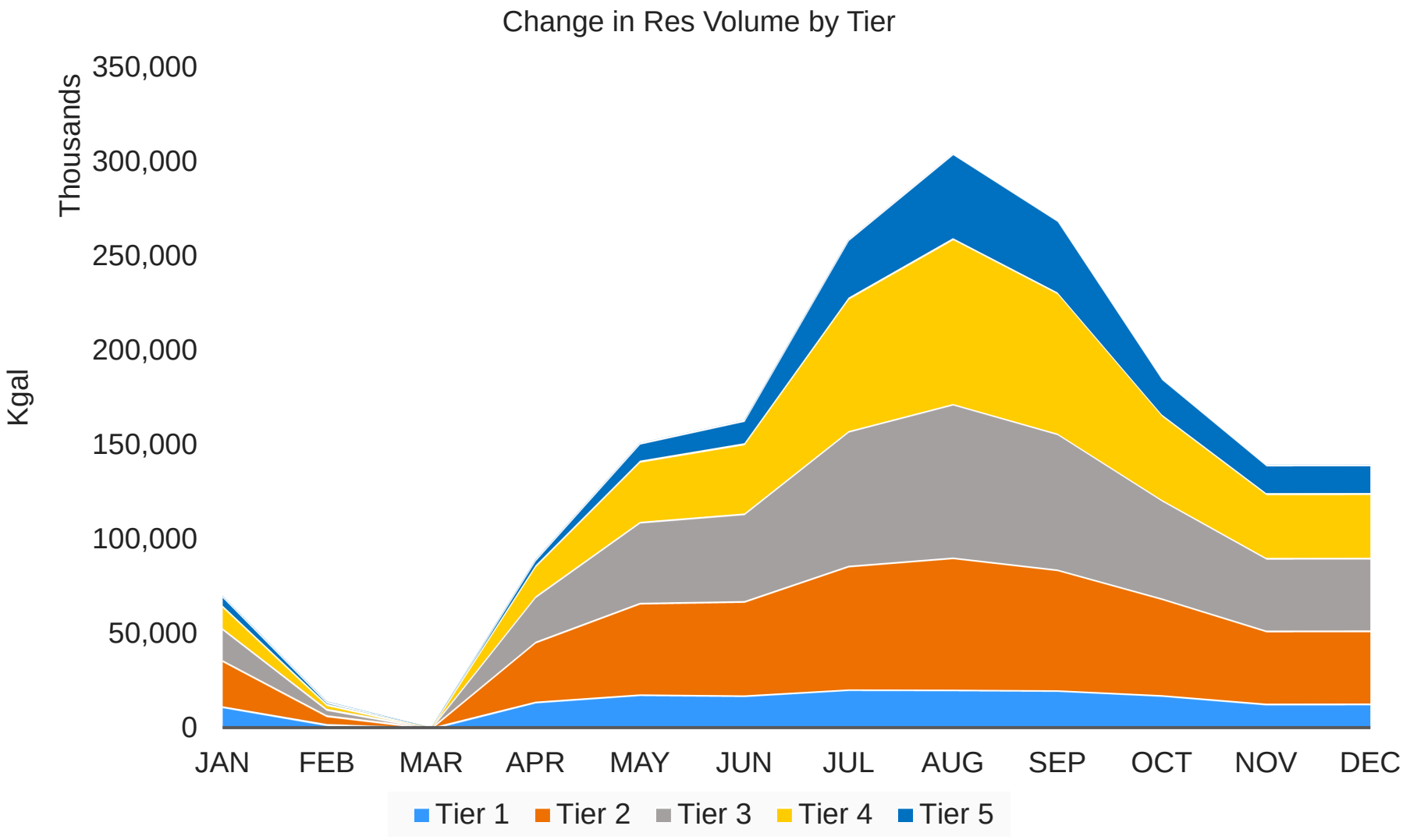
Single family water use by tier



Active Tiers	Lower Bound	Upper Bound	Bill Count	%	Volume	%
Tier 1	-	6	381,574	46%	1,948,916,900	44%
Tier 2	7	12	245,084	30%	1,091,913,400	24%
Tier 3	13	20	129,938	16%	718,062,100	16%
Tier 4	21	40	58,994	7%	554,712,300	12%
Tier 5	41		11,124	1%	162,908,400	4%

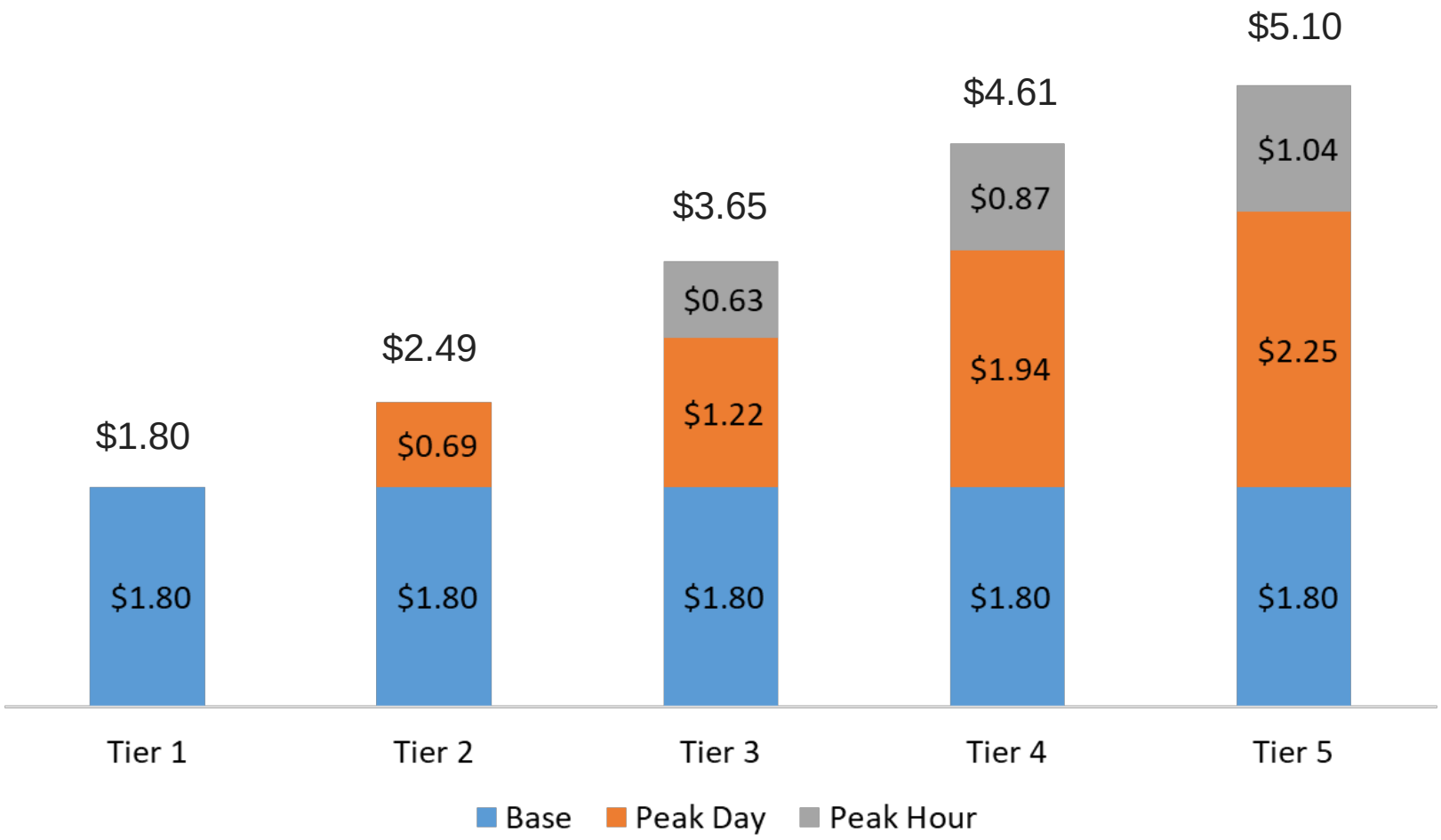
Single Family
Tiered Rates

Residential Change in Water Use by Tier

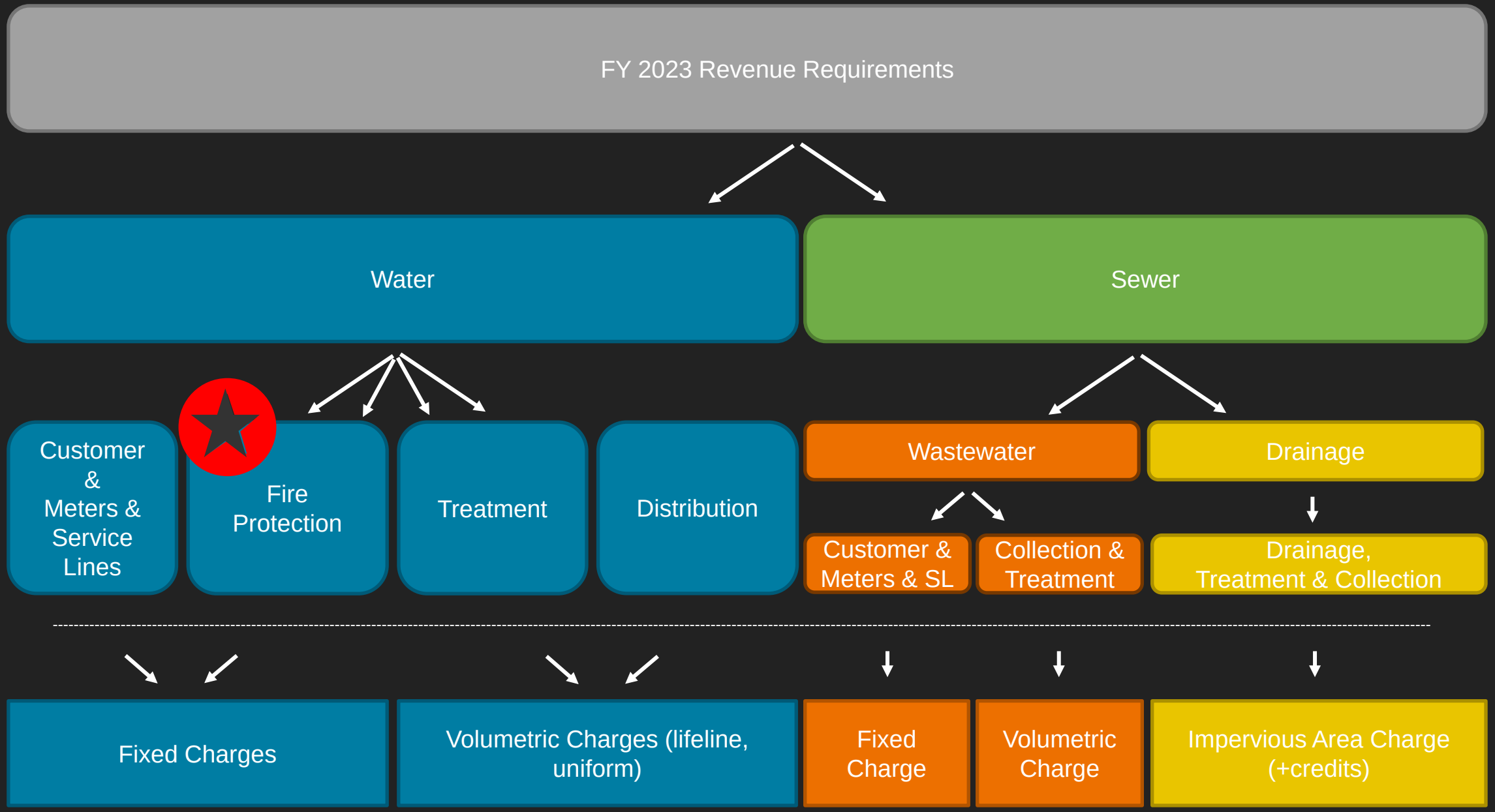


Single Family
Tiered Rates

Single family tiered rate calculations ($/1,000 gal)

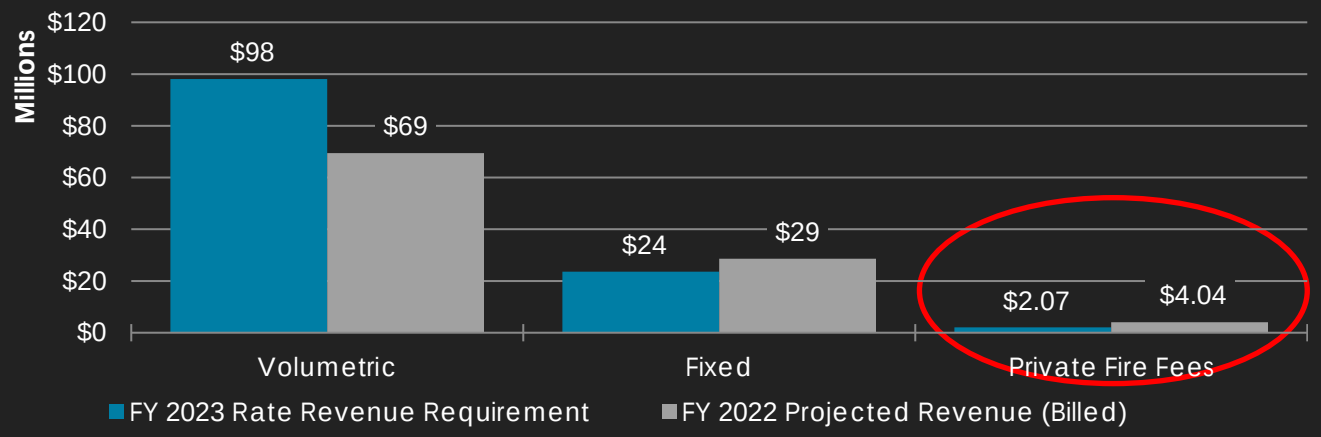


DWSD Fire Protection Charges


FY 2023 Revenue Requirements
Water
Sewer
Customer & Meters & Service Lines
Fire Protection
Treatment
Distribution
Wastewater
Drainage
Customer & Meters & SL
Collection & Treatment
Drainage, Treatment & Collection
Fixed Charges
Volumetric Charges (lifeline, uniform)
Fixed Charge
Volumetric Charge
Impervious Area Charge (+credits)

Water Cost Allocation

- Applied AWWA's M1 Base Extra Capacity method
- Used 3 historical years of usage and peaking factors provided by GLWA
- Stantec independently calculated fire max day and peak hour requirements



M1 Approach

Apprn. Description	Center	Cost Center Description	FY 2023 Water Expense for COSA	Allocation Factor	Allocations Treatment	Distribution	Meters & Service Lines	Customer
Operating Expenses								
Administration	1001	Chief Exec Officer	$ 799,245	Weighted Internal	0.0%	76.7%	12.9%	10.4%
Administration	1601	BOWC	$ 167,833	Weighted Internal	0.0%	76.7%	12.9%	10.4%
Operations	2401	Deputy Director Administration	$ 1,885,701	Distribution Only	0.0%	100.0%	0.0%	0.0%
Operations	2411	Field Engineering	$ 3,256,889	Distribution Only	0.0%	100.0%	0.0%	0.0%
Operations	2421	Facility Oper	$ 3,946,270	Distribution Only	0.0%	100.0%	0.0%	0.0%
Operations	2422	Fleet Operations	$ 2,418,049	Distribution Only	0.0%	100.0%	0.0%	0.0%
Operations	2431	Maint & Repair	$ 8,232,028	Distribution Only	0.0%	100.0%	0.0%	0.0%
Operations	2432	Meter Operations	$ 3,035,773	Meters & Service Lines Only	0.0%	0.0%	100.0%	0.0%
Operations	2435	Lead Service	$ 278,500	Meters & Service Lines Only	0.0%	0.0%	100.0%	0.0%
Compliance	3101	General Counsel	$ 933,352	Weighted Internal	0.0%	76.7%	12.9%	10.4%
Compliance	3201	Org Development	$ 736,578	Weighted Internal	0.0%	76.7%	12.9%	10.4%
Compliance	3301	Info Technology	$ 5,300,370	Weighted Internal	0.0%	76.7%	12.9%	10.4%
Compliance	3411	Compliance-Security	$ 1,813,324	Weighted Internal	0.0%	76.7%	12.9%	10.4%
Compliance	3421	Compliance-Public Affairs	$ 873,592	Weighted Internal	0.0%	76.7%	12.9%	10.4%
Finance	4001	Chief Financial Officer	$ 1,995,979	Weighted Internal	0.0%	76.7%	12.9%	10.4%
Finance	4111	Finance	$ 802,763	Weighted Internal	0.0%	76.7%	12.9%	10.4%
Finance	4121	Procurement	$ 1,497,078	Weighted Internal	0.0%	76.7%	12.9%	10.4%
Finance	4131	Treasury	$ 1,218,827	Weighted Internal	0.0%	76.7%	12.9%	10.4%
Finance	4151	Budget	$ 176,557	Weighted Internal	0.0%	76.7%	12.9%	10.4%
Finance	4161	Billing & Collect	$ 1,218,255	Customer Only	0.0%	0.0%	0.0%	100.0%
Finance	4170	Internal Aud	$ 279,283	Weighted Internal	0.0%	76.7%	12.9%	10.4%
Customer Svc	5111	Customer Service	$ 1,456,827	Customer Only	0.0%	0.0%	0.0%	100.0%
Operations	2223	Storm Drainage	$ 850,069	Weighted Internal	0.0%	76.7%	12.9%	10.4%
			$ 43,173,140					
Non-Operating Expenses								
Non-Operating	7111	Water Pension Expense	$ 21,015,700	Weighted Internal	0.0%	76.7%	12.9%	10.4%
Non-Operating	7111	Water Retail Assistance Program	$ 603,344	Weighted Internal	0.0%	76.7%	12.9%	10.4%
			$ 21,619,044					
GLWA Expenses								
Non-Operating	487111	WDWSD-R Non-Operating Exp	$ 22,985,900	Treatment Only	100.0%	0.0%	0.0%	0.0%
Water - Pre-Bifurcation Debt	Debt		$ 33,438,800	Distribution Only	0.0%	100.0%	0.0%	0.0%
			$ 56,424,700					
Repair & Maintenance								
Water - Repair & Maintenance	M&R		$ 11,544,000	Distribution Only	0.0%	100.0%	0.0%	0.0%
Contribution to (Use of) Operating Reserves	M&R		$ (6,766,254)	Distribution Only	0.0%	100.0%	0.0%	0.0%
			$ 4,777,746					

M1 Approach

	Base Average Day	Extra Max Day	Extra Peak Hour	Meters & Service Lines	Customer	Fire Protection	Total
Treatment	69%	31%					**$22,985,900**
Distribution	50%	23%	27%				**$88,945,108**
Meters & Service Lines				100%			**$8,478,792**
Customer					100%		**$6,843,571**
Fire Protection						100%	**$713,357**
Total	**$60,438,125**	**$27,372,918**	**$24,119,965**	**$8,478,792**	**$6,843,571**	**$713,357**	

	Average Units	Max Day Units	Peak Hour Units
Model Units (FY 2023)	7,089.8	9,506.7	11,245.9
DWSD Coincident Peaking Ratios[1]	1.00	1.34	1.59
Calculated DWSD Fire Flow Requirements	-	794.1	2,887.7
Total with Fire Flow Requirements[2]	7,089.8	10,300.9	14,133.6
Calculated DWSD Peaking Ratios	**1.00**	**1.45**	**1.99**

(1) Peaking factors based on Black & Veatch Phase 1 Report.
(2) DWSD Fire Flow Requirements calculation shown in Schedule 9.

M1 Approach

	Base Average Day	Extra Max Day	Extra Peak Hour	Meters & Service Lines	Customer	Direct Fire Protection
Cost	$60,438,125	$27,372,918	$24,119,965	$8,478,792	$6,843,571	$713,357
Units	**Mcf/day**	**Mcf/day**	**Mcf/day**	**Equivalent Meters/Services**	**Bills**	**Hydrants**
Retail[1]	7,090	2,417	1,739	243,907	2,299,762	-
Public Fire[2]	-	743	1,959			29,948
Private Fire[2]	-	51	135	15,642	21,017	-
Total Units	**7,090**	**3,211**	**3,833**	**259,548**	**2,320,779**	**29,948**
Cost per Unit	$23.36	$8,524.63	$6,293.18	$32.67	$2.95	$23.82
Allocation to Class						**Total Class Cost**
Retail	$60,438,125	$20,603,357	$10,944,675	$7,967,815	$6,781,596	$0 **$106,735,568**
Public Fire	$0	$6,334,399	$12,328,353	$0	$0	$713,357 **$19,376,109**
Private Fire	$0	$435,162	$846,937	$510,977	$61,975	$0 **$1,855,051**

(1) Retail average day, max day, and peak hour units shown in Schedule 7. Retail equivalent meters and bills based FY 2021 actual billing data adjusted for FY 2022 & FY 2023 growth.

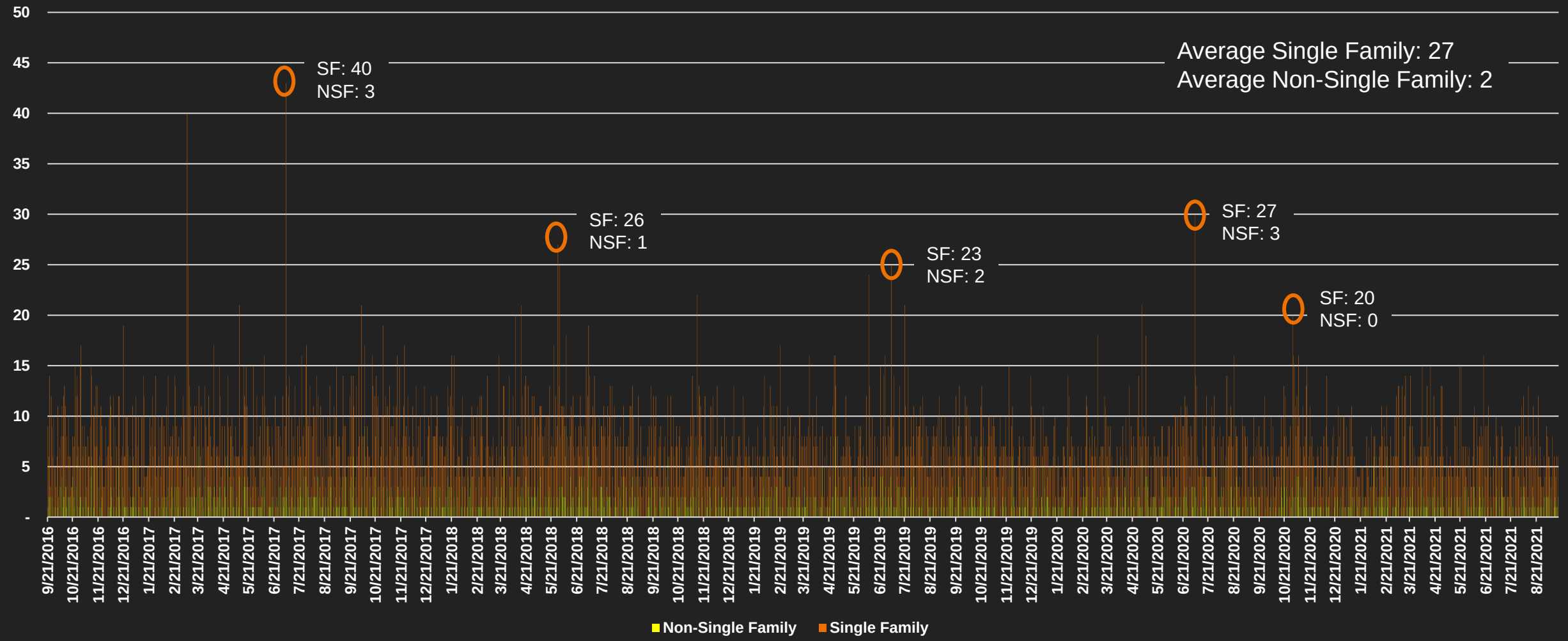
(2) Public and Private Fire max day and peak hour units calculation shown in Schedule 9. Bills and hydrants shown in Schedule 10.

Fire Protection Units of Service

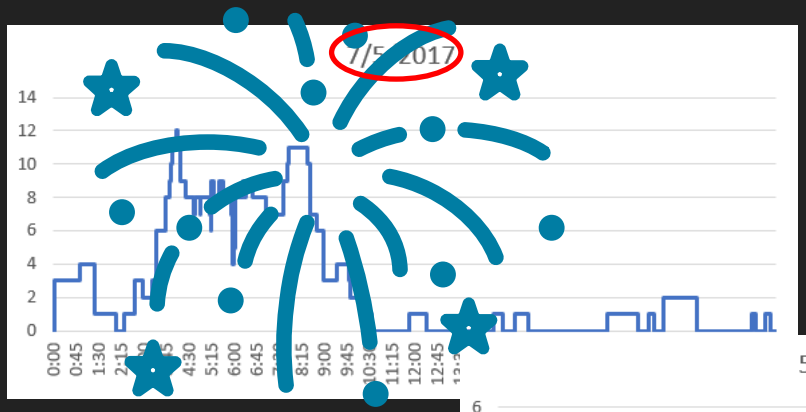
Fire Type	FY 2017-21 Max Fires/Day[1]	FY 2017-21 Max Fire/Hour[2]	Duration (min)	Gallons/Minute (gpm)	Peak Day Demand (MGD)	Peak Hour Demand (MGD)
Single Family[3]	27	8	120	1,500	4.9	17.3
Non-Single Family[4]	2	1	180	3,000	1.1	4.3
Total Fire (MGD)					5.9	21.6
Total Fire (Mcf)					794.1	2,887.7
Extra Capacity						2,093.6

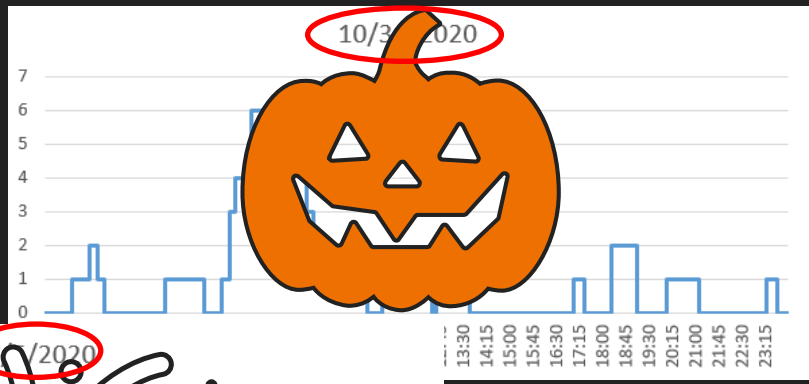
(1) Maximum fires/day based on average of 2017-2021 maximum fire incidents in a single day for structure fires.
(2) Maximum fires/hour based on average of 2017-2021 maximum fire incidents in a single hour on maximum day for structure fires.
(3) Per ISO Guidelines (Chapter 7) needed fire flow is 1,500 gpm and duration for 2 hours when distance between residential dwellings is 0-10 feet. Detroit ordinance minimum setbacks are 4 feet on a side / 14 ft combined total.
(4) Needed Fire Flow Duration for commercial properties based on ISO Fire Suppression Rating Schedule.

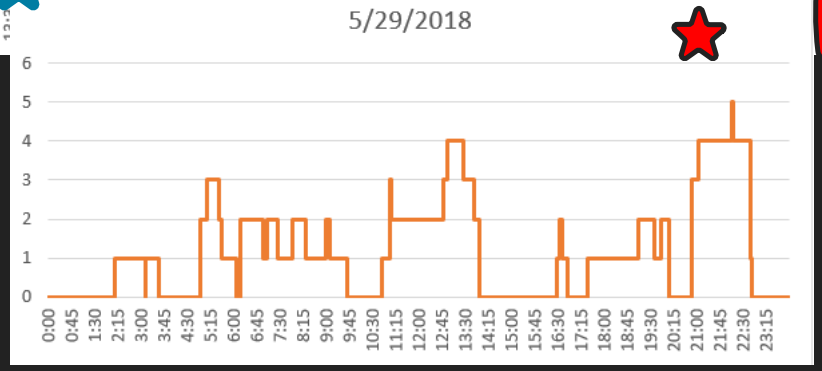
Maximum Fires per Day (Coincident Peak)

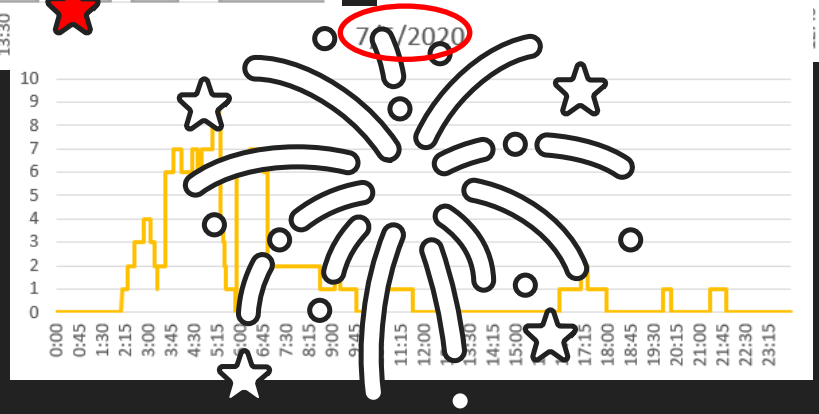


Maximum Coinciding Fires on Max Day









Fire Protection Units of Service

Fire Type	FY 2017-21 Max Fires/Day[1]	FY 2017-21 Max Fire/Hour[2]	Duration (min)	Gallons/Minute (gpm)	Peak Day Demand (MGD)	Peak Hour Demand (MGD)
Single Family[3]	27	8	120	1,500	4.9	17.3
Non-Single Family[4]	2	1	180	3,000	1.1	4.3
Total Fire (MGD)					5.9	21.6
Total Fire (Mcf)					794.1	2,887.7
Extra Capacity						2,093.6

(1) Maximum fires/day based on average of 2017-2021 maximum fire incidents in a single day for structure fires.
(2) Maximum fires/hour based on average of 2017-2021 maximum fire incidents in a single hour on maximum day for structure fires.
(3) Per ISO Guidelines (Chapter 7) needed fire flow is 1,500 gpm and duration for 2 hours when distance between residential dwellings is 0-10 feet. Detroit ordinance minimum setbacks are 4 feet on a side / 14 ft combined total.
(4) Needed Fire Flow Duration for commercial properties based on ISO Fire Suppression Rating Schedule.

Allocating Fire Demands to Public & Private

Fire Type	6" Equivalency for Capacity[1]	5/8" Equivalency for Meters & Services[2]	Private Fire Connections[3]	Public Fire[4]
4" Fireline	0.34	5.81	629	
6" Fireline	1.00	9.18	622	
8" Fireline	2.13	11.77	439	
10" Fireline	3.83	16.33	41	
12" Fireline	6.19	21.72	20	
Hydrants	1.00			29,948
Total Bills			**21,017**	**N/A**
Total Equivalent Capacity Units			**2,057**	**29,948**
Total 5/8" Equivalents for Meters & Services			**15,642**	**N/A**

(1) Assumes hydrants are on 6" line and uses Hazen Williams formula to calculate flow capacity.
(2) Based on line costs per DWSD staff by size and cost of 5/8" meter used for flow detection.
(3) Private fire meters based on FY 2021 actual billing data adjusted for FY 2022 & FY 2023 growth.
(4) Current total fire hydrants as of April 11, 2022 based on data per Detroit Fire Department.

Cost Allocation Results

	Base Average Day	Extra Max Day	Extra Peak Hour	Meters & Service Lines	Customer	Direct Fire Protection
Cost	$60,438,125	$27,372,918	$24,119,965	$8,478,792	$6,843,571	$713,357

Units	**Mcf/day**	**Mcf/day**	**Mcf/day**	**Equivalent Meters/Services**	**Bills**	**Hydrants**
Retail[1]	7,090	2,417	1,739	243,907	2,299,762	-
Public Fire[2]	-	743	1,959			29,948
Private Fire[2]	-	51	135	15,642	21,017	-
Total Units	**7,090**	**3,211**	**3,833**	**259,548**	**2,320,779**	**29,948**
Cost per Unit	$23.36	$8,524.63	$6,293.18	$32.67	$2.95	$23.82

Allocation to Class							**Total Class Cost**
Retail	$60,438,125	$20,603,357	$10,944,675	$7,967,815	$6,781,596	$0	**$106,735,568**
Public Fire	$0	$6,334,399	$12,328,353	$0	$0	$713,357	**$19,376,109**
Private Fire	$0	$435,162	$846,937	$510,977	$61,975	$0	**$1,855,051**

(1) Retail average day, max day, and peak hour units shown in Schedule 7. Retail equivalent meters and bills based FY 2021 actual billing data adjusted for FY 2022 & FY 2023 growth.

(2) Public and Private Fire max day and peak hour units calculation shown in Schedule 9. Bills and hydrants shown in Schedule 10.

Allocating Fire Demands to Public & Private

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Hydrants	1.00			29,948
Total Bills			**21,017**	**N/A**
Total Equivalent Capacity Units			**2,057**	**29,948**
Total 5/8" Equivalents for Meters & Services			**15,642**	**N/A**

(1) Assumes hydrants are on 6" line and uses Hazen Williams formula to calculate flow capacity.
(2) Based on line costs per DWSD staff by size and cost of 5/8" meter used for flow detection.
(3) Private fire meters based on FY 2021 actual billing data adjusted for FY 2022 & FY 2023 growth.
(4) Current total fire hydrants as of April 11, 2022 based on data per Detroit Fire Department.

Fire Line Equivalency Factor

Size	Meter Cost	Labor Cost	ARM/MXU - 200W (Time)	Van	Pipe	Adapter	Tee	Companion Flange	Restraint Rod	Total Cost w/ Meter	Total Cost w/ 5/8" Meter	Fire Line Equivalency - Cost w/ 5/8" Meter[2]	Capacity Equivalency - Flow Ratios
5/8"	$59.39	$17.00	$78.00	$12.91						$167.30	$167.30	1.00	1.00
3/4"	$74.00	$17.00	$78.00	$12.91						$181.91	$167.30	1.00	1.50
1"	$104.00	$17.00	$78.00	$12.91						$211.91	$167.30	1.00	2.50
1 1/2"	$411.00	$36.36	$78.00	$12.91						$538.27	$186.66	1.12	5.00
2"	$512.00	$54.54	$104.00	$19.37						$689.91	$237.30	1.42	8.00
3"	$1,647.90	$222.88	$104.00	$51.64	$238.10	$98.17	$101.32	$32.21	$0.00	$2,496.22	$907.71	5.43	25.50
4"	$1,943.00	$222.88	$104.00	$51.64	$221.19	$125.61	$135.27	$52.47	$0.00	$2,856.06	$972.45	5.81	46.00
6"	$2,886.00	$581.76	$104.00	$103.28	$244.88	$184.44	$191.62	$65.75	$0.00	$4,361.73	$1,535.12	9.18	140.00
8"	$4,307.00	$581.76	$104.00	$206.56	$344.25	$291.49	$289.43	$91.82	$0.00	$6,216.31	$1,968.70	11.77	185.00
10"	$8,465.00	$891.52	$104.00	$206.56	$468.79	$413.40	$485.32	$103.44	$0.00	$11,138.03	$2,732.42	16.33	352.25
12"												21.72	550.40
14"												28.89	880.65
16"												38.43	1,144.85

(1) Equivalency for meters 10" and smaller based on actual installation and meter costs; equivalency for meters 12" and larger based on average cost increase betweem 3" - 10" meter sizes.
(2) Equivalency for meters 10" and smaller based on actual installation costs with 5/8" meter cost; equivalency for meters 12" and larger based on average cost increase between 3" - 10" meter sizes.

Cost Allocation Results

	Base Average Day	Extra Max Day	Extra Peak Hour	Meters & Service Lines	Customer	Direct Fire Protection
Cost	$60,438,125	$27,372,918	$24,119,965	$8,478,792	$6,843,571	$713,357

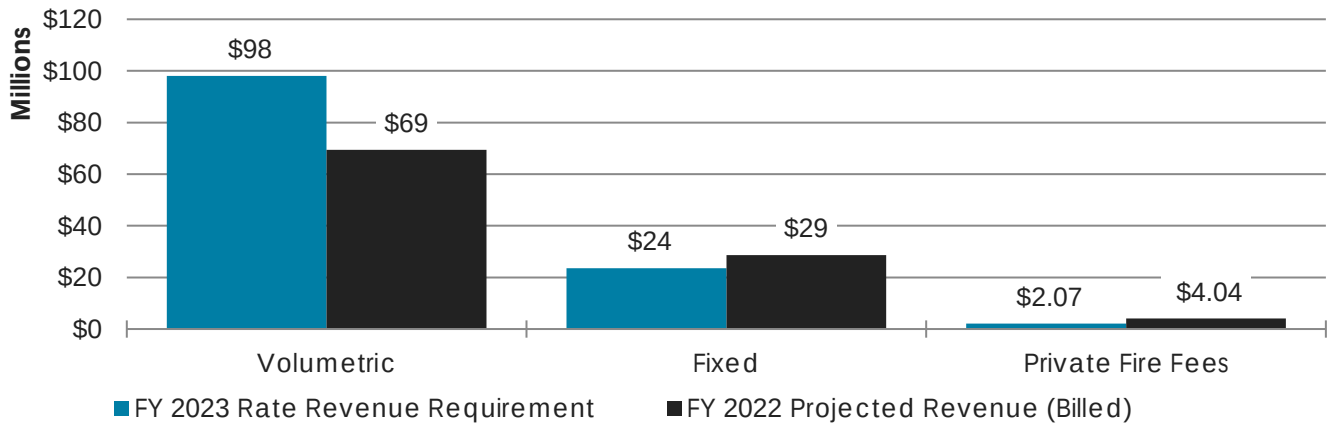
Units	**Mcf/day**	**Mcf/day**	**Mcf/day**	**Equivalent Meters/Services**	**Bills**	**Hydrants**
Retail[1]	7,090	2,417	1,739	243,907	2,299,762	-
Public Fire[2]	-	743	1,959			29,948
Private Fire[2]	-	51	135	15,642	21,017	-
Total Units	**7,090**	**3,211**	**3,833**	**259,548**	**2,320,779**	**29,948**
Cost per Unit	$23.36	$8,524.63	$6,293.18	$32.67	$2.95	$23.82

Allocation to Class						**Total Class Cost**
Retail	$60,438,125	$20,603,357	$10,944,675	$7,967,815	$6,781,596	$0 **$106,735,568**
Public Fire	$0	$6,334,399	$12,328,353	$0	$0	$713,357 **$19,376,109**
Private Fire	$0	$435,162	$846,937	$510,977	$61,975	$0 **$1,855,051**

(1) Retail average day, max day, and peak hour units shown in Schedule 7. Retail equivalent meters and bills based FY 2021 actual billing data adjusted for FY 2022 & FY 2023 growth.

(2) Public and Private Fire max day and peak hour units calculation shown in Schedule 9. Bills and hydrants shown in Schedule 10.

Cost Allocation Results



	Volumetric	Fixed	Private Fire Fees	
FY 2023 Total Expenses	$101,674,212	$24,437,465	$1,855,051	
Less: Non-Rate Revenues[7]	(13,679,244)	(3,287,816)	0	*(Indirect Retail)*
Initial Rate Revenue Requirement	$ 87,994,968	$ 21,149,650	$ 1,855,051	$ 110,999,669
Bad Debt Adjustment[8]	10,120,810	2,432,544	213,360	
FY 2023 Rate Revenue Requirement	**$ 98,115,778**	**$ 23,582,193**	**$ 2,068,412**	**$ 123,766,383**
FY 2022 Projected Rate Revenue (Billed)[3]	**$ 69,433,800**	**$ 28,619,200**	**$ 4,041,900**	**$ 102,094,900**
FY 2022 Projected Rate Revenue (Net)	62,225,133	25,647,934	3,622,267	91,495,334
% Cost Recovery	*71%*	*121%*	*195%*	*82%*

Union County Water

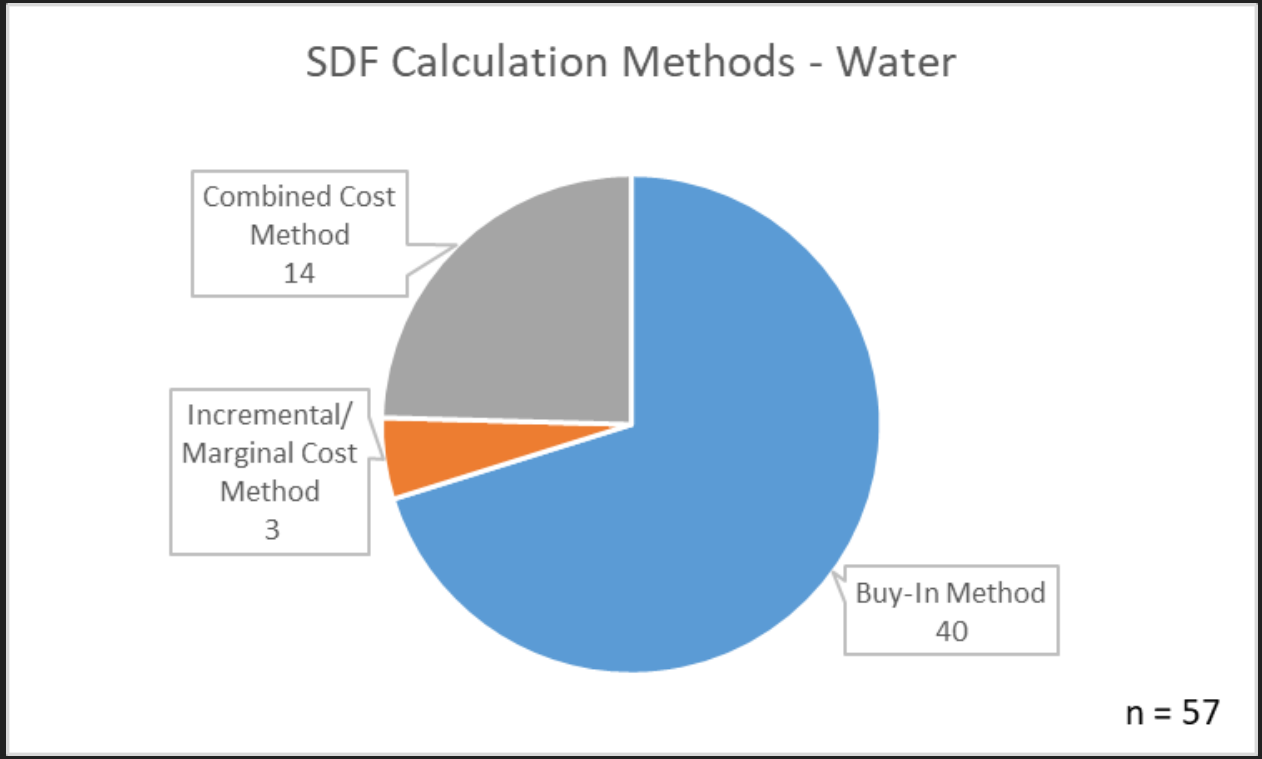
System Development Fees

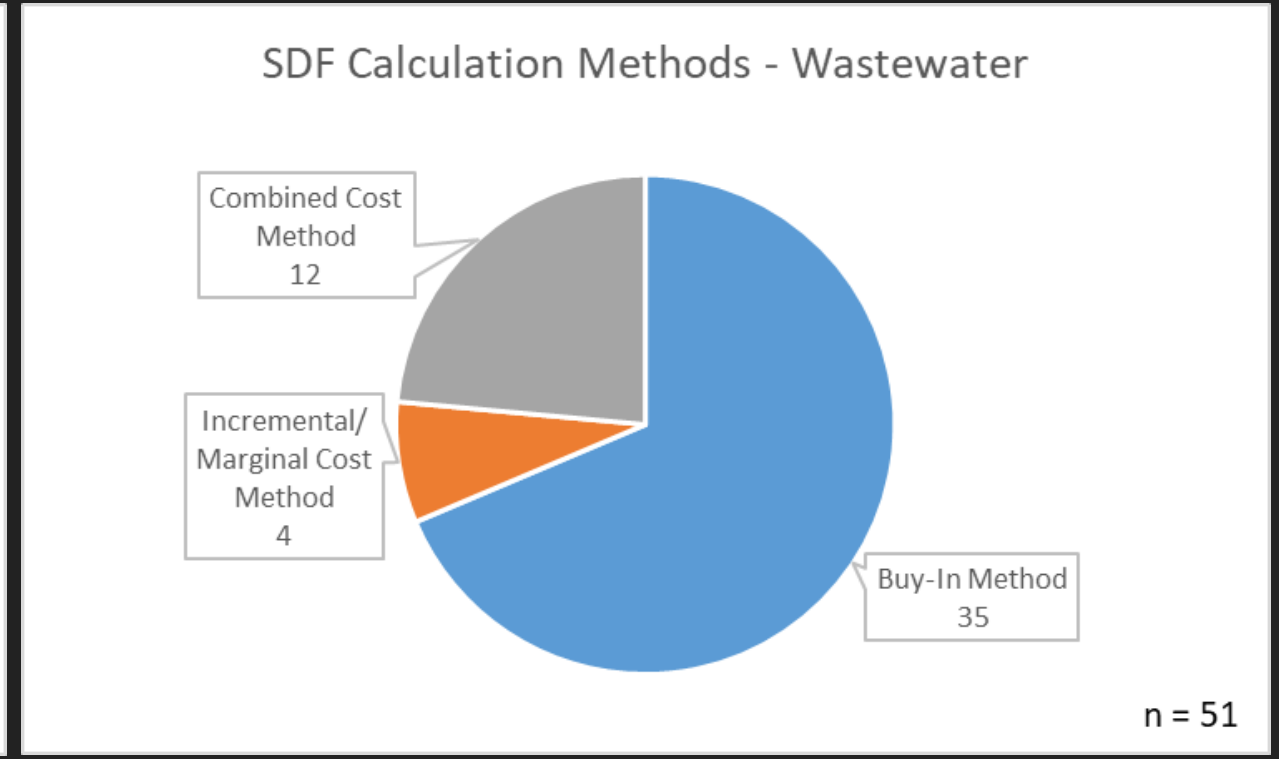
Stantec

System Development Fee Methodologies

Methodology	Description	Use of System Dev. Fee Revenues	Appropriate For
Buy-In Method	Fees are based on cost of constructing existing utility system capacity	Revenues can be used for reimbursement of existing costs for improvements with capacity & rehab	System with ample existing capacity to sell
Incremental Cost Method	Fees are based on planned capital system expansion	First, expansion projects and second, debt service	System with no/very limited existing capacity to sell
Combined Method	Fees are based on cost of existing system and planned capital improvements	First expansion projects, second debt service, and also for reimbursement of existing costs for improvements with capacity & rehab	System with existing capacity to sell and with significant growth related capital projects

Survey of SDF Calculation Methodologies

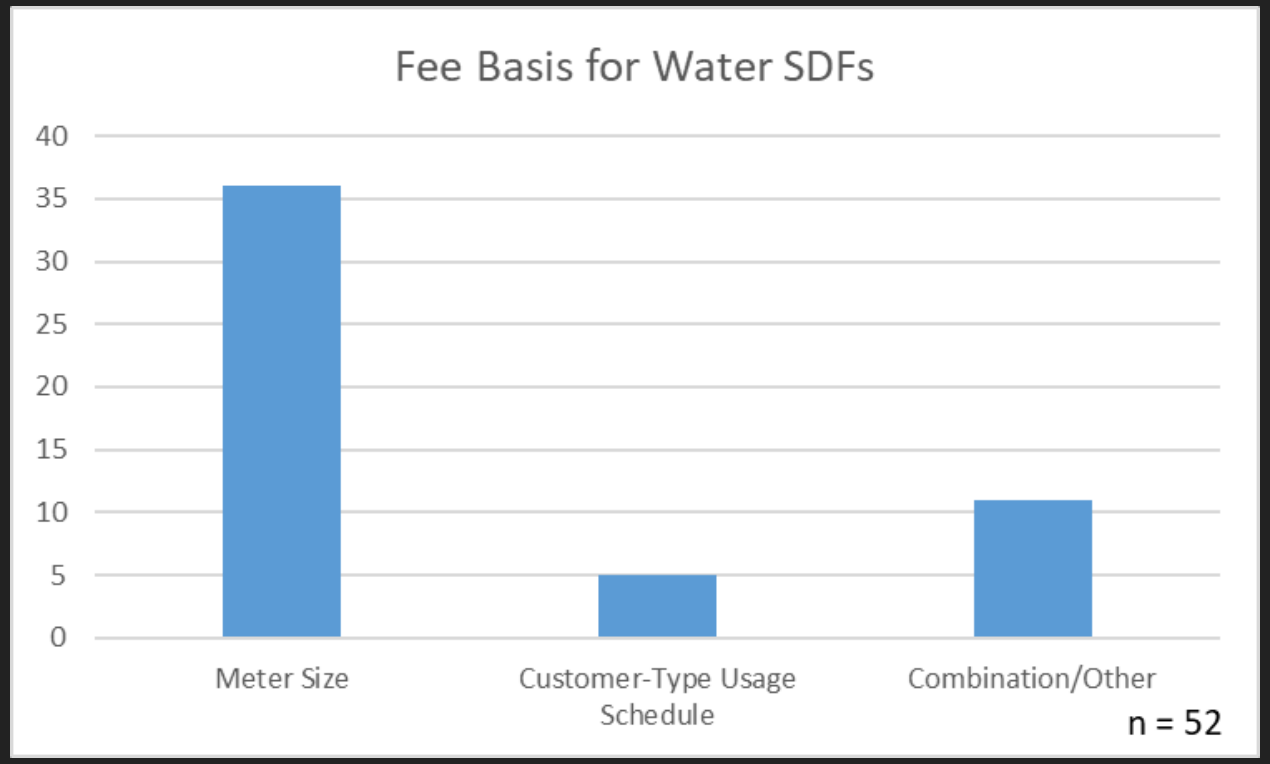


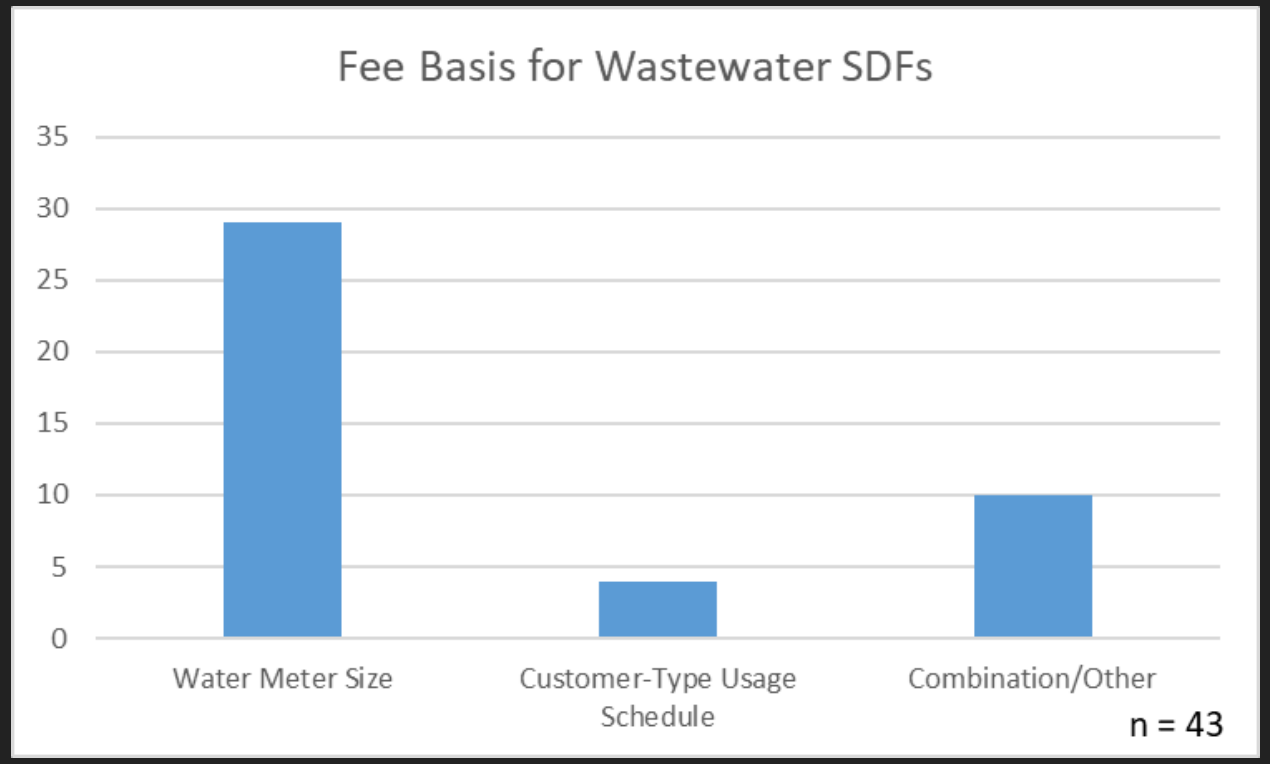


Union County used the combined cost method

Source: UNC Environmental Finance Center, 2019 Report on System Development Fees in North Carolina

Survey of SDF Calculation Basis

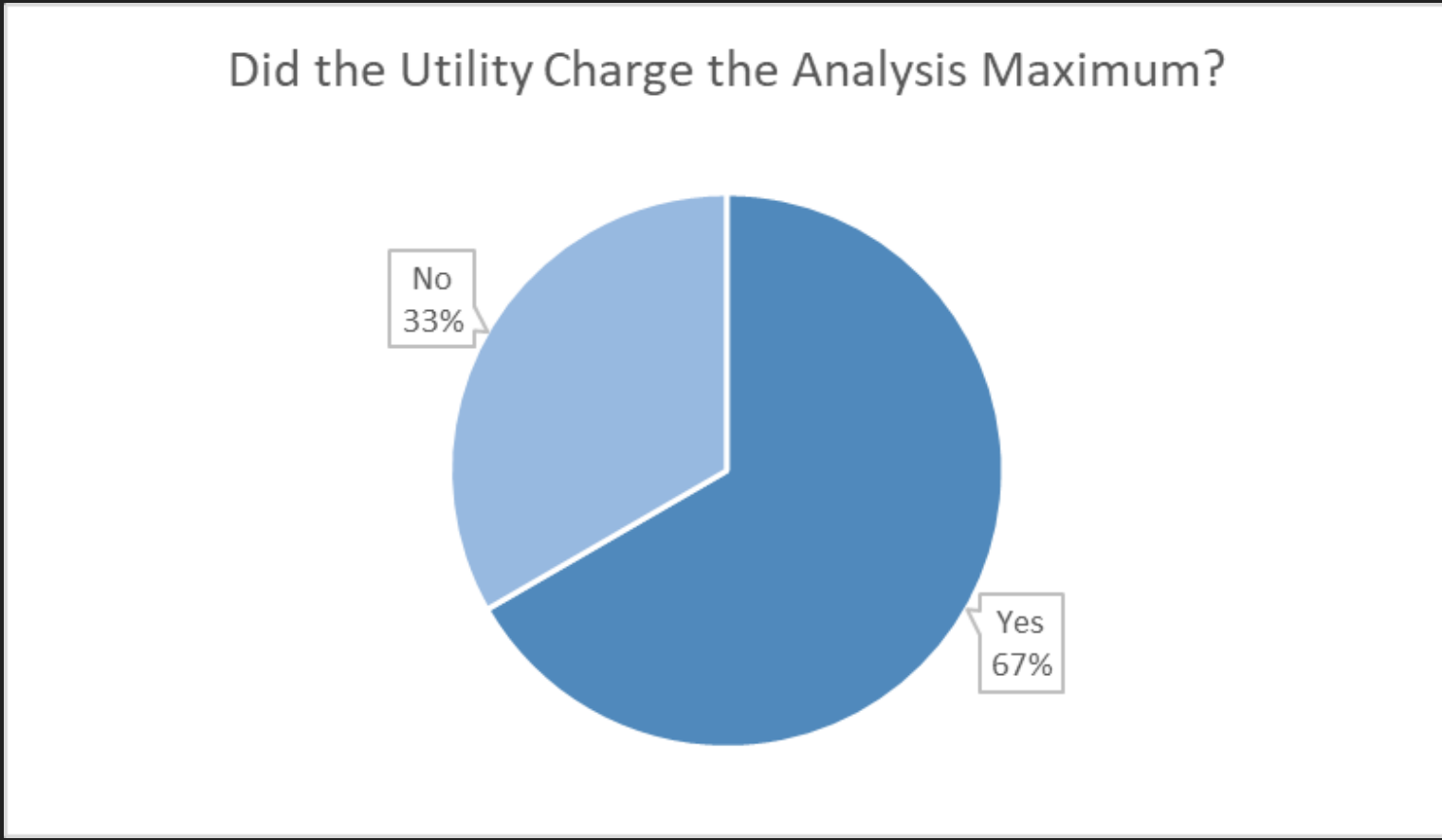




Union County Uses Meter Size method for Water and Wastewater

Source: UNC Environmental Finance Center, 2019 Report on System Development Fees in North Carolina

Survey of SDF Maximum Charges



Union County charged the analysis maximum

Source: UNC Environmental Finance Center, 2019 Report on System Development Fees in North Carolina

Union County SDF Calculation

$$\text{System Development Fee} = \frac{\text{Value of System - Credit}}{\text{System Capacity}}$$

1) Value of Utility System
   - Depreciated value escalated to current replacement cost, and/or
   - Future capital investment
2) Credit
   - Outstanding principal on existing utility debt, grants, contributions (including present value of revenue for same capital investment)
3) System Capacity
   - Total capacity in utility system, and/or
   - Future capacity

Water SDF Calculation

	Buy-In Method	Incremental Method	Combined Method
Gross Plant in Service	$510 M	N/A*	N/A*
Capital Improvement Program	-		
Principal Credit	(342) M		
Future Revenue Credit (min. 25%)	-		
Net System Value	**$167 M**		
System Capacity (MGD)	35		
Level of Service (gpd)	328		
Equivalent Units	106,700		
Plus Escalation Factor to FY 2024	6.8%		
Calculated Fee per ERU	**$1,678**		
Current Fee per ERU	$3,200		
Change	-48%		

*No new facilities or expansion of capacity is currently planned for the water system.

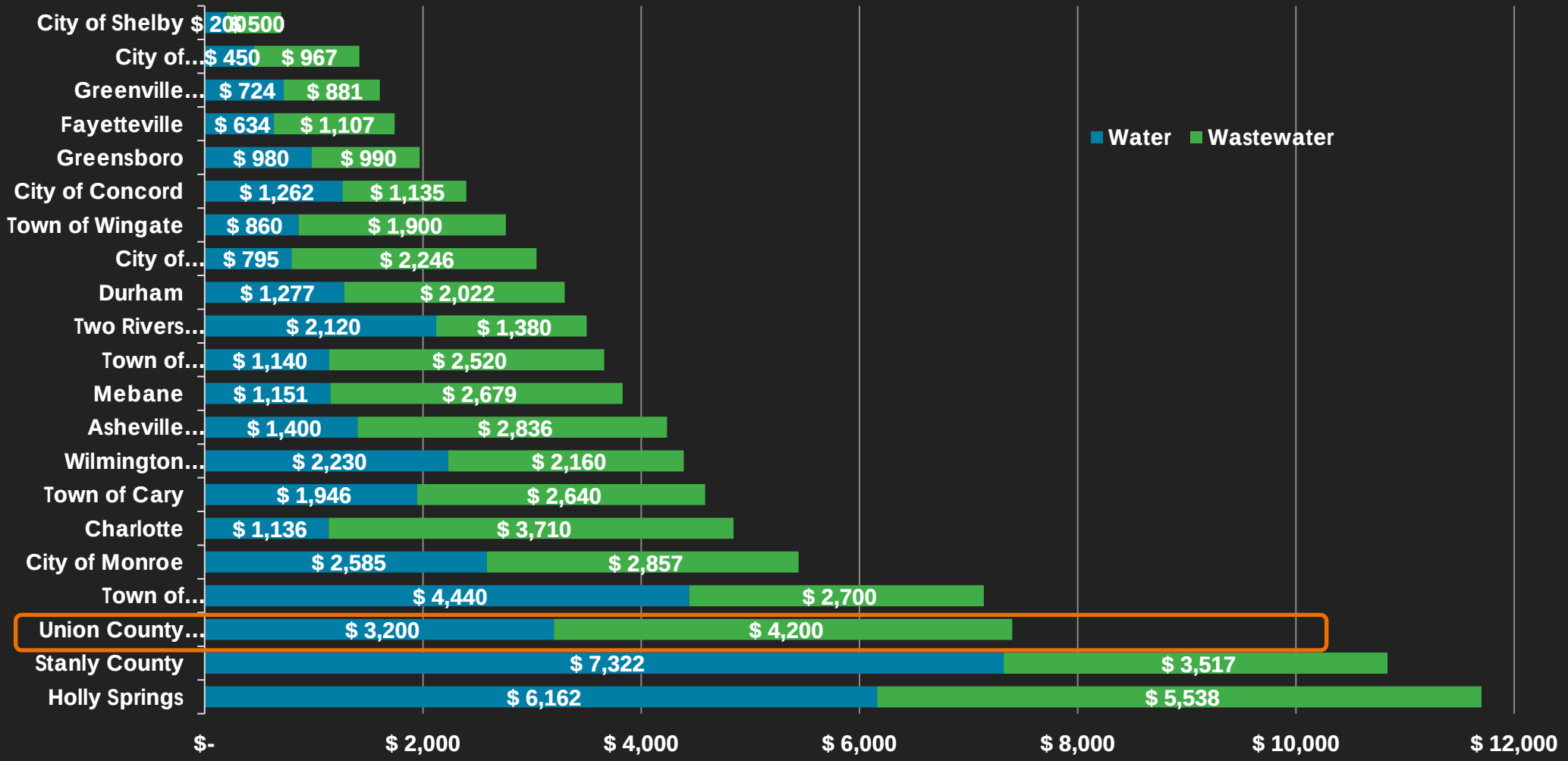
Sewer SDF Calculation – 10-Year CIP with Facility Expansion

12 Mile Expansion to 12 MGD			
	Buy-In	Incremental	Combined
Gross Plant in Service	$223 M	-	$223 M
Capital Improvement Program	-	102 M*	102 M*
Principal Credit	(84) M	-	(84) M
Future Revenue Credit (min. 25%)	-	(26) M	(26) M
Net System Value	**$139 M**	**$76 M**	**$216 M**
System Capacity (MGD)	15.37	4.5	19.87
Level of Service (gpd)	255	255	255
Equivalent Units	60,200	17,600	77,800
Plus Escalation Factor to FY 2024	6.8%	6.8%	6.8%
Calculated Fee per ERU	**$2,473**	**$4,634**	**$2,962**
Current Fee per ERU	$4,200	$4,200	$4,200
Change	-41%	10%	-29%

*Expansion to 12 MGD estimate of $55M was provided in Q1 2021.

Local SDF Survey

2022 survey of local community Water & Sewer SDFs vs. current Union County SDFs



Common Questions/Considerations for SDFs

How should SDFs be applied to…

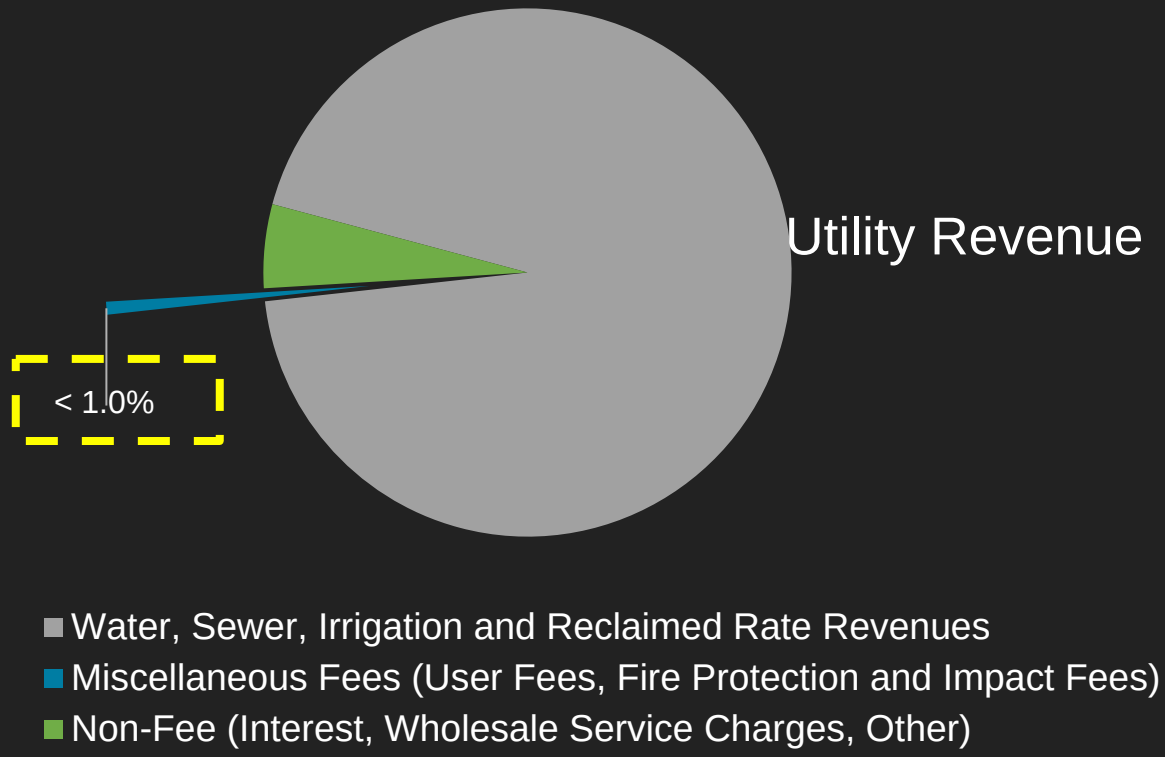
- Dedicated fire lines
- Non-standard demands/large industrial users
- Additional irrigation only meters
- Converting to central service
- Affordable housing
- Redevelopment

Miscellaneous Fees

Miscellaneous Fees

- Recover cost of services directly from the beneficiary
- Haven't been updated in several years

- **Customer Deposits**
- **User Fees & Fire Protection**
- **Impact Fees**



Miscellaneous Fees

Overview

- Tap fees, account setup, meter installation/removal, meter verification, disconnect processing, deposits, & others
- Reflect <4% of overall system revenues
- Many fees have not been updated in several years/decades

Purpose

- Recover the cost of specific services from the customer or to promote positive customer behavior

Goal

- Identify costs associated with activities to inform fees

Study Process

Staff identified costs and activities for each service and populated in Stantec's cost template

Labor

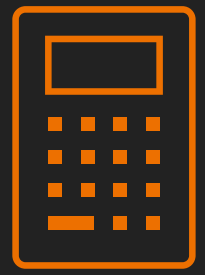
- How much time does each role spend to perform this service?

Equipment/Vehicles

- What pieces of equipment or vehicles are utilized to perform the service?

Materials

- What materials are used as part of this service?



Hours Spent (Customer Service, Utility Tech) X Costs per Hour (Labor, vehicles & equipment) + Unit Costs (Materials) = **Cost of Service**

Benchmarking – Disconnect Processing Fees

	Disconnect Processing Fee	Notes
Charlotte Water	$ 32.00	$16 fee for both disconnect and reconnect
City of Concord	$ 50.00	"Non-Payment Administration Fee" Disconnection for non-payment will require a deposit equal to two months average bill for reconnection of services.
City of Concord - After Hours	$ 100.00	"Non-Payment Administration Fee" Disconnection for non-payment will require a deposit equal to two months average bill for reconnection of services.
City of Monroe	$ 30.00	"Subject to Disconnection Fee"
City of Kannapolis	$ 30.00	"Non-payment administrative service disconnect fee" After Hours Reconnect Fee = $100
Town of Harrisburg	$ 100.00	"Reconnect Fee"
Town of Wingate	$ 30.00	"Delinquency Fee"
Two Rivers (City of Gastonia)	$ 25.00	If services are disconnected for non-payment, other fees associated with reconnection or service calls may be due, in addition to the past due balance on the account, in order to have services restored.
Town of Cary, NC	$ 33.00	Fee for processing disconnection of service due to nonpayment of utility charges.
Town of Cary, NC - After Hours	$ 48.00	Fee for processing disconnection of service due to nonpayment of utility charges.
Union County Current	$ 50.00	
Union County Calculated	$ 140.00	

Cost of Service – Potential New Fees

Proposed New Fees

Recover costs of some services being performed today by County at no charge to the customer

Fee Description	Cost of Service
After Hours Trip Fee - Reconnect	$ 125.00
Installation / Removal of Temporary Hydrant Meter	$ 230.00
Trip Charge for Excessive Requests	$ 65.00
Residential Meter Test (Flow Test)	$ 90.00
Large Meter Testing (Flow Test)	$ 160.00

Miscellaneous Fees – Conclusions & Recommendations

Conclusions

- Many current fees have not been updated in several years
- Most fees are not recovering the cost of service
- There are services being provided today that County is not charging for
- Calculated fees are generally within comparable range to other utilities

Recommendations

- Develop implementation plans for calculated fees (phasing may be required)
- Regularly review miscellaneous fees to ensure appropriate cost recovery

Phase-in Example

Service Fees & Charges

Activity: Customer specific or account and meter related services

At or Above Range
Within Range
At or Below Range

Description	Current Fee ($)	Phase In Approach to Proposed Fee ($)				Benchmarking Range ($)
		FY 24	FY 25	FY 26	FY 27	FY 23
Turn on: Water meter / reclaimed water connection, per meter / connection	20	30	40	50	60	10 - 63
Special Reading	15	30	45	60	75	18 - 71
Collector Fee (for each collection attempt)	5	8.75	12.50	16.25	20	4 - 10
Check Reading (if correct reading has been made)	15	30	45	60	75	18 - 71
Read for change of account	15	30	45	60	75	18 - 71
Reset meter: Water	50	68.75	87.50	106.25	125	50 - 325
Water meter test, if meter is correct:						
Less than or equal to 2-inch size	50	87.50	125	162.50	200	40 - 200
Greater than 2-inch size	100	132.50	165	197.50	230	130 - 400
Turn-off: Water	No Charge (N/C)	30	40	50	60	10 - 63
Lawn meter removed	70	156.25	242.50	328.75	415	70 - 350