Aerial view of Suisun City
Via Google Earth

Suisun-Solano Water Authority

Water Rate Study

Preliminary *Draft* Report

July 2021

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Table of Contents

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Table of Figures

Section 1. Purpose and Overview of the Study

A. Purpose

The Suisun-Solano Water Authority (SSWA or "the Authority") retained NBS to conduct a comprehensive water rate study update. While the Authority had several objectives to address in the study, the main objective was ensuring adequate funding for operating and capital costs. Other objectives include maintaining adequate reserves, revenue stability in water rates, and complying with certain legal standards (e.g., California Constitution Article XIII D, Section 6, which is commonly referred to as Proposition 218 [Prop 218]). The rates resulting from this study were developed in a manner consistent with industry standard cost-of-service principles. In addition to documenting the rate study methodology, this report is provided with the intent of assisting the Authority maintain transparent communications with the residents and businesses it serves.

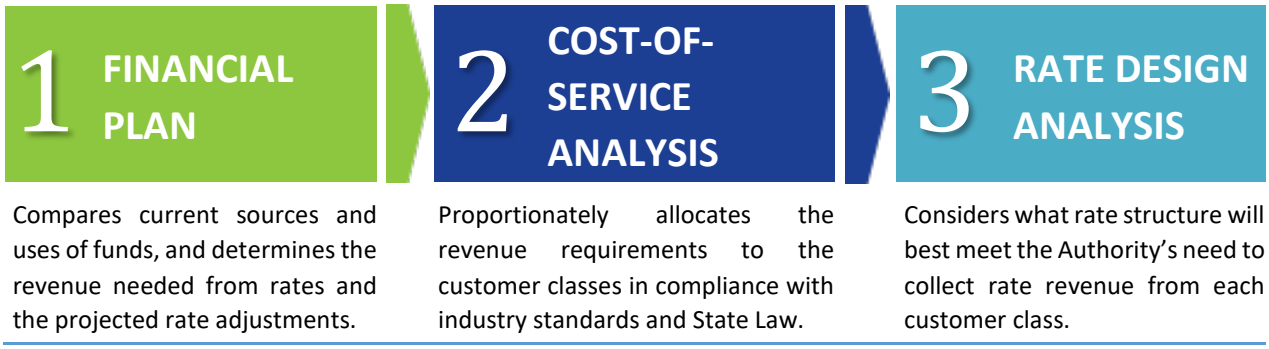
NBS worked cooperatively with Authority staff and the Executive Committee throughout the course of the study to develop rate alternatives that would best meet the Authority's broader rate-related goals and objectives. Based on the recommendations from the Board and the Executive Committee, the proposed rates are summarized in this report and presented for the public approval process.

B. Overview of the Study

Comprehensive rate studies, such as this one, typically include the following three components, as outlined in **Figure 1**:

1. Preparation of a **Financial Plan**, which identifies the net revenue requirements for the utility;
2. **Cost-of-Service Analysis**, which determines the cost of providing service to each customer class; and,
3. **Rate Design Analysis**, which evaluates different rate structure alternatives.

Figure 1. Primary Components of a Rate Study



These steps are intended to follow industry standards and reflect the fundamental principles of cost-of-service rate making embodied in the American Water Works Association's (AWWA) *Principles of Water*

Rates, Fees, and Charges,[1] also referred to as the M1 Manual. The rate study also addresses the legal requirements under Proposition 218 that rates not exceed the cost of providing the service and that rates be proportionate to the cost of providing service. In terms of the chronology of the study, these three steps represent the order in which they were performed. Detailed tables and figures documenting the development of the proposed rates are provided in *Appendix A*.

The Authority provided NBS with the data necessary to conduct the study, including historical, current, and projected revenues and expenditures, number of customer accounts, and water consumption data along with other operational and capital cost information.

Financial Plan

As a part of the rate study, NBS projected revenues and expenditures on a cash-flow basis for the next ten years, although the proposed rates are for a three-year period (FY 2021/22 though FY 2023/24). Given that the Authority has significant capital needs and outstanding bond proceeds to spend on capital projects, it was determined by SSWA that a three-year rate period was appropriate for this study.

The amount of rate revenue required, that will allow reserves to be maintained at the recommended levels, is known as the *net revenue requirement*. As current rate revenue falls short of the net revenue requirement, rate adjustments - or more accurately, adjustments in the total revenue collected from rates - are recommended. This report presents an overview of the methodologies, assumptions, and data used along with the financial plan and proposed rates developed in this study.[2]

Cost-of-Service Analysis

The basic purpose of the cost-of-service analysis (COSA) is to fairly and equitably allocate costs to customer classes. The cost-of-service analysis consists of two major components: (1) the classification of expenses, and (2) the allocation of costs to customer classes. A key task is the "classification" of the water revenue requirements into the following categories:

- Commodity related costs (i.e., chemical, electricity, and water costs)
- Capacity related costs (i.e., costs for conveyance and storage facilities necessary to operate the water delivery system)
- Customer service-related costs (i.e., administrative costs)

These cost allocation factors represent the types of cost allocations in the cost of service. Further details are discussed below and documented in *Appendix A*.

Rate Design Analysis

Several criteria are typically considered in setting rates and developing sound rate structures. The fundamentals of this process have been well documented in a number of rate-setting manuals, such as the AWWA M1 Manual. The foundation for evaluating rate structures is generally credited to James C.

[1] *Principles of Water Rates, Fees, and Charges,* Manual of Water Supply Practices, M1 Manual, American Water Works Association, Seventh Edition, 2017.

[2] The complete financial plan is set forth in *Appendix A*.

Bonbright in the *Principles of Public Utility Rates,*[3] which outlines pricing policies, theories, and economic concepts along with various rate designs. The following is a simplified list of the attributes of a sound rate structure:

- Rates should be easy to understand from the customer's perspective.
- Rates should be easy to administer from the utility's perspective.
- Rates should be equitable and non-discriminating (that is, cost based).
- There should be continuity in the rate making philosophy over time.
- Rates should provide month-to-month and year-to-year revenue stability.

Rate Structure Terminology

This section covers basic rate design criteria that NBS and Authority staff considered as a part of their review of rate structure alternatives. One of the most fundamental points in considering rate structures is the relationship between fixed and variable costs. Fixed costs, such as debt service and personnel costs, typically do not vary with the amount of water consumed. In contrast, variable costs, such as the cost of purchased water, chemicals, and electricity, tend to change with the quantity of water sold. The vast majority of rate structures contain a fixed, or minimum, charge in combination with a volumetric charge.

- **Fixed Charges** – Fixed charges can be called base charges, minimum monthly charges, customer charges, fixed meter charges, etc. Fixed charges for water utilities typically increase by meter size. For example, a customer with a 2-inch meter has a fixed meter charge that is nearly four times greater than the typical residential customer charge based on the meter's safe operating capacity (See *Appendix B*).[4] In the Authority's case, the typical meter size is the 5/8 x 3/4-inch meter which represents 94% of all meters in the potable water system. Since a large portion of water utility costs are typically related to meeting capacity requirements, individual capacity demands are important in establishing equitable rates for customers.
- **Variable (Consumption-Based) Charges** – In contrast to fixed charges, variable costs (e.g., electricity used in pumping water, chemicals for treatment, etc.) tend to change with the quantity of water produced. For a water utility, variable charges are generally based on metered consumption and charged on a dollar-per-unit basis (for example, per one hundred cubic feet, or ccf, in the Authority's case). Under a uniform (or single-tier) rate structure, the cost per unit does not change with consumption and provides a simple and straightforward approach that is easy to understand from the customer's perspective and simple to administer from the utility's perspective.

[3] James C. Bonbright, Albert L. Danielsen, and David R. Kamerschen, *Principles of Public Utility Rates*, (Arlington, VA: Public Utilities Report, Inc., Second Edition, 1988), p. 383-384.

[4] *Water Meters – Selection, Installation, Testing and Maintenance*, Manual of Water Supply Practices, M6, American Water Works Association, Fifth Edition, 2012, Table 5-3.

Key Financial Assumptions

The following is a summary of the key financial assumptions used in the water rate analyses:

- **Funding of Capital Projects –** The capital costs attributable to existing customers will be funded with a combination of cash reserves and proceeds from the revenue bond issuance. Capital costs attributable to growth, or future customers, are assumed to be funded with capacity fee revenue. All capital projects listed in the financial plan are from the Authority's capital improvement program through FY 2025/26.[5]
- **Reserve Targets** – The Authority maintains reserves for operations, capital, and other specific needs that are set at levels jointly recommended by Authority staff and NBS. The details of the utility's reserve targets are covered in the following section of this report.
- **Inflation and Growth Projections** – Assumptions regarding cost inflation were made in order to project future year revenues and expenses for the study period. The following inflation factors were used in the analysis:
    - ✓ General cost inflation is set at 3.12% annually and is based on the five-year average change in the Consumer Price Index for All Urban Consumers in the San Francisco-Oakland-Hayward areas.[6]
    - ✓ Customer growth rate is set at 0.44% annually and is based on historical number of new connections in 2014 through 2018.[7]
    - ✓ Labor cost inflation is set at 3.0% annually and is based on the five-year average change in the Sacramento and San Francisco County Employment and Wage Inflation Index (for all industries), per the BLS.

The next section discusses the water rate study in further detail.

[5] The Authority provided capital improvement costs through FY 2025/26; future years are projected at $1 million annually.
[6] Per the Bureau of Labor Statistics website (BLS).
[7] Source file: *No. 7B SSWA Official Statement Series 2019.pdf*, p. 27.

Section 2. Water Rate Study

A. Developing Recommended Water Rates

The Authority's water rate analysis was undertaken with a few specific objectives, including:

- Generate sufficient revenue to meet projected capital funding requirements.
- Adjust the timing of capital improvements and plan for debt funding to minimize the impact on ratepayers.
- Develop rates that continue to provide revenue stability and adjust the current rate structure to reflect the allocation of cost components more accurately (i.e., 51/49 split between fixed and variable charges).
- Comply with Prop 218 requirements to ensure equity among customer classes.

NBS developed a financial plan and various water rate alternatives as requested by Authority staff over the course of this study. The rate structure alternatives in the study all relied on industry standards and cost-of-service principles. The fixed and volume-based charges were calculated based on net revenue requirements, number of customer accounts, water consumption, and other information provided by the Authority. The Board will ultimately decide which rate alternative to adopt and implement.

The following components are included in this analysis:

- **Developing Cost Allocations:** The water revenue requirements were "functionalized" into three categories: (1) fixed capacity costs; (2) variable (or volume-based) costs; and (3) customer service costs. These functionalized costs were then used to develop unit costs based on various factors, such as water consumption, peaking factors, and number of accounts by meter size.
- **Determining Revenue Requirements by Customer Class:** The total revenue that needs to be collected from each customer class was determined using the functional costs and allocation factors. For example, customer costs are allocated based on the number of meters, while volume-related costs are allocated based on the water consumption of each customer class. Once the costs are allocated and the net revenue requirement for each customer class is determined, collecting the revenue requirements from each customer class is addressed within the rate design.
- **Rate Design and Fixed vs. Variable Costs:** The revenue requirements for each customer class are collected through a combination of fixed monthly service charges and volumetric rates. California law and industry practices provide flexibility regarding the actual percentages collected from fixed and variable rates.

B. Water Utility Revenue Requirements

It is important for municipal utilities to maintain reasonable reserves in order to handle emergencies, fund working capital, maintain a good credit rating, and generally follow sound financial management practices. Rate increases are governed by the need to meet operating and capital costs, maintain

adequate debt coverage, and build reasonable reserve funds. The current state of the Authority, with regard to these objectives, is as follows:

- **Meeting Revenue Requirements**: For FY 2021/22 through FY 2023/24, the projected net revenue requirement (that is, total annual expenses plus debt service and rate-funded capital costs less non-rate revenues) for the water utility is approximately $5.7 to $6.1 million, annually. If no rate adjustments are implemented, the Authority is projected to run an annual deficit of approximately $942,000 by FY 2025/26 which would continue to grow to $1.2 million by FY 2030/31. Therefore, without implementing the recommended rate increases, more significant increases will be required in the future.

- **Meeting Capital Improvement Costs:** The Authority must be able to fund necessary capital improvements and rehabilitation in order to maintain the current level of service for its customers. Authority staff has identified roughly $9.7 million in expected capital expenditures for FY 2021/22 through FY 2023/24.[8] The recommended rate increases will allow the water utility to complete planned capital projects while building reserve levels to meet the minimum recommended targets.

  In an effort to minimize the impact to ratepayers, the Authority is also planning to issue new revenue bonds in FY 2025/26 to help fund a portion of the planned capital improvement projects that will be needed from that point forward. However, during the 3-year rate period, the Authority will fund $5.0 million of the planned $9.7 million in capital costs with the 2019 revenue bonds and the remaining $4.7 million in capital costs with cash reserves.

- **Building and Maintaining Reserve Funds:** Reserve funds provide a basis for a utility to cope with fiscal emergencies, such as revenue shortfalls, asset failure, and natural disasters among other events. Reserve policies provide sound financial management with an overall long-range perspective to maintain financial solvency and mitigate financial risks associated with revenue instability, volatile capital costs, and emergencies. The proposed rate increases will help maintain cash reserves at an acceptable level, which is a direct result of funding a new rate stabilization reserve. If the proposed rate increases are implemented, reserve levels will continue to meet the total minimum target requirements over the 3-year rate period.

  NBS along with Authority staff have chosen to set the following reserve targets:

  - ✓ **Operating Reserve** equal to 25% (or 90 days) of operating expenses and debt service payments. The Authority adopted the operating reserve balance after considering the impact of the reserve balance on water rates in addition to the risk of unexpected costs or revenue reductions. The Authority determined that a 25% operating reserve was prudent since it also established a new Rate Stabilization Reserve. An operating reserve is intended to promote financial viability in the event of any short-term fluctuation in revenues and/or expenditures. Fluctuations might be caused by weather patterns, the natural inflow and outflow of cash during billing cycles, natural variability in demand-

[8] Does not include the $970,675 in capital improvement projects to be funded through capacity fee reserves.

based revenue streams (e.g., volumetric charges), and - particularly in periods of economic distress - changes or trends in the age of receivables.

- ✓ **Rate Stabilization Reserve** is set at $300,000. The financial plan assumes that the rate stabilization reserve remains at this balance. This reserve is intended to provide additional financial security to the Utility should any unforeseen revenue shortages or capital emergencies occur.

- ✓ **Capital Rehabilitation and Replacement Reserve** is set to maintain a minimum balance of $1 million but is increased annually if there are positive operating cash inflows after debt service.

- **Maintaining Adequate Bond Coverage:** The Authority is required by the rate covenant of the 2019 Revenue Bonds to maintain a debt service coverage ratio of at least 1.20. The benefit of maintaining a higher coverage ratio is that it strengthens the Authority's credit rating which can help lower the interest rates for debt-funded capital projects and, in turn, reduce annual debt service payments. It is projected that, without the recommended rate increases, the Authority will not be able to meet the debt coverage requirement beginning in FY 2025/26.

Figure 2 summarizes the sources and uses of funds, net revenue requirements, and the recommended annual percent increases in the total rate revenue proposed for the next three (3) years.

Figure 2. Summary of Water Revenue Requirements

Summary of Sources and Uses of Funds and Net Revenue Req'ts.	Actuals FY 2019/20	Projection FY 2020/21	Projected Rate Adoption Period FY 2021/22	FY 2022/23	FY 2023/24
Sources of Water Funds					
Rate Revenue Under Prevailing Rates[1]	$ 6,385,098	$ 6,400,000	$ 6,428,160	$ 6,456,444	$ 6,484,852
Un-Anticipated Savings	-	10,613	-	-	-
Non-Rate Revenues	446,639	417,479	458,988	453,988	453,988
Interest Earnings (in all reserves except the Debt Reserve)[2]	40,882	8,485	8,795	9,225	9,485
Total Sources of Funds	**$ 6,872,619**	**$ 6,836,577**	**$ 6,895,943**	**$ 6,919,657**	**$ 6,948,325**
Uses of Water Funds					
Operating Expenses [3]	$ 4,788,391	$ 4,888,656	$ 5,230,288	$ 5,360,119	$ 5,521,577
Debt Service	844,941	1,015,363	924,560	993,776	995,729
Rate-Funded Capital Expenses	-	-	-	-	-
Total Use of Funds	**$ 5,633,332**	**$ 5,904,019**	**$ 6,154,849**	**$ 6,353,896**	**$ 6,517,306**
Surplus (Deficiency) before Rate Increase	**$ 1,239,287**	**$ 932,559**	**$ 741,094**	**$ 565,761**	**$ 431,020**
Additional Revenue from Rate Increases	-	-	192,845	459,699	809,050
Surplus (Deficiency) after Rate Increase	**$ 1,239,287**	**$ 932,559**	**$ 933,939**	**$ 1,025,460**	**$ 1,240,070**
Projected Annual Rate Revenue Increase	***0.00%***	***0.00%***	***3.00%***	***4.00%***	***5.00%***
Cumulative Rate Increases	*0.00%*	*0.00%*	*3.00%*	*7.12%*	*12.48%*
Net Revenue Requirement	**$ 5,145,811**	**$ 5,467,441**	**$ 5,687,066**	**$ 5,890,683**	**$ 6,053,833**

1. Revenues are actuals for FY 2019/20 and projected thereafter. Source file: *SSWA Fund Detail Budget with Actual FY19.xlsx*.
2. Interest earnings for FY 2019/20 were provided by SSWA and then calculated for later years based on projected cash balances and historical LAIF returns.
3. Operating expenses are actuals for FY 2019/20. Inflationary factors are applied to these expenses in FY 2020/21 and beyond.

Figure 3 summarizes the projected reserve fund balances and reserve targets for the water utility. A detailed version of the water utility's proposed 10-year financial plan is included in *Appendix A*. The tables in the Appendix include revenue requirements, reserve funds, revenue sources, proposed rate adjustments, and the Authority's capital improvement program.

Figure 3. Summary of Water Reserve Funds

Beginning Reserve Fund Balances and Recommended Reserve Targets	Actuals FY 2019/20	Projection FY 2020/21	Projected Rate Adoption Period FY 2021/22	FY 2022/23	FY 2023/24
Operating Fund					
Ending Balance	$ 1,933,595	$ 1,455,969	$ 1,539,000	$ 1,588,000	$ 1,629,000
Recommended Minimum Target	*1,408,000*	*1,476,000*	*1,539,000*	*1,588,000*	*1,629,000*
Rate Stabilization Fund					
Ending Balance	$ 300,000	$ 303,000	$ 306,000	$ 309,000	$ 312,000
Recommended Minimum Target	*300,000*	*300,000*	*300,000*	*300,000*	*300,000*
Capital Rehabilitation & Replacement Fund					
Ending Balance	$ 4,023,042	$ 3,838,027	$ 2,453,498	$ 3,429,958	$ 3,744,247
Recommended Minimum Target	*1,000,000*	*1,000,000*	*1,000,000*	*1,000,000*	*1,000,000*
Debt Reserve Fund					
Ending Balance	$ -	$ 37	$ 37	$ 37	$ 37
Recommended Minimum Target	*-*	*-*	*-*	*-*	*-*
Total Ending Balance	**$ 6,256,637**	**$ 5,597,033**	**$ 4,298,535**	**$ 5,326,995**	**$ 5,685,284**
Total Recommended Minimum Target	***$ 2,708,000***	***$ 2,776,000***	***$ 2,839,000***	***$ 2,888,000***	***$ 2,929,000***

C. Characteristics of Water Customers by Class

Customer classes are determined by combining customers with similar demand characteristics and types of use into categories that reflect the cost differentials to serve each type of customer. The amount of consumption, peaking factors, and number of meters by size are used in the cost-of-service analysis to allocate costs to customer classes and determine the appropriate rate structure. The Authority's most recent consumption data is summarized in **Figure 4,** peaking factors in **Figure 5**, and number of customers by customer class is shown in **Figure 6**.

Figure 4 below summarizes the most recent consumption data by customer class and represents the expected percent of consumption over the 3-year rate period.

Figure 4. Water Consumption by Customer Class

Development of the Commodity Allocation Factor		
Customer Class	**FY 2018/19 Consumption (ccf)[1]**	**Percent of Consumption**
Single Family Residential	873,525	**72.9%**
Multi-Family & Non-Residential[2]	324,727	**27.1%**
Total	**1,198,252**	**100%**

1. Consumption data provided by the Authority and represents a conservative estimate.
   Source file: *No. 3 Summary of user charge-rate revenues by month.xlsx.*
2. Includes *Public Facility* consumption of 1,152 ccf.

Peaking factors, or peaking consumption, for each customer class are shown in Figure 5. A "peaking factor" is the relationship of each customer class' average use to its peak use, which is generally during the

summer months. A peaking factor is indicative of a customer's maximum water demand and the impact of each customer connected to the water system. Both operating costs and capital infrastructure costs incurred to accommodate peak system capacity events are generally allocated to each meter size according to its contribution to peak capacity events. These peaking factors are used to allocate capacity-related costs to each customer class and described in more detail in Section 2D of the study.

Figure 5. Peaking Factors by Customer Class

Development of the Capacity Allocation Factor				
Customer Class	Average Bi-Monthly Use (ccf)[1]	Peak Bi-Monthly Use (ccf)[1]	Peak Month Factor	Capacity Allocation Factor
Single Family Residential	145,588	189,541	1.30	**69.1%**
Multi-Family & Non-Residential	54,121	84,628	1.56	**30.9%**
Total	**199,709**	**274,169**	**1.37**	**100%**

1. Consumption source file: *No. 3 Summary of user charge-rate revenues by month.xlsx*.

The number of customers in each customer class (also known as customer allocation factors) is shown in Figure 6.

Figure 6. Number of Accounts by Customer Class

Development of the Customer Allocation Factor		
Customer Class	Number of Accounts[1]	Percent of Total
Single Family Residential	8,097	**95.2%**
Multi-Family & Non-Residential	410	**4.8%**
Total	**8,507**	**100%**

1. Data source is the meter count in the City's billing data for July 2018 - June 2019 included in source file: *No. 3 Summary of user charge-rate revenues by month.xlsx*.

D. Cost-of-Service Analysis

Once the net revenue requirements are determined, the cost-of-service analysis proportionately distributes those revenue requirements to each component of the water rate structure by allocating costs through the functionalization and classification process. The cost-of-service analysis consists of two major components: (1) the classification of expenses, and (2) the allocation of costs to customer classes. All costs in the Authority's budget were classified according to the function they serve and allocated to each component of the rate structure in proportion to the level of service required by customers. The level of service is related to volumes of peak and non-peak demand, infrastructure capacity, and customer service which are based on the allocation factors (e.g., water consumption, peaking factors, and number of accounts by meter size). Ultimately, a cost-of-service analysis should result in rates that are proportional to the cost of providing service to each customer.

Functionalization, Classification and Allocation

Most costs are not typically allocated 100 percent to fixed or variable categories, but rather allocated to multiple functions of water service, such as supply, treatment, and distribution. In the study, costs were classified using the commodity-demand method which is found in the AWWA M1 Manual.[9] In accordance with this method, budgeted costs were "classified" into three categories: (1) commodity-related costs; (2) capacity-related costs; and (3) customer-related costs. The classification process then allocates these costs to the following cost causation components described below:

- **Commodity-related costs:** These are costs related to the amount of water produced and delivered and commonly include the costs of chemicals used in the treatment process, energy related to pumping for transmission and distribution, water quality testing, and source of supply. Each customer class is allocated commodity-related costs based on the percentage of total consumption by that class.

- **Capacity-related costs:** These are costs associated with constructing and operating the water system to ensure there is sufficient capacity in the system to meet the demand of each meter connected. This includes both operating costs and capital infrastructure costs incurred to accommodate peak system capacity events.

    - ✓ **Fire Protection-related costs:** Providing immediate availability of water in the volumes and at the pressures needed to supply fire hydrants and sprinklers, which are used for the purpose of protecting property from fire, is a property-related service the costs of which the Authority may recover through water rates. The Legislature has specifically reinforced this concept by adopting SB 1386.[10] While municipalities and utilities in other states have sometimes recovered costs for fire protection through property taxes, California law has long authorized water utilities to collect these costs from their customers whose properties are served by fire protection water facilities. The service delivered to property owners is the capacity to provide water when needed; accordingly, the Authority's costs allocated to fire protection are based on hydraulic capacity. The cost of this capacity-related service is included with all other capacity-related, or fixed, costs. The Authority allocates the cost of fire protection as an indirect part of water rates to customer classes on the same basis as other fixed costs rather than separately identifying a component charge designated for fire protection.

- **Customer-related costs:** These are costs associated with having a customer connected to the water system and includes costs for meter reading, postage, billing, and other administrative

[9] *Principles of Water Rates, Fees, and Charges*, Manual of Water Supply Practices, M1, AWWA, Seventh Edition, 2017, p. 83.

[10] Senate Bill 1386 states that "hydrants, as defined, are part of the system of public improvements included in the definition of 'water' for purposes of the Proposition 218 Omnibus Implementation Act…and the fees or charges for property-related water service imposed or increased, as specified, may include the costs to construct, maintain, repair, or replace hydrants as needed or consistent with fire codes and industry standards, and may include the cost of water distributed through hydrants." The bill also authorizes "the fees or charges for the aspects of water service related to hydrants and the water distributed through them to be fixed and collected as a separate fee or charge or included in the other water rates and charges fixed and collected by a public agency, as specified." Source: *https://leginfo.legislature.ca.gov*.

duties. Customer service costs do not differ based on meter size; therefore, these costs are spread equally among all meters. Each customer class is allocated customer-related costs based on the percentage of total meters in that class.

Once costs are allocated to these cost causation components, they are then used to establish new water rates in the form of fixed and variable charges. The tables in *Appendix A* show how the Authority's expenses were classified and allocated to these cost causation components.

Figure 7 below summarizes how cost components are grouped with respect to fixed and variable components.

Figure 7. Cost Functionalization Summary

Ideally, utilities should recover all of their fixed costs from fixed charges and all of their variable costs from volumetric charges. When this is the case, fluctuations in water sales revenues would be directly offset by reductions or increases in variable expenses. When rates are set in this manner, they provide greater revenue stability for the utility. However, other factors, such as ease of understanding and ease of administration, are also be considered when designing water rates.[11]

An important objective in this study was to develop rates that are consistent with the existing rate structure, which consists of fixed rates based on meter size and a uniform volumetric charge for all water usage. A second objective in the study was to develop rates that are relatively stable from year to year. The current rate structure collects approximately 50% of rate revenue from fixed rates and 50% from volumetric rates. The proposed rate structure collects approximately 51% from fixed charges and 49% from variable charges which is largely consistent with existing rates but modified slightly to reflect the new allocation of budgeted costs to the various cost causation components. Given that SSWA has a significant amount of capital improvements planned for the next few years (and recently completed) and that the annual debt service payments will go from approximately $992,000 to $1.5 million beginning in FY 2025/26, this is a reasonable and balanced approach to rate setting. Many utilities have struggled with revenue stability in recent years given conservation mandates and water supply shortages. SSWA's new rate structure balances the need to maintain revenue stability while still giving customers considerable control over their bill. **Figure 8** summarizes the allocation of net revenue requirements to each cost causation component for the proposed rate structure.

[11] *Principles of Water Rates, Fees, and Charges*, Manual of Water Supply Practices, M1, AWWA, Seventh Edition, pp. 5 and 96.

Figure 8. Summary of Rate Revenue Requirements

Classification Components	SSWA Proposed Net Revenue Requirements FY 2021/22[1]	
Commodity-Related Costs	$ 3,400,336	*51%*
Capacity-Related Costs	3,162,187	*48%*
Customer-Related Costs	58,482	*1%*
Net Revenue Requirement	**$ 6,621,005**	*100%*

1. Reflects SSWA's updated ratio of fixed vs. volumetric charges.

Development of Proposed Rates

Volumetric Rates

Currently, SSWA charges a uniform volumetric rate for all customers and the proposed rates maintain this structure. Given the single source of water supply, a uniform volumetric rate is appropriate for SSWA.

Figure 9. Development of Volumetric Rate

Customer Classes	Water Consumption (ccf/yr)[1]	Target Revenue Reqt. from Volumetric	Uniform Commodity Rates ($/ccf)
Single Family Residential	873,525	$ 2,478,843	$2.84
Multi-Family & Non-Residential	324,727	921,493	$2.84
Total	**1,198,252**	**3,400,336**	

1. Number of accounts and water consumption is from source file: *No. 3 Summary of user charge-rate revenues by month.xlsx.*

Fixed Rates

Given the projected variable rate revenue shown in Figure 9, the remaining rate revenue must be collected from fixed charges. The fixed meter charge recognizes that the water utility incurs fixed costs regardless of whether customers actually use water. There are two components that comprise the fixed meter charge: (1) the customer component, and (2) the capacity component. The customer component is comprised of those costs relating to reading and maintaining meters, customer billing and collection, and other customer service-related costs. The customer service costs do not differ among the various meter sizes; therefore, the rate for this component of the fixed meter charge is the same for each meter size.

The capacity component recovers costs associated with sizing the water system to ensure there is sufficient capacity in the system to meet peak demand. The utility must construct and operate the system to deliver water at peak times. A user class with higher peaking (capacity) needs is allocated a proportionately higher share of the capacity related costs compared to customer classes with lower peaking needs. Therefore, meter sizes have different fixed charges based on their capacity requirements

which means that larger meters have the potential to use more of the system's capacity,[12] or said differently, they can have higher peaking factors compared to smaller meters. The potential capacity demanded (peaking) is proportional to the maximum hydraulic flow through each meter size as established by the AWWA hydraulic capacity ratios.[13] The AWWA capacity ratios used for this report are shown in the second column of **Figure 10**.

As an example, a 2-inch meter has a greater capacity, or potential peak demand than a 3/4-inch meter; therefore, the fixed charge for a 2-inch meter is larger than a 3/4-inch meter based on the proportionate capacity requirements for this size meter.[14] A "hydraulic capacity factor" is calculated by dividing the maximum capacity, or flow, of large meters by the capacity of the base meter size, which is typically the most common residential meter size (in this case, a 5/8 x 3/4-inch meter).

The actual number of meters by size is then multiplied by the corresponding capacity ratios to calculate equivalent meters. The number of equivalent meters is used as a proxy for the potential demand that each customer can place on the water system. A significant portion of a water system's peak capacity and, in turn, the utility's fixed operating and capital costs, are related to meeting system capacity requirements.

For FY 2021/22, Figure 10 shows how the fixed bi-monthly service charges were calculated. The customer component of the rate is $1.15 per meter and does not vary by meter size because it represents costs to the utility for having connections to the water system. Capacity costs vary by meter size and are based on the hydraulic capacity of each size meter. The ratios shown are the ratio of potential flow through each meter size compared to the flow through a 3/4-inch meter.[15] For example, column 2 in Figure 10 shows the hydraulic capacity of a 4-inch meter is 10 times that of a 3/4-inch meter and therefore the capacity component of the fixed meter charge is 10 times that of the 3/4-inch meter. The rate for the meter capacity component for a 4-inch meter is derived in column 6 of Figure 10, and is scaled using the AWWA hydraulic meter capacity ratios shown in column 2. The fixed charge for all 5/8 x 3/4-inch and 3/4-inch meters is assumed to be the same in order to mirror the existing rate structure. This is shown in Figure 10 by adjusting the hydraulic capacity ratio of the 3/4-inch meter to 1.0 for the following reasons:

- The desire for a single fixed meter charge across all customer classes.
- The overwhelming number of meters between 5/8 x 3/4-inch and 3/4-inch being single family residential.

[12] System capacity is the system's ability to supply water to all delivery points at the time of demand.

[13] AWWA Manual M6, *Water Meters - Selection, Installation, Testing, and Maintenance*, Table 5-3, which assumes displacement meters for 5/8 through 2-inch meters and singlejet meters for 3 through 6-inch meters.

[14] This is reflected in the fixed charge calculations by using the AWWA hydraulic capacity factors to represent the maximum volume each meter size is capable of delivering.

[15] Meter Equivalency Factors in *Appendix A* (see Table 29) show potential flow or meter capacity for each meter size from which the hydraulic capacity factor was derived.

Figure 10. Calculation of FY 2021/22 Fixed Meter Charges

Meter Size	Hydraulic Capacity Factor	Number of Meters	Equivalent Meters	Fixed Charge		Total Fixed Meter Charge	Estimated Revenue
				Customer Component	Capacity Component		
5/8 - 3/4 inch	1.00	7,952	7,952	$1.15	$56.98	$58.12	$ 2,773,181
3/4 inch	1.00	23	23	$1.15	$56.98	$58.12	8,021
1 inch	1.60	280	448	$1.15	$91.16	$92.31	155,081
1 1/2 inch	2.00	150	300	$1.15	$113.96	$115.10	103,591
2 inch	4.00	77	308	$1.15	$227.91	$229.06	105,824
3 inch	6.40	17	109	$1.15	$364.66	$365.80	37,312
4 inch	10.00	5	50	$1.15	$569.78	$570.92	17,128
6 inch	20.00	3	60	$1.15	$1,139.55	$1,140.70	20,533
Total		**8,507**	**9,250**				**$ 3,220,669**

It should be noted that the sum of the total revenue in Figure 10 matches the sum of the customer and commodity related costs shown in Figure 8.

E. Current vs. Proposed Water Rates

The process of designing water rates provides the opportunity to incorporate a number of rate-design objectives and policies, including revenue stability and equity among customer classes. The proposed water rates in this study were developed based on input provided by Authority staff, the Executive Committee, and the Board. One of SSWA's goals for this study was to maintain the existing rate structure that consists of a fixed rate based on meter size (regardless of customer class) and a uniform volumetric rate based on bi-monthly water consumption.

Figure 11 presents a comparison of the current and proposed water rates for FY 2021/22 through FY 2023/24 for each meter size. Projected rates for each fiscal year[16] reflect adjustments based on the cost-of-service analysis, the 51% fixed/49% variable rate design structure, and the recommended percent increases in rate revenue planned for each year. More detailed tables on the development of the proposed water rates are documented in *Appendix A*.

[16] The initial rate adjustment will be implemented as soon as the Prop 218 process is completed, and all future rate adjustments are scheduled to be effective on July 1st of each year.

Figure 11. Current and Proposed Water Rates

Suisun-Solano Water Authority Current and Proposed Water Rates				
Water Rate Schedule	Current Rates	Proposed Rates[1]		
		FY 2021/22	FY 2022/23	FY 2023/24
Fixed Charges:				
5/8 x 3/4 inch	$55.15	$58.12	$60.45	$63.47
3/4 inch	$55.15	$58.12	$60.45	$63.47
1 inch	$87.55	$92.31	$96.00	$100.80
1 1/2 inch	$109.15	$115.10	$119.70	$125.69
2 inch	$217.14	$229.06	$238.22	$250.13
3 inch	$325.13	$365.80	$380.43	$399.46
4 inch	$433.12	$570.92	$593.76	$623.45
6 inch	$1,081.06	$1,140.70	$1,186.33	$1,245.64
Commodity Charges for All Water Usage ($/ccf*):				
Uniform Rate	$2.49	$2.84	$2.95	$3.10

1. These rates collect 51% of the total rate revenue from the fixed charges and 49% from the commodity charges.

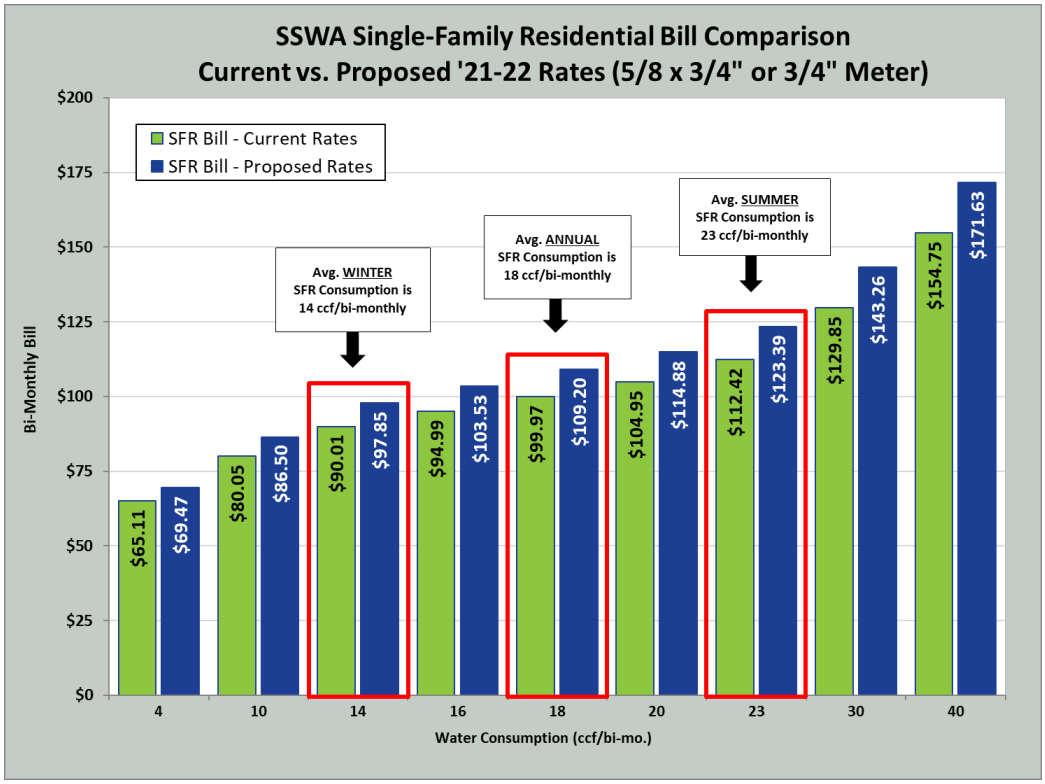
** ccf = 100 cubic feet, or approximately 748 gallons.*

F. Comparison of Current and Proposed Bi-Monthly Bills

Comparison of Current and Proposed Single-Family Residential Bills

Figure 12 compares bi-monthly water bills for a 5/8 x 3/4-inch meter under current and proposed water rates for single-family residential customers in the first year of the new rate period. These bi-monthly bill comparisons are based on typical meter sizes and average consumption levels for each customer class. If consumption stays consistent with FY 2018/19 levels, all single-family residential customers are expected to see an increase in their bi-monthly water bill due to the percentage increase in overall rate revenue to be collected from all customers.

Figure 12. Bi-Monthly Water Bill Comparison for Single-Family Residential Customers



Multi-Family and Non-Residential Water Customers

Multi-family and non-residential customers are subject to the same fixed bi-monthly charge and uniform volumetric charge as single-family residential customers. The proposed rates reflect the cost of providing water service to each customer class as described previously in this study. As a result, bi-monthly bills for multi-family and non-residential customers will also vary based on their actual consumption as well as their meter size.

Figure 13 compares current and proposed bi-monthly bills for multi-family and non-residential customers with a 1 1/2-inch meter at various levels of consumption. As Figure 13 demonstrates, the bi-monthly water bill for multi-family and non-residential customers will also increase if the recommended rates are adopted.

Figure 13. Bi-Monthly Water Bill Comparison for Multi-Family & Non-Residential Customers

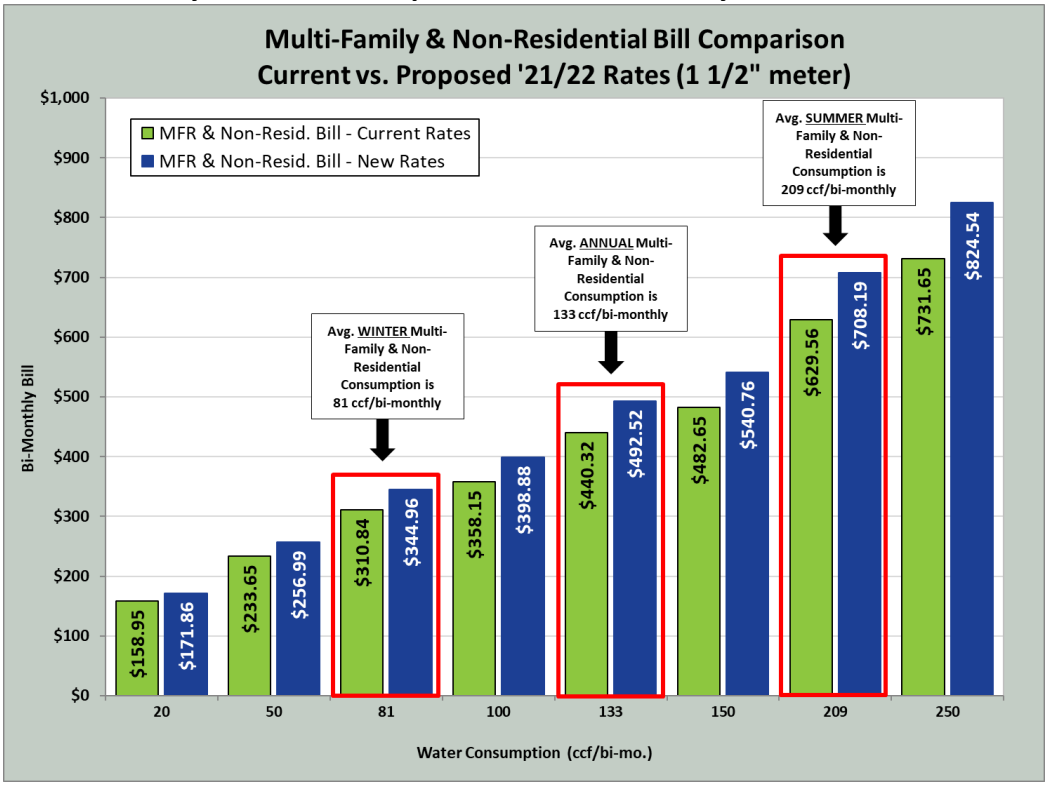
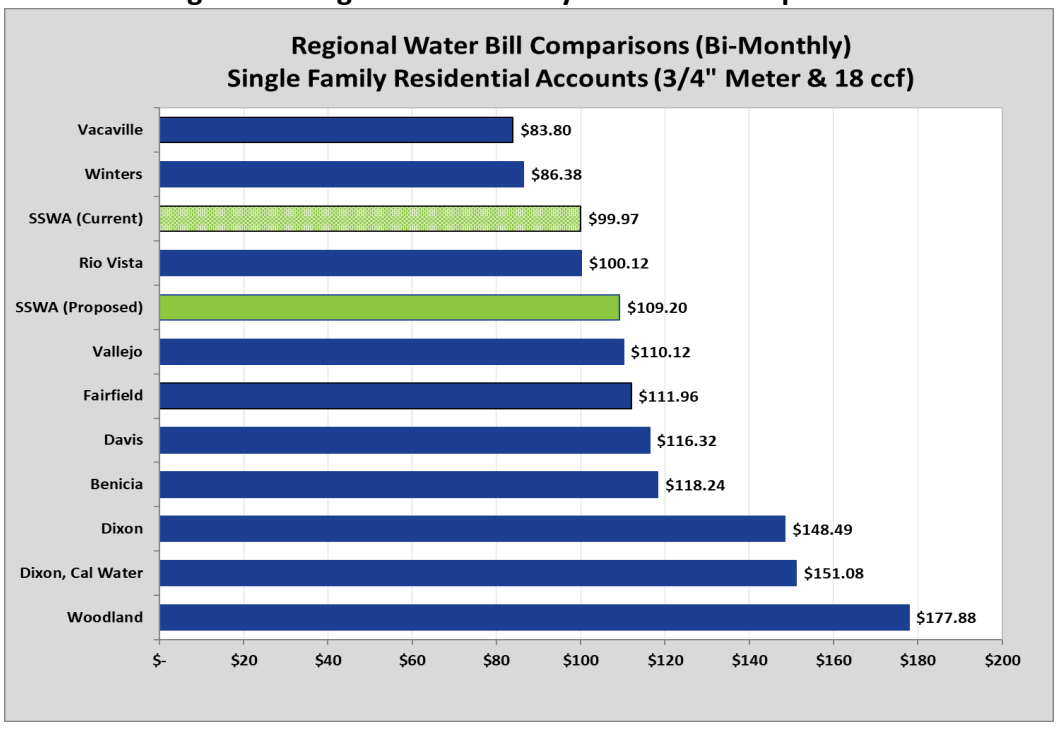


Figure 14 compares the current and proposed bi-monthly water bills for the typical single-family residential customer to those of other surrounding communities.

Figure 14. Regional Bi-Monthly Water Bill Comparisons



Section 3. Recommendations and Next Steps

A. Consultant Recommendations

NBS recommends the Authority take the following actions:

- **Approve and Accept this Study:** NBS recommends the Authority's Board of Directors formally approve and adopt this study and its recommendations, and then proceed with the steps required to implement the proposed rates. This will provide documentation of the rate study analyses and the basis for analyzing potential changes to future rates.
- **Implement Recommended Levels of Rate Increases and Proposed Rates**: Based on successfully meeting the Proposition 218 procedural requirements, the Authority should proceed with implementing the 3-year schedule of proposed rates and rate adjustments previously shown in Figure 11. This will help ensure the continued financial health of the Authority's water utility.

B. Next Steps

Annually Review Rates and Revenue - Any time an agency adopts new utility rates or rate structures, those new rates should be closely monitored over the next several years to ensure the revenue generated is sufficient to meet the annual revenue requirements. Changing economic and water consumption patterns underscore the need for this review, as well as potential and unforeseen changes in revenue requirements - particularly those related to environmental regulations that can significantly affect capital improvements and repair and replacement costs.

C. Principal Assumptions and Considerations

In preparing this report and the opinions and recommendations included herein, NBS has relied on a number of principal assumptions and considerations with regard to financial matters, conditions, and events that may occur in the future. This information and assumptions, including the Authority's budgets, capital improvement costs, and information from Authority staff were provided by sources we believe to be reliable although NBS has not independently verified this data.

While we believe NBS' use of such information and assumptions is reasonable for the purpose of this report and its recommendations, some assumptions will invariably not materialize as stated herein or may vary significantly due to unanticipated events and circumstances. Therefore, the actual results can be expected to vary from those projected to the extent that actual future conditions differ from those assumed by us or provided to us by others.

Note: The attached Appendices provide more detailed information on the analysis of the water revenue requirements, cost-of-service analysis and cost allocations, and the rate design analyses that have been summarized in this report.

Section 4. Abbreviations and Acronyms[17]

Alt.	Alternative
Avg.	Average
AWWA	American Water Works Association
CAP	Capacity
CCF	Hundred Cubic Feet (same as HCF); equal to 748 gallons
CCI	Construction Cost Index
COM	Commodity
Comm.	Commercial
COS	Cost of Service
COSA	Cost of Service Analysis
CPI	Consumer Price Index
CIP	Capital Improvement Program
Excl.	Exclude
ENR	Engineering News Record
EDU	Equivalent Dwelling Unit
Exp.	Expense
FY	Fiscal Year (e.g., July 1st to June 30th)
GPM	Gallons per Minute
HCF	Hundred Cubic Feet; equal to 748 gallons or 1 CCF
Ind.	Industrial
Irr.	Irrigation
LAIF	Local Agency Investment Fund
MFR	Multi-Family Residential
Mo.	Month
N/A	Not Available or Not Applicable
O&M	Operational and Maintenance Expenses
Prop 218	Proposition 218 (1996) – State Constitutional amendment expanded restrictions of local government revenue collections.
Req't	Requirement
Res.	Residential
Rev.	Revenue
R&R	Rehabilitation and Replacement
SFR	Single Family Residential
SRF Loan	State Revolving Fund Loan
V. / Vs. / vs.	Versus

[17] This section identifies abbreviations and acronyms that may be used in this report. This section has not been viewed, arranged, or edited by an attorney, nor should it be relied on as legal advice. The intent of this section is to support the recognition and analysis of this report. Any questions regarding clarification of this document should be directed to staff or an attorney specializing in this particular subject matter.

Appendix A. Detailed Water Rate Tables and Figures

Appendix B. Meter Capacity Factors

Table 5-3 Test requirements for new, rebuilt, and repaired cold–water meters*

Displacement Meters (AWWA C700 and C710)

Size	Maximum Rate (All Meters) Flow Rate†	Test Quantity††		Accuracy Limits	Intermediate Rate (All Meters) Flow Rate**	Test Quantity††		Accuracy Limits	Minimum Rate (New and Rebuilt) Flow Rate	Test Quantity††		Accuracy Limits	Minimum (Repaired) Accuracy Limits
in.	*gpm*	*gal*	*ft³*	*percent*	*gpm*	*gal*	*ft³*	*percent*	*gpm*	*gal*	*ft³*	*percent*	*percent (min)*
½	8	100	10	98.5–101.5	2	10	1	98.5–101.5	¼	10	1	95–101	90
½ × ¾	8	100	10	98.5–101.5	2	10	1	98.5–101.5	¼	10	1	95–101	90
⅝	15	100	10	98.5–101.5	2	10	1	98.5–101.5	¼	10	1	95–101	90
⅝ × ¾	15	100	10	98.5–101.5	2	10	1	98.5–101.5	¼	10	1	95–101	90
¾	25	100	10	98.5–101.5	3	10	1	98.5–101.5	½	10	1	95–101	90
1	40	100	10	98.5–101.5	4	10	1	98.5–101.5	¾	10	1	95–101	90
1½	60	100	10	98.5–101.5	8	100	10	98.5–101.5	1½	100	10	95–101	90
2	100	100	10	98.5–101.5	15	100	10	98.5–101.5	2	100	10	95–101	90

Multijet Meters (AWWA C708)

Size	Maximum Rate (All Meters) Flow Rate†	Test Quantity††		Accuracy Limits	Intermediate Rate (All Meters) Flow Rate**	Test Quantity††		Accuracy Limits	Minimum Rate (New and Rebuilt) Flow Rate	Test Quantity††		Accuracy Limits	Minimum (Repaired) Accuracy Limits
in.	*gpm*	*gal*	*ft³*	*percent*	*gpm*	*gal*	*ft³*	*percent*	*gpm*	*gal*	*ft³*	*percent*	*percent (min)*
⅝	15	100	10	98.5–101.5	1	10	1	98.5–101.5	½	10	1	97–103	90
⅝ × ¾	15	100	10	98.5–101.5	1	10	1	98.5–101.5	½	10	1	97–103	90
¾	25	100	10	98.5–101.5	2	10	1	98.5–101.5	½	10	1	97–103	90
1	35	100	10	98.5–101.5	3	10	1	98.5–101.5	¾	10	1	97–103	90
1½	70	100	10	98.5–101.5	5	100	10	98.5–101.5	1½	100	10	97–103	90
2	100	100	10	98.5–101.5	8	100	10	98.5–101.5	2	100	10	97–103	90

Singlejet Meters (AWWA C712)

Size	Maximum Rate (All Meters) Flow Rate†	Test Quantity††		Accuracy Limits	Intermediate Rate (All Meters) Flow Rate**	Test Quantity††		Accuracy Limits	Minimum Rate (New and Rebuilt) Flow Rate	Test Quantity††		Accuracy Limits	Minimum (Repaired) Accuracy Limits
in.	*gpm*	*gal*	*ft³*	*percent*	*gpm*	*gal*	*ft³*	*percent*	*gpm*	*gal*	*ft³*	*percent*	*percent (min)*
⅝	15	100	10	98.5–101.5	2	10	1	98.5–101.5	¼	10	1	95–101.5	90
⅝ × ¾	15	100	10	98.5–101.5	2	10	1	98.5–101.5	¼	10	1	95–101.5	90
¾	25	100	10	98.5–101.5	3	10	1	98.5–101.5	½	10	1	95–101.5	90
1	40	100	10	98.5–101.5	4	10	1	98.5–101.5	¾	10	1	95–101.5	90
1½	50	100	10	98.5–101.5	8	100	10	98.5–101.5	½	100	10	95–101.5	90
2	100	100	10	98.5–101.5	15	100	10	98.5–101.5	½	100	10	95–101.5	90
3	160	500	50	98.5–101.5	20	100	10	98.5–101.5	½	100	10	95–101.5	90
4	250	500	50	98.5–101.5	40	100	10	98.5–101.5	⅜	100	10	95–101.5	90
6	500	1,000	100	98.5–101.5	60	100	10	98.5–101.5	1½	100	10	95–101.5	90

Fluidic–Oscillator Meters (AWWA C713)

Size	Maximum Rate (All Meters) Flow Rate†	Test Quantity††		Accuracy Limits	Intermediate Rate (All Meters) Flow Rate**	Test Quantity††		Accuracy Limits	Minimum Rate (New and Rebuilt) Flow Rate	Test Quantity††		Accuracy Limits	Minimum (Repaired) Accuracy Limits
in.	*gpm*	*gal*	*ft³*	*percent*	*gpm*	*gal*	*ft³*	*percent*	*gpm*	*gal*	*ft³*	*percent*	*percent (min)*
½	8	100	10	98.5–101.5	2	10	1	98.5–101.5	¼	10	1	95–101	90
½ × ¾	8	100	10	98.5–101.5	2	10	1	98.5–101.5	¼	10	1	95–101	90
⅝	15	100	10	98.5–101.5	2	10	1	98.5–101.5	¼	10	1	95–101	90
⅝ × ¾	15	100	10	98.5–101.5	2	10	1	98.5–101.5	¼	10	1	95–101	90

(continued)

Appendix B. Meter Capacity Factors, cont.

Table 5-3 Test requirements for new, rebuilt, and repaired cold-water meters* (continued)

Fluidic–Oscillator Meters (AWWA C713)

¾	25	100	10	98.5–101.5	3	10	1	98.5–101.5	½	10	1	95–101	90
1	40	100	10	98.5–101.5	4	10	1	98.5–101.5	¾	10	1	95–101	90
1½	50	100	10	98.5–101.5	8	100	10	98.5–101.5	1½	100	10	95–101	90
2	100	100	10	98.5–101.5	15	100	10	98.5–101.5	2	100	10	95–101	90

Class I Turbine Meters, Vertical–Shaft Type (AWWA C701)

	Maximum Rate (All Meters)				Intermediate Rate (All Meters)				Minimum Rate (New and Rebuilt)				Minimum (Repaired)
Size	Flow Rate†	Test Quantity††		Accuracy Limits	Flow Rate**	Test Quantity††		Accuracy Limits	Flow Rate	Test Quantity††		Accuracy Limits	Accuracy Limits
in.	*gpm*	*gal*	*ft³*	*percent*	*gpm*	*gal*	*ft³*	*percent*	*gpm*	*gal*	*ft³*	*percent*	*percent (min)*
¾	30	100	10	98–102	3	10	1	98–102	1½	10	1	98–102	—
1	50	100	10	98–102	5	10	1	98–102	2	10	1	98–102	—
1½	100	500	50	98–102	10	100	10	98–102	3	100	10	98–102	—
2	160	500	50	98–102	16	100	10	98–102	4	100	10	98–102	—
3	350	1,000	100	98–102	35	100	10	98–102	6	100	10	98–102	—
4	600	1,500	200	98–102	60	100	10	98–102	8	100	10	98–102	—
6	1,250	4,000	500	98–102	125	1,000	100	98–102	15	1,000	100	98–102	—

Class II Turbine Meters, In–Line (High–Velocity) Type (AWWA C701)

	Maximum Rate (All Meters)				Intermediate Rate (All Meters)				Minimum Rate (New and Rebuilt)				Minimum (Repaired)
Size	Flow Rate†	Test Quantity††		Accuracy Limits	Flow Rate**	Test Quantity††		Accuracy Limits	Flow Rate	Test Quantity††		Accuracy Limits	Accuracy Limits
in.	*gpm*	*gal*	*ft³*	*percent*	*gpm*	*gal*	*ft³*	*percent*	*gpm*	*gal*	*ft³*	*percent*	*percent (min)*
1½	100	500	50	98.5–101.5					4	100	10	98.5–101.5	—
2	160	500	50	98.5–101.5					4	100	10	98.5–101.5	—
3	350	1,000	100	98.5–101.5					8	100	10	98.5–101.5	—
4	630	1,500	200	98.5–101.5					15	100	10	98.5–101.5	—
6	1,400	4,000	500	98.5–101.5					30	1,000	100	98.5–101.5	—
8	2,400	7,000	900	98.5–101.5					50	1,000	100	98.5–101.5	—
10	3,800	10,000	1,300	98.5–101.5					75	1,000	100	98.5–101.5	—
12	5,000	15,000	2,000	98.5–101.5					120	1,000	100	98.5–101.5	—
16	10,000	30,000	4,000	98.5–101.5					200	1,000	100	98.5–101.5	—
20	15,000	40,000	5,000	98.5–101.5					300	1,000	100	98.5–101.5	—

Propeller Meters (AWWA C704)

	Maximum Rate (All Meters)				Intermediate Rate (All Meters)				Minimum Rate (New and Rebuilt)				Minimum (Repaired)
Size	Flow Rate†	Test Quantity††		Accuracy Limits	Flow Rate**	Test Quantity††		Accuracy Limits	Flow Rate	Test Quantity††		Accuracy Limits	Accuracy Limits
in.	*gpm*	*gal*	*ft³*	*percent*	*gpm*	*gal*	*ft³*	*percent*	*gpm*	*gal*	*ft³*	*percent*	*percent (min)*
2	100	300	40	98–102					35	200	25	98–102	90
3	250	800	100	98–102					40	200	25	98–102	90
4	500	1,500	200	98–102					50	250	30	98–102	90
6	1,200	2,500	300	98–102					90	500	60	98–102	90
8	1,500	3,000	400	98–102					100	500	60	98–102	90
10	2,000	4,000	500	98–102					125	500	60	98–102	90
12	2,800	6,000	800	98–102					150	750	100	98–102	90
14	3,750	8,000	1,000	98–102					250	1,000	130	98–102	90
16	4,750	10,000	1,300	98–102					350	1,500	200	98–102	90
18	5,625	12,000	1,600	98–102					450	2,000	250	98–102	90
20	6,875	15,000	2,000	98–102					550	2,500	300	98–102	90
24	10,000	20,000	2,500	98–102					800	4,000	500	98–102	90
30	15,000	30,000	4,000	98–102					1,200	6,000	800	98–102	90
36	20,000	40,000	5,000	98–102					1,500	7,500	1,000	98–102	90

(continued)

Appendix B. Meter Capacity Factors, cont.

Table 5-3 Test requirements for new, rebuilt, and repaired cold-water meters* (continued)

Propeller Meters (AWWA C704)

Size	Maximum Rate (All Meters) Flow Rate†	Test Quantity††		Accuracy Limits	Change Over Point (All Meters) Flow Rate**	Test Quantity††		Accuracy Limits	Minimum Rate (New and Rebuilt) Flow Rate	Test Quantity††		Accuracy Limits	Minimum (Repaired) Accuracy Limits
in.	*gpm*	*gal*	*ft³*	*percent*	*gpm*	*gal*	*ft³*	*percent*	*gpm*	*gal*	*ft³*	*percent*	*percent (min)*
42	28,000	40,000	5,000	98–102	2,000	10,000	1,300	98–102	90				
48	35,000	50,000	6,000	98–102	2,500	12,500	1,500	98–102	90				
54	45,000	60,000	8,000	98–102	3,200	16,000	2,000	98–102	90				
60	60,000	70,000	9,000	98–102	4,000	20,000	2,500	98–102	90				
66	75,000	80,000	11,000	98–102	4,750	25,000	3,000	98–102	90				
72	90,000	90,000	12,000	98–102	5,500	28,000	3,500	98–102	90				

Compound Meters (AWWA C702)§

Size	Maximum Rate (All Meters) Flow Rate†	Test Quantity††		Accuracy Limits	Change Over Point (All Meters) Flow Rate**	Test Quantity††		Accuracy Limits	Minimum Rate (New and Rebuilt) Flow Rate	Test Quantity††		Accuracy Limits	Minimum (Repaired) Accuracy Limits
in.	*gpm*	*gal*	*ft³*	*percent*	*gpm*	*gal*	*ft³*	*percent*	*gpm*	*gal*	*ft³*	*percent*	*percent (min)*
				Class I Class II									
2	160	400	50	97–103 98.5–101.5				90–103				95–101	90
3	320	1,000	100	97–103 98.5–101.5				90–103				95–101	90
4	500	1,500	200	97–103 98.5–101.5				90–103				95–101	90
6	1,000	3,000	400	97–103 98.5–101.5				90–103				95–101	90
8	1,600	4,000	500	97–103 98.5–101.5				90–103				95–101	90
10	2,300	4,000	500	97–103 98.5–101.5				90–103				95–101	90

Fire-Service Type, Type I and Type II (AWWA C703)
(Test at intermediate rate not necessary.)§

Size	Maximum Rate (All Meters) Flow Rate†	Test Quantity††		Accuracy Limits	Change Over Point (All Meters) Flow Rate**	Test Quantity††		Accuracy Limits	Minimum Rate (New and Rebuilt) Flow Rate	Test Quantity††		Accuracy Limits	Minimum (Repaired) Accuracy Limits
in.	*gpm*	*gal*	*ft³*	*percent*	*gpm*	*gal*	*ft³*	*percent*	*gpm*	*gal*	*ft³*	*percent*	*percent (min)*
				Type I Type II									
3	350	700	100	97–103 98.5–101.5									90
4	700	1,500	200	97–103 98.5–101.5				Not less				Not less	90
6	1,600	3,000	400	97–103 98.5–101.5				than 85%				than 95%	90
8	2,800	5,000	700	97–103 98.5–101.5									90
10	4,400	9,000	1,200	97–103 98.5–101.5									90

Fire Service Type, Type III (AWWA C703)

Size	Maximum Rate (All Meters) Flow Rate†	Test Quantity††		Accuracy Limits	Intermediate Rate (All Meters) Flow Rate**	Test Quantity††		Accuracy Limits	Minimum Rate (New and Rebuilt) Flow Rate	Test Quantity††		Accuracy Limits	Minimum (Repaired) Accuracy Limits
in.	*gpm*	*gal*	*ft³*	*percent*	*gpm*	*gal*	*ft³*	*percent*	*gpm*	*gal*	*ft³*	*percent*	*percent (min)*
3	350	700	100	98.5–101.5	10	100	10	98.5–101.5	4	100	10	95–101.5	—
4	700	1,500	200	98.5–101.5	30	500	50	98.5–101.5	10	100	10	95–101.5	—
6	1,600	3,000	400	98.5–101.5	60	1000	100	98.5–101.5	20	1000	100	95–101.5	—
8	2,800	5,000	700	98.5–101.5	70	1000	100	98.5–101.5	30	1000	100	95–101.5	—
10	4,400	9,000	1,200	98.5–101.5	110	1000	100	98.5–101.5	35	1000	100	95–101.5	—

* A rebuilt meter is one that has had the measuring element replaced with a factory-made new unit. A repaired meter is one that has had the old measuring element cleaned and refurbished in a utility repair shop.

† These are suggested test flows and test quantities. Testing for high rates of flow can be achieved by testing the meter at 25% of the meters rating if the manufacturer's original test certificate indicates a linear curve between 25% and 100% of the rated flow range.

†† Quantity should be one or more full revolutions of the test hand but not less than 3 min running. When limited test capabilities force the use of smaller test quantities, the resultant increase in total test uncertainties and errors need to be recognized when establishing acceptance criteria tolerance.

§ The bypass meter should be tested in accordance with the appropriate test requirements for the type of meter used.

** As this rate varies according to manufacturer, it should be determined for each type of meter tested.

Metric Conversions: in. × 25.4 = mm, gal × 0.003785 = m^3, gpm × 0.2268 = m^3/h, ft^3 × 0.02831 = m^3.