Water Management Plan

Revision 2

U.S. Environmental Protection Agency
Office of Research and Development
Ground Water and Ecosystems Restoration Division

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EPA

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
GROUND WATER AND ECOSYSTEMS RESTORATION DIVISION
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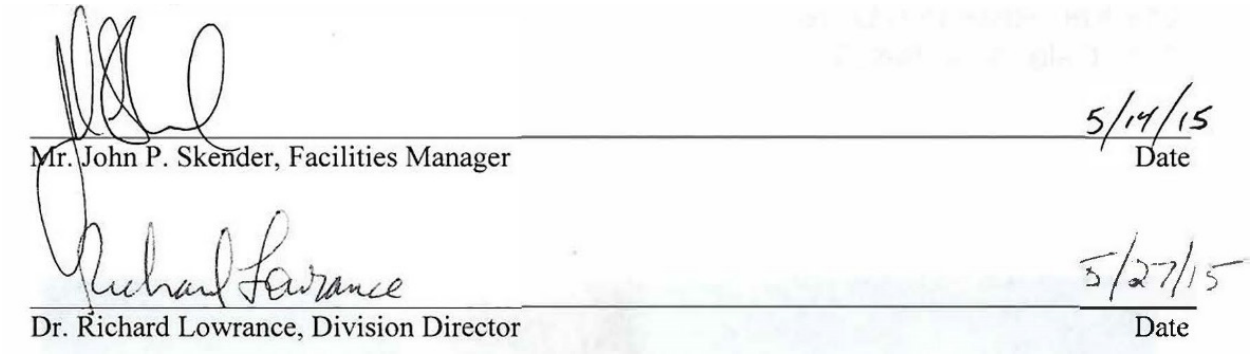
ADA, OKLAHOMA

WATER MANAGEMENT PLAN, REVISION 2

Approved by:



Mr. John P. Skender, Facilities Manager — Date: 5/14/15

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1.0 IDENTIFIED WATER CONSERVATION OPPORTUNITIES

In October 2014, a water use and conservation assessment was conducted at the U.S. Environmental Protection Agency's (EPA's) Robert S. Kerr Environmental Research Center (RSKERC) in Ada, Oklahoma. Under this Water Management Plan, RSKERC will consider implementing the potential water conservation and management opportunities identified during the water assessment, which are summarized in Table 1.

The rest of this Water Management Plan describes RSKERC's water reduction goals, water use trends, end uses of water, completed water efficiency projects, and drought management plans.

2.0 BACKGROUND AND PURPOSE

In 2007, Executive Order (EO) 13423, *Strengthening Federal Environmental, Energy, and Transportation Management*, called for federal agencies to reduce water use intensity by 2 percent per year between fiscal year (FY) 2007 and FY 2015 for a total reduction of 16 percent, compared to a FY 2007 baseline. This goal was revised and extended by EO 13514, *Federal Leadership in Environmental, Energy, and Economic Performance*. EO 13514 calls for reducing potable water use intensity by 2 percent annually through FY 2020, relative to the FY 2007 baseline, for a 26 percent total reduction. Water use intensity is measured in gallons per gross square feet (gsf).

The implementation instructions for water efficiency and management provisions of EO 13514 direct that agencies replacing fixtures or other water-using products should purchase Federal Energy Management Program-designated or WaterSense® labeled products.

In addition to the potable water use reduction requirements, EO 13514 requires agencies to reduce industrial, landscaping, and agricultural (ILA) water use by 2 percent annually or 20 percent by the end of FY 2020, relative to an FY 2010 baseline (including non-potable sources). The EO also directs agencies to identify, promote, and implement water reuse strategies that reduce potable water use.

The Energy Independence and Security Act of 2007 directs agencies to complete comprehensive energy and water evaluations of 25 percent of covered facilities (i.e., those accounting for 75 percent of total energy use) each year; implement cost-effective measures identified through life cycle analyses; and measure and verify water savings.

In summary, existing EOs and federal law require substantial reductions in all forms of water use, as well as ongoing, regular assessments of facility water use to identify and implement saving opportunities.

This Water Management Plan has been developed to document and promote the efficient use of water at RSKERC, so that the facility can contribute to meeting these Agency-wide objectives.

Table 1. Potential Water Conservation Opportunities, RSKERC

Suggested Priority	Project Description	Project Cost	Potential Water Savings (gallons)	Potential Energy Savings (MMBtus)	Potential Utility Cost Savings	Potential Payback (years)
1	Install 0.5 gallon per minute (gpm) aerators on two lavatory faucets on the second floor where previous aerators have been removed.	$20	6,000	2	$60	0.3
2a	Replace four existing urinals that flush at 1.0 gallons per flush (gpf) with a WaterSense labeled models flushing at 0.125 gpf.	$4,000	8,000	N/A	$30	133
2b	If urinal replacement is not considered cost effective, replace 1.0-gpf flush valve inserts with new inserts rated at 0.5 gpf.	$200	5,000	N/A	$20	10
3	Conduct irrigation system audit to ensure system is distributing water and operating as efficiently as the design intended. Following the audit, implement recommendations and train staff to manage irrigation system efficiently such that only required zones are watered.	$4,300	TBD based on audit findings	N/A	TBD based on audit findings	TBD based on audit findings
4	Install rainwater collection system to collect rainwater from the LCC roof. System would include a 2,000 gallon underground storage tank, pump to distribute the water throughout the irrigation system, and the necessary controls.	$20,000	50,000	-0.2	$160	127

3.0 FACILITY INFORMATION

RSKERC is an EPA-owned, EPA-operated facility situated on a 16-acre tract 3 miles south of Ada, Oklahoma. Completed in 1966, the main laboratory building provides approximately 50,000 square feet of laboratory and office space in a four-story structure. An addition to the facility in 1993 provides another 20,000 square feet for the library, computer support services, and the library conference center (LCC). The 2008 addition of an east wing to the main laboratory provides approximately 9,200 square feet of conditioned office space. The nearby 10,000-square-foot annex building contains a machine shop and storage facilities for field equipment and supplies. Separate, smaller buildings have been constructed for storing bulk chemicals, compressed gases, and hazardous waste. In total, the research center contains 87,119 square feet of conditioned space.

RSKERC is occupied by approximately 96 employees. The facility operates on a flex time schedule, one shift per day from 6 a.m. to 6 p.m., Monday through Friday.

4.0 WATER MANAGEMENT GOALS

RSKERC achieves its resource conservation goals by implementing the ORD Multi-Site Laboratory Environmental Management System (EMS) program. Within the EMS and otherwise, ORD's collective water management goals include:

- Annually, achieve the Agency ConservW targets (set by EPA's Sustainable Facilities Practices Branch) as a cumulative total of all seven ORD locations.

- Identify at least one water conservation project or stormwater management project for ORD to complete in FY 2015 and obtain funding.

Although not expressly stated, ORD's objectives and targets for water management imply a goal of achieving a 26 percent potable water reduction by the end of 2020, compared to a 2007 baseline, and of achieving a 20 percent ILA water reduction by the end of 2020, compared to a 2010 baseline, as set forth in EO 13514.

5.0 WATER USE INFORMATION

RSKERC uses potable water primarily for cooling tower make-up, irrigation, and restroom uses. Discussed further in Section 5.3, RSKERC's potable water use has decreased since the FY 2007 baseline year. The following sections provide additional details on RSKERC's water use.

5.1 Water Supply

Ada City Utilities provides RSKERC's potable water and sewer service. RSKERC does not use any sources of non-potable fresh water.

5.2 Meters and Submeters

Incoming city water supply is metered with six meters under five different water accounts. Table 2 lists the account numbers and associated usage area.

Table 2. RSKERC Water Use Accounts

Account Number	Description	Meter Location
60-0475-00	LCC	Below grade, exterior north face of LCC
60-0480-00	Main laboratory	Below grade, exterior north corner of main laboratory
60-0485-00	Main laboratory bypass	Below grade, exterior north corner of main laboratory
60-0490-00	Cooling tower, hazardous material storage	Below grade, east of main parking lot
60-0495-00, meter 1	Irrigation sprinkler	Below grade, near the east entrance along Kerr Research Drive
60-0495-00, meter 2	Annex building	Below grade, east of main parking lot

Flow totalizing meters are also installed on many of the subsystem flows. An inventory of submetered flows is provided below:

- Cooling tower blowdown
- Air-handler condensate recovery system
- RO permeate used in laboratories
- Fire system
- Make up to the closed ground loop for the ground source heat pump
- Make up the internal, closed, chilled water loop

There is generally no flow through the meters to the two closed-loop systems.

Under this Water Management Plan, facilities management staff will continue to record meter readings at least monthly and report values to the Facilities Manager so that water use trends can be monitored on an ongoing basis and leaks or other malfunctions can be quickly identified. Any unexpected changes in water use will be investigated and resolved immediately.

5.3 Historical Water Use

In response to EO 13423, RSKERC set a FY 2007 potable water use intensity baseline of 44.88 gallons per gsf. In FY 2014, water use intensity had decreased to 13.12 gallons per gsf—a 73.2 percent reduction compared to the FY 2007 baseline. Figure 1 illustrates RSKERC's potable water use intensity from FY 2007 to FY 2014.

Described in Table 3, RSKERC completed several water efficiency projects since FY 2008 to contribute its water use reduction.

Figure 1. Annual Potable Water Use Intensity, RSKERC, FY 2007–FY 2014

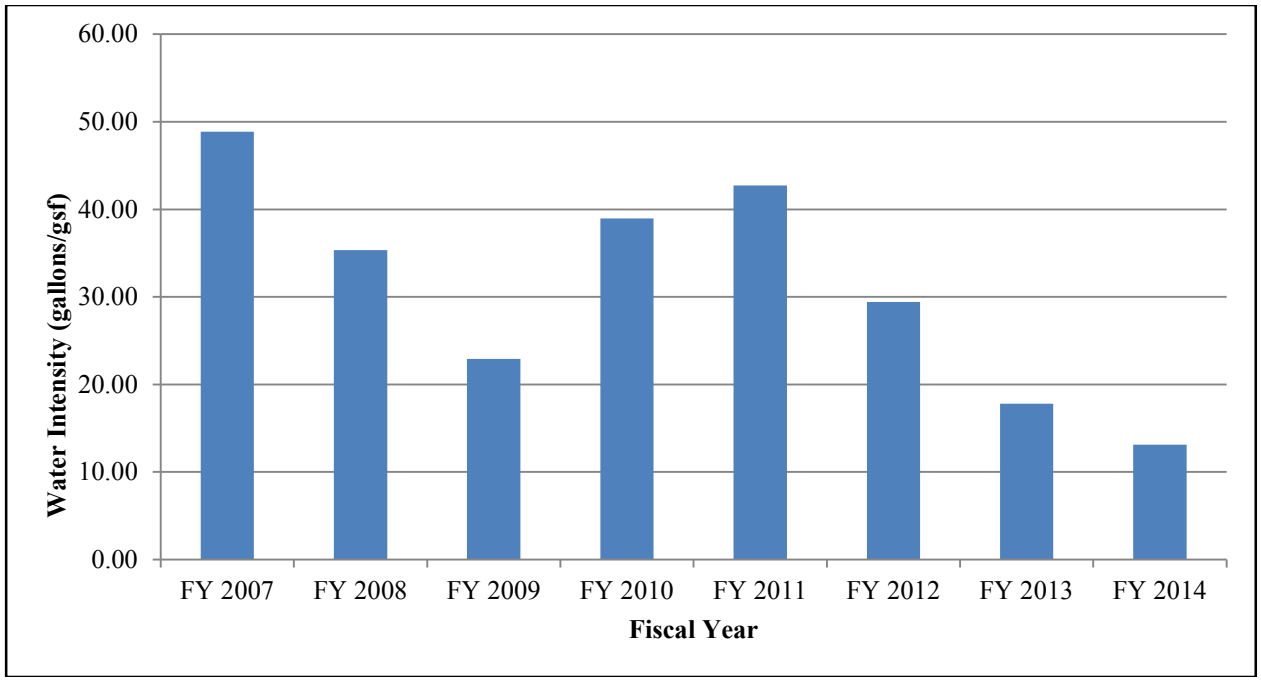


Table 3. Completed Water Efficiency Projects Since FY 2008, RSKERC

Project	Implementation Cost	Estimated Annual Water Savings (gallons)	Completion Year	Additional Notes
RO System Replacement	$26,000	105,000	FY 2014	RSKERC replaced the RO system with a more efficient and more appropriately sized system in FY 2014.
Minimize Single-Pass Cooling	$0	80,000	FY 2014	RSKERC minimized the flow rate of the single-pass cooling on the air compressors such that cooling water is only used when necessary.
Cooling Tower Blowdown Meter	$500	Not estimated	FY 2014	RSKERC installed a blowdown meter on the on cooling tower in April 2014. The meter is monitored monthly.
Install Air Handler Condensate Recovery System	$9,484	188,400	FY 2013	RSKERC installed a system to recover air handler condensate and route it to the cooling towers in FY 2013. In FY 2014, the system provided 188,400 gallons of make-up water to the cooling tower system.
Toilets	$14,800	171,000	FY 2013	RSKERC has replaced or retrofitted all 28 of its toilets with dual-flush toilets with a rated flush volume of 1.6 gpf for full flush and 1.1 gpf for reduced flush.
Urinals	$12,000	90,000	FY 2013	RSKERC replaced 12 of 16 urinals with WaterSense labeled models flushing at 0.125 gpf.
Faucet aerators	$260	35,000	FY 2013	RSKERC retrofitted 26 lavatory faucets with faucet aerators that flow at 0.5 gpm.
Showerheads	$400	14,000	FY 2013	RSKERC replaced 6 of 8 showerheads with WaterSense labeled models flowing at 1.5 gpm. Two showerheads already flowed at 2.0 gpm.
Fix Leak in Cooling Tower	$0	515,000	FY 2012	RSKERC fixed a leak in the cooling tower resulting from a stuck valve.
Irrigation	$50,000	400,000	FY 2010	Based on recommendations from a 2008 irrigation audit, RSKERC has optimized irrigation water use by only irrigating certain zones and only when necessary.

5.4 End Uses of Water

Table 4 and Figure 2 describe the end uses of water at RSKERC.

Figure 3 identifies the facility's water use based on the water source. RSKERC has been able to reduce its need for potable water by recovering and using air handler condensate as cooling tower make-up water, thus supplying over 14 percent of current water demand by water generated on site.

Figure 4 provides a graph of RSKERC's monthly potable water use in FY 2014, which illustrates RSKERC's seasonal water use pattern that can be attributed to higher cooling tower make-up water and irrigation demands in the summer months.

RSKERC's end uses of water are described in more detail in this section. Potential projects discussed in this section are summarized in Table 1.

Table 4. Major Water Uses, RSKERC, FY 2014

Major Process	FY 2014 Annual Water Use (gallons)	Percent of Total Potable Water Use (%)	Estimated Utility Costs[a]	Basis of Estimate
Cooling tower make-up	484,210	42.4	$1,600	FY 2014 metered total.
Irrigation	435,703	38.1	$1,400	FY 2014 metered total.
Restroom Fixtures	141,000	12.3	$580	Engineering estimate based on fixtures installed, occupancy, and daily usage factors.
Miscellaneous laboratory use (single-pass cooling for air compressors, glassware washers, autoclaves, water softeners, etc.)	49,361	4.3	$210	Calculated by difference from known total water use and all other calculated water uses.
RO System	23,000	2.0	$90	Engineering estimated based on meter readings of RO product between January and October 2014, extrapolated for full fiscal year.
Ornamental Landscape Fountain	9,600	0.8	$40	Engineering estimate based on annual pan evaporation amount and assumption that the fountain is 8' x 24'.
Total Potable Water Use	**1,142,874**	**100**		FY 2014 metered total.
Onsite Alternative Water Use				
Cooling tower make-up (air handler condensate)	188,400	-	-	FY 2014 metered total.

[a] Utility cost is calculated using the most current water and sewer rates available. According to the City of Ada, each account is billed a minimum monthly charge of $12.39 for the first 200 cubic feet of water, and $2.39 for each additional 100 cubic feet ($3.20/kGal). For sewer, each account (excluding the irrigation and cooling tower accounts) is billed a minimum monthly charge of $12.24 for the first 200 cubic feet, and $0.70 for each additional 100 cubic feet ($0.94/kGal).

Figure 2. Percentage of Potable Water End Uses, RSKERC, FY 2014

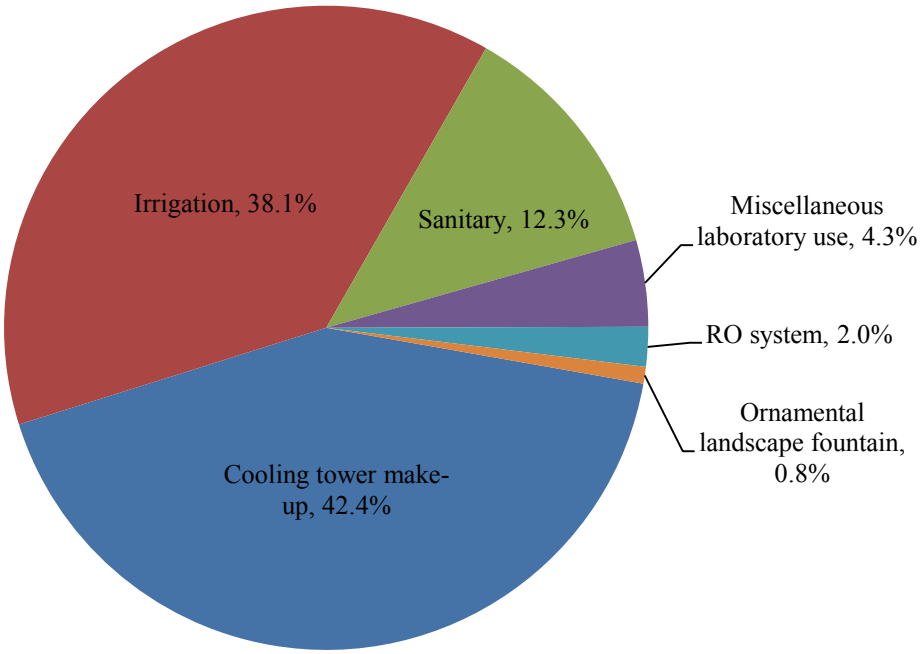


Figure 3. Percentage of Water Sources, RSKERC, FY 2014

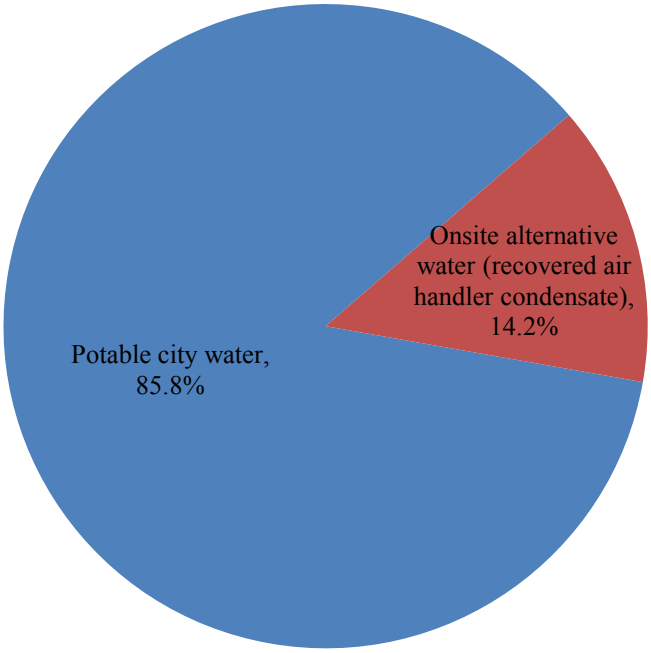
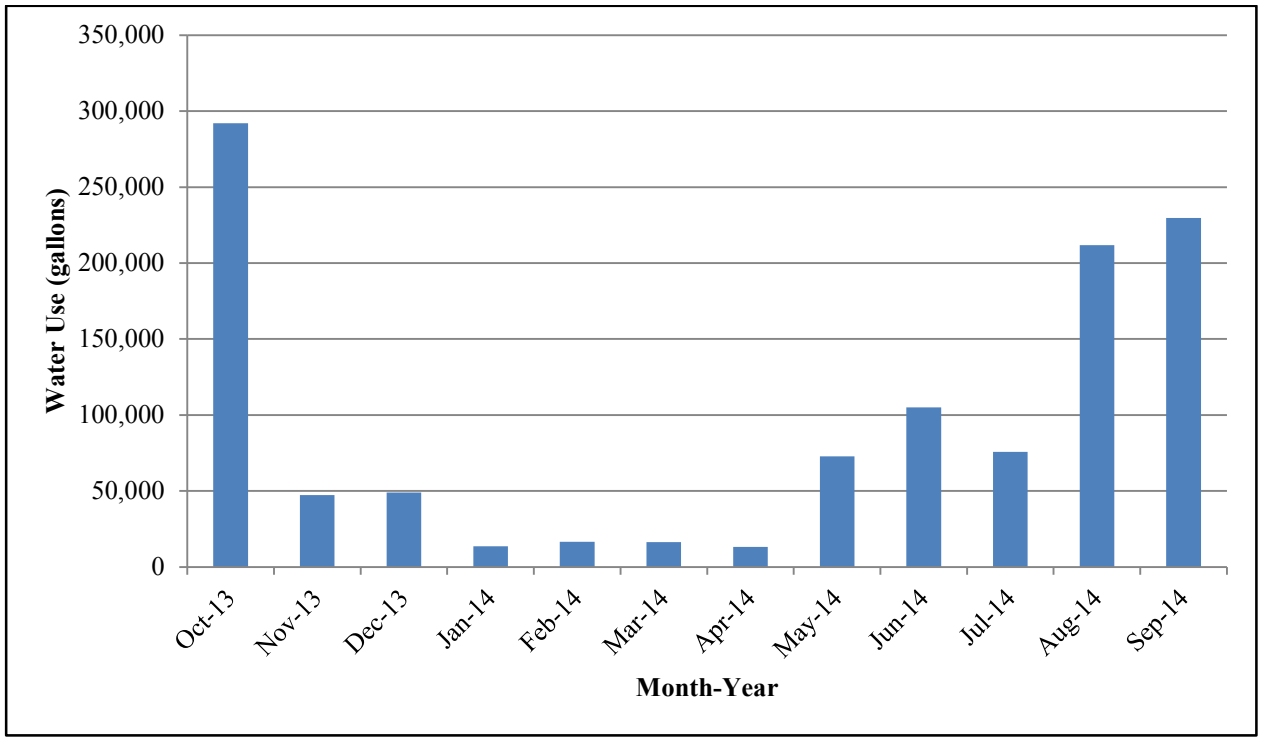


Figure 4. Monthly Water Use, RSKERC, FY 2014



Cooling Tower Make-Up

RSKERC's most significant water use is from operation of the cooling tower system, which accounts for approximately 42.4 percent of its annual potable water use. RSKERC is equipped with a two-cell cooling tower, rated at 450 tons of total cooling capacity. Since the ground source heat pump system came on line, RSKERC has generally only been required to operate one of the tower cells. However, during particularly hot summer months, RSKERC operates both cells to assist the ground source heat pump in cooling.

During the cooling season, a cooling tower maintenance contractor performs a monthly quality, performance, and water chemistry review of cooling tower operation. Chemical treatment is provided to control scale and corrosion. A conductivity meter set at 1,800 microSiemens per centimeter (*u*S/cm) is used to control blowdown. When maintained, this set point results in efficient water use, as the facility achieves approximately seven cycles of concentration in the cooling tower. Cooling tower make-up water quantities are metered separately and recorded monthly. The facility does not pay for sewer service on the meter that supplies the cooling tower. The cooling tower blowdown is also metered, and meter readings are recorded and reported to the Facilities Manager monthly.

RSKERC collects air handler condensate from the air handling units on the roof and uses it for cooling tower make-up. The collected condensate is metered, and RSKERC records readings monthly. Collected air handler condensate makes up approximately 28 percent of the cooling tower system's make-up water demand.

RSKERC is considering implementing an energy conservation project that would replace the existing Tranter plate and frame heat exchanger with a larger capacity heat exchanger. This would allow further utilization of the cooling towers to reduce the temperature of water in the geothermal loop running through the ground source heat pump system. Because the cooling towers would be used to help dissipate more heat, the ground source heat pump system could run at a lower temperature and pressure and therefore be more energy efficient. If this project is implemented, increased use of the cooling towers up to existing capacity will result in additional water use from evaporation and system blowdown.

Irrigation

Irrigation accounts for approximately 38.1 percent of RSKERC's potable annual water use. Two of the facility's 16 acres are covered with irrigated landscape. The irrigated landscape is primarily covered with Bermuda grass. The landscape is not composed of native, drought-resistant plantings and supplemental irrigation is required to maintain a lush, green landscape. In the front of the main facility, within approximately 10 feet of the building exterior, RSKERC has a mulched area with shrubs and other plantings and an ornamental landscape fountain.

In 2008, RSKERC's irrigation system was audited by a WaterSense® irrigation partner. Using the audit's findings, RSKERC hired an irrigation contractor to install a new, water-efficient irrigation system and control scheme. The new system, including the weather-based irrigation controller, was installed in May 2010. The irrigation system is composed of 19 different irrigation zones.

Based on discussions with O&M staff, the irrigation system is only activated in some zones, particularly to prevent loss of plantings during dry periods. Zones that require significant watering during the summer months include the planters in the medians located in the parking lot and at the main entrance of the laboratory (Zones 10, 11, 12, 14, 15, 16, and 17), and the shrubs at the front of the building near the ornamental fountain (Zone 9). RSKERC will consider conducting a new irrigation audit to optimize the efficiency of the existing irrigation system and to identify zones of the irrigation system that can be valved off or disconnected.

To reduce potable water use from irrigation, RSKERC could consider installing a rainwater collection system. Rainwater can be collected from the LCC roof, which has a collection area of approximately 3,500 square feet. Providing storage for a 1" storm event would require a 2,000 gallon storage tank and associated pumps and controls. Such as system could save approximately 50,000 gallons of water per year, but the payback period is estimated to be 127 years.

Restroom Fixtures

All of the toilets installed at RSKERC are dual-flush models (1.6 gallons per flush [gpf] for full flush/1.1 gpf for reduced flush). 75 percent of the urinals are WaterSense labeled high-efficiency urinals flushing at 0.125 gpf. The remaining urinals are Energy Policy Act of 1992 (EPAct 1992)-compliant urinals flushing at 1.0 gpf.

24 of RSKERC's 28 lavatory faucets have been equipped with aerators that limit the flow to 0.5 gallons per minute (gpm). The 0.5 gpm flow rate is lower than the EPAct requirement for faucets

and is compliant with the American Society of Mechanical Engineers/Canadian Standards Association (ASME/CSA) standard for lavatory faucets in public use. This flow rate is sufficient for hand washing and is considered a best practice for lavatory sinks in public settings. On three of the four faucets with flow rates greater than 0.5 gpm, the aerators had been removed and therefore the flow is uncontrolled. One faucet, located in the restroom of the Annex, is an EPAct 1992-compliant faucet flowing at 2.2 gpm.

WaterSense labeled showerheads have been installed throughout RSKERC. 6 of the 8 showerheads flow at 1.5 gpm, while the remaining two have flow rates of 2.0 gpm.

Janitorial staff and employees are trained to report leaks or other maintenance problems. The facility operation and maintenance contractor performs a daily inspection of all restroom fixtures to maintain and ensure proper operation. Identified leaks or other maintenance problems are immediately corrected.

Table 5 provides an inventory of sanitary fixtures.

Table 5. Restroom Fixtures Inventory, RSKERC

Fixture Type	Flow Rate	Total Number
Toilets	Dual-Flush (1.6 gpf/1.1 gpf)	28
Urinals	1.0 gpf	4
	0.125 gpf	12
Lavatory faucets	2.2 gpm	1
	uncontrolled	3
	0.5 gpm	24
Showers	2.0 gpm	2
	1.5 gpm	6

To reduce restroom water use, RSKERC will consider replacing the remaining urinals that flush at 1.0 gpf with WaterSense labeled models flushing at 0.125 gpf. Alternatively, because full urinal replacement has a long payback period, replacing existing flush valve inserts with inserts rated at 0.5 gpf may be a more cost effective approach. If RSKERC decides to replace the flush valve inserts, it should consider conducting a pilot with one urinal to verify adequate performance and user satisfaction with the lower flush volume.

To further reduce restroom water use, RSKERC will reinstall aerators on the faucets where the aerators have been removed. In the men's restroom on the second floor of the laboratory, 0.5 gpm aerators will be installed. In the restroom located in the Annex, a 2.2 gpm aerator will be installed since this sink is used by O&M staff that may need to wash heavily soiled hands.

Miscellaneous Laboratory Uses

Single-pass cooling is supplied to two air compressors in the penthouse when they are in operation. The flow of cooling water is controlled with a solenoid valve so the water only flows

while the compressors are running. During the assessment, single-pass cooling water was only running at a trickle and is not considered a major area of water consumption.

RSKERC contains glassware washers in the laboratories. It is also equipped with two steam sterilizers with temperature-activated control valves that only allow tempering water to flow when they are operating. The Consolidated Stills & Sterilizers Model 4906-32 was installed in 2007. The Consolidated Stills & Sterilizers Model 4600-90 was installed in 1999. Each steam sterilizer is used a few times per month.

RSKERC has two water softeners, which each regenerate automatically based system controls and monitoring.

Heat is supplied by electric ground source heat pumps. The heat pumps operate using external and internal closed cooling water loops, which consume virtually no water.

Reverse Osmosis System

Purified water for laboratory use is generated through a multi-step process consisting of deionization and reverse osmosis (RO). The RO system was replaced in December 2013 with a more efficient and appropriately sized model for RSKERC's laboratory requirements. Based on the replacement, the system's reject water use significantly reduced. As RO permeate is generated, it fills a 500 gallon tank, and a float switch controls when more RO water is produced. RO system permeate is metered as it runs to the laboratories. Meter readings are recorded monthly.

Ornamental Landscape Fountain

RSKERC has an ornamental landscape fountain located at the main entrance. The fountain recirculates water and is filled using an automatic valve to make up for evaporation or other losses.

6.0 DROUGHT CONTINGENCY PLAN

This section describes the RSKERC's drought contingency plans.

6.1 Drought Risk

RSKERC is located in an area that periodically experiences drought and, at times, can experience extreme drought. Water is supplied by Ada City Utilities, which obtains water from the Arbuckle-Simpson Aquifer, an underground reservoir located approximately 11 miles south of Ada. The aquifer occupies more than 500 square miles of underground terrain. The water flows by gravity from the aquifer approximately 11 miles north into the city's water treatment plant.

Information on drought and water resource monitoring in Oklahoma can be reviewed at: http://www.owrb.state.ok.us/supply/drought/drought_index.php.

The Oklahoma Department of Environmental Quality maintains information on local water systems experiencing problems or implementing water use restrictions at: http://www.owrb.ok.gov/supply/drought/dr7_systems.php.

6.2 Recent Contributions to Drought Contingency

RSKERC set a FY 2007 potable water use intensity baseline of 44.88 gallons per gsf. As of FY 2014, RSKERC has reduced its water use intensity to 13.12 gallons per gsf—a 73.2 percent reduction compared to the FY 2007 baseline. Table 3 identifies water conservation projects implemented by RSKERC since FY 2008 that have contributed its water use reduction. In addition, RSKERC staff records and monitors water meters and submeters so that leaks or other malfunctions resulting in increased water use can be identified and resolved.

6.3 Potential Capital Improvement Projects to Reduce Water Use

Potential capital improvement projects are identified in Table 1. These projects represent RSKERC's plan to further reduce facility water use, particularly if faced with water supply limitations. If necessary, all of these projects could be implemented relatively quickly, although some do not have short-term payback periods. If fully implemented, these projects are estimated to reduce facility water use by up to six percent.

6.4 Opportunities for Short-Term Response to Local Drought

In the event of a drought or other water supply shortage, RSKERC will follow the water use recommendations and restrictions of the City of Ada. As required, the facilities manager, in consultation with the laboratory director, will implement the facility response to City of Ada water use restrictions.

For short-term response to local drought, RSKERC could curtail outdoor water use, limiting it to one day per week, or ultimately eliminating in entirely. In general, only zones where there is potential loss of plantings require irrigation during summer months. Significantly reducing irrigation water use is projected to reduce facility water use by 30 to 40 percent beyond current levels. However, significantly reducing or entirely eliminating irrigation water use could damage existing landscape plant material if implemented for an extended period.

In addition to reducing and/or eliminating outdoor water use for irrigation, RSKERC could also cease operation of the ornamental landscaping fountain in the event of a drought. While the fountain is recirculating and is not a heavy water user, almost 10,000 gallons of water is lost annually through evaporation and must be made up via an automatic valve throughout the year.

6.5 Considerations for New Construction

RSKERC's current facility includes many aspects that are considered water efficiency best practices. However, if EPA had the opportunity to construct a new facility, the design choices listed below could be considered to further reduce water use.

1) RSKERC could consider restroom fixtures with maximum flow rate and performance requirements provided in Table 6.

Table 6. Requirements for Restroom Fixtures in New Laboratory Construction

Fixture Type	Maximum Flow Rate	Performance Requirement
Toilets	1.28 gpf	WaterSense labeled once specification is released (expected 2015)
Urinals	0.125 gpf	WaterSense labeled
Lavatory faucets	0.5 gpm	None
Showerheads	1.75 gpm	WaterSense labeled

2) RSKERC could consider landscaping that does not require supplemental irrigation and does not have any ornamental fountains.

3) When evaluating laboratory-wide DI/RO requirements, the Laboratory could consider whether point-of-use systems in individual laboratories would offer more efficient operation than central laboratory systems sized for maximum concurrent needs in multiple laboratories.