FARR WEST ENGINEERING

Water Conservation Plan

Douglas County Utilities

Douglas County, Nevada

March 2022

DOUGLAS COUNTY NEVADA




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1.0 INTRODUCTION

This Water Conservation Plan (the Plan) was prepared for Douglas County Utilities (the Utility) to serve as a framework for implementing and evaluating water conservation strategies. Water conservation is most effective when practiced in a proactive manner. Rather than only taking action once an emergency scenario occurs (e.g., extended drought, disruption of water supply), a proactive approach can help mitigate impacts of emergency events before they occur. This can result in a more resilient and sustainable water system for the water supplier and customers. One major advantage of initiating water conservation practices is that they can potentially save water without requiring major capital improvement and infrastructure projects.

1.1 STATUTORY REQUIREMENTS

This report was completed for Douglas County in accordance with Nevada Revised Statutes (NRS) 540. Specifically, NRS 540.141 (effective as of January 1, 2020) requires that a Water Conservation Plan must include the following:

a) Public education and outreach
b) Conservation methods to meet service area and legal needs
c) Water systems management and loss evaluation
d) Effluent reuse optimization
e) Contingency plan for drought conditions to ensure potable water supply
f) Schedule for plan implementation
g) Pathway to metering all connections
h) Water efficiency standards for new development
i) Tiered rate structure
j) Time and day-based watering restrictions

Additionally, NRS 540.141 requires that any plan covering an area of 500 connections or more implements measures to evaluate plan effectiveness and quantifies gallons of water saved annually by each proposed conservation measure. Furthermore, NRS 540.131 mandates that the Water Conservation Plan must be updated every five years.

1.2 SERVICE AREA

Douglas County Utilities provides potable water to several geographically diverse regions. These regions include Carson Valley and a part of the Lake Tahoe Basin. Areas are listed in Table 1 below. District and sub-districts are subdivided into smaller service areas, summarized in Table 2 below.

Table 1. Regions of Douglas County

Region	Districts and/or Sub-districts
Carson Valley	West Valley Water District, East Valley Sub-water District, North County Sub-water District
Sunrise Estates	Sunrise Estates Sub-water District
Fairgrounds	Fairgrounds Sub-water District
China Springs	China Springs Sub-water District
Lake Tahoe	Tahoe Sub-water District

Table 2. Douglas County Districts and Service Areas

District or Sub-District	District or Sub-District Service Area
West Valley Water District	Walley's Genoa Lakes/Sierra Shadows Mountain Meadows Montana
Tahoe Sub-Water District	Zephyr Cove Skyland/Cave Rock Uppaway
East Valley Sub-Water District	Airport Mountain View East Valley
Foothill Sub-Water District	Sheridan Acres Jobs Peak
China Springs Sub-Water District	China Springs
North County Sub-Water District	Wells #1 and #2
Sunrise Estates Sub-Water District	Wells #1 and #2
Fairgrounds Sub-Water District	Well #1

It is worth noting that the area was previously subdivided differently. In 2013, the Carson Valley and Lake Tahoe systems were treated as separate entities. Prior to 2010, the areas were subdivided even further, splitting out the areas into individual zones (i.e., West Valley, Jobs Peak, etc.). In the context of this Plan, the system corresponds to the entire Douglas County area. This encompasses all areas including the Lake Tahoe and Carson Valley Systems. However, the Utility does not service the following areas within Douglas County: Gardnerville, Minden, Indian Hills, Sierra Estates, Logan Creek, Kingsbury, Round Hill, and Glenbrook GIDs.

1.3 DEMOGRAPHICS

The number of residential customers served by the Utility are likely much fewer than the total population of Douglas County; while the Utility currently services 3,578 residential accounts, 2019 US Census Bureau data estimates the total population of Douglas County at 48,905 people. This difference is because the Utility does not serve areas including Gardnerville, Minden, Indian Hills, Sierra Estates, Logan Creek, Kingsbury, Round Hill, and Glenbrook GIDs. To approximate the number of customers served by the Utility in 2021, the number of residential connections was multiplied by the Census Bureau's current estimate of 2.31 residents per household in Douglas County. Future growth projections are depicted in Figure 1, with an assumed linear annual growth rate of 0.45%, which was also derived from Census Bureau data. A detailed breakdown of connection and customer account types is discussed in Section 2.4 of his Plan.

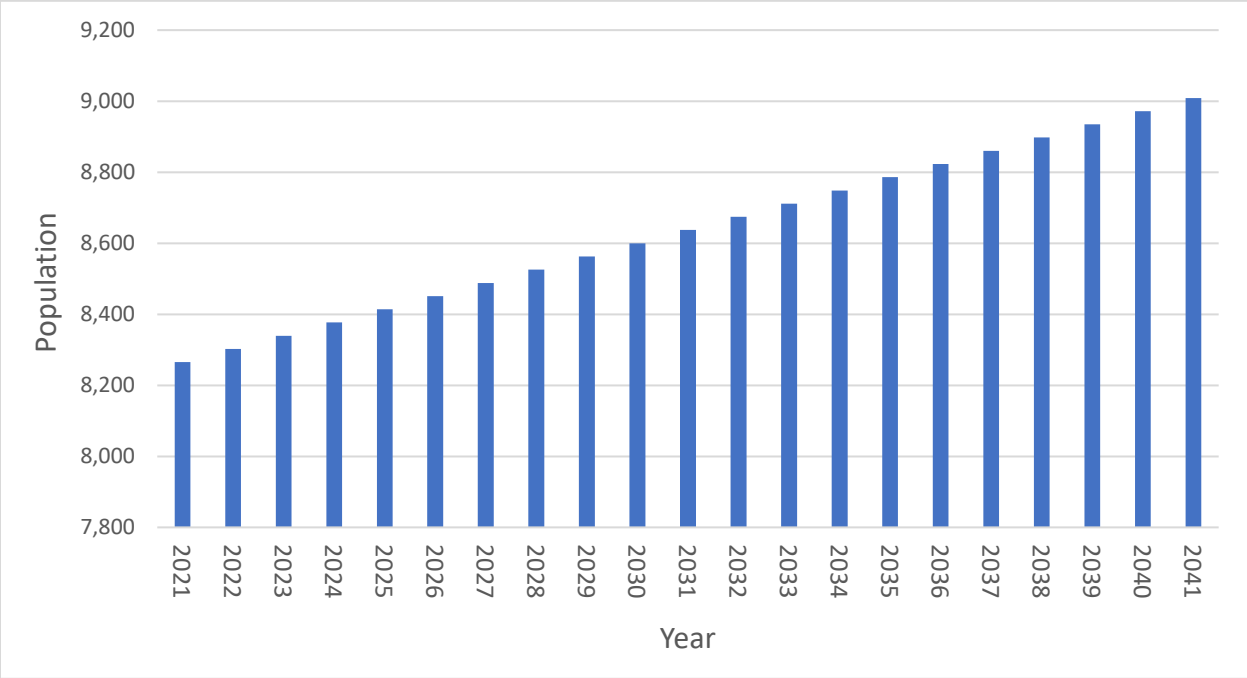

Figure 1. Projected service area population.
These data only correspond to the estimated number of residential customers served by the Utility rather than the entire population of Douglas County. Data projected into 2041 assumes an average annual growth rate of approximately 0.45%. It should be noted that the linear projection method may overestimate future population numbers.

2.0 WATER USE PROFILE: CURRENT AND FORECASTED

2.1 WATER RIGHTS

Douglas County uses a mixture of groundwater and surface water rights to meet customer demand. Carson Valley systems primarily use groundwater rights, while the Tahoe systems rely mostly on surface water. Douglas County maintains a significant beneficial interest with the Town of Minden of over 3,700 acre-feet annually (AFA). Current water rights holdings are summarized in Table 3.

Table 3. Water Rights Summary

Point of Diversion	Groundwater (AFA)	Surface Water (AFA)
Walmart Well	78.74	[-]
Lampe Park	92.04	[-]
China Springs	36.22	[-]
West Valley	1,230.08	280.00
North County	439.01	[-]
Job's Peak-Sheridan	272.19	[-]
Beneficial Interest in Town of Minden Wells	3,727.34	[-]
Uppaway	46.97	[-]
Uppaway Well #2	25.19	[-]
Cave Rock/Skyland	[-]	458.64
Zephyr Water Utility District	[-]	271.35
Misc./Not Identified	25.21	[-]
Total	5,926.02	1,056.96

2.2 WATER SUPPLY, PRODUCTION, AND STORAGE

Water produced for the Carson Valley consists primarily of groundwater, specifically from aquifers within the Carson Valley (Hydrographic Basin No. 105) and Eagle Valley (Hydrographic Basin No. 104). These aquifers consist mostly of unconsolidated and semi-consolidated Quaternary to Tertiary alluvial fan, fluvial, and pluvial deposits. Additional aquifers are also present in jointed and fractured bedrock composed of volcanic, intrusive, and metamorphic rocks. Based on the water production data between 2016-2020 for the Carson Valley, the total amount of annual water produced ranged from 2,061 to 2,239 AF, with an annual average of 2,158 AF (Figure 2). The highest monthly production typically occurs in August; the average monthly demand was 373 AF during this month (averaged over a period of 5 years). It was necessary to make several assumptions when analyzing the 2020 Carson Valley data. This was due to the Minden Intertie Heybourne meter that went out of service during the same year, which the Utility had used to calculate overall use for previous years. As a substitute, the regular Minden Intertie data were used (different from the Heybourne meter data), and deliveries to Indian Hills General Improvement District and Carson City were subtracted out. Consequently, the 2020 water production data presented may be slightly different than the actual amount of water produced for the service area. The estimated amount total water produced in 2020 was 2,234 AF, which is within the range of reasonable values for water annually produced for the

Carson Valley systems; this amount includes water produced by the Utility's own sources in addition to imports from the Minden intertie.

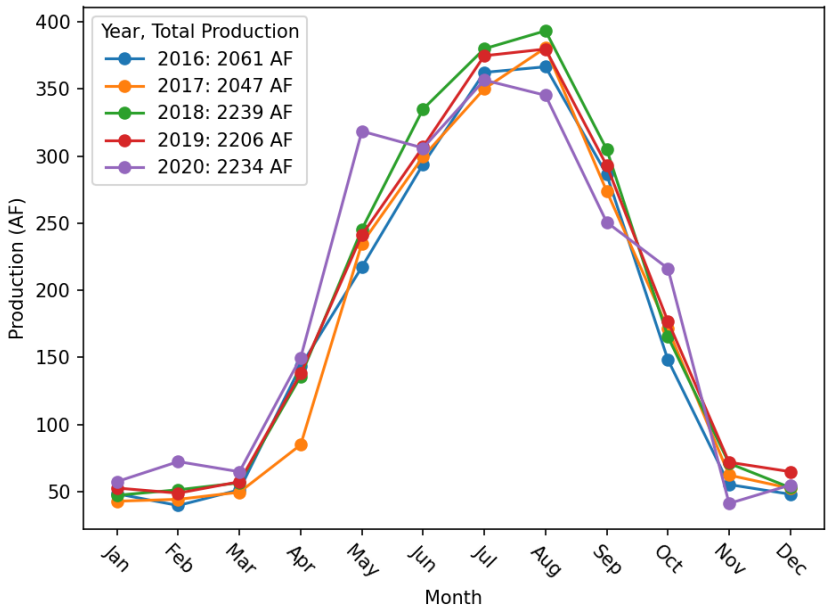

Figure 2. Carson Valley monthly water production (2016-2020).

Water production for the Tahoe systems comes from intakes installed directly in Lake Tahoe, with a small amount of water pumped from wells in the Uppaway area. Analysis over the same time period (2016-2020), shows the total annual water production in the Tahoe Systems ranged from 597 to 685 AF, resulting in an average annual production 637 AF over the five-year period (Figure 3).

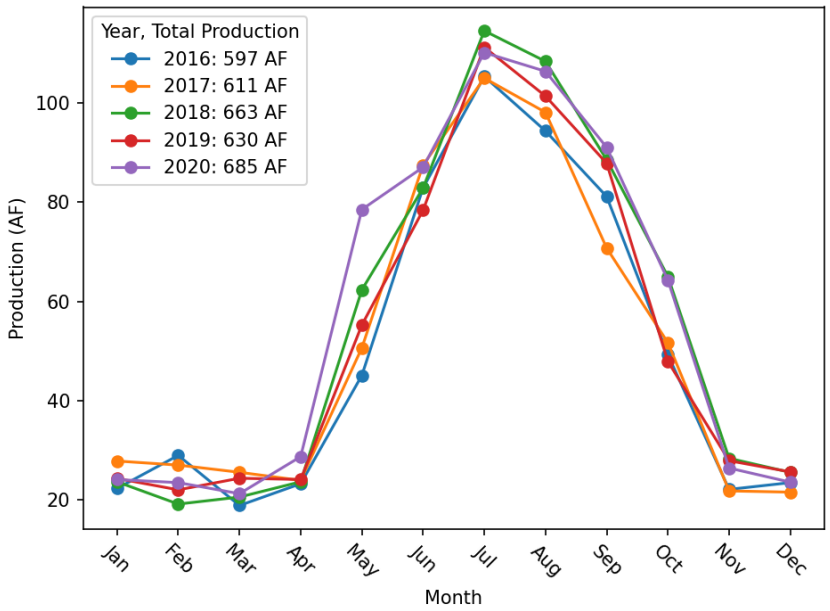

Figure 3. Tahoe system monthly water production (2016-2020).

Combined production for both systems is presented in Figure 4. The water production trends are a composite of both the Carson Valley and Tahoe systems. The use profile trend from month-to-month is generally similar when the two systems are superposed.

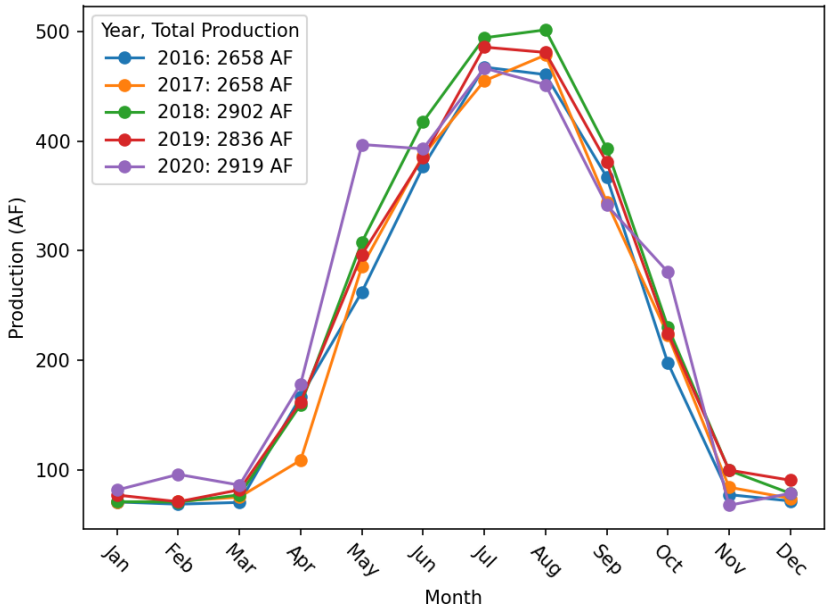

Figure 4. Combined monthly water production (2016-2020).
This plot combines the monthly water production of both the Carson Valley and Tahoe systems.

Estimated water system demands from years 2016 through 2020 are presented in Table 4. Demand estimates and calculation methods were incorporated from a previous Water Facility Master Plan Technical Memorandum (TM) completed by Farr West in 2020. These estimates pertain only to systems in the Carson Valley, as it is difficult to accurately estimate demands in the Tahoe systems due to lack of metering.

Table 4. Carson Valley Water Demand Parameters

Carson Valley System Demand	2016	2017	2018	2019	2020	Average
Annual Demand (AFA)	2,061	2,047	2,239	2,206	2,234	2,157
Annual Demand (Mgal/Year)	672	667	730	719	728	703
Average Day Demand (gpm)	1,278	1,269	1,388	1,368	1,388	1,338
Max Day Demand (gpm)	2,675	2,778	2,871	2,772	2,793	2,778
MDD:ADD (Calculated Peaking Factor)	2.09	2.19	2.07	2.03	2.01	2.08
Peak Hour Demand (gpm)	5,112	5,076	5,552	5,472	5,585	5,359

Table 5. Storage Tanks and Capacities

No.	Tank Name	Capacity (Gal)
1	China Springs	325,900
2	Fairgrounds	200,000
3	Sierra Shadows	410,000
4	Genoa Lakes	730,000
5	Eagle Ridge	307,800
6	Sheridan Acres	298,000
7	Job's Peak	555,200
8	Jack's Valley/North County	2,000,000
9	Canyon Creek - Upper	1,034,186
10	Canyon Creek - Lower	500,000
11	Johnson Lane #1	1,584,320
12	Johnson Lane #2	1,534,700
13	Skyline	507,582
14	Mountain View	600,800
15	ZWUD	626,000
16	Lower Cave Rock	198,000
17	Upper Cave Rock	216,000
18	Lakeridge	300,000
19	Hidden Woods	124,000
20	Skyland	850,000
21	Uppaway	135,000
	Total:	13,037,488

2.3 FORECASTED WATER USE

Annual water production was projected from years 2021 through 2041 (Figure 5). The projection was based on an annual population growth rate of 0.45% (see Section 1.3 of this report) applied to the estimated water production for year 2020. This projection assumes a constant growth rate and continuation of water supply practices as they currently exist.

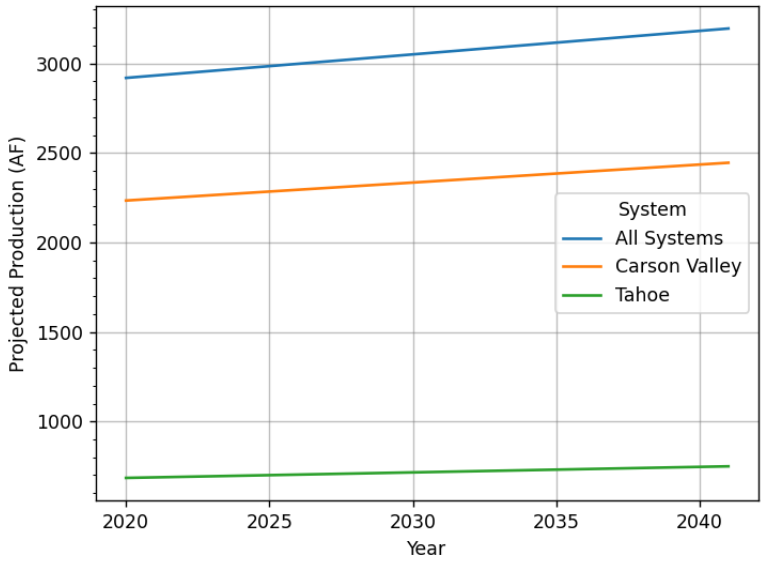

Figure 5. Projected annual water production through 2041.
These data represent projected growth of the Carson Valley, Tahoe, and combined Systems.

2.4 SERVICE CONNECTIONS AND METERS

At the time of this report, there are approximately 4,027 connections in the service area. Residential customers comprise approximately 89% of the connections. A breakdown of connections categorized by use types is presented in Figure 6. In addition, subdivided account types depicted in Figure 7 (it should be noted that sewer EDU and pretreatment inspection fee accounts were excluded in this figure). At first, there may appear to be a discrepancy between the population of Douglas County and the number of connections serviced by the Utility. This difference is because the Utility does not provide service to the following areas within Douglas County: Minden, Gardnerville, Indian Hills, Sierra Estates, Logan Creek, Kingsbury, Round Hill, and Glenbrook GIDs.

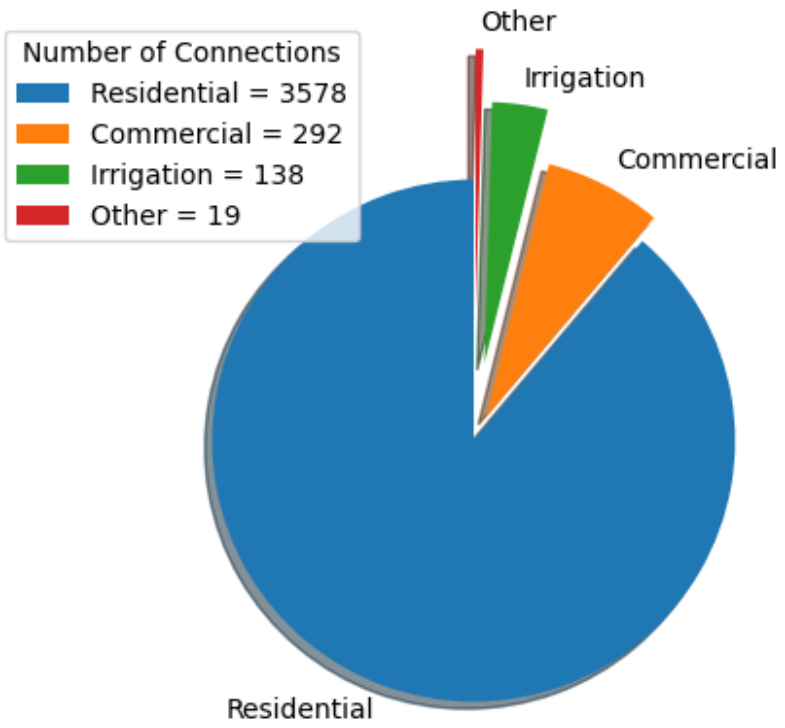

Figure 6. Numbers of service connections classified by type.

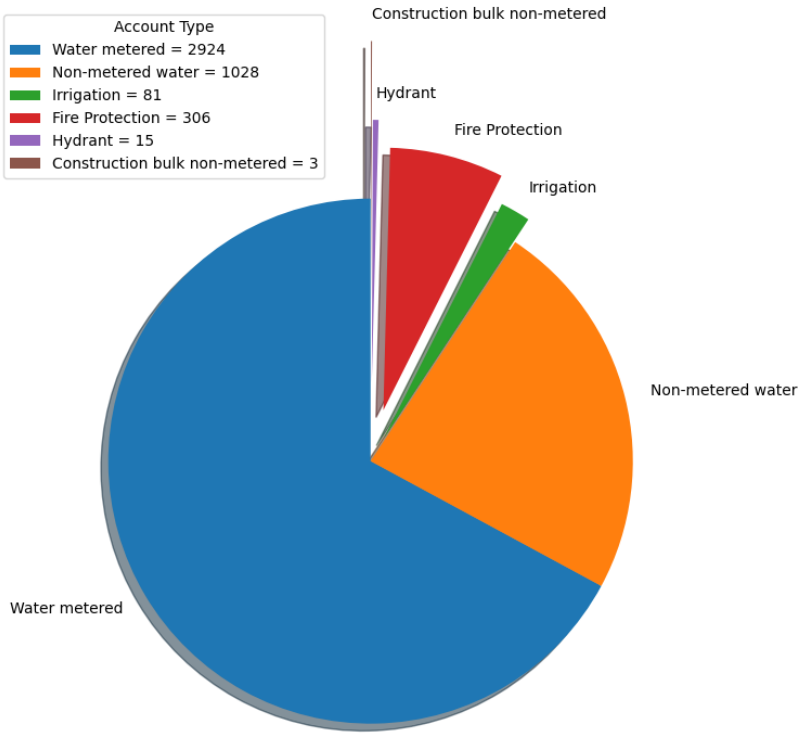

Figure 7. Accounts classified by type.

2.5 RATE STRUCTURE

A tiered billing rate structure is currently implemented for residences in the Carson Valley areas (Figure 8). These rates were adopted in 2019. Rates are billed for each 1,000 gallons used, with an additional baseline charge that depends on the connection diameter. Commercial and irrigation water use is billed at a flat rate. The current base rate and pricing block structure are listed in Table 5.

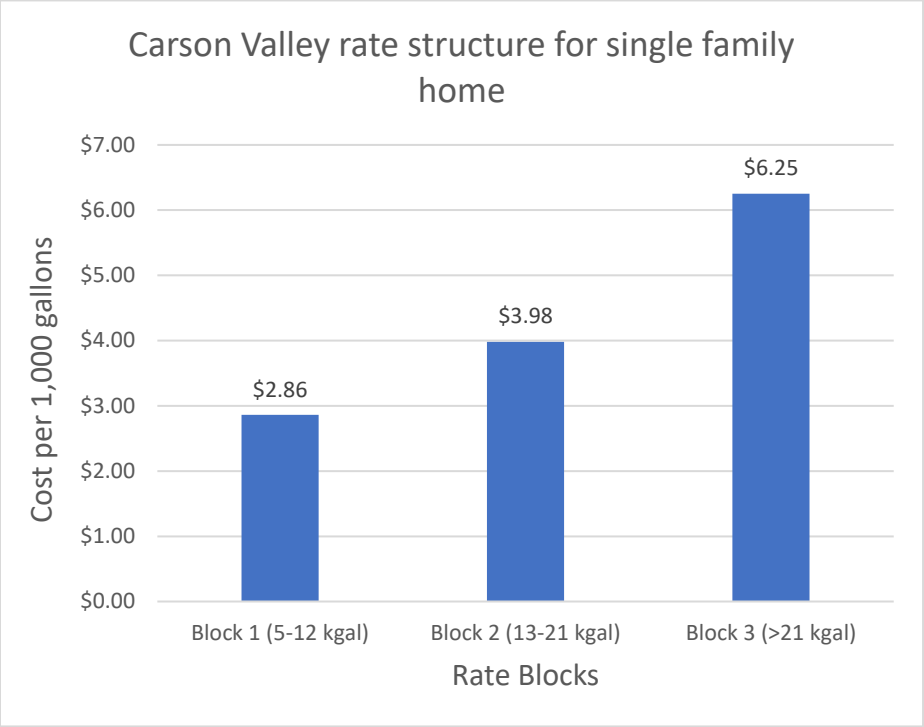

Figure 8. Rate structure for Carson Valley for fiscal year 2020-2021
These rate blocks correspond to billing per 1,000 gallons used for residences in Carson Valley. There is also a base fee which varies based on connection size and encompasses the first 4,000 gallons used.

Table 6. Carson Valley Pricing Structure for Fiscal Year 2020-2021

			Volume charge		
			Block 1	Block 2	Block 3
Class	Service size	Monthly Fixed Charge (includes first 4k gals)	(5-12 kgals)	(13-21 kgals)	(>21 kgals)
Residential	5/8"	$32.86	$2.86	$3.98	$6.25
	3/4"	$32.86			
	1"	$67.93			
	1 1/2"	$125.53			
	2"	$196.61			
Class	Service size	Monthly Fixed Charge (includes first 4k gals)	All usage (0k gals and above)		
Commercial	5/8"	$33.69	$3.58		
	3/4"	$33.69			
	1"	$71.75			
	1 1/2"	$134.48			
	2"	$211.45			
	3"	$431.01			
	4"	$661.12			
	6"	$1,296.57			
	8"	$2,058.01			
Irrigation	5/8"	$18.02	$3.85		
	3/4"	$18.02			
	1"	$32.60			
	1 1/2"	$56.16			
	2"	$86.12			
	3"	$180.38			
	4"	$269.50			

The Tahoe service districts, referred to as the Tahoe Township by the Utility, is currently billed at a monthly "unmetered" rate (Table 6). With this format, a monthly fixed charge is applied based on the connection size in addition to a $20 capital improvement surcharge. A 2019 resolution stated that metering could be implemented in the future, if it is in the Utility's best interest. Planned rate schedules for each fiscal year through 2024 are included in Appendix A.

Table 7. Tahoe Township Pricing Structure for Fiscal Year 2020-2021

Class	Service size	Monthly fixed charge
Unmetered residential	5/8"	$71.66
	3/4"	$71.66
	1"	$106.72
	1 1/2"	$164.32
	2"	$235.40

3.0 CONSERVATION STRATEGIES

This section summarizes multiple conservation measures and incentives which can be implemented to reduce water use. The majority of the actions described in this Section are required by NRS 540.141. There is also a slight distinction between a conservation measure and incentive. While a conservation measure can be implemented as a suggestion, mandate, or ordinance, a conservation incentive provides some benefit such as a financial assistance to encourage customer participation.

3.1 CONSERVATION MEASURES

3.1.1 Water Efficiency Standards for New Development

One effective way to enhance water conservation is to require specific water efficiency standards for new development, as required by NRS 540.141(1)(h). A benefit of this method is that it can eliminate the need for fixture and appliance retrofits far into the future. Standards for new development can include, but are not limited to the following:

- Advanced metering infrastructure which can provide hourly customer metering data to the Utility via the internet
- For multi-family developments, install meters on each individual account (sub-metering)
- Install high-efficiency fixtures and appliances including:
    - Faucets
    - Showerheads
    - Toilets
    - Urinals
    - Clothes washers
    - Dishwashers
- Require development plan reviews for all new commercial and industrial developments to establish proposed water use efficiency
- Enforce ordinances via city or state law
- New structures should utilize air conditioning systems rather than evaporative coolers

At a minimum, new fixtures and appliances including faucets, toilets, and showerheads are required to meet standards specified in the 1992 U.S. Energy Policy Act. Examples of this standard along with general benchmarks for efficiency are described in Table 7.

Table 8. Example Fixture/Appliance Efficiency Benchmarks for New development

Area	Fixture or Appliance	Flow Rating	Federal Standard	Potential demand reduction (gal/connection/day)
Kitchen	Efficient kitchen faucet	1.8 gpm	2.2 gpm	9
	Faucet aerator	2 gpm	2.2 gpm	6
	Dishwasher (residential)	5 gal/wash	[-]	5
	Efficient dishwasher	4.25 gal/wash	[-]	7
Laundry	Faucet aerator	2 gpm	2.2 gpm	6
	Efficient washing machine	14 gal/wash	[-]	8
Bathroom	Low-flow showerhead	1.5 gpm	2.5 gpm	20
	High-efficiency showerhead	2 gpm	2.5 gpm	12
	Standard showerhead	2.5 gpm	2.5 gpm	4
	High-efficiency faucet	1.5 gpm	[-]	12
	High-efficiency faucet aerator	1.2-1.5 gpm	[-]	12-16
	Standard faucet aerator	2.2 gpm	[-]	4
	Ultra high-efficiency toilet	0.8 gal/flush	1.6 gal/flush	34
	High-efficiency toilet	1.28 gal/flush	1.6 gal/flush	28
	Standard toilet	1.6 gal/flush	1.6 gal/flush	24
	Dual-flush toilet	1.6/0.8 gal/flush	1.6 gal/flush	29
	Water displacement device	0.5 gal/flush	1.6 gal/flush	6

3.1.2 Tiered Rate Structure

The Utility currently uses a tiered billing rate structure for residential connections in the Carson Valley area (Table 5). However, billing for commercial and irrigation water use are currently billed at a flat rate (Table 5). Additionally, residential connections in the Tahoe systems are currently unmetered and billed at a fixed monthly rate that varies by connection size (Table 6). As per NRS 540.141, it is recommended that the Utility bills all types of customer accounts using a tiered rate structure. However, the Utility has opted to continue billing some accounts on a fixed-rate basis, determining that it was not in the financial interest of the Utility or customers to use a tiered rate structure for those accounts. The utility will continually evaluate the costs and benefits of the hybrid rate structure on a regular basis and may move more accounts to a tiered rate structure in the future, if considered prudent.

3.1.3 Landscape Watering Restrictions

Landscape watering restrictions based on certain times and days can be an effective means of limiting water use with minimal implementation cost. Inclusion of this measure in the Plan is required by NRS 540.141. One strategy is to impose landscape watering restrictions during the five months of the year with the highest average temperature (May 1 – September 30). The objective of implementing measures through these dates is to minimize water losses to evapotranspiration (ET), which are more extreme during higher temperatures.

Although some of the measures below are included in various stages of the drought contingency plan (Section 7.0), implementation of some measures irrespective of drought status could be beneficial for the service area. Examples of residential measures to put in place during these months can include:

- Designate three specific days each week for watering, such as:
  - Odd addresses water on Monday, Wednesday, Friday
  - Even addresses water on Tuesday, Thursday, Saturday
  - The Utility should avoid a two-day watering schedule, as some cases show that it can increase water consumption
- For sprinkler systems, set irrigation cycles to a maximum of 15 or 30 minutes
- Limit watering times to mornings and evenings (e.g., 7 PM – 7 AM)

These measures can be implemented as either a recommendation or a mandate. Effectiveness of the mandate or recommendation can be tied closely to public education and outreach incentives. While the Utility may opt to utilize recommended watering restrictions for residences, the Utility should implement a mandate for municipal properties and buildings.

3.1.4 Conservation Education

3.1.4.1 Education and Outreach for the General Public

The Utility currently has several education and public outreach measures in place, including conservation billing inserts and email/webpage notifications for customers. Topics that can be covered by outreach include watering best practices, drip irrigation methods, fixture/appliance retrofit options, and greywater system benefits. Examples of other common public outreach methods that can be implemented include:

- Social media presence for information, events scheduling
- Free educational workshops for landscaping improvements
- Public information programs
- Literature (brochures and posters)
- Advertisement and awareness campaigns
- Paper mail/door placard notifications
- Email newsletters

The Utility plans to implement a number of new education and outreach methods to raise awareness of water conservation importance and best practices. The Utility has proposed the following new outreach methods: literature, advertisement, and public awareness campaigns via social media. For the literature method and approach, the company will obtain and distribute water conservation brochures to hand out to customers. The Utility will also introduce an advertising campaign to promote conservation; this method will be in a similar vein to the "Friendly Reminder" notices currently distributed to customers. For the public awareness campaign, social media will be used to reach an even wider audience of water customers. Education and outreach methods will have a particular focus on the spring season. All of the education and outreach approaches will center on increasing the awareness of the limited supply of water, encourage reducing lawn sizes, and using more arid and semi-arid plants for landscaping. These actions are anticipated to substantially expand the reach of conservation information and education. Examples of standard educational leaflets are included in Appendix B.

3.1.4.2 Public School Education and Outreach

Promoting water conservation in public schools is an essential component of a water conservation plan. In addition to promoting water conservation importance and practices, public school outreach programs should cover the following topics: the hydrologic cycle, necessity of potable water for life, drinking water sources, impacts of environmental pollution on water supply, and costs of producing and delivering water. Many of

these topics can be easily integrated with physical science curriculum. This way, the public outreach from the Utility is not the first instance where students are exposed to water conservation. The overarching goal of public school outreach is to make students aware of the limited water supply and importance of conserving water, with a particular focus on residential irrigation reduction. Outreach can be completed either via in-class presentations or fieldtrips to a local water authority. The social media outreach actions are anticipated to overlap with public school outreach.

3.1.5 Effluent Reuse

If a water supplier practices effluent reuse, NRS 540.141 requires that the Plan describes and evaluates it. The Utility's previous Water Conservation Plan stated that it planned to use effluent reuse in the future. Specifically, it states:

"Treated effluent will be used to replace supplemental and non-supplemental groundwater pumped for irrigation where feasible."

The Utility has been reusing effluent since approximately 2009. This is consistent with the 2008 water conservation plan. Application areas have included Incline Village Wetlands, wastewater treatment plant landscaping, a rapid infiltration basin, and Bently Ranch (located in the Minden area). Douglas County reused approximately 210 AF of effluent in calendar year 2020, with most of the effluent distributed to Bently Ranch. Effluent Reuse from years 2009 through 2020 are displayed in Figure 9.

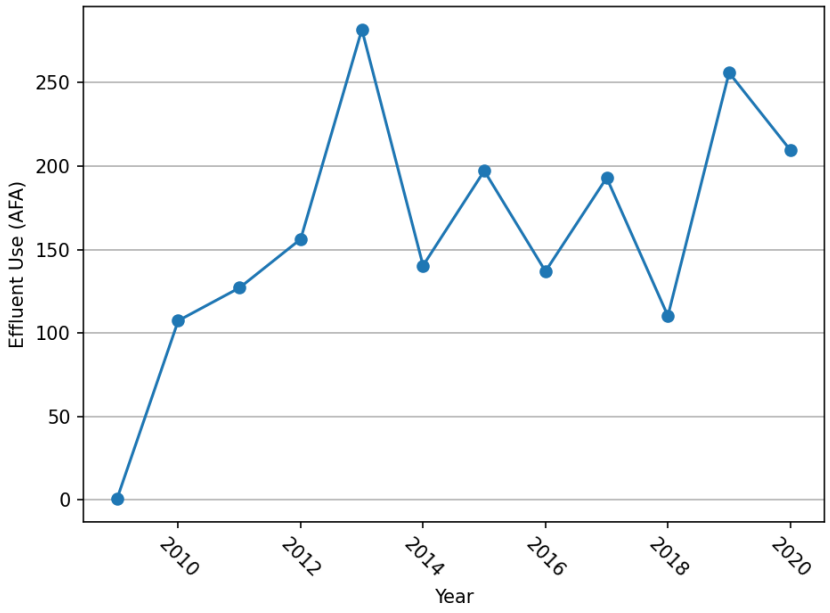

Figure 9. Effluent reuse from 2009-2020.
Data shows effluent reuse amounts throughout the entire Douglas County area.

3.2 CONSERVATION INCENTIVES

The following subsections detail conservation incentives, each of which are required by NRS 540.151. Incentives put in place by the Utility are not limited to those describe below. Additional conservation incentives can be introduced at the discretion of the Utility.

3.2.1 Retrofit Incentives Program

It is recommended that the Utility provides incentives to residential customers to retrofit existing plumbing fixtures with newer, more water-efficient counterparts. Replacement of fixtures such as faucets, showerheads, and toilets can help drive water savings. Similarly, installation of new high-efficiency appliances including washing machines and dishwashers can decrease water consumption. Providing incentives for individual residences to replace older fixtures and appliances with newer, less water-intensive counteracts can be an effective conservation strategy. Incentives can increase the number of citizens who opt to update these features on their own. There are two main methods of introducing retrofit incentives: 1) The Utility can keep a supply of high-efficiency/low-flow fixtures and distribute them directly to customers who request them, or; 2) the Utility can provide a credit schedule for retrofits (e.g. $10 for showerhead replacement, $15 for high-efficiency faucet replacement, $100 ultra high-efficiency toilet replacement) that can be paid out to the customer directly or through a bill rebate credit. Of the two retrofit incentive approaches, the former is ideal, as it minimizes administrative costs generated by billing changes and receipt processing. A retrofit incentives program can easily be combined and promoted with conservation education and outreach (seen Section 3.1.4).

A less conventional, but potentially effective retrofit strategy is to encourage households to install a greywater system. One use of the greywater system is a shower-to-toilet connection. With this method, outflow from the shower is used to fill the toilet tank; this allows the toilet to utilize non-potable water for flushing. However, the residence should attempt to utilize products without elevated levels of salt, boron, or chlorine bleach, or to exclude any drainages that use these sources from the greywater system. Additionally, a backflow prevention device should be installed to eliminate the potential for greywater to contaminate potable water in the Utility's transmission lines. The installation of greywater system can also be incentivized in the form of a rebate from the Utility.

3.2.2 Landscaping Incentives

Landscaping incentives can be extremely useful for decreasing water consumption, particularly in residential suburban areas where landscaping is common and closely tied to home value. Watering of conventional lawns can present a substantial water demand, sometimes requiring as much as 300 gallons per day. Factors including inefficient watering practices and significant loss of water to ET can exacerbate the issue. Subsequently, turf removal incentives provide a potential means to lessen water used for lawn irrigation. With this approach, the Utility could provide a financial incentive (e.g. $1 per square-foot, up to $1,000) for residential customers to remove turf. Because approximately 30% of residential water use is expended for outdoor irrigation, a decrease in the number of lawns can serve as an effective conservation benefit. An additional landscaping practice to reduce water use is to select low water use native plants and turf for landscaping; plants already adapted to arid and semi-arid regions will require less water than plants adapted to more lush and wet climates.

Upgrades to traditional irrigation systems can also be an effective way to reduce water use. For a typical aboveground sprinkler, installing a timer system to automatically water only during nighttime hours can also generate water savings. The main advantage of a sprinkler timing system is that it reduces loss of water to ET; it is also complementary to landscape watering restriction conservation measures. Smart irrigation timers are also very effective at conserving water. Smart irrigation timers can change the run times of each zone based on weather conditions and ET rates. Another water-saving practice is to replace traditional sprinklers with drip irrigation systems. Drip irrigation can serve as a low-cost, less water intensive irrigation method that can still sustain plants and vegetation.

Greywater systems can also be utilized for irrigation purposes. The greywater system can be built to divert outflow water from sinks, bathtubs, showers, and washing machines to landscaping rather than flowing directly to the municipal sewer or septic tank. Examples of greywater system devices include irrigation drums, pumps, and landscape drainage systems. All outflow sources of water should be non-fecal, so toilet

effluent should not be used. Nutrients in the effluent can even provide a benefit for plants growing at the residence. As with the shower-to-toilet greywater setup, the residence should attempt to utilize products without elevated levels of salt, boron, or chlorine bleach, or to exclude any drainages that use these sources from the greywater system. Similarly, backflow devices should also be installed at the residence.

Cisterns for rainwater collection can also be an effective alternative irrigation strategy; however, they are less useful in regions that receive only a small amount of annual precipitation. Rebates could be provided as an incentive for homeowners who install a greywater or rainwater collection system approved by the Utility.

3.3 ADDITIONAL CONSIDERATIONS

3.3.1 System Pressure

According to the Utility, the average system pressure is approximately 62.7 pounds per square inch (psi). Variation in pressures between different zones spread across distinct topographies are not uncommon, particularly between systems in the mountain and valley ranges. Conducting a comprehensive system pressure analysis could allow the Utility to better optimize system pressures and reduce system leaks, which would generate additional water savings. According to the EPA (1998):

"Reducing excessive pressures in the distribution system can save a significant quantity of water. Reducing water pressure can decrease leakage, amount of flow through open faucets, and stresses on pipes and joints which may result in leaks. Lower water pressure may also decrease system deterioration, reducing the need for repairs and extending the life of existing facilities. Furthermore, lower pressures can help reduce wear on end-use fixtures and appliances."

3.3.2 Metering and Sub-metering

As detailed in Section 2.4 of this report, there are 1,028 accounts classified as "non-metered" water, compared to 2,924 accounts classified as "metered" water. The majority of unmetered accounts correspond to residential connections for the Tahoe systems. These connections pay a fixed monthly rate that varies depending on the connection size. The Utility has completed a cost-benefit analysis of installing meters at all Tahoe connections. Because of the cost of meter installation and reliance of Tahoe connections on surface water intakes, it was deemed that retroactively installing meters at all locations would not benefit the Utility or ratepayers, at this time. However, building ordinances require that new development in the Tahoe system area include meter vaults and metering equipment. Additionally, the Utility should consider installing sub-metering equipment in certain areas, particularly for developments such as multi-family residential. However, it should be noted that NRS requires water suppliers to create a plan that moves towards metering of all connections.

3.3.3 Behavioral Conservation Measures

Numerous behavioral conservation measures are presented in Appendix C. These practices are relatively simple and can be implemented on an individual customer basis. Customers can be informed of these measures through the public outreach and education conducted by the Utility.

3.4 PLAN IMPLEMENTATION SCHEDULE

A timeline for implementation of each conservation measure and incentive is presented in Table 8.

Conservation Measure/Incentive	Implementation Start
Water efficiency standards for new development	Currently in place

Tiered rate structure	Currently in place through most of service area
Landscape watering restrictions	Dependent on drought conditions
Conservation education	Currently in place
Effluent reuse	Currently in place
Retrofit incentives	To be determined
Landscaping incentives	To be determined

Table 9. Plan Implementation Schedule

4.0 WATER AUDIT

In the State of Nevada, all Water Conservation Plans completed after January 1, 2020 are required to have an accompanying water audit submitted with the Plan, as per NRS 540.131 and 540.145. The water audit is to be completed using American Water Works Association (AWWA) Free Water Audit Software (FWAS) Version 6. The FWAS consists of a spreadsheet to input water supply, authorized consumption, and water losses, along with system and cost data for the utility.

The completed water audit document is included in Appendix D of this report. During the next update to this Water Conservation Plan, the accompanying water audit must be recompleted to allow comparison of results. It should be noted that the FWAS software provides a rudimentary estimation of water losses and system efficiencies and is not a substitute for a more comprehensive water audit. The audit was completed using the most readily available and reasonable data provided by the Utility for calendar year 2020.

A summary sheet of the water balance from the AWWA audit is presented in Figure 10. Water supply inputs to the water budget include: volume from own sources (pumping from wells, surface water intakes), water imported (Minden intertie), and water exported (deliveries to Indian Hills and Carson City). Consumption inputs included billed metered, unbilled unmetered, and unbilled metered water. The amount of billed metered and unbilled metered water were calculated based on the total number of Carson Valley and Tahoe accounts. Unaccounted-for water (non-revenue water) was estimated using an unaccounted-for water proportion of 12.6% of total water produced and imported. Estimates of the non-revenue water percentage were calculated in a previous Water Facilities Master Plan TM completed by Farr West in 2020. Because the Utility is a public agency, production cost for each acre-foot of water was assumed to be 98% of the sale cost.

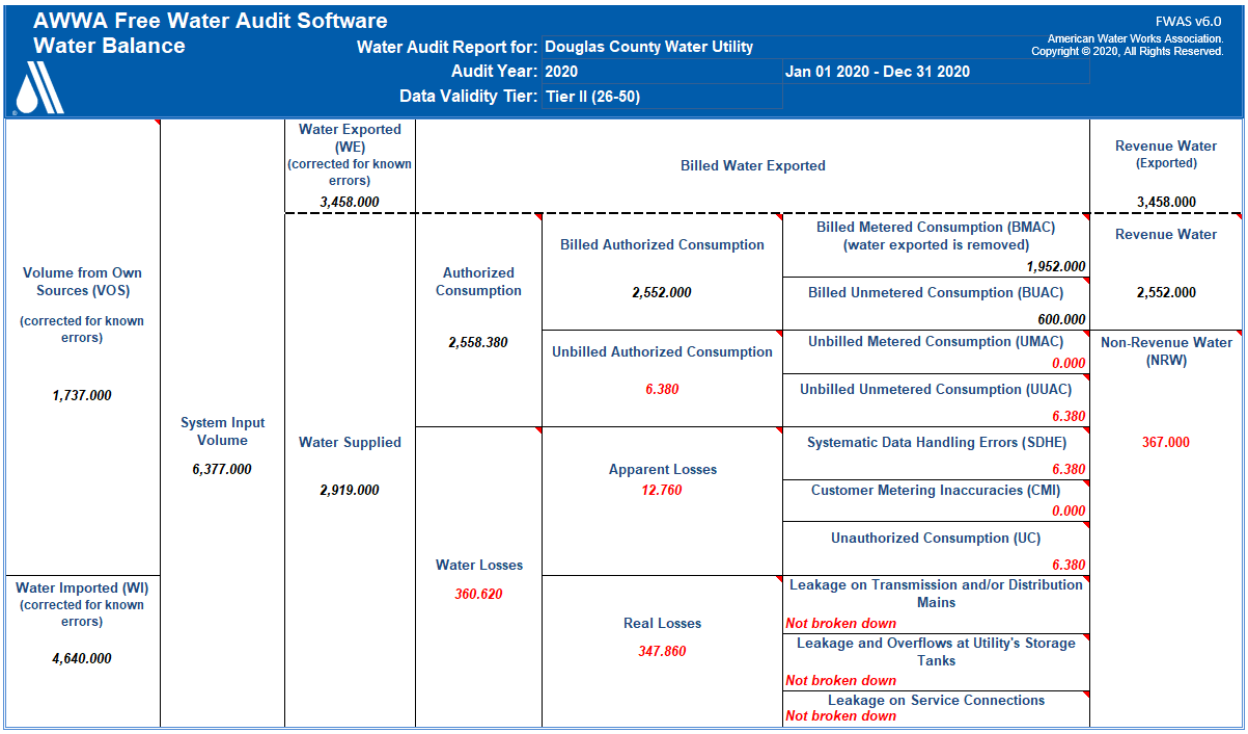

Figure 10. Water balance summary from water audit.
Water balance inputs are based on data provided by the Utility for calendar year 2020.

5.0 ESTIMATED WATER SAVINGS

5.1 SAVINGS FROM RETROFITS AND WATER EFFICIENCY STANDARDS

The potential retrofit water savings estimates in Table 9 were calculated using AWWA methodologies and incorporate several assumptions. First, these estimates assume that half of the approximately 3,578 residential customers in the service area replaced fixtures that were originally installed in the 1980s or earlier. Note, increasing or decreasing this coverage percentage would directly affect the estimated reduction in water use. Second, all fixture and appliance efficiency gains were adapted from AWWA M52 (2017) and Vickers (2001). Implementing water efficiency standards for new development can also help reduce the amount of water used in the future.

Table 10. Potential Water Savings from Fixture/Appliance Retrofits

Action	Potential water savings per household (gpd/connection)	Estimated Reduction in Water Use for Service Area (MGY)
Retrofit kitchen and bathroom with efficient faucet	9	2.9
Retrofit kitchen and bathroom with high-efficiency faucet	12	3.9
Retrofit bathrooms with low-flow showerhead	20	6.5
Retrofit bathrooms with ultra high-efficiency toilet	34	11.1
Retrofit laundry with efficient washing machine	8	2.6
Retrofit kitchen with efficient dishwasher	7	2.3

Similarly, installation of a greywater shower-to-toilet system can generate additional water savings. If enough water is supplied to the toilet tank, then potable water used for filling the tank and flushing would be virtually eliminated. Even in a household where an ultra-high efficiency toilet is installed, this could lead to water savings of more than 3,900 gallons annually for a single residence (this assumes an average of 13.5 flushes per household at 0.8 gallons per-flush). Greywater systems can be an effective water saving device, especially when saturation is reached with conventional appliance and fixtures retrofits (i.e., the majority of customers in the service area have already installed more efficient fixtures and appliances).

5.2 SAVINGS FROM TIERED RATE STRUCTURE

Water savings from tiered rate structures are generated by encouraging customers to use less water through increasing prices associated with higher uses. Customers can easily understand the need for conservation to avoid a large monthly bill from excessive water use. Although it is difficult to measure water saved directly from rate structure changes, some relevant conservation resources list a 5 percent reduction as a reasonable assumption following rate increases; this would be equivalent to roughly 146 AFA in savings relative to the total water production in 2020.

5.3 SAVINGS FROM LANDCSAPE WATERING RESTRICTIONS

Although estimates of from watering schedule restrictions can be difficult to quantify, some larger urban areas have estimated a 20 to 30 percent reduction in landscape watering use by implementing this measure. It should be noted that designated watering days often provide more benefits to the engineering aspects of Utility as opposed to water reduction. Designated watering days tend to spread out usage throughout the week, thus reducing the amount of water used during peak use times. Reduction of the peaking factor can help to improve the system longevity and reduce system leaks and breaks.

5.4 SAVINGS FROM CONSERVATION EDUCATION

Water savings generated directly from conservation education are difficult to estimate, due to the qualitative nature of this method. However, other utilities have approximated savings from education measures ranging from a 2 to 5 percent reduction in water use. Assuming the customer base was fully educated, this would be equivalent to saving between 58 and 146 AFA, respectively (relative to the 2020 total water production). The expansion of the Utility's outreach methods, described in Section 3.1.4.1, are anticipated to expand the reach of public education and awareness. These practices may further increase water savings generated via conservation education.

5.5 SAVINGS FROM EFFLUENT REUSE

During 2020, Douglas County reused approximately 210 AFA of effluent. Most of this water was applied to irrigation areas. This savings amount is substantial, as it is equivalent to roughly 7% of the total water produced by the Utility in 2020. Continuing to scale up effluent reuse capabilities and locations (particularly for landscaping and agriculture) could provide additional water savings in the future.

5.6 SAVINGS FROM LANDSCAPING INCENTIVES

Removal of a water intensive residential lawn can lead water savings of nearly 300 gallons per-day in some cases. Exact estimates of water saved from use of xeriscape or drip irrigation (as opposed to regular sprinkler watering) are unknown, since landscape information on customers' properties is unknown. However, landscape retrofits of lawn to xeriscape could generate significant reductions in water use on a household-by-household basis. For a landscape greywater system, estimated water savings can vary by system type. Laundry-to-landscape systems tend to produce and save less water than pumped landscape systems. For a household of two, estimated savings from landscape greywater systems can range from roughly 3,700 to 7,900 gallons annually. These calculations assume that the irrigation season extends through half of the year.

6.0 DROUGHT CONTINGENCY PLAN

6.1 PLAN STAGES AND TRIGGER CRITERIA

Water resources are designed to meet normal seasonal system demands. Drought conditions occur when a prolonged period of abnormally dry weather causes a serious hydrologic imbalance in an affected area. This imbalance causes water sources not to be replenished.

The drought plan is implemented when water sources are diminished to a point that water system demands require management to avoid unsafe water system conditions.

Douglas County owns and operates several water systems that have different water sources and varied seasonal system demands.

Each system is monitored autonomously by the Water Utility Division.

The Water Operations Manager and or their designee continually monitor each water system to determine if the source water is meeting the current and forecasted seasonal system demands.

Declaration:

When it is determined that a system and or systems could potentially have challenges meeting the forecasted seasonal system demands, this information is reported to the Director of Public Works.

Depending on the severity of the anticipated drought condition, the Public Works Director may issue a water conservation reminder letter to consumers asking for voluntary conservation.

When it is anticipated that a water system and or systems could potentially have challenges meeting forecasted seasonal system demands to a point that could cause unsafe water conditions, the Public Works Director recommends to the County Manager that a drought declaration should be implemented.

The County Manger will present the data to the Board of Commissioners, which has the authority to confirm and enact a drought declaration.

Implementation:

Once a drought declaration has been enacted, authority for implementation of the drought plan is delegated to the Public Works Director.

Implementation of any part of this plan may be localized to a specific system and or systems.

The following restrictions will be imposed on the drought affected water systems owned and operated by Douglas County.

Stage 1: Drought Warning Stage

Trigger

The Warning Stage may occur when total precipitation is below normal for the months of October through March. Information regarding Snowpack, Stream-flow Forecasts, and Reservoir Capacity as reported in the USDA Natural Resources Conservation Service Nevada Water Supply Outlook in April of each year for the Lake Tahoe, Truckee and Carson River Basins will be considered.

Lake Tahoe Specific Monitoring Details: Lake Tahoe water elevation is also continually monitored. The natural lake level is 6223 feet above sea level (FSL). The dam structure allows the lake to be filled to a max level of 6229.1 FSL. When the lake level goes below 6223 FSL, a drought condition is considered to exist in that localized water service area.

Measures

1) Public announcements are made via the Douglas County website, social media and mail sent to consumers regarding service areas affected, the level of drought condition and what measures are being implemented.
2) The Board of County Commissioners may adopt a resolution reminding customer of existing regulations and calling for voluntary conservation measures in addition to any applicable water-use regulations as discussed in the water conservation measures section (see Appendices B, C and D). Reminders and voluntary measures may include:
    a) Water from the County's water system should not be allowed to pool, pond, or run-off of applied areas.
    b) Hard surfaces including sidewalks, driveways, parking areas, or decks should not be washed or hosed down with water supplied through the County's water system unless required by health and safety requirements.
    c) Washing of vehicles should be done only with hoses equipped with an automatic shut off device or at facilities designated as commercial vehicle wash.
    d) Water used for watering lawns and landscaping, should be limited to three days per week as follows:
        i Residences with even numbered addresses, common areas or multiple units served by one connection, should water only on Monday, Wednesday, & Friday;
        ii Residences with odd numbered addresses and commercial and industrial customers should water only on Tuesday, Thursday & Saturday;
    e) Watering of lawns, landscaping, and gardens should not occur between the hours of 10:00 am and 6:00 pm.
    f) Use of water for decorative purposes is discouraged.
3) Contact public agencies within the affected drought areas and ask for voluntary watering cuts on irrigation systems.
4) Issue written notices to all customers that have excessive leaks and or broken irrigation systems. If the leak and or broken irrigation system is not resolved within five days of the written notice, the service connection shall be shut off until these leaks and or system breaks have been repaired.

Stage 2: Drought Alert Stage

Triggers

The Alert Stage may occur when total precipitation is below normal for the months of October through March for three or more consecutive years. Information regarding Snowpack, Stream-flow Forecasts, and Reservoir Capacity as reported in the USDA Natural Resources Conservation Service Nevada Water Supply Outlook in April of each year for the Lake Tahoe, Truckee and Carson River Basins will be considered.

Lake Tahoe Specific Monitoring Details: Lake Tahoe water elevation is also continually monitored. The natural lake level is 6223 feet above sea level (FSL). The dam structure allows the lake to be filled to a max level of 6229.1 FSL. When the lake level goes below 6223 FSL, a drought condition is considered to exist in that localized water service area.

Measures

The following measures are in addition to, or supersede, those included in the Drought Warning Stage:

1) Public announcements are made via the Douglas County website, social media and mail sent to consumers regarding service areas affected, the level of drought condition and what measures are being implemented.
2) The Board of County Commissioners intends to adopt an Ordinance calling for the following mandatory conservation measures (these measures shall be in addition to or supersede those included in the Warning Stage 1):
    a) Water from the County's water system **shall not** be allowed to pool, pond, or run-off of applied areas.
    b) Hard surfaces including sidewalks, driveways, parking areas, or decks **may not** be washed or hosed down with water supplied through the County's water system unless required by health and safety requirements.
    c) Washing of vehicles **shall** be done only with hoses equipped with an automatic shut off device or at facilities designated as commercial vehicle wash.
    d) Water used for watering lawns and landscaping, **shall** be limited to three days per week as follows:
        i Residences with even numbered addresses, common areas or multiple units served by one connection, **may** water only on Monday, Wednesday, & Friday;
        ii Residences with odd numbered addresses and commercial and industrial customers **may** water only on Tuesday, Thursday & Saturday;
    e) Watering of lawns, landscaping, and gardens **shall not** occur between the hours of 10:00 am and 6:00 pm.
    f) Use of water for decorative purposes is **prohibited**.
3) Public agencies within the affected drought areas **shall be** strongly encouraged to immediately implement mandatory conservation measures consistent with the conservation measures adopted by the County.
4) The use of fire hydrants **shall be** limited to fire protection uses only.
5) Issue written notices to all customers that have excessive leaks and or broken irrigation systems. If the leak and or broken irrigation system is not resolved within five days of the written notice, the service connection will be shut off until these leaks and or system breaks have been repaired.

Stage 3: Severe Drought Stage

Triggers

The Severe Drought Stage may occur when groundwater levels are significantly below normal. Water Operations staff will monitor the depths of wells operated by the County and those wells included in the voluntary well monitoring program. In addition to groundwater levels the additional conditions will also be assessed:

1) Source water pumping levels drop and there is a 25 % reduction in a system source water flow measured in Gallons Per Day (GPD).
2) A regulated water constituent rises up to a State and or Federal Maximum Contaminant Level (MCL) which causes an inadvertent 25 % reduction in a system source water flow measured in Gallons Per Day (GPD) for compliance purposes.
3) When Lake Tahoe level goes below 6220 FSL.

When Water Operations determines well depths have dropped to a predetermined level for each well, and those levels are not recovering after sustained periods of rest or any of the additional monitoring conditions have been met, staff will advise the Public Works Director and County Manager of the situation and make a recommendation regarding a possible Severe Drought Stage declaration.

Measures

The following measures are in addition to or supersede those included in the Drought Alert Stage:

1) The Board of County Commissioners intends to declare a water shortage emergency and public announcements will be made via the Douglas County website, social media and mail sent to consumers regarding service areas affected, the level of drought condition and what measures are being implemented.
2) The Board of County Commissioners intends to adopt an Ordinance requiring the following mandatory water restrictions (these measures shall be in addition to, or supersede, those included in the Warning Stage 1 and Alert Drought Stage 2):
    a) Water used for watering lawns and landscaping, **shall be** limited to two days per week as follows:
        i Residences with even numbered addresses, common areas or multiple units served by one connection, may water only on Monday and Wednesday;
        ii Residences with odd numbered addresses and commercial and industrial customers may water only on Tuesday and Thursday;

    b) Metered services that **do not** have a 25% reduction on metered water above the consumption of 10,000 gallons on the following monthly consumption will be issued a written notice. Continued non-compliance could result in a flow restriction device being installed on the service connection.

    c) Watering of lawns, landscaping, and gardens **shall not** occur between the hours of 10:00 am and 6:00 pm.
    d) All decorative water feature usage is **prohibited**.
3) Public agencies within the affected drought areas **shall be** strongly encouraged to immediately implement mandatory conservation measures consistent with the conservation measures adopted by the County.
4) The use of fire hydrants **shall be** limited to fire protection uses only.
5) The use of water for general construction or maintenance activities, including dust control, compaction and concrete curing, is considered nonessential and as such is not permitted.
6) Issue written notices to all customers that have excessive leaks and or broken irrigation systems. If the leak and or broken irrigation system is not resolved within 72 hours of the written notice, the service connection will be shut off until these leaks and or system breaks have been repaired.

Stage 4: Emergency Drought Stage

Triggers

The Emergency Drought Stage should be declared when the County source water flow cannot keep up with daily system demands and/or maintain fire protection levels in the system tanks. Conditions that will be assessed in determining the Emergency Drought Stage will include:

1) Source water pumping levels drastically drop and there is a 50 % reduction in a system source water flow measured in Gallons Per Day (GPD).
2) A regulated water constituent rises up to a State and or Federal Maximum Contaminant Level (MCL) which causes an inadvertent 50 % reduction in a system source water flow measured in Gallons Per Day (GPD) for compliance purposes.
3) When Lake Tahoe level goes below 6217 FSL.
4) There is a severe system failure which effects the ability to keep up with daily system demands and or maintain fire protection levels in the system tanks.

Measures

The following measures are in addition to or supersede those included in the Severe Drought Stage:

1) The Board of County Commissioners intends to declare a water shortage emergency and public announcements will be made via the Douglas County website, social media and mail sent to consumers regarding service areas affected, the level of drought condition and what measures are being implemented.
2) The Board of County Commissioners intends to adopt an Ordinance calling for the following mandatory water restrictions (these measures shall be in addition to or supersede those included in the Warning Stage 1, Drought Alert Stage 2 and Severe Drought Stage 3):
    a) The planting of new lawns is **prohibited** from July through September.
    b) From October 1st through March 31st all watering of vegetation, including lawns, landscaping and gardens is **prohibited**.
    c) From April 1st through September 31st all watering of vegetation, including lawns, landscaping and gardens shall be limited to two days per week as follows:
        - Residences with even numbered addresses, common areas or multiple units served by one connection, may water only on Monday and Wednesday;
        - Residences with odd numbered addresses and commercial and industrial customers may water only on Tuesday and Thursday;
    d) Metered services that **do not** have a 50% reduction above the consumption of 10,000 gallons on the following monthly consumption will be issued a written notice. Continued non-compliance could result in a flow restriction device being installed on the service connection.
3) Public agencies within the affected drought areas **shall be** strongly encouraged to immediately implement mandatory conservation measures consistent with the conservation measures adopted by the County.
4) The use of fire hydrants **shall be** limited to fire protection uses only.
5) The use of water for general construction or maintenance activities, including dust control, compaction and concrete curing, is considered nonessential and as such is **not permitted**.
6) Issue written notices to all customers that have excessive leaks and or broken irrigation systems. If the leak and or broken irrigation system is not resolved within 72 hours of the written notice, the service connection will be shut off until these leaks and or system breaks have been repaired.

6.2 FUTURE DROUGHT MITIGATION PROJECTS

Capital improvement programs (CIPs) can provide opportunities to increase the Utility's drought resiliency. The Utility recently released a list of CIP requests for the coming fiscal years. Relevant proposed projects and accompanying budgets are summarized in Table 10.

Table 11. Proposed Drought Mitigation Projects

Project	Cost	Mitigation Action
New Carson Valley Well and Infrastructure	$2,000,000	Increase capacity
Replace Compromised Power Supply at Cave Rock Water Intake Pump	$450,000	Increase capacity
Cave Rock Water Distribution System Improvements	$6,500,000	Reduce leaks
Cave Rock Drive Water Line Replacement	$1,560,000	Reduce leaks
Fairgrounds Water System Evaluation	$150,000	Reduce leaks
Genoa Lakes Tank and Well Evaluation	$100,000	Reduce leaks
Construct Jacks Valley Road Tank No. 2	$2,000,000	Increase storage
Lower Cave Rock Booster Station Pump Station Replacement	$500,000	Increase capacity
Skyland Water Distribution System Improvements	$1,500,000	Reduce leaks
Uppaway Water System Improvements	$2,300,000	Reduce leaks
Water SCADA Upgrades	$526,270	Reduce leaks, data collection
West Valley Water System Improvements	$600,000	Reduce leaks
West Valley Well	$3,250,000	Increase capacity
ZWUD Water System Improvements	$2,302,000	Reduce leaks

Projects that increase water supply, storage, or reduce water losses are especially beneficial. For instance, projects such as the new Carson Valley and West Valley wells would likely increase the Utility's groundwater production capacity. Replacing or improving water systems (i.e., the Cave Rock, West Valley, and ZWUD projects) could reduce leaks and water losses. Building a new tank in the Jacks Valley Road area would increase overall system storage. Additionally, proposed upgrades to the SCADA system should improve data collection regarding water use.

7.0 PLAN METRICS AND EVALUATION

Requirements from NRS 540.141(2)(a) state that water suppliers must include means of measuring the effectiveness of conservation measures moving forward. Over the next five years, the Utility should focus primarily on initiating and developing routine data collection operations. These data should include pumping, flow, metering, and pressure data. In particular, increasing the number of meters in the service area could help to improve estimates of non-revenue water. Consistent data collection, record keeping, and analysis can provide a solid foundation for evaluating the effectiveness of different measures and identifying system inefficiencies; absent these, the validity of collected data may be suspect. Moving towards installation of meters at unmetered connections and ensuring that current meters remain working should be prioritized. The Utility should also attempt to restore the functionality of the Minden Heybourne meter. Conducting a comprehensive rate study could also be beneficial for the Utility. In addition, the AWWA audit documentation also recommends the following:

- Analyze business process for customer metering and billing functions and water supply operations; identify data gaps; improve supply metering.
- Conduct loss assessment investigations on a sample portion of the system; customer meter testing, leak survey, unauthorized consumption, etc.
- Begin to assess long-term needs requiring large expenditure: customer meter replacement, water main replacement program, new customer billing system or AMR/AMI system.

Examples additional evaluation methods that the Utility should consider implementing in the future include:

- Create and implement a conservation performance model
    - This model would utilize water sales and account usage info
- Utilize statistical methods for program evaluation. Analytical approaches could include:
    - Monthly conservation performance models
    - Specific conservation measure analysis
    - Pre/post measure implementation analysis
    - Water price elasticity response
- Establish implementation schedule and KPI criteria for each conservation measure/incentive
- Conduct customer survey to gauge reception and effectiveness of specific conservation measures (i.e., conservation education programs)
- Keep a record of any new meter installs or rate structure changes in Tahoe systems
    - Correlating changes in water use coincident with this work could be particularly informative

Results of the water audit (Appendix D) revealed that approximately 12.6% of the Utility's water is unaccounted for. The unaccounted-for water could be a product of system losses, unmetered or unauthorized use, or instrumentation/totalizer meter errors. These water audit, supply, and metering data can be used to establish loss reduction goals for the Utility to pursue. Reducing the unaccounted-for water to 10% the of total production is a reasonable goal for the Utility to work towards.

The Utility completes routine maintenance and monitoring activity to evaluate the distribution system integrity and reduce leaks. For instance, water storage tanks undergo dive inspections on a regular basis. Dive inspections are used to detect system leaks and to identify water losses in part of the system. The Utility also current has a replacement policy in place for older meters. Any meters that are over 20 years old are automatically replaced. Replacement helps to reduce the number of aged meters, which may be more susceptible to deficient flow measurements.

In addition to the routine monitoring and maintenance work, there are several CIP projects currently proposed by the Utility which could assist in meeting this unaccounted-for water reduction goal. Proposed projects which have the potential to reduce water losses and leaks include: Cave Rock Water Distribution System Improvements, Cave Rock Drive Water Line Replacements, Fairgrounds Water System Evaluation,

Genoa Lakes Tank and Well Evaluation, Zephyr Water Utility District System Improvements, Uppaway Water System Improvements, Skyland Water Distribution System Improvements, and West Valley Water System Improvements. Additionally, the Utility has proposed possible upgrades to the water distribution SCADA system, which could enhance monitoring and leak detection capabilities.

8.0 LIMITATIONS

This plan was prepared by Farr West Engineering for Douglas County Utilities. The plan has been prepared in accordance with NRS requirements and generally accepted local regulatory practices. The analyses and recommendations herein reflect our best judgment based on the information and data made available to Farr West Engineering at the time of preparation. Execution of recommendations and metric tracking are the responsibility of the Client, and will not be performed by Farr West. Any use which a third party makes of this report, or any reliance on or decisions to be made based upon it, are the responsibility of such third parties. Farr West accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.

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APPENDIX A: BILLING RATE STRUCTURE 2019 RESOLUTION

Exhibit A: CONSOLIDATED RATE SCHEDULE - METERED WATER SERVICE

Monthly water rates for Fiscal Years 2020 through 2024

FY 2019-2020

Effective July 1, 2019

Class	Service Size	Monthly Fixed Charge (includes first X gal.)	Volume charge Block 1 (0-12 gal)	Block 2 (13-22 gal)	Block 3 (Over 22 gal)
Residential	5/8"	$31.00	$2.70	$3.75	$5.90
	3/4"	$31.00	$2.70	$3.75	$5.90
	1"	$64.08	$2.70	$3.75	$5.90
	1 1/2"	$158.42	$2.70	$3.75	$5.90
	2"	$385.48	$2.70	$3.75	$5.90

Class	Service Size	Monthly Fixed Charge	All usage (X gal and above)
Commercial	5/8"	$31.78	$3.38
	3/8"	$31.78	$3.38
	1"	$67.69	$3.38
	1 1/2"	$126.87	$3.38
	2"	$199.48	$3.38
	3"	$466.62	$3.38
	4"	$823.69	$3.38
	6"	$1,223.18	$3.38
	8"	$1,841.52	$3.38
Irrigation	5/8"	$27.00	$3.64
	3/4"	$27.00	$3.64
	1"	$30.75	$3.64
	1 1/2"	$52.98	$3.64
	2"	$81.25	$3.64
	3"	$270.17	$3.64
	4"	$264.24	$3.64

FY 2020-2021

Effective July 1, 2020

Class	Service Size	Monthly Fixed Charge (includes first X gal.)	Volume charge Block 1 (0-12 gal)	Block 2 (13-22 gal)	Block 3 (Over 22 gal)
Residential	5/8"	$32.86	$2.86	$3.98	$6.25
	3/4"	$32.86	$2.86	$3.98	$6.25
	1"	$67.93	$2.86	$3.98	$6.25
	1 1/2"	$125.52	$2.86	$3.98	$6.25
	2"	$308.61	$2.86	$3.98	$6.25

Class	Service Size	Monthly Fixed Charge	All usage (X gal and above)
Commercial	5/8"	$33.69	$3.58
	3/4	$33.69	$3.58
	1"	$71.75	$3.58
	1 1/2"	$134.48	$3.58
	2"	$211.45	$3.58
	3"	$491.01	$3.58
	4"	$861.12	$3.58
	6"	$1,296.57	$3.58
	8"	$2,068.01	$3.58
Irrigation	5/8"	$28.62	$3.85
	3/4"	$28.62	$3.85
	1"	$32.60	$3.85
	1 1/2"	$56.16	$3.85
	2"	$86.12	$3.85
	3"	$286.38	$3.85
	4"	$280.56	$3.85

FY 2021-2022

Effective July 1, 2021

Class	Service Size	Monthly fixed charge (includes first X gal.)	Volume charge Block 1 (0-12 gal)	Block 2 (13-22 gal)	Block 3 (Over 22 gal)
Residential	5/8"	$34.83	$3.03	$4.21	$6.63
	3/4"	$34.83	$3.03	$4.21	$6.63
	1"	$72.00	$3.03	$4.21	$6.63
	1 1/2"	$133.06	$3.03	$4.21	$6.63
	2"	$269.40	$3.03	$4.21	$6.63

Class	Service Size	Monthly Fixed Charge	All usage (X gal and above)
Commercial	5/8"	$35.71	$3.80
	3/4"	$35.71	$3.80
	1"	$76.06	$3.80
	1 1/2"	$142.55	$3.80
	2"	$224.14	$3.80
	3"	$456.87	$3.80
	4"	$760.78	$3.80
	6"	$1,374.36	$3.80
	8"	$2,181.49	$3.80
Irrigation	5/8"	$29.10	$4.09
	3/4"	$29.10	$4.09
	1"	$34.55	$4.09
	1 1/2"	$59.53	$4.09
	2"	$91.29	$4.09
	3"	$291.21	$4.09
	4"	$285.07	$4.09

FY 2022-2023

Effective July 1, 2022

Class	Service Size	Monthly fixed charge (includes first X gal.)	Volume charge Block 1 (0-12 gal)	Block 2 (13-22 gal)	Block 3 (Over 22 gal)
Residential	5/8"	$36.92	$3.22	$4.47	$7.03
	3/4"	$36.92	$3.22	$4.47	$7.03
	1"	$76.32	$3.22	$4.47	$7.03
	1 1/2"	$141.04	$3.22	$4.47	$7.03
	2"	$220.93	$3.22	$4.47	$7.03

Class	Service Size	Monthly Fixed Charge	All usage (X gal and above)
Commercial	5/8"	$37.85	$4.03
	3/4"	$37.85	$4.03
	1"	$80.62	$4.03
	1 1/2"	$151.13	$4.03
	2"	$237.59	$4.03
	3"	$484.20	$4.03
	4"	$742.83	$4.03
	6"	$1,456.82	$4.03
	8"	$2,312.38	$4.03
Irrigation	5/8"	$29.25	$4.33
	3/4"	$29.25	$4.33
	1"	$36.62	$4.33
	1 1/2"	$63.16	$4.33
	2"	$96.77	$4.33
	3"	$292.68	$4.33
	4"	$302.63	$4.33

FY 2023-2024

Effective July 1, 2023

Class	Service Size	Monthly fixed charge (includes first X gal.)	Volume charge Block 1 (0-12 gal)	Block 2 (13-22 gal)	Block 3 (Over 22 gal)
Residential	5/8"	$39.14	$3.41	$4.73	$7.45
	3/4"	$39.14	$3.41	$4.73	$7.45
	1"	$80.90	$3.41	$4.73	$7.45
	1 1/2"	$149.50	$3.41	$4.73	$7.45
	2"	$234.16	$3.41	$4.73	$7.45

Class	Service Size	Monthly Fixed Charge	All usage (X gal and above)
Commercial	5/8"	$40.12	$4.27
	3/4"	$40.12	$4.27
	1"	$85.46	$4.27
	1 1/2"	$269.17	$4.27
	2"	$251.84	$4.27
	3"	$513.34	$4.27
	4"	$787.40	$4.27
	6"	$1,544.23	$4.27
	8"	$2,451.12	$4.27
Irrigation	5/8"	$21.47	$4.59
	3/4"	$21.47	$4.59
	1"	$38.82	$4.59
	1 1/2"	$66.86	$4.59
	2"	$102.57	$4.59
	3"	$214.84	$4.59
	4"	$310.97	$4.59

Exhibit B: CONSOLIDATED RATE SCHEDULE - METERED PRIVATE FIRE SERVICE CHARGES
Monthly water rates for Fiscal Years 2020 through 2024

FY 2019-2020
Effective July 1, 2019

Service Size	With Domestic Service Residential and Commercial	Without Domestic Service Residential	Without Domestic Service - Commercial
5/8"	$2.62	$16.30	$27.95
3/4"	$2.62	$16.30	$27.95
1"	$3.67	$17.35	$29.00
1 1/2"	$4.71	$18.39	$30.04
2"	$7.59	$21.27	$32.92
2 1/2"	$18.39	$32.01	$43.66
3"	$28.80	$42.48	$54.13
4"	$36.65	$50.33	$61.98
6"	$54.98	$68.66	$80.31
8"	$75.93	$89.61	$101.26
10"	$97.43	$111.11	$122.76

FY 2020-2021
Effective July 1, 2020

Service Size	With Domestic Service Residential and Commercial	Without Domestic Service Residential	Without Domestic Service - Commercial
5/8"	$2.78	$17.28	$29.63
3/4"	$2.78	$17.28	$29.63
1"	$3.89	$18.39	$30.74
1 1/2"	$5.00	$19.50	$31.85
2"	$8.05	$22.55	$34.90
2 1/2"	$19.43	$33.93	$46.28
3"	$30.53	$45.03	$57.38
4"	$38.85	$53.35	$65.70
6"	$58.28	$72.78	$85.13
8"	$80.48	$94.98	$107.33
10"	$103.28	$117.78	$130.13

FY 2021-2022
Effective July 1, 2021

Service Size	With Domestic Service Residential and Commercial	Without Domestic Service Residential	Without Domestic Service - Commercial
5/8"	$2.94	$18.31	$31.40
3/4"	$2.94	$18.31	$31.40
1"	$4.12	$19.49	$32.58
1 1/2"	$5.30	$20.67	$33.76
2"	$8.53	$23.90	$36.99
2 1/2"	$20.59	$35.96	$49.05
3"	$32.36	$47.73	$60.82
4"	$41.19	$56.56	$69.65
6"	$61.78	$77.15	$90.24
8"	$85.31	$100.68	$113.77
10"	$109.47	$124.84	$137.93

FY 2022-2023
Effective July 1, 2022

Service Size	With Domestic Service Residential and Commercial	Without Domestic Service Residential	Without Domestic Service - Commercial
5/8"	$3.12	$19.41	$33.29
3/4"	$3.12	$19.41	$33.29
1"	$4.37	$20.66	$34.53
1 1/2"	$5.61	$21.91	$35.78
2"	$9.04	$25.34	$39.21
2 1/2"	$21.83	$38.12	$52.00
3"	$34.30	$50.59	$64.47
4"	$43.66	$59.95	$73.82
6"	$65.48	$81.78	$95.65
8"	$90.43	$106.72	$120.60
10"	$116.04	$132.33	$146.21

FY 2023-2024
Effective July 1, 2023

Service Size	With Domestic Service Residential and Commercial	Without Domestic Service Residential	Without Domestic Service - Commercial
5/8"	$3.31	$20.58	$35.28
3/4"	$3.31	$20.58	$35.28
1"	$4.63	$21.90	$36.61
1 1/2"	$5.95	$23.22	$37.93
2"	$9.59	$26.86	$41.56
2 1/2"	$23.14	$40.41	$55.12
3"	$36.36	$53.63	$68.34
4"	$46.28	$63.55	$78.25
6"	$69.41	$86.68	$101.39
8"	$95.86	$113.13	$127.84
10"	$123.00	$140.27	$154.98

Exhibit C: CONSOLIDATED RATE SCHEDULE - UNMETERED RESIDENTIAL WATER SERVICE
Monthly water rates for Fiscal Years 2020 through 2024

FY 2019-2020
Effective July 1, 2019

Class	Service size	Monthly fixed charge [1]
Unmetered Residential	5/8"	$67.60
	3/4"	$67.60
	1"	$100.68
	1 1/2"	$155.02
	2"	$222.08

FY 2020-2021
Effective July 1, 2020

Class	Service size	Monthly fixed charge [1]
Unmetered Residential	5/8"	$71.66
	3/4"	$71.66
	1"	$106.72
	1 1/2"	$164.32
	2"	$235.40

FY 2021-2022
Effective July 1, 2021

Class	Service size	Monthly fixed charge [1]
Unmetered Residential	5/8"	$75.96
	3/4"	$75.96
	1"	$113.12
	1 1/2"	$174.18
	2"	$249.53

FY 2022-2023
Effective July 1, 2022

Class	Service size	Monthly fixed charge [1]
Unmetered Residential	5/8"	$80.51
	3/4"	$80.51
	1"	$119.91
	1 1/2"	$184.63
	2"	$264.50

FY 2023-2024
Effective July 1, 2023

Class	Service size	Monthly fixed charge [1]
Unmetered Residential	5/8"	$85.34
	3/4"	$85.34
	1"	$127.11
	1 1/2"	$195.71
	2"	$280.37

[1] All residential, commercial, and irrigation service connections within Tahoe Township will be charged a Capital Improvement Surcharge of Twenty Dollars ($20) per month.

Exhibit D: CONSOLIDATED RATE SCHEDULE - CONNECTION CHARGES

Effective July 1, 2019

Line Size	Meter Capacity Ratio	Connection Charge[1]
5/8"	1	$5,024
3/4"	1.5	$5,024
1"	2.5	$12,560
1 1/2"	5	$25,120
2"	8	$40,192
3"	16	$80,384
4"	25	$125,600
6"	50	$251,200
8"	80	$401,920
10"	210	$1,055,040

[1] The connection charge is for each individual residential, commerical and irrigation service connection to the water system. Meter capacity ratio source: AWWA

APPENDIX B: CONSERVATION EDUCATIONAL MATERIALS

Read any good meters lately? Guide provides instruction for reading and interpreting meter information. It also teaches water customers how to measure the amount of water they use in different applications.

Yes, you can...fix a leaky faucet by yourself pamphlet gives step-by-step instructions on how to fix a leaking faucet. It includes a list of tools necessary to perform the repairs.

Preventing Floods and Leaks in Your Home emphasizes the importance of locating a master valve and discusses where it might be. It also deals with faucet, toilet, and hose leaks.

Disaster Preparedness, Storing Water for Emergencies addresses four important emergency questions; How much water should be stored, How long can tap water be stored safely, What is a boil water order, and How will I know when the water is safe again?

25 Facts About Water is a list of 25 water facts that encourage conservation.

Lets Learn About the Water Cycle diagrams the seven stages of the water cycle.

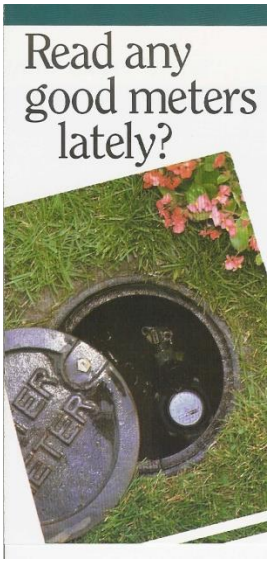
Its a Natural makes suggestions regarding landscape including planning, design, soils, and irrigation.

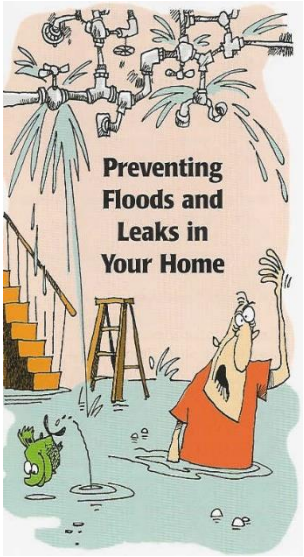
Water Conservation at Home discusses in-home conservation practices for bathroom, kitchen, and outdoor water use.

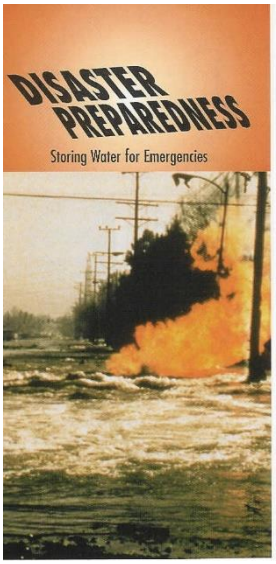
55 Facts Figures & Follies of Water Conservation is similar to "25 Facts about Water" but it provides a bit more information.

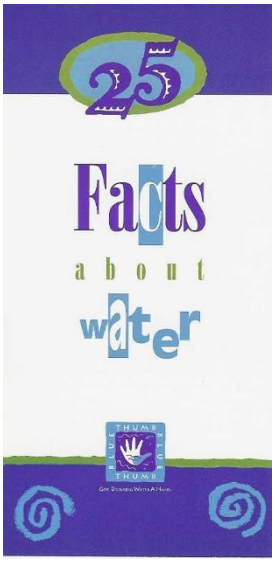
In addition to the above mentioned AWWA publications, The University of Nevada Cooperative Extension publishes Fact Sheets that encourage conservation. Fact Sheet 90-09 "Making a Little Water Go a Long Way in Your Home" contains residential conservation tips, Fact Sheet 90-40 "Watering Tips to Beat the Drain on the Southwest's Water Supply" provides tips to make landscapes more water efficient and Fact Sheet 91-32 is a list of low water-use plants for southern Nevada. \

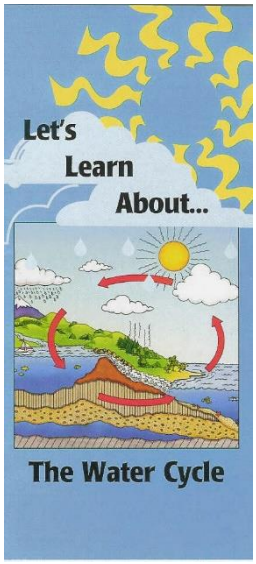
AWWA Conservation Pamphlets

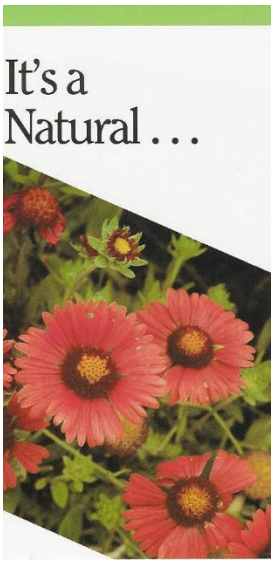


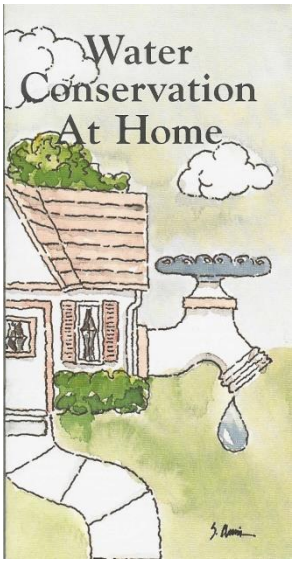


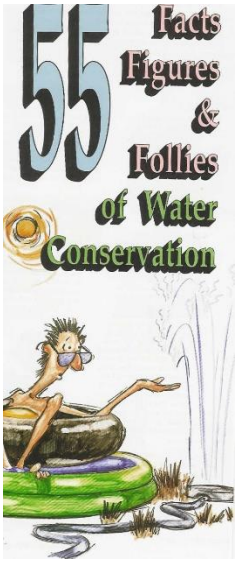

DISASTER PREPAREDNESS
Storing Water for Emergencies


25
Facts
about
water


Let's
Learn
About...
The Water Cycle


It's a
Natural . . .


Water
Conservation
At Home


55
Facts
Figures
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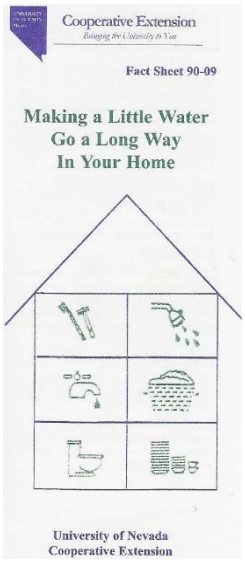
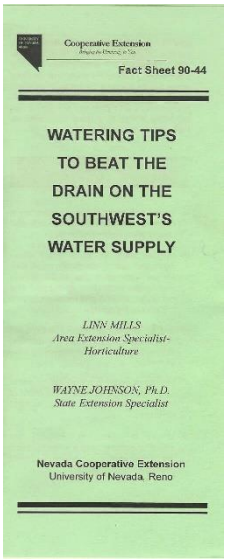
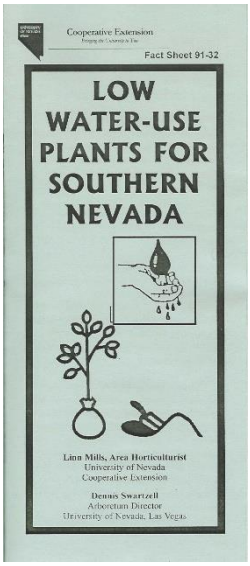
of Water
Conservation


Cooperative Extension
Fact Sheet 90-09
Making a Little Water Go a Long Way In Your Home
University of Nevada Cooperative Extension


Cooperative Extension
Fact Sheet 90-44
WATERING TIPS TO BEAT THE DRAIN ON THE SOUTHWEST'S WATER SUPPLY
LINN MILLS
Area Extension Specialist-Horticulture
WAYNE JOHNSON, Ph.D.
State Extension Specialist
Nevada Cooperative Extension
University of Nevada, Reno


Cooperative Extension
Fact Sheet 91-32
LOW WATER-USE PLANTS FOR SOUTHERN NEVADA
Linn Mills, Area Horticulturist
University of Nevada
Cooperative Extension
Dennis Swartzell
Arboretum Director
University of Nevada, Las Vegas

APPENDIX C: BEHAVIORAL CONSERVATION MEASURES

Residential Behaviors

1. When washing dishes by hand, don't let the water run while rinsing. Fill one sink with wash water and the other with rinse water.
2. Evaporative coolers require a seasonal maintenance checkup. For more efficient cooling, check your evaporative cooler annually.
3. Run your washing machine and dishwasher only when they are full. This can save up to 1,000 gallons a month.
4. Use the garbage disposal sparingly. Compost instead and save gallons every time.
5. Keep a pitcher of water in the refrigerator instead of running the tap for cold drinks, so that every drop goes down the drain.
6. Check your water meter and bill to track your usage.
7. Wash your produce in the sink or a pan that is partially filled with water instead of running water from the tap.
8. Use a broom instead of a hose to clean your driveway or sidewalk and save 80 gallons of water every time.
9. If your shower can fill a one-gallon bucket in less than 20 seconds, then replace it with a water efficient showerhead.
10. Collect the water you use for rinsing produce and reuse it to water houseplants.
11. We're more likely to notice leaky faucets indoors, but don't forget to check outdoor faucets, pipes, and hoses for leaks.
12. When you shop for a new appliance, consider one offering cycle and load size adjustments. They are more water and energy-efficient than older appliances.
13. Time your shower to keep it under 5 minutes. This can save up to 1,000 gallons a month.
14. Install low-volume toilets.
15. When cleaning a fish tank, use the water you've drained on your plants. The water is rich in nitrogen and phosphorous, providing a free and effective fertilizer.
16. Put food coloring in the toilet tank. If it seeps into the toilet bowl, there is a leak. It's easy to fix, and can save more than 600 gallons per month.
17. Plug the bathtub before turning the water on, and then adjust the temperature as the tub fills up.
18. Designate one glass for your drinking water each day. This will cut down on the average number of dishwasher runs.
19. Don't use running water to thaw food.
20. Use a wrench to fix leaky faucets. It's simple, inexpensive, and can save 140 gallons a week.
21. When doing laundry, match the water level to the size of the load.
22. Teach your children to turn the faucets off tightly after each use.

23. Install a low-flow showerhead. They are inexpensive, easy to install, and can save more than 500 gallons a week per household.
24. Soak your pots and pans instead of letting the water run while you scrape them clean.
25. Make sure you know where ethe master water shut-off valve is located. This could save gallons of water and damage to your home if a pipe were to burst.
26. Turn off the water while you brush your teeth and save 4 gallons a minute. This can be equivalent to 200 gallons a week for a family of four.
27. Make sure your toilet flapper doesn't stick open after flushing.
28. Make sure there are aerators on all of your faucets.
29. Install an instant water heater on your kitchen sink so you don't have to let the water run while it heats up. This will also reduce heating costs for your household.
30. Cut back on rinsing if your dishwasher is new. Newer models clean more thoroughly than old ones.
31. Bathe your young children together.
32. Winterize outdoor spigots when temps dip to 20 degrees F to prevent pipes from bursting or freezing.
33. Insulate hot water pipes so you don't have to run as much water to get hot water to the faucet.
34. Drop tissue in the trash instead of flushing it and save gallons every time.
35. If your toilet was installed prior to 1980, place a toilet dam or bottle filled with water tank in your toilet tank to cut down on the amount of water used for each flush. Be sure these devices do not interfere with operating parts.
36. Install water softening systems only when necessary. Save water and salt by running the minimum number of regenerations necessary to maintain water softness.
37. Wash clothes only when you have a full load and save up to 600 gallons each month.
38. Listen for dripping faucets and toilets that flush on their own. Fixing a leak can save 500 gallons each month.
39. Cook food in as little water as possible. This will also retain more of the nutrients.
40. Turn the water off while you shampoo and condition your hair. This can save more than 50 gallons a week.
41. Choose new water-saving appliance, like washing machines that save up to 20 gallons per load.
42. Select the proper size pans for cooking. Large pans require more cooking water than may be necessary.
43. Turn off the water while you shave; this can save more than 100 gallons a week.
44. To save water and time, consider washing your face or brushing your teeth while in the shower.
45. For hanging baskets, planters and pots, place ice cubes under the moss or dirt to give your plants a cool drink of water and help eliminate water overflow.

46. Throw trimmings and peelings from fruits and vegetables into your yard compost to prevent from using the garbage disposal.
47. Keep a bucket in the shower to catch water as it warms up or runs. Use this water to flush toilets or water plants.
48. When you are washing your hands, don't let the water run while you lather.
49. Pre-treat stains before washing clothes to avoid re-washing.
50. Use the shortest wash cycle for lightly soiled cloths.
51. Check washing machine hoses regularly for leaks.
52. Do not pre-rinse dishes except in cases of stuck or burnt-on food.
53. Scrape off food with a utensil or used paper napkin when pre-cleaning for the dishwasher.

Landscape Behaviors

1. Check your sprinkler system frequently and adjust sprinklers so only your lawn is watered and not the house, sidewalk, or street.
2. Avoid planting turf in areas that are hard to water such as steep inclines and isolated strips along sidewalks and driveways.
3. Plant during the spring or fall when the watering requirements are lower.
4. Minimize evaporation by watering during the early morning hours, when temperatures are cooler and winds are lighter.
5. Use a layer of organic mulch around plants to reduce evaporation and save hundreds of gallons of water a year.
6. Divide your watering cycle into shorter periods to reduce runoff and allow for better absorption every time you water.
7. Only water your lawn when needed. You can tell this by simply walking across your lawn. If you leave footprints, it's time to water.
8. Adjust your lawn mower to a higher setting. Longer grass shades root systems and holds soil moisture better than a closely clipped lawn.
9. Use the sprinkler for larger areas of grass. Water small patches by hand to avoid waste.
10. Use porous materials for walkways and patios to keep water in your yard and prevent wasteful runoff.
11. Direct downspouts and other runoff towards shrubs and trees, or collect and use for your garden.
12. Install a rain shut-off device on your automatic sprinklers to eliminate unnecessary watering.
13. Choose a water-efficient drip irrigation system for trees, shrubs and flowers. Watering at the roots is very effective, be careful not to over water.
14. Reduce the amount of grass in your yard by planting shrubs and ground cover with rock and granite mulching.

15. Remember to check your sprinkler system valves periodically for leaks and keep the heads in good shape.
16. Don't water your lawn on windy days. After all, sidewalks and driveways don't need water.
17. Water your plants deeply but less frequently to create healthier and stronger landscapes.
18. When watering grass on steep slopes, use a soaker hose to prevent wasteful runoff.
19. Group plants with the same watering needs together to get the most out of your watering time.
20. Remember to weed your lawn and garden regularly. Weeds compete with other plants for nutrients, light, and water.
21. While fertilizers promote plant growth, they also increase water consumption. Apply the minimum amount of fertilizer needed.
22. Avoid installing ornamental water features and fountains that spray water into the air. Trickling or cascading fountains lose less water to evaporation.
23. Buy a rain gauge to track how much rain or irrigation your yard receives. Check with your local water agency to see how much rain is needed to skip an irrigation cycle.
24. Teach your family how to shut off your automatic watering systems. Turn sprinklers off if the system is malfunctioning or when a storm is approaching.
25. Set a kitchen timer when watering your lawn or garden with a hose.
26. Next time you add or replace a flower or shrub, choose a low water use plant for year-round landscape color and save up to 550 gallons each year.
27. Use a screwdriver as a soil probe to test soil moisture. If it goes in easily, don't water. Proper lawn watering can save thousands of gallons of water annually.
28. Avoid over-seeding your lawn with winter grass. Once established, ryegrass needs water every three to five days, whereas dormant Bermuda grass needs water only once a month.
29. Landscape with Xeriscape trees, plants and groundcovers. Call your local conservation office for more information about these water thrifty plants.
30. If you have an evaporative cooler, direct the water drain to a flowerbed, tree, or your lawn.
31. Leave lower branches on trees and shrubs and allow leaf litter to accumulate on top of the soil. This keeps the soil cooler and reduces evaporation.
32. Start a compost pile. Using compost when you plant adds water-holding organic matter to the soil.
33. Use sprinklers that throw big drops of water close to the ground. Smaller drops of water and mist often evaporate before they hit the ground.
34. More plants die from over-watering than from under-watering. Be sure only to water plants when necessary.
35. Water only as rapidly as the soil can absorb the water.
36. Aerate your lawn. Punch holes in your lawn about six inches apart so water will reach the roots rather than run off the surface.

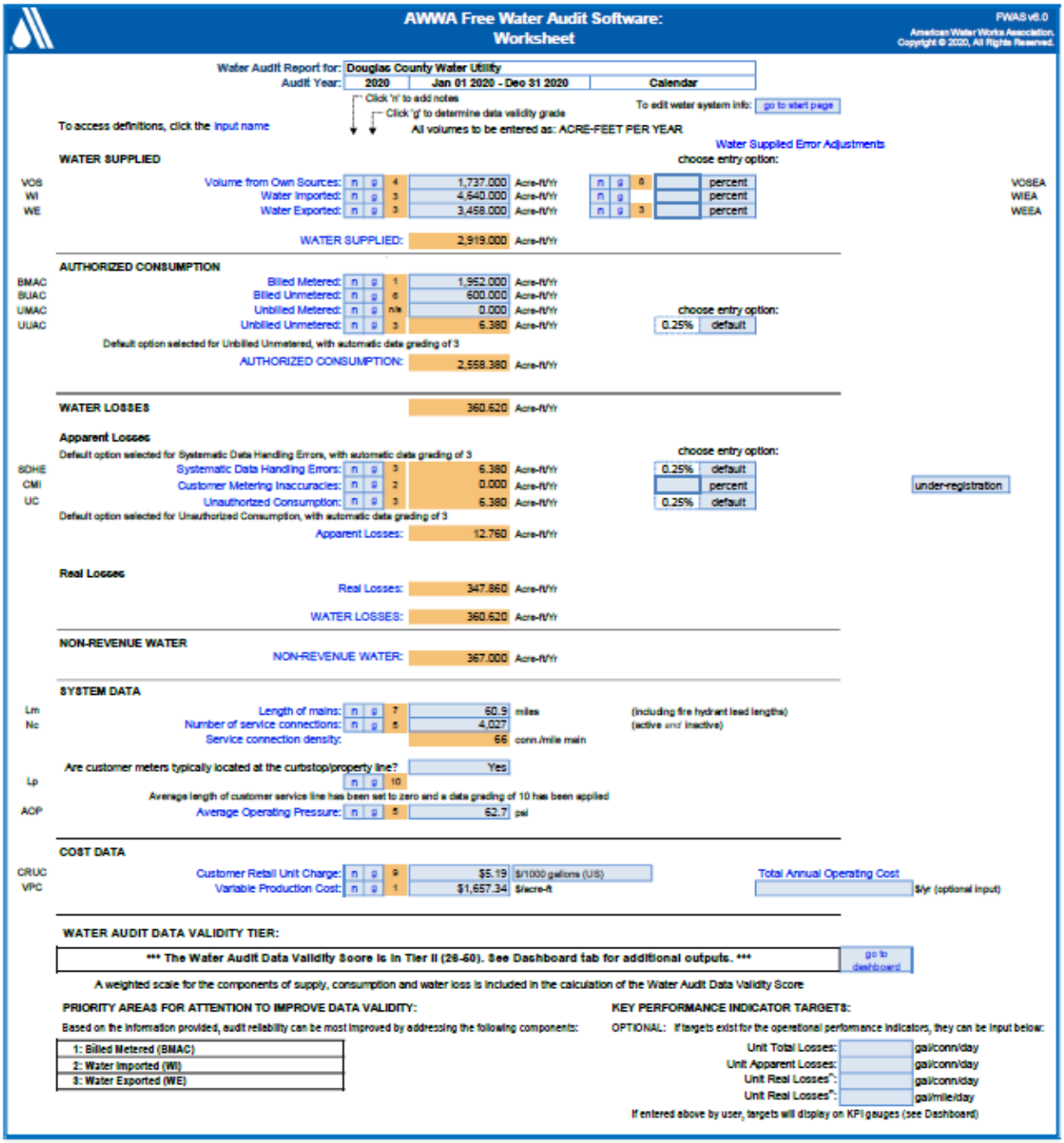
Community Behaviors

1. Encourage your school system and local government to help develop and promote a water conservation ethic among children and adults.
2. Make suggestions to your employer to save water (and dollars) at work.
3. Support projects that use reclaimed wastewater for irrigation and other uses.
4. Encourage your friends and neighbors to be part of a water-conscious community.
5. Pick-up the phone and report significant water losses from broken pipes, open hydrants and errant sprinklers to the property owner or your water management district.

Miscellaneous Behaviors

1. Install covers on pools and spas and check for leaks around your pumps.
2. Periodically check your pool for leaks if you have an automatic refilling device.
3. Use a commercial car wash that recycles water.
4. Don't buy recreational water toys that require a constant flow of water.
5. Use a grease pencil to mark the water level of your pool at the skimmer. Check the mark 24 hours later. Your pool should lose no more than ¼ inch each day.
6. When the kids want to cool off, use the sprinkler in an area where your lawn needs it the most.
7. Make sure your swimming pools, fountains, and ponds are equipped with re-circulating pumps.
8. Bathe your pets outdoors in an area in need of water.
9. While staying in a hotel or even at home, consider reusing your towels.
10. When backwashing your pool, consider using the water on your landscaping.

APPENDIX D: WATER AUDIT



AWWA Free Water Audit Software: Worksheet

FWAS v6.0

American Water Works Association. Copyright © 2020, All Rights Reserved.

Water Audit Report for: Douglas County Water Utility

Audit Year: 2020 | Jan 01 2020 - Dec 31 2020 | Calendar

Click 'n' to add notes

Click 'g' to determine data validity grade

To edit water system info: go to start page

To access definitions, click the input name

All volumes to be entered as: ACRE-FEET PER YEAR

Water Supplied Error Adjustments

WATER SUPPLIED

choose entry option:

VOS	Volume from Own Sources:	n	g	4	1,737.000	Acre-ft/Yr		percent	VOSEA
WI	Water Imported:	n	g	3	4,640.000	Acre-ft/Yr		percent	WIEA
WE	Water Exported:	n	g	3	3,458.000	Acre-ft/Yr		percent	WEEA

WATER SUPPLIED: 2,919.000 Acre-ft/Yr

AUTHORIZED CONSUMPTION

choose entry option:

BMAC	Billed Metered:	n	g	1	1,952.000	Acre-ft/Yr		
BUAC	Billed Unmetered:	n	g	6	600.000	Acre-ft/Yr		
UMAC	Unbilled Metered:	n	g	n/a	0.000	Acre-ft/Yr		
UUAC	Unbilled Unmetered:	n	g	3	6.380	Acre-ft/Yr	0.25%	default

Default option selected for Unbilled Unmetered, with automatic data grading of 3

AUTHORIZED CONSUMPTION: 2,558.380 Acre-ft/Yr

WATER LOSSES 360.620 Acre-ft/Yr

Apparent Losses

Default option selected for Systematic Data Handling Errors, with automatic data grading of 3

choose entry option:

SDHE	Systematic Data Handling Errors:	n	g	3	6.380	Acre-ft/Yr	0.25%	default	
CMI	Customer Metering Inaccuracies:	n	g	2	0.000	Acre-ft/Yr		percent	under-registration
UC	Unauthorized Consumption:	n	g	3	6.380	Acre-ft/Yr	0.25%	default	

Default option selected for Unauthorized Consumption, with automatic data grading of 3

Apparent Losses: 12.760 Acre-ft/Yr

Real Losses

Real Losses: 347.860 Acre-ft/Yr

WATER LOSSES: 360.620 Acre-ft/Yr

NON-REVENUE WATER

NON-REVENUE WATER: 367.000 Acre-ft/Yr

SYSTEM DATA

Lm	Length of mains:	n	g	7	60.9	miles	(including fire hydrant lead lengths)
Nc	Number of service connections:	n	g	5	4,027		(active and inactive)
	Service connection density:				66	conn./mile main	

Are customer meters typically located at the curbstop/property line? Yes

Lp: n g 10

Average length of customer service line has been set to zero and a data grading of 10 has been applied

AOP: Average Operating Pressure: n g 5 62.7 psi

COST DATA

CRUC	Customer Retail Unit Charge:	n	g	9	$5.19	$/1000 gallons (US)	Total Annual Operating Cost
VPC	Variable Production Cost:	n	g	1	$1,657.34	$/acre-ft	$/yr (optional input)

WATER AUDIT DATA VALIDITY TIER:

*** The Water Audit Data Validity Score is in Tier II (26-50). See Dashboard tab for additional outputs. ***

go to dashboard

A weighted scale for the components of supply, consumption and water loss is included in the calculation of the Water Audit Data Validity Score

PRIORITY AREAS FOR ATTENTION TO IMPROVE DATA VALIDITY:

Based on the information provided, audit reliability can be most improved by addressing the following components:

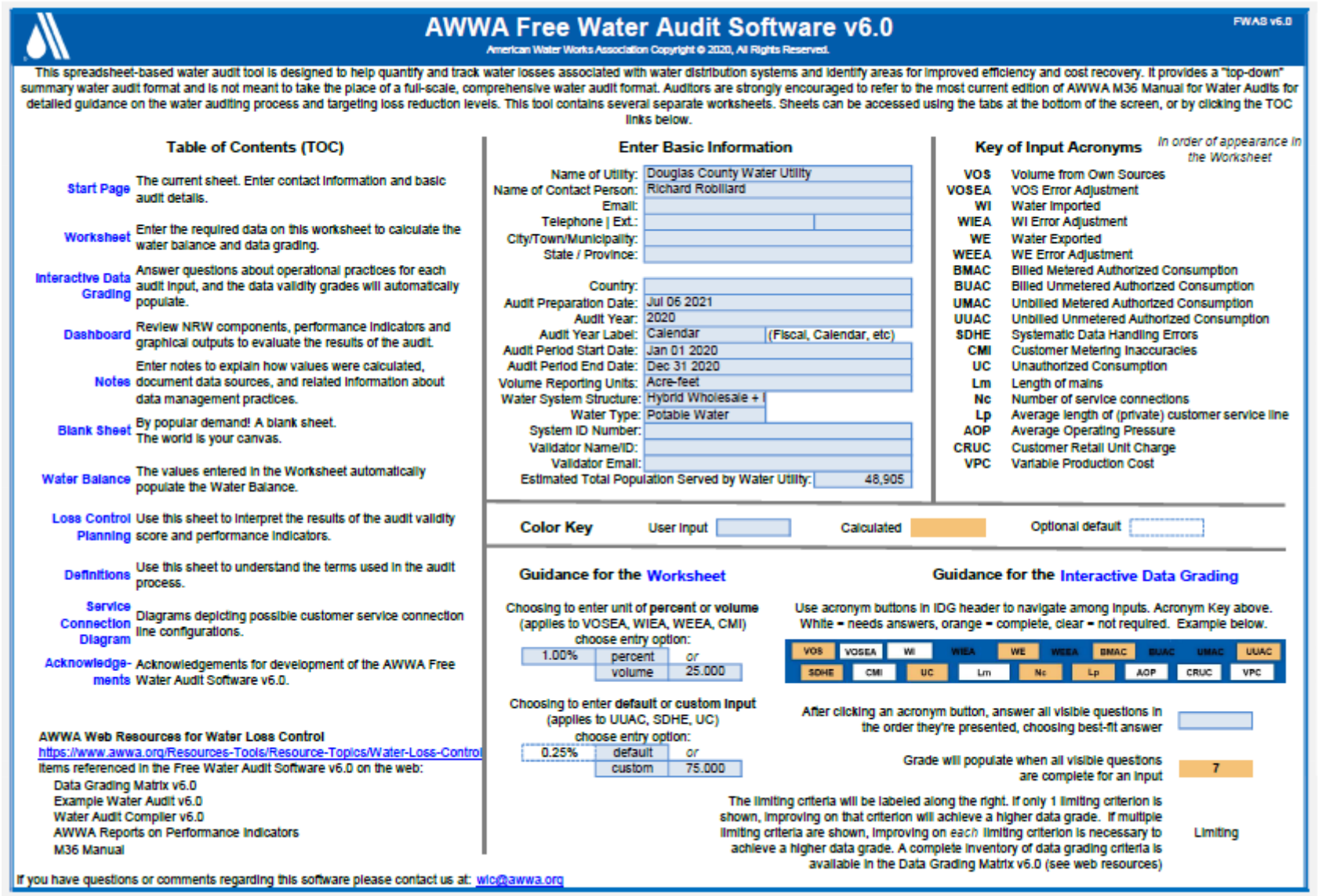
1: Billed Metered (BMAC)
2: Water Imported (WI)
3: Water Exported (WE)

KEY PERFORMANCE INDICATOR TARGETS:

OPTIONAL: If targets exist for the operational performance indicators, they can be input below:

Unit Total Losses:		gal/conn/day
Unit Apparent Losses:		gal/conn/day
Unit Real Losses*:		gal/conn/day
Unit Real Losses*:		gal/mile/day

If entered above by user, targets will display on KPI gauges (see Dashboard)



AWWA Free Water Audit Software v6.0

FWAS v6.0

This spreadsheet-based water audit tool is designed to help quantify and track water losses associated with water distribution systems and identify areas for improved efficiency and cost recovery. It provides a "top-down" summary water audit format and is not meant to take the place of a full-scale, comprehensive water audit format. Auditors are strongly encouraged to refer to the most current edition of AWWA M36 Manual for Water Audits for detailed guidance on the water auditing process and targeting loss reduction levels. This tool contains several separate worksheets. Sheets can be accessed using the tabs at the bottom of the screen, or by clicking the TOC links below.

Table of Contents (TOC)

Start Page	The current sheet. Enter contact information and basic audit details.
Worksheet	Enter the required data on this worksheet to calculate the water balance and data grading.
Interactive Data Grading	Answer questions about operational practices for each audit input, and the data validity grades will automatically populate.
Dashboard	Review NRW components, performance indicators and graphical outputs to evaluate the results of the audit.
Notes	Enter notes to explain how values were calculated, document data sources, and related information about data management practices.
Blank Sheet	By popular demand! A blank sheet. The world is your canvas.
Water Balance	The values entered in the Worksheet automatically populate the Water Balance.
Loss Control Planning	Use this sheet to interpret the results of the audit validity score and performance indicators.
Definitions	Use this sheet to understand the terms used in the audit process.
Service Connection Diagram	Diagrams depicting possible customer service connection line configurations.
Acknowledgements	Acknowledgements for development of the AWWA Free Water Audit Software v6.0.

AWWA Web Resources for Water Loss Control

https://www.awwa.org/Resources-Tools/Resource-Topics/Water-Loss-Control

Items referenced in the Free Water Audit Software v6.0 on the web:

- Data Grading Matrix v6.0
- Example Water Audit v6.0
- Water Audit Compiler v6.0
- AWWA Reports on Performance Indicators
- M36 Manual

Enter Basic Information

Name of Utility:	Douglas County Water Utility
Name of Contact Person:	Richard Robillard
Email:	
Telephone | Ext.:	
City/Town/Municipality:	
State / Province:	
Country:	
Audit Preparation Date:	Jul 06 2021
Audit Year:	2020
Audit Year Label:	Calendar (Fiscal, Calendar, etc)
Audit Period Start Date:	Jan 01 2020
Audit Period End Date:	Dec 31 2020
Volume Reporting Units:	Acre-feet
Water System Structure:	Hybrid Wholesale + R
Water Type:	Potable Water
System ID Number:	
Validator Name/ID:	
Validator Email:	
Estimated Total Population Served by Water Utility:	48,905

Key of Input Acronyms

In order of appearance in the Worksheet

VOS	Volume from Own Sources
VOSEA	VOS Error Adjustment
WI	Water Imported
WIEA	WI Error Adjustment
WE	Water Exported
WEEA	WE Error Adjustment
BMAC	Billed Metered Authorized Consumption
BUAC	Billed Unmetered Authorized Consumption
UMAC	Unbilled Metered Authorized Consumption
UUAC	Unbilled Unmetered Authorized Consumption
SDHE	Systematic Data Handling Errors
CMI	Customer Metering Inaccuracies
UC	Unauthorized Consumption
Lm	Length of mains
Nc	Number of service connections
Lp	Average length of (private) customer service line
AOP	Average Operating Pressure
CRUC	Customer Retail Unit Charge
VPC	Variable Production Cost

Color Key User Input | Calculated | Optional default

Guidance for the Worksheet

Choosing to enter unit of **percent** or **volume** (applies to VOSEA, WIEA, WEEA, CMI) choose entry option:

1.00%	percent	*or*
	volume	25.000

Choosing to enter **default** or **custom input** (applies to UUAC, SDHE, UC) choose entry option:

0.25%	default	*or*
	custom	75.000

Guidance for the Interactive Data Grading

Use acronym buttons in IDG header to navigate among inputs. Acronym Key above. White = needs answers, orange = complete, clear = not required. Example below.

VOS	VOSEA	WI	WIEA	WE	WEEA	BMAC	BUAC	UMAC	UUAC
SDHE	CMI	UC	Lm	Nc	Lp	AOP	CRUC	VPC	

After clicking an acronym button, answer all visible questions in the order they're presented, choosing best-fit answer

Grade will populate when all visible questions are complete for an input: 7

The limiting criteria will be labeled along the right. If only 1 limiting criterion is shown, improving on that criterion will achieve a higher data grade. If multiple limiting criteria are shown, improving on *each* limiting criterion is necessary to achieve a higher data grade. A complete inventory of data grading criteria is available in the Data Grading Matrix v6.0 (see web resources)

Limiting

If you have questions or comments regarding this software please contact us at: wlc@awwa.org

go to Input

Volume from Own Sources (VOS) - Data Grading Criteria

go to notes

vos	Criteria Question	Select Best-Fit Answers to All Visible Questions	
vos.0	Did the water utility supply any water from its own sources during the audit year?	Yes	
vos.1	What percent of own supply volume is metered?	>75% - 90%	Limiting

For questions 2-10 below: Choose the answer that applies for those meters that measure >90% of the finished water volume.
In-situ flow accuracy testing - a test process that confirms the flow measuring accuracy of the primary device (the flowmeter), in its installed location, using an independent reference volume.
Electronic calibration - a process that checks for error in the metering secondary device(s) and/or the tertiary device(s).
Secondary device can include conversion to mA, meter transmitter or similar instrumentation.
Tertiary device can include SCADA, historian or other computerized archival system.

vos.2		
vos.3		
vos.4		
vos.5		
vos.6		
vos.7		
vos.8		
vos.9		
vos.10		
	FINAL DATA GRADE FOR THIS AUDIT INPUT:	4

go to input

Volume from Own Sources Error Adjustment (VOSEA) - Data Grading Criteria

go to notes

vosea	Criteria Question	Select Best-Fit Answers to All Visible Questions	
vosea.1	Are tank levels monitored automatically & recorded daily?	Yes	
vosea.2	Are daily changes of stored water volumes in distribution system tanks included in the tabulation of the daily "Volume from Own Sources" quantity?	No	Limiting
vosea.3	Is the annual net distribution storage change included in either the VOS input or the VOSEA input?	No	
vosea.4	Are the flow accuracy test and/or electronic calibration results included in the VOSEA input in the water audit?	No error adjustment made due to absence of testing or calibration results	
	FINAL DATA GRADE FOR THIS AUDIT INPUT:	**8**	

go to Input

Water Imported (WI) - Data Grading Criteria

go to notes

wi	Criteria Question	Select Best-Fit Answers to All Visible Questions	
wi.0	Did the water utility import any water during the audit year?	Yes	
wi.1	What percent of water imported is metered?	>99%	
	For questions 2-10 below: Choose the answer that applies for those meters that measure >90% of the water imported volume. **In-situ flow accuracy testing –** a test process that confirms the flow measuring accuracy of the primary device (the flowmeter), in its installed location, using an independent reference volume. **Electronic calibration –** a process that checks for error in the metering secondary device(s) and/or the tertiary device(s). **Secondary device** can include conversion to mA, meter transmitter or similar instrumentation. **Tertiary device** can include SCADA, historian or other computerized archival system.		
wi.2	What is the frequency of electronic calibration?	None, or Not within last 5 years	Limiting
wi.3			
wi.4			
wi.5	What is the frequency of in-situ flow accuracy testing?	None, or Not within last 5 years	Limiting
wi.6			
wi.7			
wi.8			
wi.9	Which best describes the frequency of meter readings (data collection frequency as opposed to billing frequency)?	Once per month	
wi.10	What is the frequency of data review & correction by Exporting or Importing Utility for data gaps and/or anomalies? These can include numbers that are outside of typical patterns, and zero or 'null' values that may reflect a gap in data recording.	Once per month	
	FINAL DATA GRADE FOR THIS AUDIT INPUT:	**3**	

go to Input

Water Imported Error Adjustment (WIEA) - Data Grading Criteria

go to notes

wiea	Criteria Question	Select Best-Fit Answers to All Visible Questions
wiea.1	Is an agreement in place between Exporting and Importing Utility for the purchase of water?	Yes, written
wiea.2	Are meter accuracy testing or electronic calibration requirements stipulated in the water purchase agreement?	
wiea.3	Are flow accuracy test and/or electronic calibration results used to inform the error adjustment input in the water audit?	
wiea.4	Who has access to the import meter readings including current and archived data?	

FINAL DATA GRADE FOR THIS AUDIT INPUT:

go to input

Water Exported (WE) - Data Grading Criteria

go to notes

we	Criteria Question	Select Best-Fit Answers to All Visible Questions	
we.0	Did the water utility export any water during the audit year?	Yes	
we.1	What percent of water exported is metered?	>99%	
	For questions 2-10 below: Choose the answer that applies for those meters that measure >90% of the water exported volume. **In-situ flow accuracy testing** = a test process that confirms the flow measuring accuracy of the primary device (the flowmeter), in its installed location, using an independent reference volume. **Electronic calibration** = a process that checks for error in the metering secondary device(s) and/or the tertiary device(s). **Secondary device** can include conversion to mA, meter transmitter or similar instrumentation. **Tertiary device** can include SCADA, historian or other computerized archival system.		
we.2	What is the frequency of electronic calibration?	None, or Not within last 5 years	Limiting
we.3			
we.4			
we.5	What is the frequency of in-situ flow accuracy testing?	None, or Not within last 5 years	Limiting
we.6			
we.7			
we.8			
we.9	Which best describes the frequency of meter readings (data collection frequency as opposed to billing frequency)?	Once per month	
we.10	What is the frequency of data review & correction by Exporting or Importing Utility for data gaps and/or anomalies? These can include numbers that are outside of typical patterns, and zero or 'null' values that may reflect a gap in data recording.	Once per month	
	FINAL DATA GRADE FOR THIS AUDIT INPUT:	3	

go to input

Water Exported Error Adjustment (WEEA) - Data Grading Criteria

go to notes

weea	Criteria Question	Select Best-Fit Answers to All Visible Questions	
weea.1	Is an agreement in place between Exporting and Importing Utility?	Yes, written	
weea.2	Are meter accuracy testing or electronic calibration requirements stipulated in the water purchase agreement?	No	Limiting
weea.3	Are flow accuracy test and/or electronic calibration results used to inform the error adjustment input in the water audit?	No	
weea.4	Who has access to the import meter readings including current and archived data?	Exporting and Importing Utility	
	FINAL DATA GRADE FOR THIS AUDIT INPUT:	3	

go to Input

Billed Metered Authorized Consumption (BMAC) - Data Grading Criteria

go to notes

bmac	Criteria Question	Select Best-Fit Answers to All Visible Questions	
bmac.0	Were any customers metered in the audit year?	Yes	
bmac.1	For billed metered accounts, what % of bills are estimated in a typical billing cycle?	5% or less	
bmac.2	How often does the utility read its customer meters? For systems with multiple read frequencies, select the reading frequency that describes the majority of your customers.	Monthly	
bmac.3	Is the BMAC volume pro-rated to represent consumption occuring exactly during the audit period?	No	
bmac.4	How frequently does internal review by utility staff of the BMAC volumes occur?	No review	Limiting
bmac.5			
bmac.6	When was the most recent billing data review by someone who is independent of the utility billing process?	More than 5 years ago, or not sure	
bmac.7			
	FINAL DATA GRADE FOR THIS AUDIT INPUT:	1	

go to Input

Billed Unmetered Authorized Consumption (BUAC) - Data Grading Criteria

go to notes

buac	Criteria Question	Select Best-Fit Answers to All Visible Questions	
buac.0	Was there any billed consumption on unmetered accounts in the audit year?	Yes	
buac.1	What portion of billed accounts are unmetered (% by number of accounts)?	>20% up to 50%	Limiting
buac.2	Methodology to quantify consumption for unmetered accounts?	Estimated for each unmetered customer OR derived from representative statistical samples of the system	
buac.3	How frequently is unmetered customer consumption estimated?	Monthly	
	FINAL DATA GRADE FOR THIS AUDIT INPUT:	6	

go to Input

Unbilled Metered Authorized Consumption (UMAC) - Data Grading Criteria

go to notes

umac	Criteria Question	Select Best-Fit Answers to All Visible Questions
umac.0	Did the water utility have any unbilled-metered consumption in the audit year?	No
umac.1		
umac.2		
umac.3		
umac.4		
	FINAL DATA GRADE FOR THIS AUDIT INPUT:	n/a

go to Input

Unbilled Unmetered Authorized Consumption (UUAC) - Data Grading Criteria

go to notes

This Data Grading Criteria is hidden when the 'default' input is used on the Worksheet

FINAL DATA GRADE FOR THIS AUDIT INPUT:	3

go to Input

Systematic Data Handling Error (SDHE) - Data Grading Criteria

go to notes

This Data Grading Criteria is hidden when the 'default' input is used on the Worksheet

FINAL DATA GRADE FOR THIS AUDIT INPUT:	3

go to Input

Customer Metering Inaccuracies (CMI) - Data Grading Criteria

go to notes

cmi	Criteria Question	Select Best-Fit Answers to All Visible Questions	
cmi.0	Was there any metered customer usage during the audit period?	Yes	
cmi.1	Do you test meters reactively (when triggered by customer complaint or billing/consumption flag)?	Reactive testing conducted	
cmi.2	For small size customer meters, which best describes the frequency of proactive testing (effort beyond when triggered by customer complaint or billing/consumption flags)?	No proactive small meter testing activity to date	
cmi.3			
cmi.4	For mid and large size customer meters, which best describes the frequency of the proactive testing program?	Not recurring, but conducted within 5 years prior to audit period	
cmi.5	Which best describes what meters are included in the proactive mid- and large customer meter testing activities?	Testing targeted to subsets of meters (ie most revenue generating or customer types)	
cmi.6	Which best describes how the input was derived?	Guesstimated without any customer meter testing data as a reference	Limiting
cmi.7	Has the input derivation been reviewed by someone with expert knowledge in the M36 methodology?	No	
cmi.8	To what extent does meter replacement occur and for which meters?	Replacement upon complete failure or special circumstance (as needed)	
cmi.9	Which best describes the reliability of meter installation records?	Records are kept for meter installations, and they include data on installation date, type, size, and manufacturer	
	FINAL DATA GRADE FOR THIS AUDIT INPUT:	2	

go to input

Unauthorized Consumption (UC) - Data Grading Criteria

go to notes

This Data Grading Criteria is hidden when the 'default' input is used on the Worksheet

FINAL DATA GRADE FOR THIS AUDIT INPUT:	3

go to input

Length of Mains (Lm) - Data Grading Criteria

go to notes

Lm	Criteria Question	Select Best-Fit Answers to All Visible Questions	
Lm.1	How was the input derived?	Derived directly from Mains inventory (GIS, ledger, etc)	
Lm.2	Are hydrant laterals included in the input derivation?	Yes	
Lm.3	Which best describes how the Mains inventory (GIS, ledger, etc) is kept up to date?	Additions or subtractions are updated in the mains inventory (GIS, ledger, etc), at least annually	
Lm.4	Which best describes how the Mains inventory (GIS, ledger, etc) is field validated to confirm field conditions match the inventory?	No field validation is conducted	Limiting
	FINAL DATA GRADE FOR THIS AUDIT INPUT:	7	

go to input

Number of Service Connections (Nc) - Data Grading Criteria

go to notes

Nc	Criteria Question	Select Best-Fit Answers to All Visible Questions	
Nc.1	How was the input derived?	Extracted from Services inventory (GIS, billing system, etc)	
Nc.2	What is the count of services based on?	Premise based, i.e. service connection count, location ID count	
Nc.3	Are inactive (but still pressurized) service lines included in the input? These may be metered or unmetered.	Yes	
Nc.4	Which best describes how the inventory of service connections (GIS, billing system, etc) is kept up to date?	Additions or subtractions are updated in the service line inventory (GIS, billing system, etc), at least annually	
Nc.5	Which best describes how the inventory of service connections (GIS, billing system, etc) is field validated to confirm field conditions match the inventory?	No field validation is conducted	Limiting
	FINAL DATA GRADE FOR THIS AUDIT INPUT:	5	

go to input

Average Length of (Private) Customer Service Line (Lp) - Data Grading Criteria

go to notes

Lp	Criteria Question	Select Best-Fit Answers to All Visible Questions
Lp.0	Are customer meters typically located at the curbstop or property line?	Yes
Lp.1		
Lp.2		
Lp.3		
Lp.4		
	FINAL DATA GRADE FOR THIS AUDIT INPUT:	10

go to input

Average Operating Pressure (AOP) - Data Grading Criteria

go to notes

aop	Criteria Question	Select Best-Fit Answers to All Visible Questions	
aop.1	Which best describes checks on the boundary integrity for the system's pressure zone(s)?	Normally-closed boundary valves between zones have been confirmed within the past 3 years to be fully closed	
aop.2	Which best describes how one-time pressure readings (i.e. from hydrants) are collected?	Collected only if there are low pressure complaints, or new development requests	
aop.3	Which best describes where continuous pressure data (via temporary data loggers or permanent telemetry) is collected?	At zone boundary conditions only (i.e. supply entry points, PRVs, booster stations)	
aop.4	Which best describes how continuous pressure data is collected?	Temporary data logger(s) deployed, but limited and not capturing seasonal variation during the year	
aop.5	How was the input derived?	Loose estimate inferred from field measurements, but no analysis nor calculations performed	Limiting
	FINAL DATA GRADE FOR THIS AUDIT INPUT:	5	

go to input

Customer Retail Unit Charge (CRUC) - Data Grading Criteria

go to notes

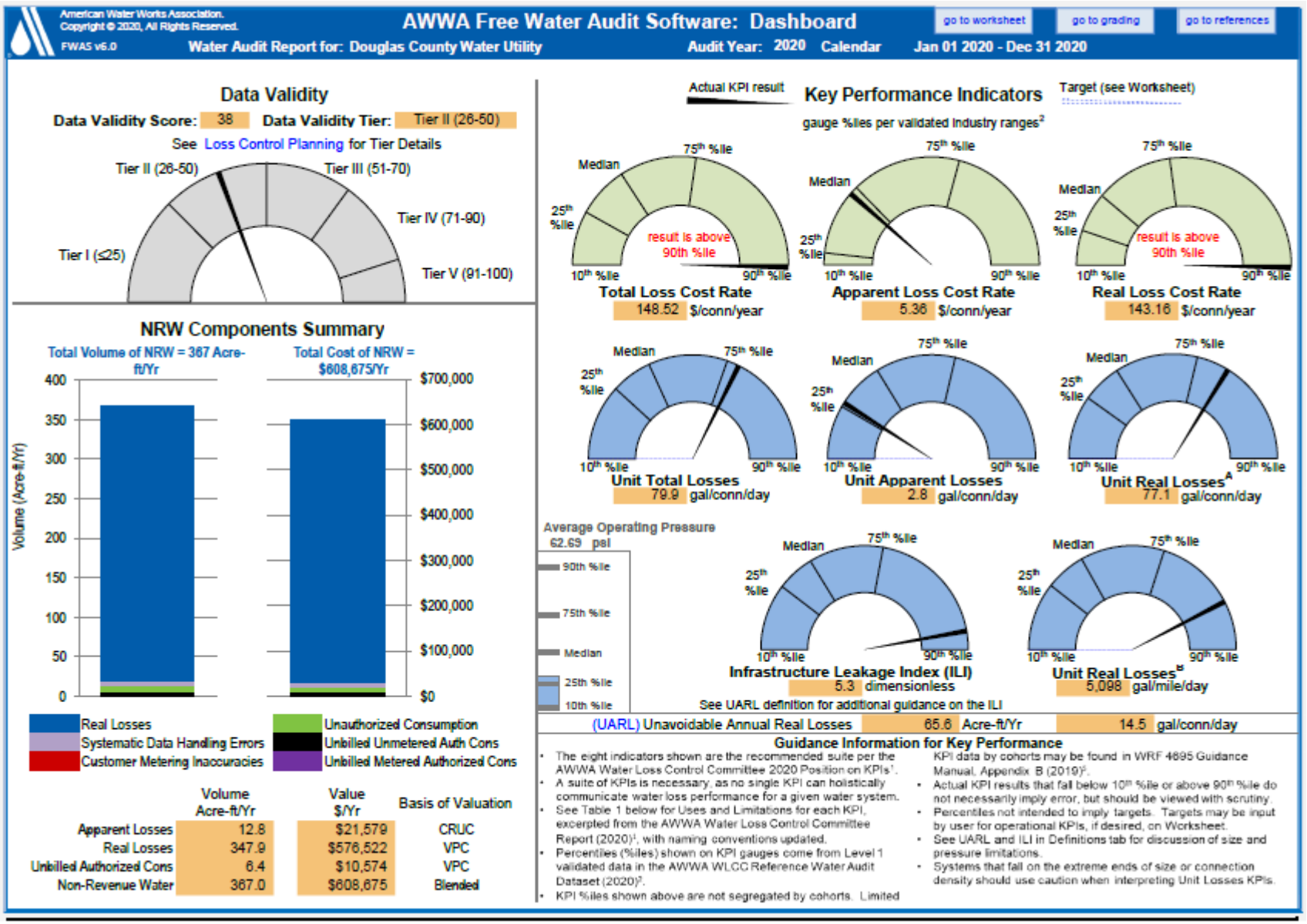
cruc	Criteria Question	Select Best-Fit Answers to All Visible Questions	
cruc.0	Was any metered consumption billed on a volumetric basis in the audit period?	Yes	
cruc.1	Which best describes the use and reliability of the current rate structure?	Customer bill calculations have been checked to confirm the rate structure is correctly implemented	
cruc.2	Choose the option that best describes how the input was derived	A volume-weighted average of all rates was calculated	
cruc.3	Is there any additional volumetric revenue the utility receives that depends on water meter readings, such as sewer?	No	
cruc.4	Has the input derivation been reviewed by someone with expert knowledge in the M36 methodology?	No	Limiting
	FINAL DATA GRADE FOR THIS AUDIT INPUT:	**9**	

go to Input

Variable Production Cost (VPC) - Data Grading Criteria

go to notes

vpc	Criteria Question	Select Best-Fit Answers to All Visible Questions	
vpc.1	Choose the option that best describes how the input was derived	Guesstimated	Limiting
vpc.2	Choose the option that best describes which short-run marginal costs have been included in the input, using the definitions below for reference. Short-run marginal costs can include the following: - chemicals + power for treatment, typically applicable if the utility is producing/treating water - power for distribution, typically applicable if pumps exist in the distribution network - water acquisition costs, typically applicable if the utility is purchasing water or incurs any extraction costs for withdrawing from a source Some short-run marginal costs may not be applicable. The auditor should analyze the system characteristics to determine which costs are applicable for inclusion in the VPC input derivation. See also the latest AWWA M36 Manual for further guidance.	Some but not all applicable short-run marginal costs are included	
vpc.3	Choose the option that best describes which long-run marginal costs have been included in the input, using the definitions below for reference. Long-run marginal costs can include the following: - water treatment residuals management, typically applicable if solids are produced from water treatment process - accelerated wear & tear on dynamic equipment, typically applicable if pumps exist for treatment and/or distribution, or any other equipment exists that wears out as a function of use instead of time (i.e. filter media, chemical dosing pumps, uv disinfection bulbs, etc) - payouts for damage claims from main and service line breaks, typically applicable if damage claims are paid by the utility - accelerated expansion of supply capacity, typically applicable if the utility is at or nearing supply capacity, or scarcity costs in water scarce areas - full cost pricing that includes all lifecycle costs and externalities (internalized or not) Some long-run marginal costs may not be applicable. The auditor should analyze the system characteristics to determine which costs are applicable for inclusion in the VPC input derivation. See also the latest AWWA M36 Manual for further guidance.	Long-run marginal costs have not been evaluated for applicability, and are not included	
vpc.4	Has the input derivation been reviewed by someone with expert knowledge in the M36 methodology?	No	
	FINAL DATA GRADE FOR THIS AUDIT INPUT:	1	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FWAS v6.0
AWWA Free Water Audit Software: Dashboard
go to worksheet
go to grading
go to references
Water Audit Report for: Douglas County Water Utility
Audit Year: 2020 Calendar
Jan 01 2020 - Dec 31 2020
Data Validity
Data Validity Score: 38
Data Validity Tier: Tier II (26-50)
See Loss Control Planning for Tier Details
Tier I (≤25)
Tier II (26-50)
Tier III (51-70)
Tier IV (71-90)
Tier V (91-100)
NRW Components Summary
Total Volume of NRW = 367 Acre-ft/Yr
Total Cost of NRW = $608,675/Yr
Volume (Acre-ft/Yr)
Real Losses
Systematic Data Handling Errors
Customer Metering Inaccuracies
Unauthorized Consumption
Unbilled Unmetered Auth Cons
Unbilled Metered Authorized Cons
Volume Acre-ft/Yr
Value $/Yr
Basis of Valuation
Apparent Losses 12.8 $21,579 CRUC
Real Losses 347.9 $576,522 VPC
Unbilled Authorized Cons 6.4 $10,574 VPC
Non-Revenue Water 367.0 $608,675 Blended
Actual KPI result
Key Performance Indicators
gauge %iles per validated industry ranges[2]
Target (see Worksheet)
Median
75th %ile
25th %ile
10th %ile
90th %ile
result is above 90th %ile
Total Loss Cost Rate
148.52 $/conn/year
Apparent Loss Cost Rate
5.36 $/conn/year
Real Loss Cost Rate
143.16 $/conn/year
Unit Total Losses
79.9 gal/conn/day
Unit Apparent Losses
2.8 gal/conn/day
Unit Real Losses[A]
77.1 gal/conn/day
Average Operating Pressure
62.69 psi
Infrastructure Leakage Index (ILI)
5.3 dimensionless
Unit Real Losses[B]
5,098 gal/mile/day
See UARL definition for additional guidance on the ILI
(UARL) Unavoidable Annual Real Losses
65.6 Acre-ft/Yr
14.5 gal/conn/day
Guidance Information for Key Performance
The eight indicators shown are the recommended suite per the AWWA Water Loss Control Committee 2020 Position on KPIs[1].
A suite of KPIs is necessary, as no single KPI can holistically communicate water loss performance for a given water system.
See Table 1 below for Uses and Limitations for each KPI, excerpted from the AWWA Water Loss Control Committee Report (2020)[1], with naming conventions updated.
Percentiles (%iles) shown on KPI gauges come from Level 1 validated data in the AWWA WLCC Reference Water Audit Dataset (2020)[2].
KPI %iles shown above are not segregated by cohorts. Limited KPI data by cohorts may be found in WRF 4695 Guidance Manual, Appendix B (2019)[2].
Actual KPI results that fall below 10th %ile or above 90th %ile do not necessarily imply error, but should be viewed with scrutiny.
Percentiles not intended to imply targets. Targets may be input by user for operational KPIs, if desired, on Worksheet.
See UARL and ILI in Definitions tab for discussion of size and pressure limitations.
Systems that fall on the extreme ends of size or connection density should use caution when interpreting Unit Losses KPIs.

Table 1

Source: AWWA Water Loss Control Committee Report (2020)[1], with naming conventions updated

2020 AWWA Water Audit Method – Water Audit Outputs and Key Performance Indicators: Uses and Limitations

Type	Indicator	Description	Suitable Purposes					Uses and Limitations	Principal Users
			Assessment	Bench-Marking	Target-Setting	Planning	Tracking		
Attribute	Apparent Loss Volume	Calculated by Free Water Audit Software	✓				✓	Assess loss level	Utility, Regulators
	Apparent Loss Cost	Calculated by Free Water Audit Software	✓				✓	Assess cost loss level	Utility, Regulators
	Real Loss Volume	Calculated by Free Water Audit Software	✓				✓	Assess loss level	Utility, Regulators
	Real Loss Cost	Calculated by Free Water Audit Software	✓				✓	Assess loss cost level	Utility, Regulators
	Unavoidable Annual Real Loss (UARL)	Calculated by Free Water Audit Software	✓				✓	Reveal theoretical technical low level of leakage	Utility, Regulators
Volume	Unit Apparent Losses (vol/conn/day)	Strong and understandable indicator for multiple users.	✓	✓	✓	✓	✓	Used for performance tracking and target-setting	Utility, Regulators
	Unit Real Losses[A] (vol/conn/day)	Strong and understandable indicator for multiple users.	✓	✓	✓	✓	✓	Used for performance tracking and target-setting	Utility, Regulators, Policy Makers
	Unit Real Losses[B] (vol/pipeline length/ day)	Strong and understandable indicator for use by utilities with low connection density.	✓	✓	✓	✓	✓	Data collection and assessment of systems with "low" connection density	Utility, Regulators, Policy Makers
	Unit Total Losses (vol/conn/day) **New KPI**	Strong and understandable indicator, suitable for high-level performance measurement.	✓				✓	High level indicator for trending analysis. Not appropriate for target-setting or benchmarking	Utilities, Customers
	Infrastructure Leakage Index (ILI)	Robust, specialized ratio KPI; can be influenced by pressure and connection density.	✓	✓			✓	Benchmarking after pressure management is implemented	Utilities
Value	Apparent Loss Cost Rate (value/conn/year) **New KPI**	Indicators with sufficient technical rigor. Provide the unit financial value of each type of loss, which is useful for planning and assessment of cost efficiency of water loss reduction and control interventions and programs.	✓			✓	✓	Data collection and assessment on AWWA indicators or contextual parameters to use in conjunction with Loss Cost Rates	Utilities, Regulators, Customers
	Real Loss Cost Rate (value/conn/year) **New KPI**		✓			✓	✓		Utilities, Regulators, Customers
Validity	Data Validity Tier (DVT)	Strong indicator of water loss audit data quality, if data has been validated. Tier provides guidance on priority areas of activity.	✓	✓		✓	✓	Assess caliber of data inputs of the water audit	Regulators, Utilities

AWWA Free Water Audit Software
Water Balance

FWAS v6.0

Water Audit Report for: Douglas County Water Utility
Audit Year: 2020 Jan 01 2020 - Dec 31 2020
Data Validity Tier: Tier II (26-50)

Volume from Own Sources (VOS) (corrected for known errors) 1,737.000	System Input Volume 6,377.000	Water Exported (WE) (corrected for known errors) 3,458.000	Billed Water Exported			Revenue Water (Exported) 3,458.000
		Water Supplied 2,919.000	Authorized Consumption 2,558.380	Billed Authorized Consumption 2,552.000	Billed Metered Consumption (BMAC) (water exported is removed) 1,952.000	Revenue Water
					Billed Unmetered Consumption (BUAC) 600.000	2,552.000
				Unbilled Authorized Consumption 6.380	Unbilled Metered Consumption (UMAC) 0.000	Non-Revenue Water (NRW)
					Unbilled Unmetered Consumption (UUAC) 6.380	
			Water Losses 360.620	Apparent Losses 12.760	Systematic Data Handling Errors (SDHE) 6.380	367.000
					Customer Metering Inaccuracies (CMI) 0.000	
					Unauthorized Consumption (UC) 6.380	
Water Imported (WI) (corrected for known errors) 4,640.000				Real Losses 347.860	Leakage on Transmission and/or Distribution Mains Not broken down	
					Leakage and Overflows at Utility's Storage Tanks Not broken down	
					Leakage on Service Connections Not broken down	