Public Utilities

City Property Water Use Efficiency

EXECUTIVE REPORT

Maddaus Water Management

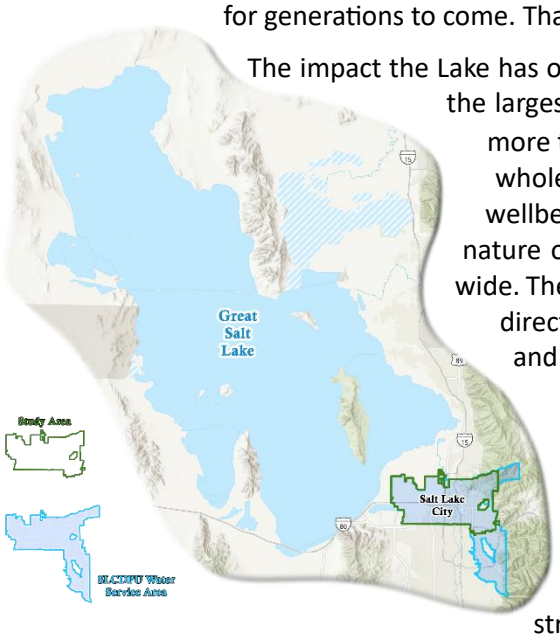
Making a Difference in the World of Water

November 2023

Introduction

WHY IS WATER EFFICIENCY IMPORTANT?

Conservation and efficiency are key considerations for any water supplier, including Salt Lake City Department of Public Utilities (SLCDPU). At SLCDPU we are charged with ensuring a safe and healthy water supply for its service area today and for generations to come. That obligation is magnified by the City's namesake: Great Salt Lake.



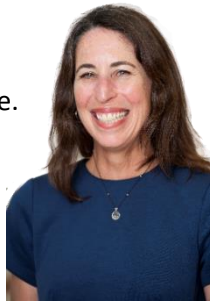
The impact the Lake has on the City and its neighbors is of no little significance. Great Salt Lake is the largest saltwater lake in the Western Hemisphere and is estimated to deliver more than $1.3 billion to the local economy.[1] I'm pleased that the region as a whole has also come to recognize the critical role the Lake plays in our overall wellbeing. Its steady decline is an ever-present reminder of the inter-connected nature of the biological world.[2] As the Lake dries, the impacts are felt far and wide. The Lake impacts dust control and related air quality, supports tourism both directly, and indirectly through lake effect snowfall, supports migratory birds and aquatic habitat, and has an impact on humidity and human health. Raising our collective awareness about the Lake's needs is just the first step toward resolving critical water supply issues.

Utah residents know and understand that Lake levels are an indicator of regional water health. Surface water is especially vulnerable to drought and elevated surface temperatures, but the long-term impacts of a changing climate ultimately impact all other sources, including the streams, rivers, wells, and springs on which our community relies.

SLC'S WATER EFFICIENCY GOALS

For decades SLCDPU has worked to achieve water savings primarily through efforts targeting irrigation and residential customers. Under the leadership of Salt Lake City's Mayor Erin Mendenhall, we are working toward making our City "more responsive to and resilient in the face of climate change and ongoing drought." Water conservation is a community issue and I am proud that SLCDPU has provided local residents and business owners a variety of resources to increase the efficiency of their own water usage. However, the future of our region's water supply cannot rest solely on the conservation efforts of individual community members. Salt Lake City can, and must, lead by example when it comes to conservation.

SLCDPU's 2020 Water Conservation Plan identified goals to reduce outdoor and indoor water use at municipal properties by 14.6% outdoors and 7.7% indoors, respectively. Considering the long-term sustainability of the community and in an effort to meet and ideally exceed these goals, we have begun a broad-based effort to take stock of our own water usage and identify areas for improvement. The information included herein will inform the City's next steps and enable the SLCDPU to more confidently "do its part" in protecting Great Salt Lake and extending the region's water supply.



It is the priority of the SLCDPU to ensure reliable, high-quality drinking water for the communities we serve. Water conservation is one of the best ways to extend the existing water supply, ensure resiliency during drought, and address declining Lake water levels. We recognize our role as a steward of water resources and the environment, from the Wasatch Mountains to Great Salt Lake. Current and future generations depend on these water supplies, and the water supplies of tomorrow depend on the actions we take today.

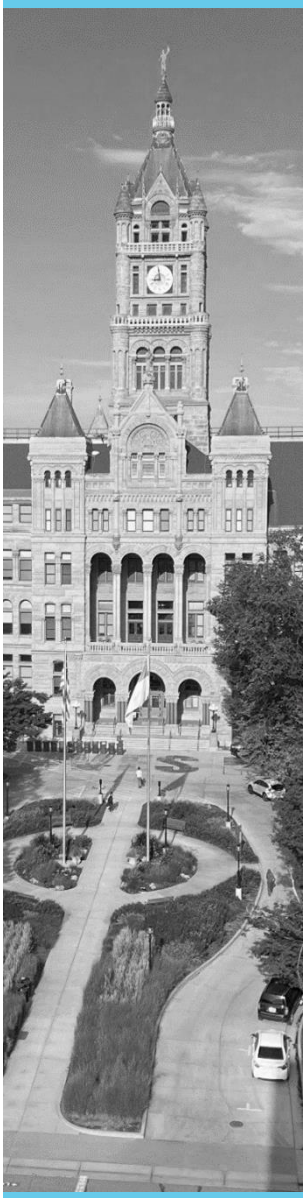
- Laura Briefer, Director, Department of Public Utilities at Salt Lake City Corporation

[1] "Consequences of Drying Lake Systems around the World." 2019. AECOM. https://documents.deq.utah.gov/water-quality/standards-technical-services/great-salt-lake-advisory-council/activities/DWQ-2019-010002.pdf

[2] https://wildlife.utah.gov/gslep/about/water-levels.html

Project Description

SLCDPU[3] has been working closely with Utah State University (USU) on outdoor efficiency programs, including Water Checks and WaterMAPS™, to support conservation on residential, commercial, and City landscapes. In 2023, the Department also began working with Maddaus Water Management (MWM) on a more comprehensive assessment of water use at municipal properties.



MWM Indoor Assessments

In May 2023, the City contracted with MWM and sub-consultant Bowen Collins & Associates (BCA) to lead the assessment effort. Over the summer, staff worked with the MWM project team to craft, distribute, and collect a survey on City properties and to collect and analyze water use data. Over the course of a week in August 2023, MWM staff were joined by SLCDPU and Facilities staff and, on occasion, shadowed by staff from the Utah Department of Water Resources, as they assessed water use at 14 City sites. This latest effort took a step inside, literally, and figuratively, evaluating indoor water use at City-owned facilities.

In advance of on-site visits, the project team collected water use data from each City meter, along with information provided by City staff in an online survey, to analyze and categorize each City facility (see Appendix for list). Sites with higher water use, as compared to other sites in their category, and/or sites with a higher savings potential (e.g., older fixtures, documented leaks, specialized high-use equipment) were selected for an onsite assessment. Sites were also chosen based on their accessibility; some facilities were limited due to security or scheduling concerns. Some property categorization is also limited as a result of mixed-use meters, meaning the same meter serves both outdoor irrigation and indoor plumbing fixtures. During these site assessments, only indoor fixtures were evaluated due to the availability of outdoor information from the Water Checks and WaterMAPS™ programs.

Outdoor Assessments

USU's Water Management Analysis and Planning Software (WaterMAPS™) program integrates parcel data, land cover data, water meter data, and weather data to calculate what is called the Landscape Irrigation Ratio (LIR). LIR values indicate how efficiently water is being used to maintain a landscape and whether the water use is outpacing the water needs of the landscape. LIRs are calculated on both an annual and a monthly basis. The City has already generated reports for a majority of residential properties, many commercial properties, and more than 60 municipal properties. While some sites present a challenge in linking meter data to where the water is used onsite, and in integrating some Salt Lake County parcel maps, the goal is to eventually assess every site within the SLCDPU service area. https://www.slc.gov/utilities/introducing-watermaps/

WaterMAPS
UtahStateUniversity

Water Checks are offered through Utah State University-Center for Water Efficient Landscaping (USU-CWEL) and paid for by the Metropolitan Water District of Salt Lake & Sandy (MWDSLS). Water Checks are on-site visual and physical irrigation system inspections conducted by USU interns. These assessments are specific to turf areas irrigated with below ground, pressurized systems and include square footage measurements; visual inspection of irrigation spray nozzles to identify mis-matched heads, and sunken, broken, or leaking heads; pressure measurements; distribution uniformity calculations; root depth measurements; inspection of irrigation controllers and scheduling. At least 15 municipal properties received Water Checks as part of this project.
https://extension.usu.edu/cwel/watercheck

[3] All acronyms used are listed in the appendix.

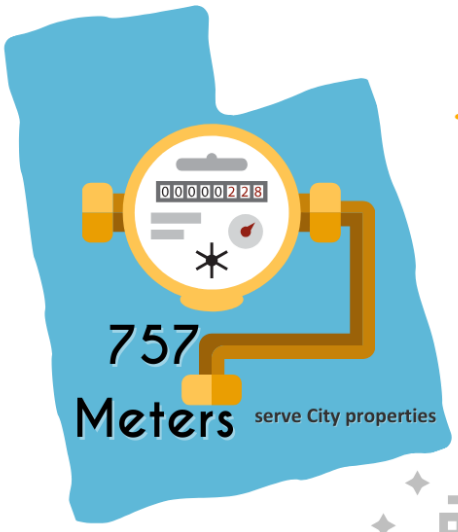
Summary of Findings

7 PROPERTY TYPES

Irrigation is a water use that can be applied across property types

- Library/ Museum
- Open Space
- Fire
- Office
- Recreation
- Facilities
- Fleet

+ Irrigation



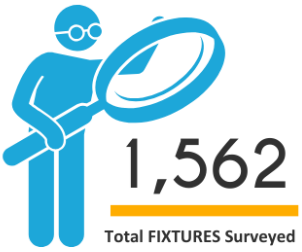
757 Meters serve City properties

Minimum

5 MILLION GALLONS

Annual Indoor Water Savings Potential

Based on 15% savings from implementing best management practices at the top 20 sites alone



1,562 Total FIXTURES Surveyed

1,075 Total FIXTURES Tested

14 CITY SITES

selected for a complete indoor water use assessment

12 TYPES OF INDOOR FIXTURES

- Tank Toilet
- Flush Valve Toilet
- Urinal
- Sink Faucet
- Pools
- Vacuum Pump
- Showerhead
- Clothes Washer
- Ice Machine
- Dishwasher
- Prerinse Spray Valve
- Cooling Towers

16 CITY SITES

have received a WaterCheck

OVER 350,000

Square feet of landscape inspected

68 CITY PROPERTIES

have WaterMaps ™

WATER CHECK ITEMS

- Square Footage
- Pressure Measurement
- Distribution Uniformity
- Root Depth
- Inspection of irrigation controller and scheduling
- Inspection of irrigation spray nozzles to identify
  - Mismatched
  - Sunken
  - Broken
  - Leaking

PROPERTY SURVEY AND SITE SELECTION

In 2022, City properties accounted for approximately 4.45% of all water consumption in the service area, just over 1 billion gallons per year (Figure 1). While total City property water use may be a comparatively small portion of the total service area use, it is important to note that this, unlike any other water use, is within the City's control. Outdoor water use accounts for more than 96% of the City's consumption, indicating an opportunity for additional assessment and improvement. While residential and commercial incentive programs rely on marketing and property owner buy-in, permissions, and action; repairing and replacing plumbing and irrigation fixtures on City properties requires no marketing and only that the City make the commitment to affect the necessary improvements and changes in practices. An added benefit is that addressing water issues and tracking savings on City properties is easier and provides a case study that can be leveraged in the future to facilitate marketing for other user groups.

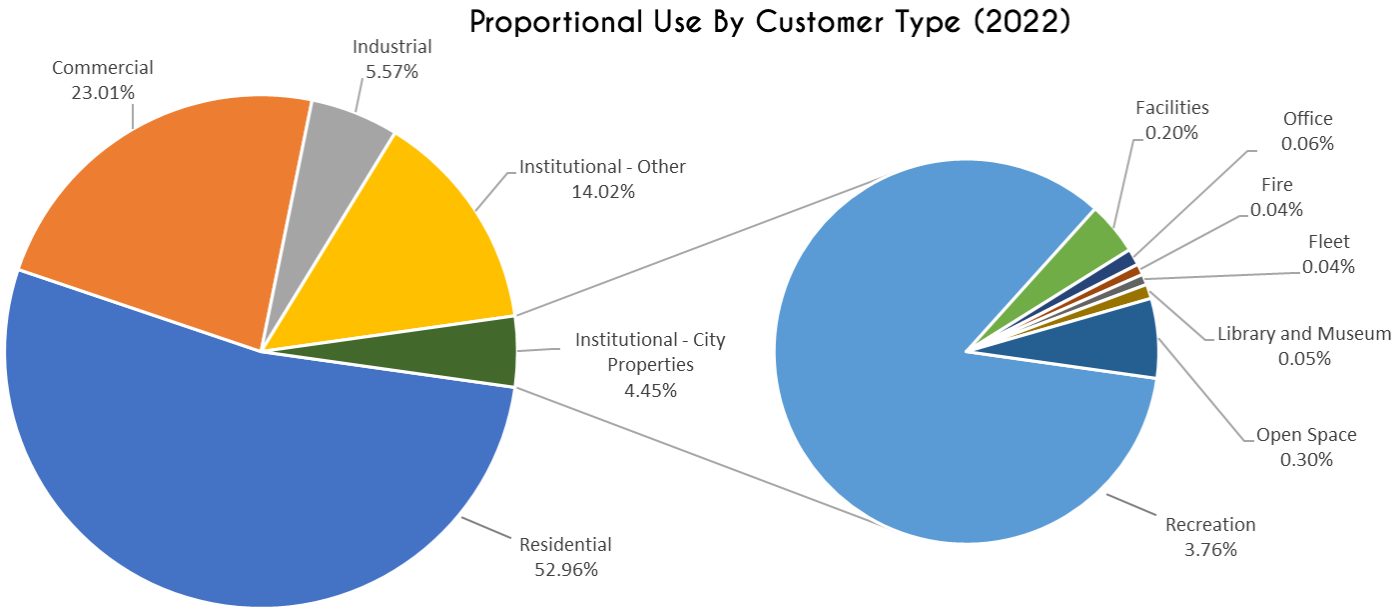


Figure 1: Average Water Use by Service-wide Customer Type and by City Property Type

One of the first steps taken to evaluate water efficiency was conducting property surveys. City staff were sent an online survey and asked to input a number of data points for each City-managed property, including

- Number of employees and/or visitors
- Indoor fixture types and quantities
- Age of the property and hours of operation
- Cooling tower information
- Presence and location of leaks or other concerns
- Landscape type and irrigation controller presence

While this data was being collected, the project team also evaluated metered water use for the City properties and categorized them by similar end uses to determine which types had the highest indoor, outdoor, and overall use (Figures 2 and 3). Using a combination of the survey data, metered water use data, and LIR obtained from Water MAPS™ reporting, the project team prioritized those sites for conducting onsite assessments, WaterMAPS™, and Water Checks. The project team considered several factors when selecting sites, including:

- High water use compared within categories
- Documented leaks or older fixtures
- Specialized water use equipment
- Variety of property types
- Accessible during the project timeframe

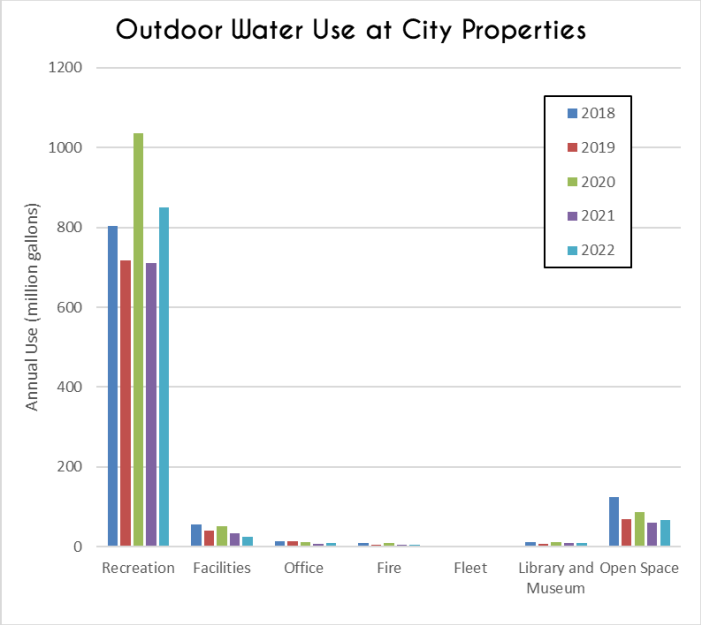


Figure 2. Outdoor water use at City properties by year and property type

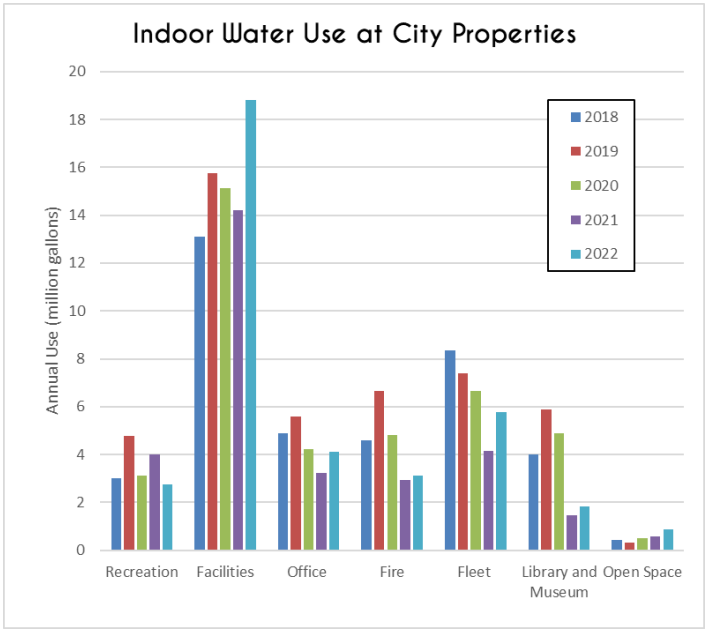


Figure 3. Indoor water use at City properties by year and property type

Some meters can be categorically defined as outdoor or indoor. Because many meters service both indoor and outdoor uses, known as a mixed-use meter, it can be difficult to fully distinguish how water is being used. In the absence of dedicated irrigation meters, indoor and outdoor use are traditionally calculated by comparing winter and summer water use. As such, BCA developed an analysis in which, for those not already categorically determined to be specifically indoor or outdoor use, if a meter detected water use in the winter, the worksheet formula assumed this would be classified as indoor use. Any water use in the months of April through October that exceeded the average winter months' "baseline" use, would be assumed to be outdoor use. However, not all water used in excess of indoor use is for landscapes; some of that water may be used for cooling towers, cleaning, and other processes. In addition, some meters that have been categorized as measuring outdoor water use, and therefore would not be expected to show winter water use, may show use from November through March due to leaks or accidental off-season programming. For this reason, a future action item is to further assess properties with mixed-use meters to better determine use and make potential improvements that would allow SLCDPU to better analyze this data.

Some meters did not have data over all the assessed years, while other meters appeared to only have recent data. This could be because a meter was turned off, reclassified, or is at a new location. Further inquiry will help to resolve these questions.

INDOOR WATER USE ASSESSMENTS

During each indoor water use assessment, the project team looked for leaks or other inefficiencies, measured fixture flow rates, and documented make, model, and manufacturer data for more than 1,000 plumbing fixtures. A list of required equipment to conduct indoor assessments is included in the appendix. All data points were subject to access, time constraints and whether data was legible. For example, not all fixtures had a labelled flow rate, and, in some circumstances, the model number was located in a place that was inaccessible or unclear due to hard water deposits. The following fixtures were measured, evaluated, and tested:

- 18 tank toilets
- 281 flush valve toilets
- 183 showerheads
- 93 urinals
- 426 faucets
- 18 ice machines
- 12 dishwashers
- 6 pre-rinse spray valves
- 6 clothes washing machines
- 22 cooling towers
- 3 pools
- 1 large vehicle wash station
- 6 Other assorted fixtures such as vacuum pumps, coffee machines, soda machines and dental equipment.

TOP 20 INDOOR USERS

The top 20 indoor municipal water users account for nearly 90% of the City's total indoor municipal water use. If the City were to implement all of the recommended best management practices for these 20 sites alone, the estimated savings is just over 5 million gallons. This is calculated as 15% savings of indoor use at the 20 City sites that use the highest volume of water. Savings volumes are extrapolated from savings associated with the Fixture Replacement Guide for Water-Efficient Equipment provided in the appendix. The list of sites is included in Table 1, on page 8. The requisite actions to achieve these estimated savings are further detailed under Conclusion and Next Steps.

MWM and Facilities Staff measure water quality for a cooling tower.

City staff measuring flow rate of shower at Salt Lake City Sports Complex.

Checking the refill and overflow tubes in toilet tanks for proper settings.

Table 1 Top 20 City Properties Sorted by Total Indoor Water Use

Top 20 Indoor Users			
	Property Title	**Avg Indoor Use**	**Avg Outdoor Use**
		2018-2022 (Gallons)	
1	Water Reclamation Facility	12,888,526	1,008,865
2	Fleet *	6,468,667	2,782,747
3	Main Library *	2,868,393	3,497,985
4	Fire Station 14 * √ ™	1,791,984	248,112
5	Glendale Youth Center *	1,746,056	2,977,115
6	Public Safety Building *	1,680,045	1,922,622
7	Water Reclamation Influent Pump Station	1,146,534	22,739
8	Plaza 349 *	975,242	728,253
9	Public Utilities Shops	797,854	216,583
10	City & County Building * ™	748,561	251,964
11	Parks and Public Lands Office *	641,971	1,120,467
12	Rose Park Golf Course * √	493,231	604,982
13	Fire Station 9 * √ ™	375,795	802,454
14	The Leonardo	316,815	237,752
15	Library Square Utility Plant	311,280	2,913,198
16	Fire Station 11 * √ ™	260,341	491,847
17	Sorenson Unity Center *	252,039	23,674
18	Fire Station 1 * √ ™	220,810	532,277
19	Fire Station 5 * √ ™	218,977	562,085
20	Public Utilities Leroy Hooton Building * √	205,289	1,608,312

Note: For those properties that received an assessment, these have been indicated by the following labels:

* indoor

√ Water Check

TM WaterMAP

OUTDOOR WATER USE ASSESSMENTS: WATER CHECKS AND WATERMAPS™

Water Checks

The Water Check program, operated by USU-CWEL and funded locally by MWDSLS, offers irrigation system assessments to homeowners, as well as commercial and institutional properties. Water Check process consists of five steps:

1. Conducting a site walk-through;
2. Conducting catch cup, pressure, soil/root depth tests;
3. Analyzing site information and test data using a tablet-based application;
4. Preparing a customized watering schedule, and;
5. Explaining and summarizing Water Check results with the participant.

A number of sites were selected to receive Water Checks based on water use, visibility, and project timeline. City sites that received a Water Check include:

- Sweet Library
- Sprague Library
- Chapman Library
- Concord Sewer Lift Station
- Day-Riverside Library
- Fire Station 1
- Fire Station 2
- Fire Station 4
- Fire Station 5
- Fire Station 7
- Fire Station 8
- Fire Station 9
- Fire Station 10
- Pioneer Precinct
- Public Utilities Leroy Hooton Building
- Salt Lake City Sports Complex

For these 16 sites, findings included widespread sprinkler head issues and problems with the irrigation zones. Identifying a process for inspection, reporting, and repair could help to improve irrigation system efficiency and reduce water waste on these sites, as well as sites not assessed.

Also of note, the vast majority of these sites are not considered parks and recreation areas and yet they have a total of:

- 269,949 square feet of irrigated turf, and
- 85,624 square feet of irrigated non turf.

269,949 square feet

The area of turf measured at non-park sites where landscape transformations could reduce water use by as much as 30 to 50 percent.

Given the expectedly high water consumption for turf, and the likelihood that this is largely decorative, the City may want to consider replacing this with a low-water-use lawn species and/or reduce the lawn footprint overall. Lastly, a more regular maintenance schedule for sprinkler heads, irrigation controllers and valves would also contribute to more efficient outdoor water use. Collectively, these actions could result in an outdoor savings of 10-12% on these properties.

WaterMAPS™

As a reminder, LIR values indicate how efficiently water is being used to maintain a landscape. LIRs of 1 indicates a property is being watered at landscape need; LIRs of 2 indicates a property is being watered twice as much as needed. As illustrated in Figure 4, WaterMAPS™ assessed City properties have demonstrated lower LIRs over the last eight years, a good sign of a trend in more efficient water use.

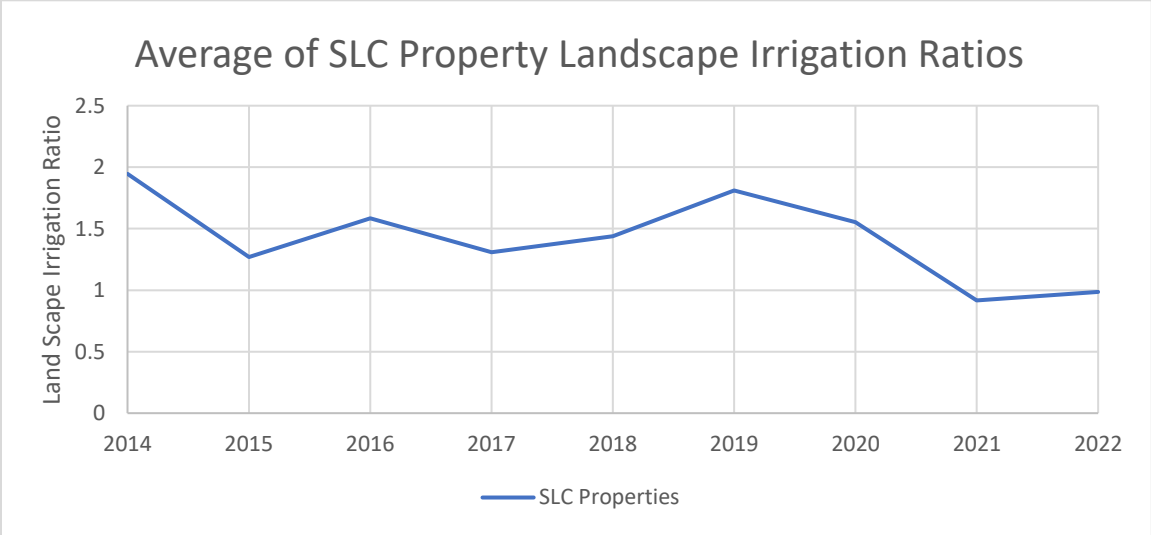


Figure 4 Average Salt Lake City Landscape Irrigation Ratios

Similar to the data presented in Figure 4, Figure 5 demonstrates that, each year, a larger proportion of WaterMAPS™ assessed properties are falling into the lower ranges of LIR. More than 70% of SLC accounts now fall within a LIR of 0-1, which means that these properties are watering at, or near, estimated landscape water need.

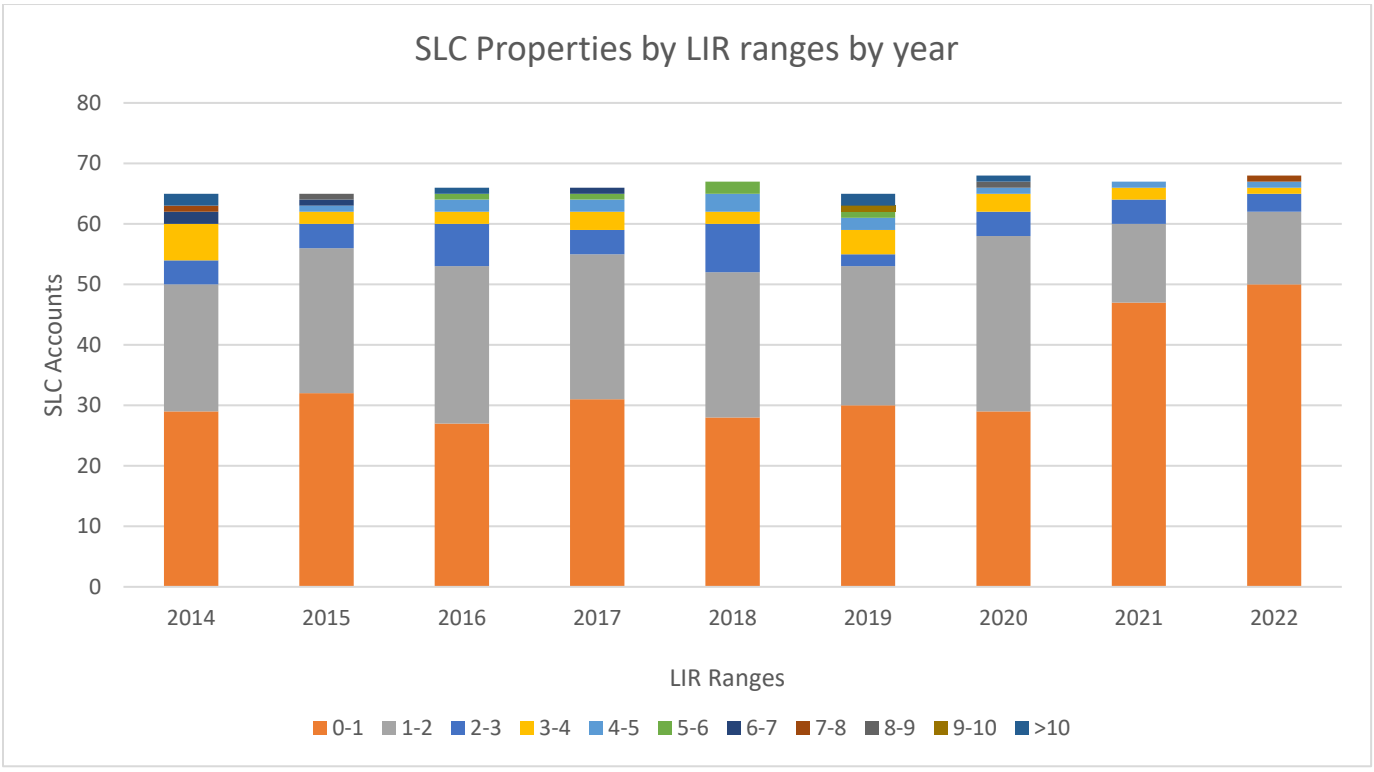


Figure 5 Salt Lake City Properties by Landscape Irrigation Ratio by Year

Water Savings Opportunities

CASE STUDIES: SALT LAKE CITY PROJECTS

As of November 2023, more than 100 City properties have received WaterMAPS™ and/or Water Checks and nearly 30 have received indoor assessments by MWM and/or SLCDPU staff. Select properties from those illustrated in Figure 6 have been chosen as case studies for the purposes of this report to demonstrate the variety and types of water efficiency projects that have either been completed, are in progress, or have been recommended for future consideration.

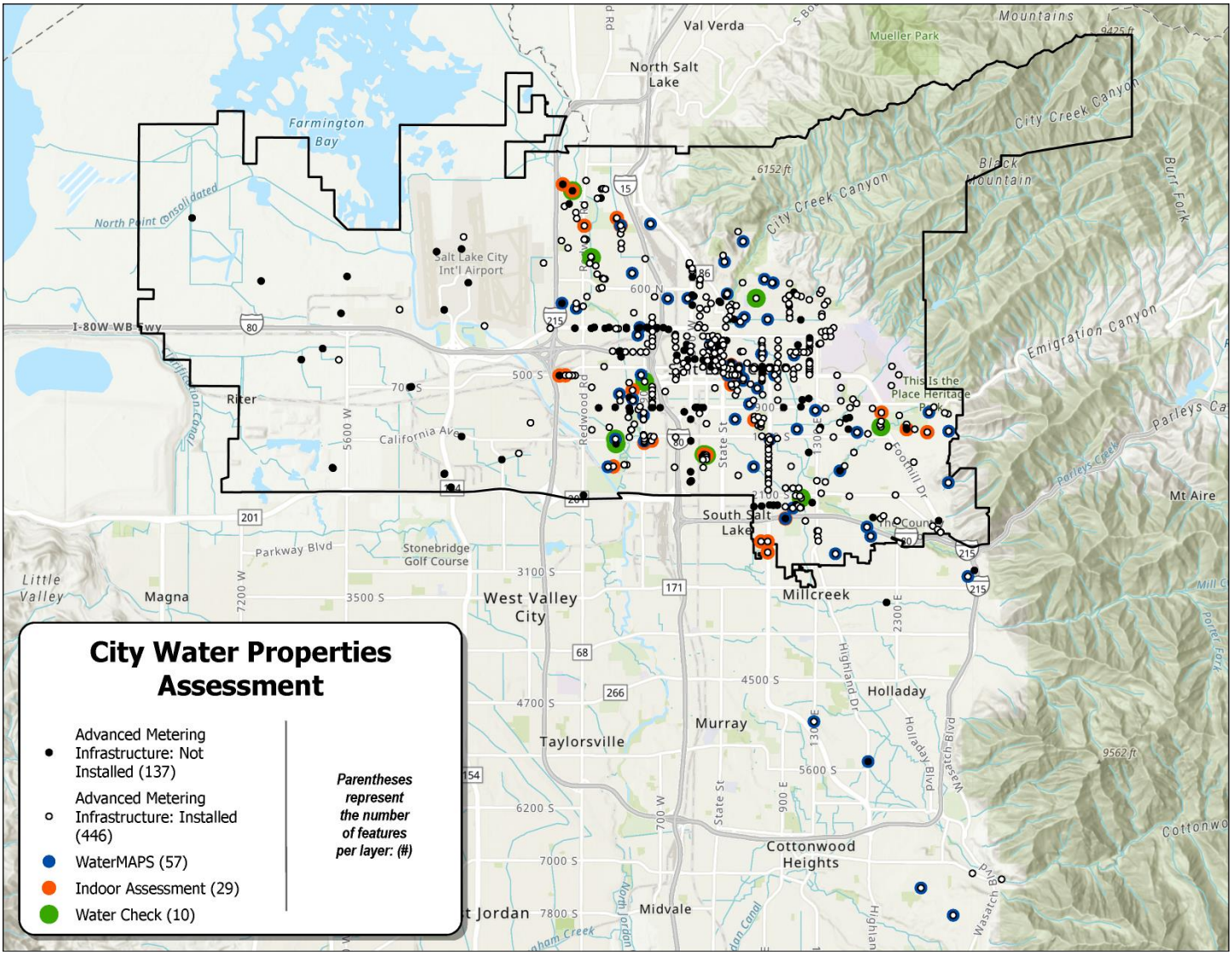
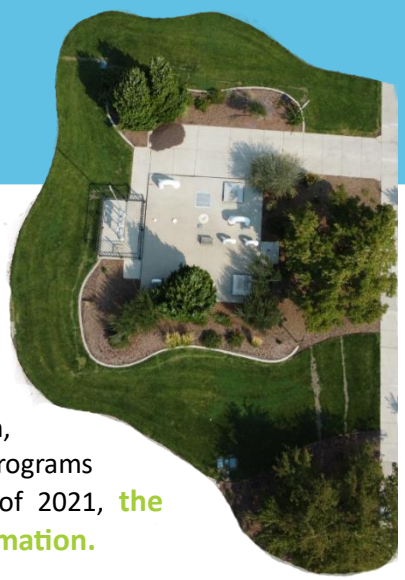


Figure 6 Map of City Property Assessments

Concord Lift Station Case Study

Elevating the landscape while lowering water use



Aerial image of Concord Lift Station after SLC TurfTrade grass seed establishment.

OPPORTUNITY

The 2020 Water Conservation Plan identified the need to reduce outdoor water use across the service area, including at City facilities. In response, Water Conservation had begun cataloguing and assessing SLCDPU sites to identify opportunities for landscape transformations and irrigation improvements. To support customer efforts in reducing outdoor water use, SLCDPU was preparing to launch the SLC TurfTrade program, offering low-cost, lower-water grass seed to service area customers. These two programs synergized at the Concord Sewer Lift Station (Concord LS), where, in the spring of 2021, **the landscape, irrigation system, and lawn received a complete landscape transformation.**

Concord LS was selected as a demonstration site due to its high visibility, ease of access, large lawn area, and high water use—700,177 gallons in 2020. Landscape transformation included reducing the lawn footprint (while continuing to provide access for large equipment); planting lower-water trees, shrubs, and perennials; installing an irrigation system that included hydrozoning, high-efficiency spray nozzles, drip, and a passive magnetic water conditioning fixture; and planting the SLC TurfTrade low-water grass blend.

OUTCOMES

A comparison of water use data, and pre-and post-transformation Water Check and WaterMAPS™ assessments of Concord LS demonstrate measurable, sustainable water savings and supports continued efforts to identify other SLCDPU and City properties for similar landscape transformation opportunities.

Distribution Uniformity (DU) measures how efficiently water is applied to a landscape. The evaluation indicated that there were sunken and tilted spray nozzles, which would lower DU, reducing system efficiency. Scheduling regular irrigation inspections and repairs would improve efficiency, increasing water savings. A DU of 75% for popup spray heads is achievable and considered excellent performance.

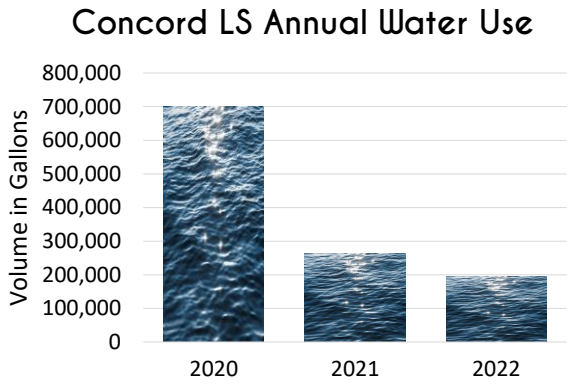
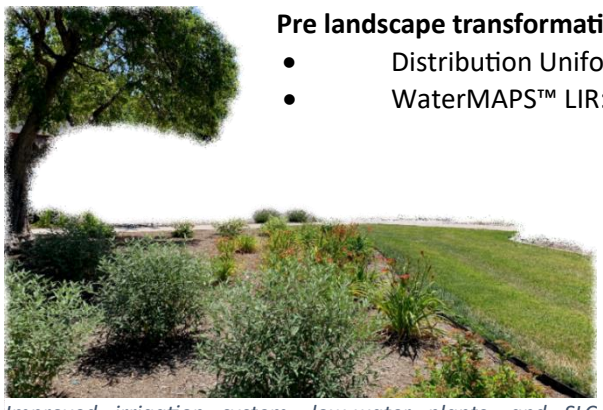


Figure 7 Concord Lift Station Annual Water Use



Improved irrigation system, low-water plants, and SLC Turftrade grass has helped reduce both water use and LIR at Concord Lift Station.

Pre landscape transformation:

- Distribution Uniformity: 45%
- WaterMAPS™ LIR: 2.69

Post landscape transformation:

- Distribution Uniformity: 58%
- WaterMAPS™ LIR: 0.66

The WaterMAPS™ LIR now indicates the landscape receives less than evapotranspiration (Eto) and is thriving due to a more appropriate plant palette, improved irrigation system, and the SLC TurfTrade grass.

Water Reclamation Facility Case Study

Reclaiming water efficiency 24/7/365

CURRENT WATER USE PATTERNS

The SLCDPU Water Reclamation Facility (WRF) averages the highest culinary water use of all City properties: more than 12 million gallons annually; however, given it treats 12 billion gallons of sewage every year, that's one gallon of culinary water for every 1,000 gallons of sewage treated. This amount is also well under the maximum annual average daily use adopted by City Council for new or expanded commercial and industrial connections. Additionally, treated sewage including the culinary water used in the treatment process is returned to Great Salt Lake via the Northwest Drain and Farmington Bay. The existing WRF is more than 60 years old and serves around 200,000 people as well as the businesses, industries, and institutions located within the City. As the only wastewater treatment facility in Salt Lake City it operates 24/7/365 without interruption, through power outages and extreme weather events, and even during construction of the New WRF. To minimize the use of culinary water, the WRF utilizes its treated effluent water wherever possible, as will be the case for the new facility. Consequently, most of the water used to process and treat wastewater is treated wastewater effluent. The WRF only uses culinary water in the process of treating wastewater where necessary, for instance for mixing polymers used in the treatment process, cooling water for pump seals, and evaporative coolers. Culinary water is also used in breakrooms and restrooms. Shower and laundry facilities are also provided for more than 60 staff who work in the facility to ensure their health and safety.

BEST PRACTICES

Construction continues at the SLC Water Reclamation Facility.

Great Salt Lake

The new WRF will replace the majority of the existing facility and is one of the largest infrastructure improvements in the history of the City, second only to the expansion of the airport. The WRF is being designed and built as an exemplary facility with advanced treatment of wastewater, a focus on sustainability, thoughtful investment of rate payers' money, public involvement, and inclusion of educational elements to better accommodate the tours provided to school children and the public each year. Traditional culinary uses in bathrooms, kitchen and showers will be designed to optimize efficiency, and the addition of submetering of culinary water lines will ensure timely monitoring and management.

Salt Lake City Golf Case Study

Winning at efficiency without disrupting play

Siberian and Snake River Wheatgrass test plot at Glendale Golf Course.

CHALLENGES

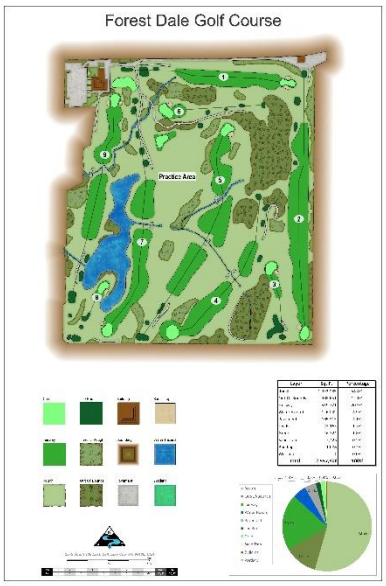
Climate change, growth, and drought can make it a challenge to sustain our traditional landscapes, especially in golf course settings where it is imperative to maintain green, actively growing grasses which tolerate traffic and recover from wear. As an enterprise fund, SLC Golf needs to balance the seemingly competing goals of playability and conservation. However, that challenge can be met through innovation, improved best practices, and alternative turf species. Fortunately, SLCDPU and Golf have a long history of collaboration to achieve these goals.

Working together with USU-CWEL, the United States Department of Agriculture - Agricultural Research Services Forage and Range Research Laboratory (USDA-ARS/FRRL), and the US Golf Association, research, pilot projects, and programs have been undertaken at each of the six City golf courses. These include:

- Turf mapping
- Water Checks
- WaterMAPS™
- Alternative turf trials
- Research-grade weather stations
- Geo-located POGO soil moisture data
- Passive magnetic water conditioning fixtures
- Indoor facility water assessments

Alternative turf trials have been underway for several years, focused on irrigated out-of-bound areas, converting areas of irrigated turf into non-irrigated meadows. However, changing the species or varieties in a turfgrass stand can be an expensive and disruptive process, especially in fairway areas that play a key role in the game. Converting turfgrass areas to new species must be a seamless process or must not otherwise significantly impact the play or visual qualities of the golf course. Identifying varieties and the best methods for transition will be the focus of the next phase of this project.

BEST PRACTICES



Map of various turf and use areas at Forest Dale Golf Course.

SLC Golf has completed GPS-aided play tracking at all courses to help guide the process of locating suitable areas in which to replace irrigated turf with non-irrigated native grasses. The next phase is to contract with a golf course architect to better integrate the plan with existing course features and make irrigation system upgrades to support the redesign.

Recently, SLC Golf worked with a local distributor to install a passive magnet water conditioning fixture on the line providing water to the course fairways, greens, tees, and roughs. Pre- and post- magnet installation Water Checks measured an average of 22% improvement in Distribution Uniformity (DU), indicating an improvement in water delivery efficiency. Since installation, the first of July, water use has decreased compared to the previous year and the number of watering days has been reduced.

Consideration should be given to extending these programs and implementing similar strategies at other City properties.

Large vehicle wash station

Fleet Car Wash Case Study

Solving the issue of winter water waste

CHALLENGES and SOLUTIONS

Every day of the year, dozens of large vehicles, including garbage and dump trucks, use the towered wash station located at Fleet. Though equipped with positive pressure nozzles, the extensive hose system is outside, exposing hoses and pipes to freezing winter temperatures. As a result, hoses are left on in a small continuous flow all winter. Flow tests taken at the site estimated a substantial water loss.

Facilities staff have tried insulating the pipes, but that doesn't address the hoses, which also freeze. Enclosing and insulating the lower section of the wash tower would help to prevent both the pipes and hoses from freezing. A heated enclosure could result in substantial savings in terms of water, money, and power. Implementing the proposed solution can save 1.38 million gallons of water every year.

At a glance

- Hoses are left running approximately 150 days per year at a rate of 0.8 gallons per minute.
- (.8 gallons/minute) x (60 minutes/hour) x (24 hours/1 day) = 1,152 gallons per day per hose
- (1,152 gallons/day) x (150 days) = 172,800 gallons per hose per season
- Total water lost = (172,800) x 8 hoses left on = 1,382,400 gallons per winter

Cooling Towers Case Study

Where Public Safety keeps their cool

CHALLENGES and SOLUTIONS

Cooling tower leak at the Main Library.

Multiple City properties use cooling towers, especially through the summer months. Issues in cooling towers can result in large levels of water loss that are not often apparent because few people have access to the area and the large, complicated, machinery requires extra training to understand and repair. Leaking or potentially problematic cooling towers were found at Fleet (where staff rely on 7 makeup air units, 3 indirect evaporative cooling units, and 10 large portable evaporative coolers), the Main Library (where the cooling tower is slated for replacement in winter 2023/24), Plaza 349 (where continued water indicative of a leak is shown at right), and the Public Safety Building. The Public Safety Building had a leak in the overflow pipe (above) that reportedly "could have been leaking at least a year."

When measured, the leak was 1.875 gallons per minute. At this rate this leak accounted for nearly **ONE MILLION GALLONS per year.**

MWM recommends a comprehensive assessment of City operated cooling towers with regular maintenance, leak repair, and a capital replacement program for those that are not operating at peak efficiency for the intended use.

MWM staff inspecting cooling tower at SLC Public Safety Building (with close-up).

AWWA M36 Water Audit and Loss Control Assessment Case Study

Identifying opportunities at the infrastructure-level

OPPORTUNITY

As part of the SLCDPU overall asset management and conservation programs, it is in the process of completing its first American Water Works Association *M36 Water Audits and Loss Control Program Manual* water audit to determine how much water the system loses due to leakage, meter error, or water theft and the cost of uncaptured revenue from non-revenue water. A validated water audit is the necessary first step in helping determine the magnitude of water loss and the cost to reduce it. Figure 8 illustrates the component volumes of water produced, supplied, delivered, or lost, and how each component nests to create the total volume of water in the system.

SLCDPU uses water differently than other City properties. For example, water is used for line flushing of new connections and repairs, water quality flushing, hydrant use and testing, and truck filling stations. Identifying methods of measuring this volume of water will help us understand how to better manage and account for this water. Proactive leak detection and repair helps reduce real water loss; continuation of this program is recommended.

<table>
<tr><td rowspan="11">Volume from Own Sources (VOS)</td><td rowspan="12">System Input Volume</td><td>Water Exported (WE) (corrected for known errors)</td><td colspan="3">Billed Water Exported</td><td>Revenue Water (Exported)</td></tr>
<tr><td rowspan="11">Water Supplied</td><td rowspan="4">Authorized Consumption</td><td rowspan="2">Billed Authorized Consumption</td><td>Billed Metered Consumption (BMAC) (water exported is removed)</td><td rowspan="2">Revenue Water</td></tr>
<tr><td>Billed Unmetered Consumption (BUAC)</td></tr>
<tr><td rowspan="2">Unbilled Authorized Consumption</td><td>Unbilled Metered Consumption (UMAC)</td><td rowspan="8">Non-Revenue Water (NRW)</td></tr>
<tr><td>Unbilled Unmetered Consumption (UUAC)</td></tr>
<tr><td rowspan="7">Water Losses</td><td rowspan="3">Apparent Losses</td><td>Systematic Data Handling Errors (SDHE)</td></tr>
<tr><td>Customer Metering Inaccuracies (CMI)</td></tr>
<tr><td>Unauthorized Consumption (UC)</td></tr>
<tr><td rowspan="4">Water Imported (WI) (corrected for known errors)</td><td rowspan="3">Real Losses</td><td>Leakage on Transmission and/or Distribution Mains</td></tr>
<tr><td>Leakage and Overflows at Utility's Storage Tanks</td></tr>
<tr><td>Leakage on Service Connections</td></tr>
</table>

Figure 8 AWWA M36 Audit Water Balance

Conclusion and Next Steps

City staff discuss the irrigation system at the SLC Sports Complex.

MWM recommends that the City initiate a five-year action plan to address implementing the Best Management Practices (BMPs) outlined on page 18, at each City property. These best practices were developed as a result of the indoor assessments, Water Checks, and Water MAPS™. If this approach is determined to be too costly for all properties, begin with the top twenty users in each category, indoor and outdoor, and tailor the BMPs based on the type of water use. MWM also recommends that the City investigate funding opportunities with state, federal and private partners. Large projects, such as replacing inefficient evaporative coolers and similar equipment, are prime candidates for these funds as they have an easy to identify start and end date, a single location or facility, and can often result in significant, quantifiable savings. Take advantage of funding partnerships and start with the simplest tasks first. For example, the Central Utah Water Conservancy District confirmed that it provides rebates on toilets for any public facility. Low flow faucet aerators of 0.5 to 1.0 gallons per minute (GPM), can be found in bulk for less than $1 each and can often be installed by hand (while removing old ones may require a wrench).

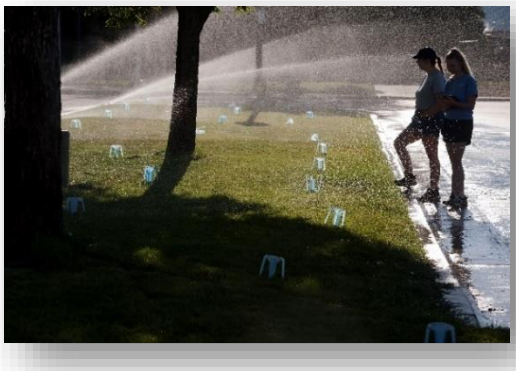
Projects planned in the coming year include:

- Complete WaterMAPS™ assessments on all City properties
- Replace poorly functioning toilets and faucets at Pioneer Precinct
- Replace cooling tower at Main Library
- Conduct remaining indoor assessments at all branch libraries
- Identify and prioritize City properties for landscape transformations

MWM and City staff at the Public Safety Building.

Nearly all City water use is consumed outdoors and the two largest sources for outdoor irrigation are golf and parks. While SLC Park usage is trending down, golf usage was back up in 2022 due to the longer season during which the courses were open. For properties with high outdoor use, investigate sites that have irrigation-only meters, but exhibit consumption outside of the irrigation season. Consider adjusting irrigation timers downward incrementally to refine the lowest threshold of water use that is necessary to maintain plant health; this action coincides with findings from the Water Check reports that indicated, of the sites assessed, most zones ran longer than recommended. Repair and replace any irrigation that is not functioning properly, especially if it results in overspray onto non-irrigable areas such as sidewalks, parking lots, or dirt areas.

SLC Parks pose special challenges that could not be fully addressed in the timeline of this report. Parks regularly contain multiple and mixed use meters on each site. One important next step will be to work closely with Parks to link specific meters with their specific irrigation zones to better perform Water Checks and WaterMAPS™.



USU-CWEL conducting a Water Check at the SLC Sports Complex.

BMPS PER SITE TYPE

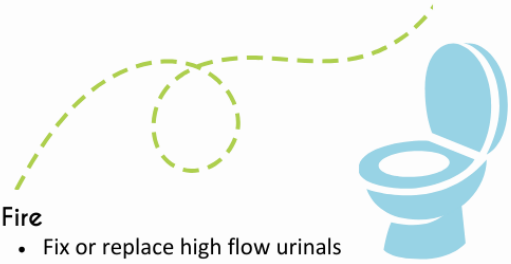
Recommended Water Efficiency Best Management Practices

Facilities

- Inspect for leaks
- Investigate where new technology may apply
- Install sub-meters wherever there is mixed use (landscaping, process water, office)
- Capture and recycle meter testing water

Recreation

- Inspect/fix pools and pool leaks
- Fix or replace leaking showerheads
- Adjust toilet water lines to improve toilet efficiency
- Replace old/faulty flushometers to improve toilet efficiency
- Install faucet aerators where missing (primarily locker rooms)
- Ensure hoses are equipped with auto shut-off nozzles



Fire

- Fix or replace high flow urinals
- Replace tank toilets with EPA WaterSense certified efficient toilets
- Adjust toilet tank water levels to improve toilet efficiency
- Fix or replace leaking/damaged showerheads
- Install faucet aerators where missing (primarily garage hand wash stations)
- Inspect/fix pipe fittings and vacuum breakers in cleaning closet(s)
- Replace inefficient clothes washer(s) with Energy Star Certified clothes washer(s)
- Purchase recycled water training truck

Library & Museum

- Fix faulty faucet and toilet sensors
- Install a submeter on the cooling tower and regularly inspect for leaks and stuck valves
- Install faucet aerators where missing (primarily break rooms)
- Adjust toilet tank water levels to improve toilet efficiency

Open Space and Landscape

- Complete WaterMAPS™ assessments
- Schedule Water Check™ Assessments
- Inspect, report, and repair irrigation issues in a timely manner
- Identify properties for landscape transformations
- Improve indoor and outdoor use data
- Consider replacing non-recreational turf with a low-water-use lawn species and/or reduce the lawn footprint overall
- Develop dashboard to access daily AMI meter data
- Inventory raw water sources
- Link meters to specific irrigation zones and areas

Office

- Fix or replace high flow urinals
- Fix faulty faucet and toilet sensors
- Adjust toilet tank water levels to improve toilet efficiency
- Replace old/faulty flushometer toilets to improve efficiency
- Inspect ornamental fountain frequently for leaks or other concerns
- Replace water-cooled ice machines with air-cooled ice machines
- Install a submeter for cooling tower(s) and regularly inspect tower(s) for leaks and stuck valves

Fleet

- Replace rooftop HVAC units
- Use dry broom for floor cleaning
- Fix or replace leaking/damaged showerheads
- Use pressure washing equipment for all wet-cleaning
- Turn off carwash hoses in winter (build insulated/heated enclosure)
- Remove/replace trough sinks
- Fix or replace faucet sensors
- Fix or replace high flow urinals
- Re-circulate water for washing

Appendices

SALT LAKE CITY WATER EFFICIENCY REPORT ACRONYMS

ADVANCED METERING INFRASTRUCTURE	AMI
ALLIANCE FOR WATER EFFICIENCY	AWE
AMERICAN WATER WORKS ASSOCIATION MANUAL 36: WATER AUDITS AND LOSS CONTROL PROGRAMS, FOURTH EDITION	AWWA M36
BOWEN COLLINS A& ASSOCIATES	BCA
DISTRIBUTION UNIFORMITY	DU
EVAPOTRANSPIRATION	ET
GALLONS	GAL
GALLONS PER CYCLE	GPC
GALLONS PER FLUSH	GPF
GALLONS PER MINUTE	GPM
GLOBAL POSITIONING SATELLITE	GPS
HEATING, VENTILATION, AND AIR CONDITIONING	HVAC
LANDSCAPE IRRIGATION RATIO	LIR
SEWER LIFT STATION	LS
MADDAUS WATER MANAGEMENT, INC.	MWM
METROPOLITAN WATER DISTRICT OF SALT LAKE & SANDY	MWDSLS
ONE-HUNDRED CUBIC FEET	CCF
REFERENCE EVAPOTRANSPIRATION	ETO
SALT LAKE CITY DEPARTMENT OF PUBLIC UTILITIES	SLCDPU
UNITED STATES DEPARTMENT OF AGRICULTURE - AGRICULTURE RESEARCH SERVICES FORAGE AND RANGE RESEARCH LABORATORY	USDA-ARS/FRRL
UNITED STATES ENVIRONMENTAL PROTECTION AGENCY WATERSENSE	EPA WATERSENSE
USU WATER MANAGEMENT ANALYSIS AND PLANNING SOFTWARE	WATERMAPS™
UTAH STATE UNIVERSITY	USU
UTAH STATE UNIVERSITY – CENTER FOR WATER EFFICIENT LANDSCAPING	USU-CWEL
WATER RECLAMATION FACILITY	WRF

CITY PROPERTY TYPE CATEGORIZATIONS

In the process of analyzing City water use data the project team developed a system of property type categorizations. As illustrated below, meters were identified then "rolled up" into one of seven categories based on their water use profile. Some sites have widely varied use types, such as the Main Library, where there are restrooms as well as retail and restaurant space, and recreation sites that have landscaping, indoor facilities, and restaurants. Office buildings are those which typically do not have any specialized water using equipment including, but not limited to, Plaza 349, the LeRoy Hooton Building, the City County Building, and Fisher Mansion.

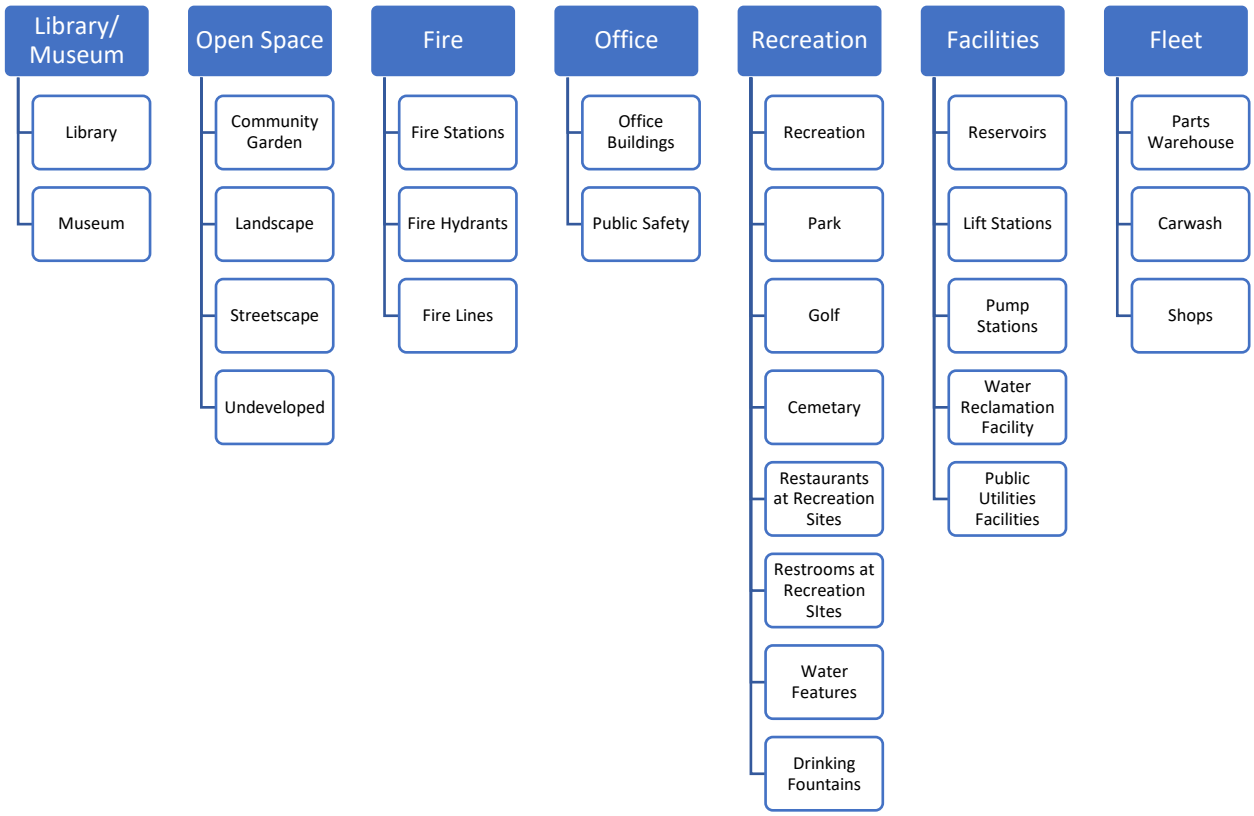


Figure 9 City Property Type Categorizations

WATER EFFICIENCY STANDARDS SHEET

Fixture Replacement Guide for Water-Efficient Equipment

Note: gal= gallons, gpm= gallons per minute, gpf= gallons per flush, gpc = gallons per cycle

Additional Resources: EPA WaterSense, MaP Testing, Alliance for Water Efficiency, Federal Energy Management Program

Fixture or Equipment Type	Applicable Models	Equipment Price (Avg.)	Best Practice Efficiency Level for Salt Lake City, Utah
Toilet	WaterSense Compliant Tank Toilets Flushometer Valve/Tank Combo Toilets	$200-400	≤1.28 gpf [4]
Urinal	WaterSense Compliant Flush Urinals Non-water Urinals (Waterless)	$150-300	≤0.5 gpf[1]
Public Bathroom Faucet	Aerators are available in a variety of sizes and spray types	$1-5 (aerators)	Manual or Sensor Faucets: ≤ 0.5 gpm [5] Metering Faucets: ≤ 0.25 gpc[2]
Residential Bathroom Faucet	WaterSense Certified Bathroom Sink Faucets & Faucet Accessories	$1-5 (aerators)	≤1.5 gpm[1]
Showerhead	WaterSense Certified Showerheads	$20-80	≤2.0 gpm[1]
Clothes Washer	EnergyStar Certified Clothes Washers	$500-800	Energy Star clothes washers: ≤ 6.0 gal/ft3 Water Factor/Integrated Water Factor
Residential Dishwasher	EnergyStar Certified Residential Dishwashers	$400-700	Energy Star dish washers: ≤ 3.5 gal/load (standard) ≤ 3.1 gal/load (compact)
Kitchen Faucet	Aerators are available in a variety of sizes and spray types	$1-5 (aerators)	≤2.2 gpm[2]
Pre-rinse Spray Valve	WaterSense Certified Pre-Rinse Spray Valves	$50-100	≤1.28 gpm[1]
Food Steamer	Energy Star Certified Commercial Steam Cookers	$10,000-30,000	Use connectionless heat steamers, also called “boilerless steamers”
Ice Machine	Energy Star Certified Commercial Ice Machines	$2,000-5,000	Use recirculating closed-loop chilled water ice machines or Energy Star air-cooled ice machines
Commercial Dishwasher	Energy Star Certified Commercial Dishwashers	$5,000-80,000	Use Energy Star commercial dishwashers meeting the water efficiency requirements
Combination Oven	Energy Star Certified Commercial Ovens	$20,000-40,000	Use connectionless, boilerless combination ovens or Energy Star combination ovens
Dipper Well	Replacement technologies include, but are not limited to, scoop showers and heated utensil holders	$150-350	Retrofit dipper well with in-line flow restrictor ≤0.3 gpm or install replacement technology

[4] EPA WaterSense Standard

[5] American Society of Mechanical Engineers (ASME)/American National Standards Institute (ANSI) Standard

AUDIT KIT MATERIALS LIST

1. **Waterproof backpack** – We recommend a quality backpack to house all items in the kit and keep hands free.
2. **Stopwatch –** to time faucets/showers/toilets. Get one with a strap to be hands-free.
3. **One small clear plastic container** that can hold 0.25 gallon – to measure faucets.
4. **One larger clear plastic container** that can hold 1.0 gallon – to measure showers. It needs to have a wide mouth (larger than 3-4-inch opening) to fit under a shower head and be transparent to read volume.
5. **Metal tape measure** – to be used to measure water depth in tank type toilets.
6. **Dye tabs** – for testing toilet leaks.
7. **Flashlight** – makes it easier to see the labels on aerators or showerheads.
8. **Cell phone and/or digital camera** – for taking pictures of equipment.
9. **Business cards** – to identify employees while on site.
10. **Batteries** – for electronic devices as needed.
11. **Tablet** – for recording data. We recommend a lightweight tablet with a hands-free neck strap and case.
12. **Notepad with lined paper and pen/pencil** – to be used just in case electronics malfunction.
13. **Drip water measuring vial** – to estimate water loss from small drip leaks.
14. **Selfie stick or telescoping mirror** – to view equipment labels that are in hard to see places.
15. **Small towel** – to dry off in case you get wet.

Optional items to bring:

1. **TDS meter** – (Total Dissolved Solids meter) to be used to measure water quality circulating in cooling tower.
2. **EC meter** – (Electrical Conductivity meter) – also used to measure water quality of cooling towers.
3. **Measuring wheel** – used to measure landscaped areas.