CENTER FOR
ReSource Conservation

October 3, 2016

Kevin Reidy and Ben Wade
Office of Water Conservation and Drought Planning Section
Colorado Water Conservation Board
1313 Sherman St., Room 721
Denver, CO 80203

Dear Mr. Reidy and Mr. Wade,

Final report for Center for ReSource Conservation grant: School District Water Efficiency Project PO# PDAA 20150000000000000231

As of October, 2016, CRC's School District Water Efficiency Project has been completed. Below is a summary of the final outcomes of the project.

The project's three stated goals were reached. These goals were:

- To educate the school district staff on the most cost effective water efficiency upgrades that can be made and/or process changes that it can implement indoors and outdoors, to cause significant reduction in water use and cost of water bills.
- To implement major water efficiency upgrades and/or operational changes within the district. Major is defined by demonstratable and significant water savings associated with the upgrades and/or changes.
- To provide educational lessons and opportunities to students in each school in the district on water conservation concepts and methods.

Perhaps the largest success of the project was through the educational opportunities that were received by students within the district. CRC was able to work with students both on indoor and outdoor assessments, teaching the students the importance of water conservation and actual direct methods for addressing water challenges within their own communities. In addition, CRC worked with the district to support the creation of an extensive educational water blog, hosted at https://blogs.svvsd.org/water/, which has been shared across the St. Vrain Valley School District and with other educators, statewide.

After indoor water assessments at 20 schools and outdoor irrigation assessments at 10 schools, St. Vrain Valley School staff were presented with a report and recommendation list containing the most appropriate, cost effective, and relevant water efficiency opportunities that CRC discovered. From these recommendations the district chose two main upgrades to focus on for fulfillment of the project requirements around demonstratable and significant water savings. Both sets of devices, an irrigation controller and 70 efficient bathroom faucets, were purchased and either have been or are in the process of being installed. Annual water savings from both of these combined are expected to be between 650-1,250 kgal. The final report, included with this cover letter, discusses the main challenges encountered

throughout the project, including the reasons for delayed installation that prevented direct measurement of water savings before the end of the project timeline.

Summaries of these project outcomes and more can be found in the attached report as well as in the Attachments at the end of the report.

CRC is grateful to have had the opportunity to work with St. Vrain Valley Schools and their excellent staff who are deeply committed to water conservation and sustainability at the district scale. The district tells CRC that this grant has been a catalyst for many water-focused projects that will continue well beyond the timeline of this particular grant.

St. Vrain Valley Schools and CRC send a sincere thank you to the CWCB for their support of this project and to water conservation across the state.

If you have any follow up questions or comments, please feel free to get in touch with the project manager, Morgan Shimabuku, at any time with the information below.

Respectfully Submitted,

Morgan Shimabuku
Senior Manager of Sustainability Programs
Center for ReSource Conservation
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The Center for ReSource Conservation

School District Water Efficiency Project Final Report

CWCB Water Efficiency Grant Program PO# PDAA 2015-231

Contents

Introduction 3
Project Background 3
Project Goals 4
    Project Timeline 5
Indoor Assessments 5
Outdoor Assessments 11
Student Education and Curriculum 15
    Student Led Assessments 16
    Curriculum 17
District Staff Survey 18
Water Conservation Upgrades 18
Main Project Challenges and Lessons Learned 20
Attachments 21

Introduction

School districts are great candidates for water conservation, often having 100s of buildings, high water fixture usage rates, old infrastructure and large landscapes that require significant watering to maintain health. While little information exists on how much money school districts spend on water utilities, energy utility costs are known to be second only to teacher salaries in many US districts[1]. The Center for ReSource Conservation (CRC) recognized the opportunity for helping school districts to identify easy and affordable water efficiency upgrades after performing more than a dozen indoor assessments at local schools in 2013. Seeing a need and an opportunity to share their expertise, CRC teamed up with the St. Vrain Valley School District (SVVSD) to bring water conservation to the students, staff, buildings, and landscapes at schools across the district in 2015 & 2016.

This CWCB funded project had three main goals: to discover and present the most cost effective water efficiency upgrades and/or processes that could be made to the district, to implement water efficiency upgrades and measure water savings, and to create educational opportunities and lessons for the students on the topic of water conservation.

This is the final report for the School District Water Efficiency Project, prepared by CRC for the CWCB. It details the project background, goals, timeline and tasks, as well as the major program accomplishments and challenges. Deliverables from the project that were turned in to SVVSD during the project timeframe are included in the Attachments at the end of the report.

Project Background

CRC is a nonprofit organization that works across the state of Colorado in partnership with water utilities to put conservation into action. More specifically, CRC serves 25+ Colorado communities through implementing residential and commercial, indoor and outdoor, water conservation programs. Starting in 2013 CRC worked with several utilities and funding support from the CWCB to create a commercial water assessment program. CRC created this program in order to fill a void in the water conservation program offerings, particularly within small to medium-sized water utilities. These utilities rarely have the infrastructure or staff to enable them to provide services for their business community. During the pilot year of the program CRC performed 11 water assessments at schools within the Front Range. Nearly every school was found to have significant potential for

[1] Xcel Energy, Managing energy costs in schools; A guide to energy conservation and savings for K-12 schools. https://www.xcelenergy.com/staticfiles/xe/Marketing/Managing-Energy-Costs-Schools.pdf

water, energy, and cost savings from upgrading fixtures and/or large appliances to WaterSense and EnergySTAR products. Based on water records analysis and billing history from these schools, CRC also found that a majority of water use occurred during the summer, suggesting that conservation opportunities exist for schools in the outdoor watering arena as well.

St. Vrain Valley Schools (SVVSD) is a pre-K-12 public school district based in Longmont, Colorado. SVVSD includes 55 different schools and over 30,000 students, spread throughout the northern Front Range. The district is serviced by 11 water providers. Their annual water use from June 2015 through June 2016 was approximately 97 million gallons.

One experience that CRC offered this project was from direct work with school districts across the state through a youth engagement energy competition, ReNew Our Schools. Through this program CRC has developed a strong set of skills involving the coordination of school district resources and staff to deliver impactful, education-based programming. Since 2011 CRC has run ReNew Our Schools within SVVSD three times. The relationships that CRC built within the district, with the administrative, maintenance team and educational teams, provided the foundation that was needed to work on this project. Before beginning on the project and grant, CRC met with the district's Energy and Sustainability Manager, Dara Ward, to discuss the project ideas, goals, timeline and obligations. After that meeting, CRC submitted and successfully received a grant to begin work with SVVSD in January of 2015.

Project Goals

The main goals of the project included:

- To educate the school district staff on the most cost effective water efficiency upgrades that can be made and/or process changes that it can implement indoors and outdoors, to cause significant reduction in water use and cost of water bills.
- To implement major water efficiency upgrades and/or operational changes within the district. Major is defined by demonstratable and significant water savings associated with the upgrades and/or changes.
- To provide educational lessons and opportunities to students in each school in the district on water conservation concepts and methods.

The stated goals were all met, as presented in the sections below.

Project Timeline

The timeline below reflects the final timeline used for the project. The project was originally planned to take one calendar year, with completion in January of 2016. Due to challenges that are discussed later in this report, the timeline was modified, with the approval of the CWCB, to end in October 2016. Where the final timeline differs from the original timeline, the original date is shown in parentheses.

Task 1: Indoor Water Assessments 4/15/15

Task 2: Outdoor Water Assessments 9/30/15 (7/31/15)

Task 3: Water Conservation Education 1/21/16 (11/15/15)

Task 4: Implementation 6/15/16 (12/18/15)

Task 5: Data Analysis and Reporting 10/3/16 (1/30/16)

Indoor Assessments

Beginning in February of 2015 the Center for ReSource Conservation (CRC) began performing indoor water assessments at 20 pre-selected schools within the SVVSD. Schools were selected by the Energy and Sustainability Manager within the district based on several factors, including relative water usage, cost of water and utility rates, use of domestic water for irrigation, schools that have shown interest in efficiency and water conservation, and schools implementing STEM programs for their students. Of the 20 schools assessed, 10 were pre-K or elementary schools, 5 were middle schools, 2 were high schools, and 2 were K-8th.

The assessments were used to evaluate and identify water conservation opportunities within restrooms, kitchens and classrooms across the district. At each school the main objective was to test all water-using fixtures and record specifications of the water-using appliances found throughout the school. Data collected during each assessment was entered into an Excel-based commercial auditing tool (created by the Brendle Group) along with utility rate information. The output from the tool for each school is included in **Attachment 1**. The aggregation of the indoor assessment data is included in **Attachment 2**. The chart in this attachment provides information at both the individual school-level, as well as the summary data at the bottom of the spreadsheet (rows 24-28).

In general, the indoor assessments revealed that there were significant opportunities for water savings at nearly every school visited. The table below shows both the total (sum) as well as the mean (average) for the categories of water, electricity, and natural gas, and cost savings per school.

These are only the savings potentially available through indoor upgrades to fixtures and appliances within the 20 schools included in the assessments and do not include potential savings from outdoor irrigation improvements. All savings are estimated on an annual time scale.

	Water Savings (kgal)	Electricity Savings (kWh)	Natural Gas Savings (therm)	Water Cost Savings	Electric Cost Savings	Natural Gas Cost Savings	Total Cost Savings
Total	9,050	109,432	11,194	$62,223	$9,738	$885	$72,307
Mean	453	5,472	560	$3,111	$487	$44	$3,615

At each school the number of fixtures and appliances that did not meet WaterSense or EnergySTAR standards were counted. Between the 20 schools, the following number of each fixture and appliance did not meet national efficiency standards set by these programs, and therefore have potential for improvement.

Handwash Sink Faucet Aerators	Kitchen-type Faucet Aerators	Toilets	Urinals	PRSVs	Clothes Washers	Residential-type Dishwasher	Commercial-type Dishwasher	Steam Cooker	Ice Machine
322	132	586	165	16	17	3	17	17	4

For water savings, and cost savings, the top recommended replacements were:

- Flushometer toilets – 1,921 kgal and $12,548 of annual savings
- Faucet Aerators – 1,881 kgal and $15,105 of annual savings
- Steam Cookers – 1,349 kgal and $16,298 of annual savings

Looking at the savings potential at each individual school, the table below shows that there was a range in potential water, energy, natural gas and cost savings. The school with the highest total potential water savings was Timberline K-8 with nearly 1 million gallons of annual savings potential. Red Hawk Elementary, a LEED Gold certified building, had only 79 thousand gallons of potential savings, as it contained nearly all WaterSense fixtures and EnergySTAR appliances already.

School	Water Savings (kgal)	Water Cost Savings ($)	Electricity Savings (kWh)	Electric Cost Savings ($)	Natural Gas Savings (therm)	Natural Gas Cost Savings ($)	Total Cost Savings ($)
Black Rock Elementary	543	$7,564	236	$24	679	$54	$7,643
Centennial Elementary	449	$1,333	4976	$448	413	$33	$1,814
Central Elementary	255	$1,903	5667	$448	428	$33	$2,384
Coal Ridge MS	532	$1,579	6003	$540	641	$51	$2,171
Columbine Elementary	280	$2,087	5385	$425	376	$29	$2,542
Erie Elementary	220	$3,059	5190	$537	239	$19	$3,615
Erie High School	769	$10,707	2423	$251	1569	$126	$11,083
Erie Middle School	235	$3,269	5190	$537	239	$19	$3,825
Fall River Elementary	397	$2,964	11437	$904	279	$22	$3,889
Legacy Elementary	746	$1,007	6161	$701	1147	$92	$1,800
Longmont Estates Elementary	249	$1,855	664	$52	459	$36	$1,943
Lyons MS/HS	261	$1,670	1334	$120	417	$33	$1,824
Niwot Elementary	364	$2,714	6530	$516	427	$33	$3,263
Prairie Ridge	416	$1,235	20086	$1,808	81	$7	$3,049
Red Hawk Elementary	79	$1,095	0	$0	0	$0	$1,095
Spark Elementary	502	$678	0	$0	436	$35	$173
Thunder Valley K-8	496	$670	5841	$665	578	$46	$1,381
Timberline K-8	975	$7,274	11028	$871	1130	$88	$8,234
Trail Ridge MS	604	$4,504	5916	$467	814	$63	$5,034
Westview MS	678	$5,056	5365	$424	842	$66	$5,545
Grand Total	**9050**	**$62,223**	**109432**	**$9,738**	**11194**	**$885**	**$72,307**

The indoor assessment results were presented to district staff in a report (**Attachment 3**) along with the outdoor assessment results. Recommendations for the district were presented along with this report, with key information on how to take all of the data and move forward on making decisions related to improving water efficiency across the district. The recommendation list was developed by the indoor assessment team and therefore included information specific to the unique aspects of the schools that were visited, including from feedback given to the assessment team from district staff at each school.

The recommendations below are related to indoor fixture and appliance upgrades as well as to behavior changes.

Kitchen Fixtures	Recommendation &/Or Observation	Further Information
PRSV	PRSVs were generally T&S or Fisher brand. The brush attachment was an important feature for the kitchen staff at most schools.	Fisher PRSV Model 2949 – 1.15 gpm, $40-$50 each, brush attachment available (Fisher 2949-9001, ~$20) http://www.webstaurantstore.com/fisher-2949-ultra-pre-rinse-spray-valve-for-pre-rinse-units/3402949.html
Sink Faucets	Faucet aerators can be used to reduce flow rates in sinks at a very small cost.	Many sinks were missing aerators, especially in kitchen-type faucets found in classrooms and/or the school kitchens. - Tamper-proof aerators are available, with male and female threads, with a variety of flow rates from AM Conservation Group. http://www.amconservationgroup.com/?post_type=product&s=aerators - Other tamper-proof aerators are available by T&S Brass. http://www.webstaurantstore.com/42251/faucet-aerators-flow-regulators.html - Timer-based faucets had occasional problems that prevented them from turning off without direct intervention from a user

Restroom Fixtures	Recommendations &/Or Observations	Further Information
Sink Faucets	Test metered sinks throughout the year to ensure they are running and turning off appropriately.	Metered sinks were common throughout many of the schools, approximately 15% of all metered sinks did not turn off on their own.
Urinals	WaterSense Urinal Flow Rate Spec is 0.5 gpf, however lower flush volumes are available and are already in use at SVVSD.	Many of the schools had urinals that specified usage of 0.125 gpf, the brand was Zurin. This flush volume is better than the WaterSense standard and we recommend using this same model when replacing old urinals, if the performance of this model is adequate in current schools.
Toilets	Run a pilot test of dual-flush toilet handle retofits and 1-3 schools. Dual-flush handles can be retrofitted onto existing flushometer toilets to provide the option of a reduced flush for liquid waste.	Several companies make dual-flush handles for both 1.6 and 3.5 gpf toilets. - AMTC has models for urinals and for toilets. Reduced flush direction, for liquid waste, is down. http://www.amtcorporation.com/manualflushvalve.htm - Sloan also has a model, but the reduced flush direction, for liquid waste, is up. http://www.sloanvalve.com/Our_Products/UPPERCUT.aspx
	Replace flushometer diaphragms regularly.	To ensure that toilets continue to flush at the specification set by the manufacturer diaphrams/cartriges need to be replaced annually to biannually.
	Check flush cycle lengths - a properly functioning flush valve should not have a flush cycle longer than 4 seconds.	BMP cited by AWE. http://www.allianceforwaterefficiency.org/commercial_restroom_audit.aspx
	When replacing flushometer toilets, consider purchasing 1.28 gpf toilets.	Two SVVSD school, Red Hawk Elementary and Lyons HS/MS, contain several 1.28 gpf toilets and therefore can be a test location for this flow rate in the school setting. In addition, Drainline transport of solid waste studies have found no significant difference in commercial or residential settings from the 1.6 gpf to the 1.28 gpf toilets. Please see the two studies here: http://www.plumbingefficiencyresearchcoalition.org/

General	Recommendation &/Or Observation	Further Information
With regards to which schools to focus attention on	When considering which schools to focus on for upgrades and improvements, one aspect to take into consideration is number of restroom users and number of days that the facility is used.	Some schools have year-round student and staff presence due to summer schooling and may be better candidates for upgrades. High schools and middle schools have the highest number of students and staff and should also be considered for upgrades.
With regards to fixture brands	Nearly all top-brands have options for WaterSense fixtures, and through this third-party certified program you can ensure that your new fixture purchases are not only efficient, but that the product works as well or better than their non-efficient counter-parts. Flushometer toilets do not currently have a WaterSense specification, but are likely to have one in the next year.	EPA WaterSense Provides an online Product Search Tool that allows users to search by fixture type and brand. http://www3.epa.gov/watersense/product_search.html
With regards to reducing toilet clogs and backups	Reduce clogging and sewer-backups with educational campaigns around only using toilets from human waste. Consider educating students in a classroom/through announcements and with additional signage in the restrooms and/or restroom stalls. Adding trash cans could help as well.	Several janitors and other maintenance staff mentioned that the biggest problem encountered with regards to plumbing is toilet clogs, most often from student mis-use of toilets for trash and other materials.
With regards to water waste reporting processes	Currently, there is little to no processes in place for water-waste reporting by students and/or non-maintenance staff in the schools. Creating a process that allows the users to report water waste could lead to significant improvement in repair of leaking fixtures, appliances, and irrigation systems.	"The process for reporting leaks could be different in every school, however some ways to promote the reporting of leaks could include: - Signage near/in restrooms and drinking fountains about what to do if leaks are spotted. - Classroom announcements that ask teachers and students to report leaks, unusual puddles, etc. - Online reporting system"

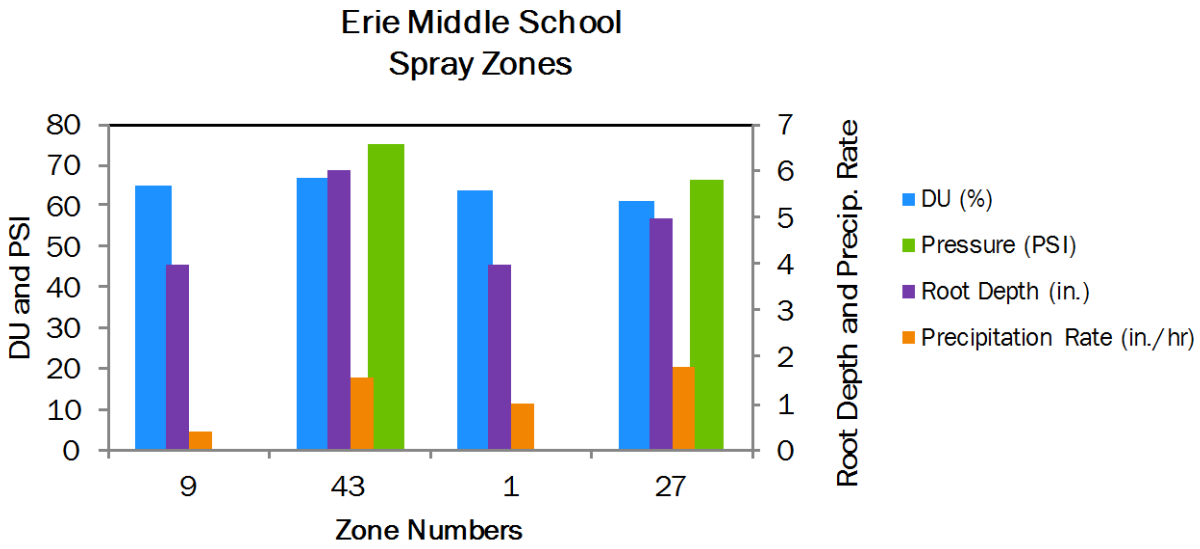
Outdoor Assessments

Complete irrigation system evaluations were performed at 10 schools during the summer of 2015. Two CRC technicians were assigned to the project and performed all of the assessments so as to maintain continuity throughout the project with the assessments. The SVVSD staff identified the top 10 highest water using schools for the outdoor irrigation assessments. They decided to limit the focus to schools that receive water from a municipality, rather than from an irrigation ditch, in order to ensure that the any savings gained would directly reduce the district's water bills. The 10 schools chosen were also a subset of the schools the received an indoor assessment.

The irrigation assessments were performed in June and July, 2015. For each assessment a standard set of steps were completed:

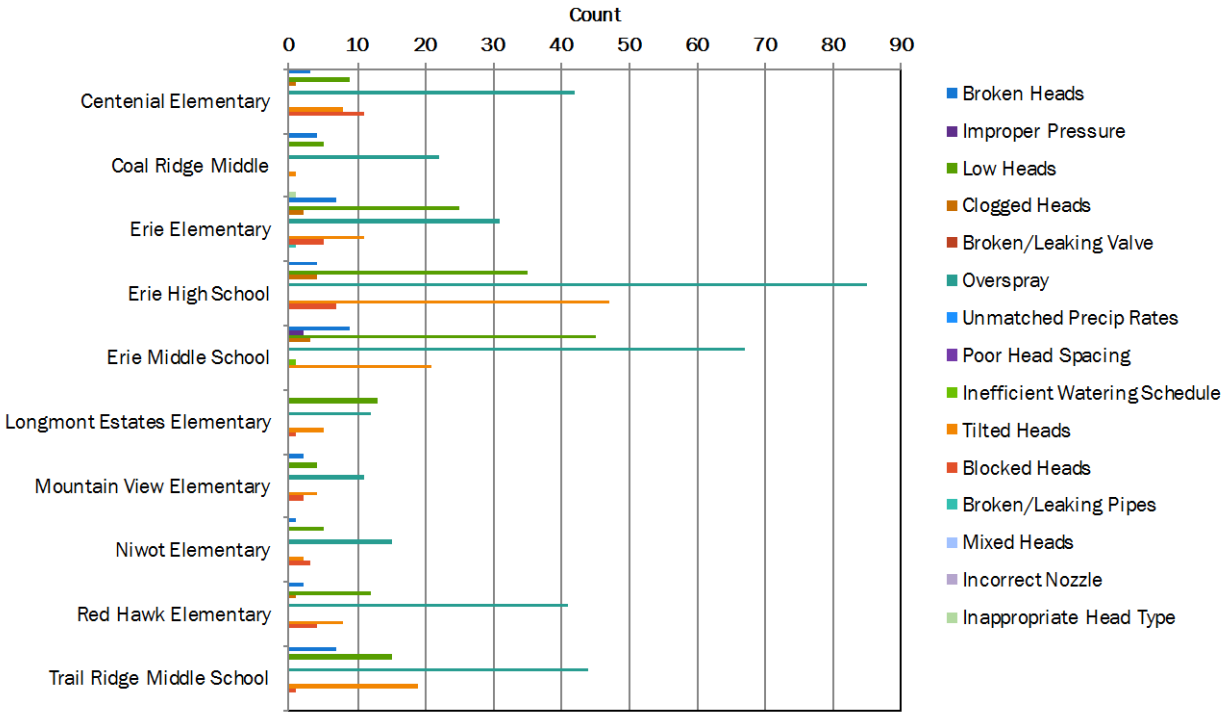
1) Visual inspection of all zones and all sprinkler heads
2) Pressure tests of all heads in a representative sample of sprinkler zones
3) Catch-Cup tests for calculating precipitation rate in a representative sample of sprinkler zones
4) Soil and root-depth test in all zones where catch-cup tests were performed

After completing the tests the data was tabulated and presented to the district in both table and graphical form. Below is an example of a graph showing the results of the tests in the four spray zones at Erie Middle School. DU = Distribution Uniformity, PSI = Pounds per Square Inch.



Distribution Uniformity (DU) is a measurement of how evenly the irrigation system's spray is covering a single zone and the minimum acceptable standard for an efficient system is 70%. Pressure, measured in pounds per square inch (PSI), indicates at what pressure the water is being pushed out of the sprinkler system. Optimal pressure for spray heads is between 20 and 30 PSI. Rotor heads operate best at pressures between 25 and 80 PSI. Root depth was only measured for turf vegetation and provided important information on how well established the turf areas across the district were. Deeper roots provide the plant with great drought resistance and frequent watering can sometimes deter deep root growth. The precipitation rate, measured in inches per hour, is an important value to know when setting sprinkler zone run times, in order to ensure the correct amount of water is being applied to the landscape each time.

During the sprinkler system visual inspections, technicians turned on every zone in the system and inspected each sprinkler head for a range of issues. The graph below shows the range of issues encountered at the 10 schools, with a count of each issue. Overspray was a common issue found with district irrigation systems, leading to significant runoff and possible overwatering. Tilted heads and low heads were the second most common problem encountered.



To augment the outdoor irrigation audits an analysis was performed of historical water use at these same schools to compare historical outdoor water use to the water demand

(evapotranspiration demand) of those landscapes based on historical weather and landscape size (Red Hawk ES data was not included due to missing data issues) . This analysis was used to provide the district with insight as to how much water has been used for irrigation compared to how much water was needed for irrigation.

By using landscape area, provided to CRC by the district, weather data from Northern Colorado Water Conservation District's weather station network (northernwater.org), and the data collected in the field, irrigation water demand was calculated for each school for the 2012 and 2013 growing seasons (March-November). Monthly irrigation water demand was compared to the total irrigation water use from those same months, subtracting out indoor water use via the minimum month method. Finally, the application ratio was calculated to present the ratio of what was used compared to what was needed on the landscape. The application ratio represents the efficiency of the water use on the landscape. If the exact amount of water needed is applied, then the application ratio is 100%. If more water was applied than was needed then the application ratio would be greater than 100% and the landscape would be considered to be over watered, and if less water was applied than was needed, then the application would be less than 100%.

All of the schools with the exception of Mountain View Elementary and Trail Ridge Middle School were found to be watering efficiently in 2012 and 2013, and in some cases were actually watering less than the estimated amount that was needed. Mountain View Elementary had an application ratio of 143% in 2012 and 123% in 2013. Trail Ridge Middle School overwatered in 2012 by approximately 38% and in 2013 75%. Erie High School was the school with the lowest application ratio of the schools audited with an AR of 49% in 2012 and 45% in 2013. On average, the schools audited had an application ratio of 96% of the water needed in 2012 and 95% in 2013. After this analysis was presented to the district irrigation staff reported that they thought the results from Erie Middle School may be inaccurate due to recent planting of previously unirrigated area that was not accounted for in the data provided to CRC.

School	Actual Water Usage 2012	Needed Water Usage 2012	Application Ratio	Actual Water Usage 2013	Needed Water Usage 2013	Application Ratio
Centennial ES	4,532	4,392	103%	2,829	3,310	85%
Erie ES	5,991	5,965	100%	4,317	4,170	104%
Niwot ES	3,043	3,167	96%	2,552	2,387	107%
Longmont Estates ES	5,082	4,759	107%	3,247	5,641	58%
MountainView ES	3,671	2,566	143%	2,387	1,934	123%
Coal Ridge MS	9,305	13,639	68%	7,323	10,703	68%
Erie MS	2,908	4,821	60%	3,094	3,370	92%
Trail Ridge MS	7,499	5,425	138%	7,162	4,089	175%
Erie HS	15,887	32,327	49%	10,059	22,598	45%
Average	6,227	8,562	96%	6,227	6,467	95%
Sum	62,269	77,062		62,269	58,201	

*All water volumes in thousands of gallons (kgal)

Finally, CRC provided the district with specific recommendations based on the results of the irrigation assessments and the analysis. CRC focused on both irrigation system-related opportunities as well as landscape change opportunities.

Irrigation System	Recommendation &/Or Observation	Further Information
Weather Based Irrigation Control System	Weather-based irrigation control (WBIC) systems have the capability to control the irrigation schedule based on ET demand. Different WBIC systems incorporate ET demand in different ways, and therefore, when compared, do not always provide equal performance.	The conventional wisdom around WBICs is that even at their best, WBICs cannot make up for poorly designed, installed, or functioning irrigation systems. The first step to becoming more water efficient is to ensure that these three aspects are operational to their full potential. After this, a WBIC controller can help to significantly improve the water application when weather conditions are significantly different than the anticipated/programmed conditions.
Sprinkler Head Replacement	While we do not recommend sprinkler head replacements as a broad measure for improving water use efficiency, in certain situations it can be used to improve the distribution uniformity of a sprinkler zone.	Based on several studies of rotary nozzles in real-world situations, the efficiency gains claimed by manufacturers have not been found. These findings contrast with tests done by the companies that sell the nozzles who found that they produced measurable water savings. Due to the contrast in the findings from the different groups, we do not recommend upgrading your nozzles with rotary nozzles for the purpose of improving efficiency.

Landscape Change	Recommendation &/Or Observation	Further Information
Turf Replacement	If turf area is replaced, consider options beyond grass or fescue such as native and climate-adapted plants. Especially for places that do not receive foot traffic, the option to install native and climate-adapted plants can help to reduce the water requirement of the landscape by over 50%.	For in-depth information on native and climate-adapted plants that do well in the Colorado Front Range, two sources provide reliable information: Northern Colorado Water Conservancy District (www.northerncolorado.org) and the CSU Extension Service, Plantalk Colorado (http://www.planttalk.org/). Maintenance of these recommended landscapes will be different than maintenance of turf, however many reports have shown that maintenance time and cost is reduced when turf is replaced with climate appropriate plants because these plants do not need mowing and require very little if any supplemental nutrients (i.e. fertilizers).
Low-Water Demo Garden(s)	Xeric Demonstration Garden Installation - for Education of students and staff	Some school districts have incorporated outdoor classrooms through the installation of water efficient landscapes. For example, see an article on the effects on a project in Texas (http://www.waterworld.com/articles/2015/10/toro-toyota-texas-land-care-wyland-foundation-help-west-dallas-school-create-water-smart-landscape.html). The funds from the grant could be used to support the planning, design and purchasing of materials for this landscape.

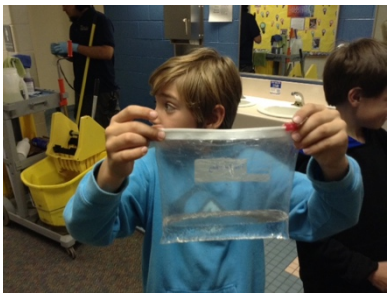
Student Education and Curriculum

One of the primary goals of this project was to provide the student body with educational opportunities around hands-on, real-world water conservation methods and measures. At the beginning of the project, CRC had planned to work with students at each school to perform small-scale, student-led water assessments. Early on in the assessment process it became clear that the challenge of coordinating and garnering interest from educators at each school would be too difficult within the timeframe of the project. While CRC was unable to involve students from every school, with the help of several educators from three different elementary schools in the district, CRC devised a lesson for sprinkler system audits for grades 2-5 and worked with approximately 40 students, 4 educators and 2 maintenance staff to perform one full indoor assessment and two partial sprinkler system assessments at two schools.

Student Led Assessments

Indoor and outdoor assessments of a school are a great way to get students excited and curious about water conservation, and the work required to do the assessments is easily modified to fit many different grade levels and learning abilities. The first student led assessment was an indoor assessment in Longmont Estates Elementary School with an afterschool "Energy Explorers" class, composed of 2nd through 5th grade students.

The indoor assessment incorporated student eyes and measurement skills through a full scale assessment of the kitchen, restrooms and classroom sinks throughout the school. The CRC auditing team led the assessment, following the standard protocol of testing each fixture for flow rate. The students were provided with modified flow rate bags (plastic sandwich bags with the 0.5 and 1 gpm levels for 5 second tests marked with a sharpie on the side) which students used to test all faucets and kitchen spray valves. Students reported all toilet and urinal flush volumes and were also employed to investigate for leaks by searching for puddles of water under and around water-using appliances. The photos below show students during the assessment.



The outdoor assessments were performed in September 2016 at two elementary schools. These assessments were modified in order to accommodate the shorter time frame of student availability and various grade levels and abilities. Prior to the education assessments with the students, CRC staff met twice with educators from the district and one time with irrigation staff from the district for planning and preparation. A full lesson plan on sprinkler inspections was developed by CRC and is included as **Attachment 4**.

The assessments were performed at Longmont Estates Elementary with twelve 2nd through 5th grade students and at Eagle Crest Elementary with twenty 4th and 5th grade students. CRC staff met with students in the classroom, provided a brief introduction on water conservation and then paired the students for the remainder of the lesson. Outside CRC walked the students through a visual

inspection of each zone and a catch-cup test. The data collected by the students at each school was used to calculate the amount of water that was used on the plot of land that was being investigated over the entire irrigation season. Overall, the students and their teachers enjoyed the lesson and being sprinkler inspectors for a day.



The summary of the lesson by the educator from Eagle Crest Elementary can be found at: http://blogs.svvsd.org/ecstemexplorers/2016/09/27/water-audit/.

Curriculum

For the student-led sprinkler inspection CRC developed it's own one hour lesson plan for students in grades 2-5 (mentioned above as **Attachment 4**). This lesson plan was used at the two schools where outdoor assessments were performed. Students were split into groups of 2 to 3 and then walked through three main steps: 1) Observation of the sprinkler zone to be inspected; 2) Visual inspection of the sprinkler system while running; 3) Catch cup test. Due to the wide age range of the student groups, the math and calculations were performed by the CRC staff, however, many 4th and 5th grade students would be able to perform the math required in this lesson with support from teaching staff.

Another way that CRC worked to involve students in water conservation education was through more traditional classroom lessons. Working with the school district's Science Coordinator, Michael O'Toole, CRC developed a lesson plan (a.k.a. "learning activity") database in conjunction with a new educational blog about water. The blog is hosted at blogs.svvsd.org/water and has a wide variety of sub-sites devoted to all topics surrounding water at the local, regional and global scales.

The "K-12 Learning Activities" page within the blog is the database of lesson plans that CRC complied. These lesson plans are organized by grade and categorized using SVVSD's Unit Plan requirements. This format makes it easy for educators to locate lessons for their students, and also to relate the lessons to the district standards that they are required to meet.

The blog was shared with all SVVSD educators and with the Colorado Science Educators Network. While there was not a means to measure the number of visitors to the "K-12 Learning Activities" site or users of the information, it's attractive design, wide range of topics and direct access to pre-designed lessons makes it easy for those who are searching for more water-related curriculum to use.

District Staff Survey

Over the course of indoor assessments CRC and the district staff realized that there were significant unknowns related to staff understanding of and involvement with water conservation lessons, reporting, and efforts. In order to address this gap CRC and district staff created an online survey that was sent to all educators, administration, maintenance professionals, food service, etc., in January 2016. The survey contained 13 questions about water use, water perceptions, water issues and in-classroom water education, as well as opportunities for survey-takers to leave comments and questions to be answered by the Energy and Sustainability Manager for the district. The survey received 785 responses from staff from across the district.

CRC and Dara Ward, Energy and Sustainability Manager from SVVSD, collated the results and created a report that was sent out to all staff (**Attachment 5**). The report not only provides summaries of staff responses to the individual survey questions, but also contains direct responses to questions brought up by the survey-takers as well as suggestions and education for district staff on various projects, policies and other materials available to learn more about water issues in the district.

The survey showed that in general, SVVSD staff think about water conservation, report leaks and other water-waste related issues, and are happy with the water quality. Two areas that remain for improvement that stood out were for the district to be more intentional with signage and/or information placement on ways to be water conscientious with water use and to provide all schools with water bottle re-filling stations. The district already had a plan to provide water bottle refilling stations at each school prior to the survey, and therefore were able to use the survey to communicate their planned timeline for installations.

Water Conservation Upgrades

One of the main goals of this project was to provide the district with funds to purchase water conservation devices, fixtures or appliances that could be installed and provide measureable water savings for the schools. After presentations from CRC and discussions between SVVSD staff, the district decided to purchase two main devices: 1) a wireless irrigation controller and master valve; and

2) 70 WaterSense bathroom sink faucets. Details of these two purchases are in the table below, including expected water savings.

Device	Quantity	Cost	Location of Install	Expected Savings
Conslwylbp024ho Signature Constellation 24 Station Controller Wall Mount B Style and 2'' Hydrometer	1	$4,7443.74	Mountain View Elementary	400-1,000 kgal per year
Toto TELC105-D10E (Ecopower Bathroom Faucet)	70	$21,190.24	33 at Westview MS, 37 at Altona MS	250 kgal per year

The controller and master valve for Mountain View Elementary's irrigation system contains a feature that allows it to "learn" the typical amount of water applied to each individual zone, with the intent that should there be a ruptured lateral line or broken sprinkler head, the system would sense an overuse of water and shutoff that zone. In addition, in the case of such an issue, it would be able to send a message to the central control to alert the operators, and then continue on with the program starting with the next zone. The controller will also monitor the mainline and if it detects flow when a program is not running it will recognize this as a mainline leak and it will shut down water flow to the entire system and send out an alarm via email and text to the system operators. This technology allows for the district to eliminate the loss of water due to broken heads, laterals and mainlines that could go unnoticed for a considerable amount of time.

Water savings were estimated based off of the findings from the irrigation analysis that found Mountain View Elementary to be using an average of 33% more water than was needed based on ET. Because this controller has the ability to have a unique water-budget or ET-based schedule for each zone, the district irrigation staff will be able to better adjust the irrigation schedules to more accurately water the landscape at this school. District irrigation staff can also use the results of the irrigation assessment by CRC to design an efficient and effective irrigation schedule for each zone.

Installation of the controller and master valve are in process, however due to IT specifications required by SVVSD security policy, the installation is scheduled to occur winter of 2016/17.

The new faucets for Westview and Altona Middle Schools are both energy and water-saving. The faucets have an internal water-powered wheel that rotates as flow travels to the faucet head, charging the battery that powers the automatic faucet flow. The faucets will be compared by district

staff to other automatic faucets and if the new model is found to be favorable, the district hopes to continue replacing faucets in other schools as the old models wear out. This could save the district both energy and water.

Installation of the faucets has occurred, however because it was later than expected, no reliable data was available for measuring direct water savings. Data used from the indoor assessment of Westview Middle School was therefore used to estimate water savings of replacing 70 faucets with average flow rate of 2.2 gpm to faucets with the 0.5 gpm flow rates.

Main Project Challenges and Lessons Learned

The project overall was a success, meeting all three goals that it set out to meet, however challenges were encountered along the way. The discussion below is presented in order to provide those with future efforts focused on helping school districts with water conservation or other sustainability projects with some insight into possible road blocks that may be encountered, as well as suggestions for overcoming them.

The CRC started the project with a strong relationship with the Energy and Sustainability Manager for the district, and also with some recognition and relationships with maintenance and educational staff. These relationships had been built over the course of several years of running an energy-focused youth engagement program with the district. Without these relationships, the water efficiency project would have been impossible. The Energy and Sustainability Manager for the district had some jurisdiction and budgetary oversight related to facilities maintenance, providing access to the persons ultimately in charge of making changes to school buildings and irrigations systems. However, even with this strong relationship, bureaucracy and other school policies and procedures slowed down decision making processes regarding the purchases, as well as the installation of the devices purchased with the grant money. The main learning opportunity from the process of working with SVVSD to upgrade certain water-saving fixtures and systems was that a minimum of one calendar year should have been built in to the plan between the time of the recommendations and the expected installation date, to account for the lengthy process of winning support for the purchases, making the purchases, and fitting the installation work into the flow of the ongoing project demands of facilities staff at a school. One way that CRC learned would speed up the process was to find ways to support purchases that were already on the district's "to do" list, rather than recommending devices or improvements that had not yet been considered. This was only possible, of course, because the projects that the district was already considering were related to water use and could be enhanced by additional support for water conservation and efficiency products or efforts.

Student involvement is innately important to any project within a school district surrounding sustainability or other environmental goals. If students are not involved in these types of projects, then the projects' meaning and impact are significantly decreased. With that said, one of the most challenging aspects to this project was to find the time and will of the educators, who provide access to the students, to get involved with the project. We found that because educators often already had a full set of lesson plans, covering the entire school year with little to no room for moving things around, they were not eager to add more activities. CRC learned that in order to involve students that we would have to be willing to work with extra-curricular groups outside of normal classroom hours. Also, to find the educators who were interested in engaging their students with the water conservation materials, CRC had to put in a solicitation in the survey that was sent out to all staff. From that, approximately 30 educators responded with interest, but only 6 eventually were willing to find time to meet with CRC and finally, only 2 were able to find time within the project timeline (even the extended timeline) to involve CRC in their lessons. Related to this challenge was the recognition that because teachers plan out their lessons so far in advance, it often takes 6-9 months of preparation time and planning to work a new lesson into a curriculum sequence. In future efforts, CRC recognizes the need to reach out to educators early on in the project and plan for involvement either with extracurricular groups and/or in future school years when educators have less of a set lesson plan.

Finally, the last main challenge encountered was CRC's inability to fit the water savings measurements into the project timeline. Due to challenges described previously of getting the water conservation devices purchased and installed, water records showing changes between pre- and post-installation were not investigated. From the analyses of water usage rates at the schools where these devices have been and/or will be installed CRC was able to estimate the expected savings from the upgrades, but the actual comparison of historic water bills was not possible. Future projects with school districts will improve this aspect of the project by ensuring a long enough timeline for such a project to occur.

Attachments

1. Indoor Assessment Excel Tool Outputs
2. Indoor Assessment Findings
3. CRC & SVVSD Water Efficiency Project Report
4. Sprinkler Inspection Lesson
5. Staff Survey Report

Attachment 1: Indoor Assessment Excel Tool Outputs

Notes:

- Only fixtures with water use above the efficiency standards set in this tool are shown. For example, if a handwash sink was measured to use 0.5 gallons per minute, then it has met the efficiency standard and was not included in tool's calculations for water savings, etc.
- Utility and cost savings are based on typical utility rates and equipment use practices. Actual savings may vary.
- Installed costs are based on typical equipment cost and may vary. Installed costs include the full cost of end-use fixtures and the additional cost of water-saving appliances over conventional alternatives.
- Rebates were not added in to the analysis at this time, but will vary by utility.

CII Water Assessment Tool - Results **Black Rock Elem** **v 1.3**

Measure	Quantity	Water Savings (kgal)	Electricity Savings (kWh)	Natural Gas Savings (therm)	Water Cost Savings* ($)	Electric Cost Savings* ($)	Natural Gas Cost Savings* ($)	Total Cost Savings* ($)	Estimated Rebate*** ($)	Installed Cost** ($)	Simple Payback (years)	Include Measure in Report?	Estimated Water Consumption (kgal)
Faucet	0	0	0	0	$0	$0	$0	$0	$0	$0		yes	0
Aerator	21	322	0	670	$4,483	$0	$54	$4,536	$0	$105	0.0	yes	429
Pre-rinse spray valve	0	0	0	0	$0	$0	$0	$0	$0	$0		yes	0
Toilet	26	114	-	-	$1,594	-	-	$1,594	$0	$13,650	8.6	yes	572
Urinal	6	101	-	-	$1,401	-	-	$1,401	$0	$2,400	1.7	yes	201
Showerhead	0	0	0	0	$0	$0	$0	$0	$0	$0		yes	0
Clothes washer	1	6	236	9	$87	$24	$1	$112	$0	$150	1.3	yes	11
Dishwasher (residential)	0		0	0	-	$0	$0	$0	$0	$0		yes	0
Dishwasher (commercial)	0	0	0	0	$0	$0	$0	$0	$0	$0		yes	47
Ice machine	0	0	0	0	$0	$0	$0	$0	$0	$0		yes	0
Steam cooker	0	0	0	0	$0	$0	$0	$0	$0	$0		yes	7
Food disposal	0	0	-	-	$0	-	-	$0	$0	$0		yes	0
Cooling tower	0	0	-	-	$0	-	-	$0	$0	$0		yes	
Custom Project	0	0	0	0	$0	$0	$0	$0	$0	$0		yes	
Total of All Measures		**543**	**236**	**679**	**$7,564**	**$24**	**$54**	**$7,643**	**$0**	**$16,305**	**2.1**		

Attachment 1: Indoor Assessment Excel Tool Outputs

CII Water Assessment Tool - Results — Centennial Elem — v 1.3

Measure	Quantity	Water Savings (kgal)	Electricity Savings (kWh)	Natural Gas Savings (therm)	Water Cost Savings* ($)	Electric Cost Savings* ($)	Natural Gas Cost Savings* ($)	Total Cost Savings* ($)	Estimated Rebate*** ($)	Installed Cost** ($)	Simple Payback (years)	Include Measure in Report?	Estimated Water Consumption (kgal)
Faucet	0	0	0	0	$0	$0	$0	$0	$0	$0		yes	0
Aerator	15	194	0	404	$577	$0	$32	$609	$0	$75	0.1	yes	290
Pre-rinse spray valve	0	0	0	0	$0	$0	$0	$0	$0	$0		yes	0
Toilet	21	90	-	-	$268	-	-	$268	$0	$11,025	41.1	yes	452
Urinal	6	79	-	-	$236	-	-	$236	$0	$2,400	10.2	yes	159
Showerhead	0	0	0	0	$0	$0	$0	$0	$0	$0		yes	0
Clothes washer	1	6	236	9	$18	$21	$1	$40	$0	$150	3.7	yes	11
Dishwasher (residential)	0		0	0	-	$0	$0	$0	$0	$0		yes	0
Dishwasher (commercial)	0	0	0	0	$0	$0	$0	$0	$0	$0		yes	44
Ice machine	0	0	0	0	$0	$0	$0	$0	$0	$0		yes	0
Steam cooker	1	79	4,740	0	$233	$427	$0	$660	$0	$630	1.0	yes	79
Food disposal	0	0	-	-	$0	-	-	$0	$0	$0		yes	0
Cooling tower	0	0	-	-	$0	-	-	$0	$0	$0		yes	
Custom Project	0	0	0	0	$0	$0	$0	$0	$0	$0		yes	
Total of All Measures		**449**	**4,976**	**413**	**$1,333**	**$448**	**$33**	**$1,814**	**$0**	**$14,280**	**7.9**		

Attachment 1: Indoor Assessment Excel Tool Outputs

CII Water Assessment Tool - Results — Central Elementary — v 1.3

Measure	Quantity	Water Savings (kgal)	Electricity Savings (kWh)	Natural Gas Savings (therm)	Water Cost Savings* ($)	Electric Cost Savings* ($)	Natural Gas Cost Savings* ($)	Total Cost Savings* ($)	Estimated Rebate*** ($)	Installed Cost** ($)	Simple Payback (years)	Include Measure in Report?	Estimated Water Consumption (kgal)
Faucet	0	0	0	0	$0	$0	$0	$0	$0	$0		yes	0
Aerator	30	86	0	179	$641	$0	$14	$655	$0	$150	0.2	yes	140
Pre-rinse spray valve	1	2	0	4	$13	$0	$0	$13	$0	$80	6.2	yes	4
Toilet	40	57	-	-	$427	-	-	$427	$0	$21,000	49.1	yes	286
Urinal	0	0	-	-	$0	-	-	$0	$0	$0		yes	0
Showerhead	0	0	0	0	$0	$0	$0	$0	$0	$0		yes	0
Clothes washer	1	6	236	9	$46	$19	$1	$66	$0	$150	2.3	yes	11
Dishwasher (residential)	0		0	0	-	$0	$0	$0	$0	$0		yes	0
Dishwasher (commercial)	1	21	424	236	$156	$33	$18	$208	$0	$770	3.7	yes	21
Ice machine	0	0	0	0	$0	$0	$0	$0	$0	$0		yes	0
Steam cooker	1	83	5,007	0	$619	$396	$0	$1,015	$0	$630	0.6	yes	83
Food disposal	0	0	-	-	$0	-	-	$0	$0	$0		yes	0
Cooling tower	0	0	-	-	$0	-	-	$0	$0	$0		yes	
Custom Project	0	0	0	0	$0	$0	$0	$0	$0	$0		yes	
Total of All Measures		**255**	**5,667**	**428**	**$1,903**	**$448**	**$33**	**$2,384**	**$0**	**$22,780**	**9.6**		

Attachment 1: Indoor Assessment Excel Tool Outputs

CII Water Assessment Tool - Results — Coal Ridge MS — v 1.3

Measure	Quantity	Water Savings (kgal)	Electricity Savings (kWh)	Natural Gas Savings (therm)	Water Cost Savings* ($)	Electric Cost Savings* ($)	Natural Gas Cost Savings* ($)	Total Cost Savings* ($)	Estimated Rebate*** ($)	Installed Cost** ($)	Simple Payback (years)	Include Measure in Report?	Estimated Water Consumption (kgal)
Faucet	0	0	0	0	$0	$0	$0	$0	$0	$0		yes	0
Aerator	52	176	0	366	$523	$0	$29	$552	$0	$260	0.5	yes	343
Pre-rinse spray valve	0	0	0	0	$0	$0	$0	$0	$0	$0		yes	0
Toilet	34	125	-	-	$373	-	-	$373	$0	$17,850	47.9	yes	627
Urinal	15	110	-	-	$327	-	-	$327	$0	$6,000	18.3	yes	220
Showerhead	1	0	0	0	$0	$0	$0	$0	$0	$30		yes	0
Clothes washer	1	6	50	15	$18	$4	$1	$24	$0	$150	6.2	yes	11
Dishwasher (residential)	0		0	0	-	$0	$0	$0	$0	$0		yes	0
Dishwasher (commercial)	1	23	465	259	$68	$42	$21	$131	$0	$770	5.9	yes	23
Ice machine	0	0	0	0	$0	$0	$0	$0	$0	$0		yes	0
Steam cooker	1	91	5,489	0	$270	$494	$0	$764	$0	$630	0.8	yes	91
Food disposal	0	0	-	-	$0	-	-	$0	$0	$0		yes	0
Cooling tower	0	0	-	-	$0	-	-	$0	$0	$0		yes	
Custom Project	0	0	0	0	$0	$0	$0	$0	$0	$0		yes	
Total of All Measures		**532**	**6,003**	**641**	**$1,579**	**$540**	**$51**	**$2,171**	**$0**	**$25,690**	**11.8**		

Attachment 1: Indoor Assessment Excel Tool Outputs

CII Water Assessment Tool - Results — Columbine Elem — v 1.3

Measure	Quantity	Water Savings (kgal)	Electricity Savings (kWh)	Natural Gas Savings (therm)	Water Cost Savings* ($)	Electric Cost Savings* ($)	Natural Gas Cost Savings* ($)	Total Cost Savings* ($)	Estimated Rebate*** ($)	Installed Cost** ($)	Simple Payback (years)	Include Measure in Report?	Estimated Water Consumption (kgal)
Faucet	0	0	0	0	$0	$0	$0	$0	$0	$0		yes	0
Aerator	10	67	0	140	$500	$0	$11	$511	$0	$50	0.1	yes	115
Pre-rinse spray valve	1	2	0	3	$12	$0	$0	$12	$0	$80	6.6	yes	4
Toilet	29	62	-	-	$459	-	-	$459	$0	$15,225	33.2	yes	266
Urinal	7	45	-	-	$335	-	-	$335	$0	$2,800	8.4	yes	90
Showerhead	0	0	0	0	$0	$0	$0	$0	$0	$0		yes	0
Clothes washer	1	6	236	9	$46	$19	$1	$66	$0	$150	2.3	yes	11
Dishwasher (residential)	1	0	9	1	$1	$1	$0	$2	$0	$10	5.6	yes	0
Dishwasher (commercial)	1	20	401	224	$148	$32	$17	$197	$0	$770	3.9	yes	20
Ice machine	0	0	0	0	$0	$0	$0	$0	$0	$0		yes	0
Steam cooker	1	79	4,740	0	$586	$374	$0	$961	$0	$630	0.7	yes	79
Food disposal	0	0	-	-	$0	-	-	$0	$0	$0		yes	0
Cooling tower	0	0	-	-	$0	-	-	$0	$0	$0		yes	
Custom Project	0	0	0	0	$0	$0	$0	$0	$0	$0		yes	
Total of All Measures		**280**	**5,385**	**376**	**$2,087**	**$425**	**$29**	**$2,542**	**$0**	**$19,715**	**7.8**		

Attachment 1: Indoor Assessment Excel Tool Outputs

CII Water Assessment Tool - Results — Erie Elementary — v 1.3

Measure	Quantity	Water Savings (kgal)	Electricity Savings (kWh)	Natural Gas Savings (therm)	Water Cost Savings* ($)	Electric Cost Savings* ($)	Natural Gas Cost Savings* ($)	Total Cost Savings* ($)	Estimated Rebate*** ($)	Installed Cost** ($)	Simple Payback (years)	Include Measure in Report?	Estimated Water Consumption (kgal)
Faucet	0	0	0	0	$0	$0	$0	$0	$0	$0		yes	0
Aerator	0	0	0	0	$0	$0	$0	$0	$0	$0		yes	0
Pre-rinse spray valve	0	0	0	0	$0	$0	$0	$0	$0	$0		yes	0
Toilet	23	61	-	-	$852	-	-	$852	$0	$12,075	14.2	yes	306
Urinal	13	54	-	-	$749	-	-	$749	$0	$5,200	6.9	yes	108
Showerhead	0	0	0	0	$0	$0	$0	$0	$0	$0		yes	0
Clothes washer	1	6	50	15	$87	$5	$1	$93	$0	$150	1.6	yes	11
Dishwasher (residential)	0		0	0	-	$0	$0	$0	$0	$0		yes	0
Dishwasher (commercial)	1	20	401	224	$276	$42	$18	$336	$0	$770	2.3	yes	20
Ice machine	0	0	0	0	$0	$0	$0	$0	$0	$0		yes	0
Steam cooker	1	79	4,740	0	$1,095	$491	$0	$1,585	$0	$630	0.4	yes	79
Food disposal	0	0	-	-	$0	-	-	$0	$0	$0		yes	0
Cooling tower	0	0	-	-	$0	-	-	$0	$0	$0		yes	
Custom Project	0	0	0	0	$0	$0	$0	$0	$0	$0		yes	
Total of All Measures		**220**	**5,190**	**239**	**$3,059**	**$537**	**$19**	**$3,615**	**$0**	**$18,825**	**5.2**		

Attachment 1: Indoor Assessment Excel Tool Outputs

CII Water Assessment Tool - Results — Erie High School — v 1.3

Measure	Quantity	Water Savings (kgal)	Electricity Savings (kWh)	Natural Gas Savings (therm)	Water Cost Savings* ($)	Electric Cost Savings* ($)	Natural Gas Cost Savings* ($)	Total Cost Savings* ($)	Estimated Rebate*** ($)	Installed Cost** ($)	Simple Payback (years)	Include Measure in Report?	Estimated Water Consumption (kgal)
Faucet	0	0	0	0	$0	$0	$0	$0	$0	$0		yes	0
Aerator	10	426	0	887	$5,932	$0	$71	$6,003	$0	$50	0.0	yes	544
Pre-rinse spray valve	0	0	0	0	$0	$0	$0	$0	$0	$0		yes	0
Toilet	42	126	-	-	$1,758	-	-	$1,758	$0	$22,050	12.5	yes	631
Urinal	11	111	-	-	$1,545	-	-	$1,545	$0	$4,400	2.8	yes	222
Showerhead	0	0	0	0	$0	$0	$0	$0	$0	$0		yes	0
Clothes washer	1	6	50	15	$87	$5	$1	$93	$0	$150	1.6	yes	11
Dishwasher (residential)	0		0	0	-	$0	$0	$0	$0	$0		yes	0
Dishwasher (commercial)	1	20	2,374	144	$279	$246	$12	$536	$0	$770	1.4	yes	20
Ice machine	0	0	0	0	$0	$0	$0	$0	$0	$0		yes	0
Steam cooker	1	79	0	523	$1,107	$0	$42	$1,149	$0	$870	0.8	yes	79
Food disposal	0	0	-	-	$0	-	-	$0	$0	$0		yes	0
Cooling tower	0	0	-	-	$0	-	-	$0	$0	$0		yes	
Custom Project	0	0	0	0	$0	$0	$0	$0	$0	$0		yes	
Total of All Measures		**769**	**2,423**	**1,569**	**$10,707**	**$251**	**$126**	**$11,083**	**$0**	**$28,290**	**2.6**		

Attachment 1: Indoor Assessment Excel Tool Outputs

CII Water Assessment Tool - Results — Erie Middle School — v 1.3

Measure	Quantity	Water Savings (kgal)	Electricity Savings (kWh)	Natural Gas Savings (therm)	Water Cost Savings* ($)	Electric Cost Savings* ($)	Natural Gas Cost Savings* ($)	Total Cost Savings* ($)	Estimated Rebate*** ($)	Installed Cost** ($)	Simple Payback (years)	Include Measure in Report?	Estimated Water Consumption (kgal)
Faucet	0	0	0	0	$0	$0	$0	$0	$0	$0		yes	0
Aerator	0	0	0	0	$0	$0	$0	$0	$0	$0		yes	0
Pre-rinse spray valve	0	0	0	0	$0	$0	$0	$0	$0	$0		yes	0
Toilet	23	130	-	-	$1,812	-	-	$1,812	$0	$12,075	6.7	yes	650
Urinal	0	0	-	-	$0	-	-	$0	$0	$0		yes	0
Showerhead	0	0	0	0	$0	$0	$0	$0	$0	$0		yes	0
Clothes washer	1	6	50	15	$87	$5	$1	$93	$0	$150	1.6	yes	11
Dishwasher (residential)	0		0	0	-	$0	$0	$0	$0	$0		yes	0
Dishwasher (commercial)	1	20	401	224	$276	$42	$18	$336	$0	$770	2.3	yes	20
Ice machine	0	0	0	0	$0	$0	$0	$0	$0	$0		yes	0
Steam cooker	1	79	4,740	0	$1,095	$491	$0	$1,585	$0	$630	0.4	yes	79
Food disposal	0	0	-	-	$0	-	-	$0	$0	$0		yes	0
Cooling tower	0	0	-	-	$0	-	-	$0	$0	$0		yes	
Custom Project	0	0	0	0	$0	$0	$0	$0	$0	$0		yes	
Total of All Measures		**235**	**5,190**	**239**	**$3,269**	**$537**	**$19**	**$3,825**	**$0**	**$13,625**	**3.6**		

Attachment 1: Indoor Assessment Excel Tool Outputs

CII Water Assessment Tool - Results — Fall River Elem — v 1.3

Measure	Quantity	Water Savings (kgal)	Electricity Savings (kWh)	Natural Gas Savings (therm)	Water Cost Savings* ($)	Electric Cost Savings* ($)	Natural Gas Cost Savings* ($)	Total Cost Savings* ($)	Estimated Rebate*** ($)	Installed Cost** ($)	Simple Payback (years)	Include Measure in Report?	Estimated Water Consumption (kgal)
Faucet	0	0	0	0	$0	$0	$0	$0	$0	$0		yes	0
Aerator	0	0	0	0	$0	$0	$0	$0	$0	$0		yes	0
Pre-rinse spray valve	2	3	0	5	$19	$0	$0	$20	$0	$160	8.2	yes	9
Toilet	18	98	-	-	$732	-	-	$732	$0	$9,450	12.9	yes	491
Urinal	8	86	-	-	$644	-	-	$644	$0	$3,200	5.0	yes	173
Showerhead	0	0	0	0	$0	$0	$0	$0	$0	$0		yes	0
Clothes washer	1	6	50	15	$46	$4	$1	$52	$0	$150	2.9	yes	11
Dishwasher (residential)	0		0	0	-	$0	$0	$0	$0	$0		yes	0
Dishwasher (commercial)	1	23	462	258	$170	$37	$20	$227	$0	$770	3.4	yes	23
Ice machine	0	0	0	0	$0	$0	$0	$0	$0	$0		yes	0
Steam cooker	2	181	10,925	0	$1,351	$863	$0	$2,214	$0	$1,260	0.6	yes	181
Food disposal	0	0	-	-	$0	-	-	$0	$0	$0		yes	0
Cooling tower	0	0	-	-	$0	-	-	$0	$0	$0		yes	
Custom Project	0	0	0	0	$0	$0	$0	$0	$0	$0		yes	
Total of All Measures		**397**	**11,437**	**279**	**$2,964**	**$904**	**$22**	**$3,889**	**$0**	**$14,990**	**3.9**		

Attachment 1: Indoor Assessment Excel Tool Outputs

CII Water Assessment Tool - Results — Legacy Elem — v 1.3

Measure	Quantity	Water Savings (kgal)	Electricity Savings (kWh)	Natural Gas Savings (therm)	Water Cost Savings* ($)	Electric Cost Savings* ($)	Natural Gas Cost Savings* ($)	Total Cost Savings* ($)	Estimated Rebate*** ($)	Installed Cost** ($)	Simple Payback (years)	Include Measure in Report?	Estimated Water Consumption (kgal)
Faucet	0	0	0	0	$0	$0	$0	$0	$0	$0		yes	0
Aerator	6	420	0	874	$566	$0	$70	$636	$0	$30	0.0	yes	555
Pre-rinse spray valve	2	3	0	6	$4	$0	$1	$5	$0	$160	34.5	yes	9
Toilet	26	108	-	-	$146	-	-	$146	$0	$13,650	93.4	yes	541
Urinal	7	95	-	-	$128	-	-	$128	$0	$2,800	21.8	yes	190
Showerhead	0	0	0	0	$0	$0	$0	$0	$0	$0		yes	0
Clothes washer	1	6	236	9	$8	$27	$1	$36	$0	$150	4.2	yes	11
Dishwasher (residential)	0		0	0	-	$0	$0	$0	$0	$0		yes	0
Dishwasher (commercial)	1	23	462	258	$31	$53	$21	$104	$0	$770	7.4	yes	23
Ice machine	0	0	0	0	$0	$0	$0	$0	$0	$0		yes	0
Steam cooker	1	91	5,463	0	$122	$622	$0	$744	$0	$630	0.8	yes	91
Food disposal	0	0	-	-	$0	-	-	$0	$0	$0		yes	0
Cooling tower	0	0	-	-	$0	-	-	$0	$0	$0		yes	
Custom Project	0	0	0	0	$0	$0	$0	$0	$0	$0		yes	
Total of All Measures		**746**	**6,161**	**1,147**	**$1,007**	**$701**	**$92**	**$1,800**	**$0**	**$18,190**	**10.1**		

Attachment 1: Indoor Assessment Excel Tool Outputs

CII Water Assessment Tool - Results — Longmont Estates Elem — v 1.3

Measure	Quantity	Water Savings (kgal)	Electricity Savings (kWh)	Natural Gas Savings (therm)	Water Cost Savings* ($)	Electric Cost Savings* ($)	Natural Gas Cost Savings* ($)	Total Cost Savings* ($)	Estimated Rebate*** ($)	Installed Cost** ($)	Simple Payback (years)	Include Measure in Report?	Estimated Water Consumption (kgal)
Faucet	0	0	0	0	$0	$0	$0	$0	$0	$0		yes	0
Aerator	31	102	0	212	$760	$0	$17	$776	$0	$155	0.2	yes	256
Pre-rinse spray valve	1	2	0	3	$12	$0	$0	$13	$0	$80	6.3	yes	4
Toilet	18	63	-	-	$469	-	-	$469	$0	$9,450	20.2	yes	314
Urinal	8	55	-	-	$412	-	-	$412	$0	$3,200	7.8	yes	110
Showerhead	0	0	0	0	$0	$0	$0	$0	$0	$0		yes	0
Clothes washer	1	6	236	9	$46	$19	$1	$66	$0	$150	2.3	yes	11
Dishwasher (residential)	1	0	9	1	$1	$1	$0	$2	$0	$10	5.6	yes	0
Dishwasher (commercial)	1	21	419	234	$155	$33	$18	$206	$0	$770	3.7	yes	21
Ice machine	0	0	0	0	$0	$0	$0	$0	$0	$0		yes	0
Steam cooker	0	0	0	0	$0	$0	$0	$0	$0	$0		yes	7
Food disposal	0	0	-	-	$0	-	-	$0	$0	$0		yes	0
Cooling tower	0	0	-	-	$0	-	-	$0	$0	$0		yes	
Custom Project	0	0	0	0	$0	$0	$0	$0	$0	$0		yes	
Total of All Measures		**249**	**664**	**459**	**$1,855**	**$52**	**$36**	**$1,943**	**$0**	**$13,815**	**7.1**		

Attachment 1: Indoor Assessment Excel Tool Outputs

CII Water Assessment Tool - Results — Lyons Jr Sr High School — v 1.3

Measure	Quantity	Water Savings (kgal)	Electricity Savings (kWh)	Natural Gas Savings (therm)	Water Cost Savings* ($)	Electric Cost Savings* ($)	Natural Gas Cost Savings* ($)	Total Cost Savings* ($)	Estimated Rebate*** ($)	Installed Cost** ($)	Simple Payback (years)	Include Measure in Report?	Estimated Water Consumption (kgal)
Faucet	0	0	0	0	$0	$0	$0	$0	$0	$0		yes	0
Aerator	44	86	0	180	$553	$0	$14	$568	$0	$220	0.4	yes	179
Pre-rinse spray valve	1	2	0	3	$10	$0	$0	$10	$0	$80	7.6	yes	4
Toilet	17	62	-	-	$398	-	-	$398	$0	$8,925	22.4	yes	311
Urinal	11	75	-	-	$477	-	-	$477	$0	$4,400	9.2	yes	129
Showerhead	0	0	0	0	$0	$0	$0	$0	$0	$0		yes	0
Clothes washer	1	6	236	9	$40	$21	$1	$62	$0	$150	2.4	yes	11
Dishwasher (residential)	1	0	9	1	$1	$1	$0	$2	$0	$10	5.7	yes	0
Dishwasher (commercial)	1	20	401	224	$127	$36	$18	$181	$0	$770	4.3	yes	20
Ice machine	2	10	688	0	$63	$62	$0	$125	$0	$0	0.0	yes	10
Steam cooker	0	0	0	0	$0	$0	$0	$0	$0	$0		yes	6
Food disposal	0	0	-	-	$0	-	-	$0	$0	$0		yes	0
Cooling tower	0	0	-	-	$0	-	-	$0	$0	$0		yes	
Custom Project	0	0	0	0	$0	$0	$0	$0	$0	$0		yes	
Total of All Measures		**261**	**1,334**	**417**	**$1,670**	**$120**	**$33**	**$1,824**	**$0**	**$14,555**	**8.0**		

Attachment 1: Indoor Assessment Excel Tool Outputs

CII Water Assessment Tool - Results — Niwot Elementary — v 1.3

Measure	Quantity	Water Savings (kgal)	Electricity Savings (kWh)	Natural Gas Savings (therm)	Water Cost Savings* ($)	Electric Cost Savings* ($)	Natural Gas Cost Savings* ($)	Total Cost Savings* ($)	Estimated Rebate*** ($)	Installed Cost** ($)	Simple Payback (years)	Include Measure in Report?	Estimated Water Consumption (kgal)
Faucet	0	0	0	0	$0	$0	$0	$0	$0	$0		yes	0
Aerator	46	130	0	271	$971	$0	$21	$992	$0	$230	0.2	yes	219
Pre-rinse spray valve	1	2	0	4	$13	$0	$0	$13	$0	$80	6.2	yes	4
Toilet	48	57	-	-	$427	-	-	$427	$0	$25,200	59.0	yes	286
Urinal	9	73	-	-	$543	-	-	$543	$0	$3,600	6.6	yes	123
Showerhead	0	0	0	0	$0	$0	$0	$0	$0	$0		yes	0
Clothes washer	1	6	236	9	$46	$19	$1	$66	$0	$150	2.3	yes	11
Dishwasher (residential)	0		0	0	-	$0	$0	$0	$0	$0		yes	0
Dishwasher (commercial)	1	13	1,287	144	$95	$102	$11	$208	$0	$2,050	9.9	yes	13
Ice machine	0	0	0	0	$0	$0	$0	$0	$0	$0		yes	0
Steam cooker	1	83	5,007	0	$619	$396	$0	$1,015	$0	$630	0.6	yes	83
Food disposal	0	0	-	-	$0	-	-	$0	$0	$0		yes	0
Cooling tower	0	0	-	-	$0	-	-	$0	$0	$0		yes	
Custom Project	0	0	0	0	$0	$0	$0	$0	$0	$0		yes	
Total of All Measures		**364**	**6,530**	**427**	**$2,714**	**$516**	**$33**	**$3,263**	**$0**	**$31,940**	**9.8**		

Attachment 1: Indoor Assessment Excel Tool Outputs

CII Water Assessment Tool - Results — Prairie Ridge — v 1.3

Measure	Quantity	Water Savings (kgal)	Electricity Savings (kWh)	Natural Gas Savings (therm)	Water Cost Savings* ($)	Electric Cost Savings* ($)	Natural Gas Cost Savings* ($)	Total Cost Savings* ($)	Estimated Rebate*** ($)	Installed Cost** ($)	Simple Payback (years)	Include Measure in Report?	Estimated Water Consumption (kgal)
Faucet	0	0	0	0	$0	$0	$0	$0	$0	$0		yes	0
Aerator	26	188	11,449	0	$557	$1,030	$0	$1,587	$0	$130	0.1	yes	286
Pre-rinse spray valve	2	1	91	0	$4	$8	$0	$13	$0	$160	12.7	yes	7
Toilet	19	68	-	-	$203	-	-	$203	$0	$9,975	49.2	yes	341
Urinal	8	60	-	-	$178	-	-	$178	$0	$3,200	18.0	yes	120
Showerhead	0	0	0	0	$0	$0	$0	$0	$0	$0		yes	0
Clothes washer	0	0	0	0	$0	$0	$0	$0	$0	$0		yes	5
Dishwasher (residential)	0		0	0	-	$0	$0	$0	$0	$0		yes	0
Dishwasher (commercial)	1	20	3,807	81	$59	$343	$7	$408	$0	$770	1.9	yes	20
Ice machine	0	0	0	0	$0	$0	$0	$0	$0	$0		yes	0
Steam cooker	1	79	4,740	0	$233	$427	$0	$660	$0	$630	1.0	yes	79
Food disposal	0	0	-	-	$0	-	-	$0	$0	$0		yes	0
Cooling tower	0	0	-	-	$0	-	-	$0	$0	$0		yes	
Custom Project	0	0	0	0	$0	$0	$0	$0	$0	$0		yes	
Total of All Measures		**416**	**20,086**	**81**	**$1,235**	**$1,808**	**$7**	**$3,049**	**$0**	**$14,865**	**4.9**		

Attachment 1: Indoor Assessment Excel Tool Outputs

CII Water Assessment Tool - Results — Red Hawk Elem — v 1.3

Measure	Quantity	Water Savings (kgal)	Electricity Savings (kWh)	Natural Gas Savings (therm)	Water Cost Savings* ($)	Electric Cost Savings* ($)	Natural Gas Cost Savings* ($)	Total Cost Savings* ($)	Estimated Rebate*** ($)	Installed Cost** ($)	Simple Payback (years)	Include Measure in Report?	Estimated Water Consumption (kgal)
Faucet	0	0	0	0	$0	$0	$0	$0	$0	$0		yes	0
Aerator	0	0	0	0	$0	$0	$0	$0	$0	$0		yes	0
Pre-rinse spray valve	0	0	0	0	$0	$0	$0	$0	$0	$0		yes	0
Toilet	13	79	-	-	$1,095	-	-	$1,095	$0	$5,200	4.7	yes	633
Urinal	0	0	-	-	$0	-	-	$0	$0	$0		yes	0
Showerhead	0	0	0	0	$0	$0	$0	$0	$0	$0		yes	0
Clothes washer	0	0	0	0	$0	$0	$0	$0	$0	$0		yes	5
Dishwasher (residential)	0		0	0	-	$0	$0	$0	$0	$0		yes	0
Dishwasher (commercial)	0	0	0	0	$0	$0	$0	$0	$0	$0		yes	57
Ice machine	0	0	0	0	$0	$0	$0	$0	$0	$0		yes	0
Steam cooker	0	0	0	0	$0	$0	$0	$0	$0	$0		yes	8
Food disposal	0	0	-	-	$0	-	-	$0	$0	$0		yes	0
Cooling tower	0	0	-	-	$0	-	-	$0	$0	$0		yes	
Custom Project	0	0	0	0	$0	$0	$0	$0	$0	$0		yes	
Total of All Measures		**79**	**0**	**0**	**$1,095**	**$0**	**$0**	**$1,095**	**$0**	**$5,200**	**4.7**		

Attachment 1: Indoor Assessment Excel Tool Outputs

CII Water Assessment Tool - Results — Spark PreSchool — v 1.3

Measure	Quantity	Water Savings (kgal)	Electricity Savings (kWh)	Natural Gas Savings (therm)	Water Cost Savings* ($)	Electric Cost Savings* ($)	Natural Gas Cost Savings* ($)	Total Cost Savings* ($)	Estimated Rebate*** ($)	Installed Cost** ($)	Simple Payback (years)	Include Measure in Report?	Estimated Water Consumption (kgal)
Faucet	0	0	0	0	$0	$0	$0	$0	$0	$0		yes	0
Aerator	17	209	0	436	$283	$0	$35	$317	$0	$85	0.3	yes	310
Pre-rinse spray valve	0	0	0	0	$0	$0	$0	$0	$0	$0		yes	0
Toilet	24	216	-	-	$292	-	-	$292	$0	$12,600	43.2	yes	564
Urinal	11	77	-	-	$103	-	-	$103	$0	$4,400	42.6	yes	153
Showerhead	0	0	0	0	$0	$0	$0	$0	$0	$0		yes	0
Clothes washer	0		0	0	-	$0	$0	$0	$0	$0		yes	0
Dishwasher (residential)	0		0	0	-	$0	$0	$0	$0	$0		yes	0
Dishwasher (commercial)	0	0	0	0	$0	$0	$0	$0	$0	$0		yes	0
Ice machine	0	0	0	0	$0	$0	$0	$0	$0	$0		yes	0
Steam cooker	0	0	0	0	$0	$0	$0	$0	$0	$0		yes	0
Food disposal	0	0	-	-	$0	-	-	$0	$0	$0		yes	0
Cooling tower	0	0	-	-	$0	-	-	$0	$0	$0		yes	
Custom Project	0	0	0	0	$0	$0	$0	$0	$0	$0		yes	
Total of All Measures		**502**	**0**	**436**	**$678**	**$0**	**$35**	**$713**	**$0**	**$17,085**	**24.0**		

Attachment 1: Indoor Assessment Excel Tool Outputs

CII Water Assessment Tool - Results — Thunder Valley K-8 — v 1.3

Measure	Quantity	Water Savings (kgal)	Electricity Savings (kWh)	Natural Gas Savings (therm)	Water Cost Savings* ($)	Electric Cost Savings* ($)	Natural Gas Cost Savings* ($)	Total Cost Savings* ($)	Estimated Rebate*** ($)	Installed Cost** ($)	Simple Payback (years)	Include Measure in Report?	Estimated Water Consumption (kgal)
Faucet	0	0	0	0	$0	$0	$0	$0	$0	$0		yes	0
Aerator	2	154	0	322	$208	$0	$26	$234	$0	$10	0.0	yes	232
Pre-rinse spray valve	1	1	0	3	$2	$0	$0	$2	$0	$80	36.4	yes	4
Toilet	47	218	-	-	$294	-	-	$294	$0	$24,675	84.0	yes	547
Urinal	9	9	-	-	$12	-	-	$12	$0	$3,600	294.8	yes	81
Showerhead	0	0	0	0	$0	$0	$0	$0	$0	$0		yes	0
Clothes washer	1	6	236	9	$8	$27	$1	$36	$0	$150	4.2	yes	11
Dishwasher (residential)	0		0	0	-	$0	$0	$0	$0	$0		yes	0
Dishwasher (commercial)	1	22	437	244	$29	$50	$20	$98	$0	$770	7.8	yes	22
Ice machine	0	0	0	0	$0	$0	$0	$0	$0	$0		yes	0
Steam cooker	1	86	5,168	0	$116	$588	$0	$704	$0	$630	0.9	yes	86
Food disposal	0	0	-	-	$0	-	-	$0	$0	$0		yes	0
Cooling tower	0	0	-	-	$0	-	-	$0	$0	$0		yes	
Custom Project	0	0	0	0	$0	$0	$0	$0	$0	$0		yes	
Total of All Measures		**496**	**5,841**	**578**	**$670**	**$665**	**$46**	**$1,381**	**$0**	**$29,915**	**21.7**		
Total of Included Measures		**496**	**5,841**	**578**	**$670**	**$665**	**$46**	**$1,381**	**$0**	**$29,915**	**21.7**		

Attachment 1: Indoor Assessment Excel Tool Outputs

CII Water Assessment Tool - Results — Timberline K-8 — v 1.3

Measure	Quantity	Water Savings (kgal)	Electricity Savings (kWh)	Natural Gas Savings (therm)	Water Cost Savings* ($)	Electric Cost Savings* ($)	Natural Gas Cost Savings* ($)	Total Cost Savings* ($)	Estimated Rebate*** ($)	Installed Cost** ($)	Simple Payback (years)	Include Measure in Report?	Estimated Water Consumption (kgal)
Faucet	0	0	0	0	$0	$0	$0	$0	$0	$0		yes	0
Aerator	28	303	0	631	$2,262	$0	$49	$2,311	$0	$140	0.1	yes	502
Pre-rinse spray valve	2	2	0	5	$18	$0	$0	$18	$0	$160	8.8	yes	8
Toilet	29	316	-	-	$2,357	-	-	$2,357	$0	$15,225	6.5	yes	940
Urinal	9	137	-	-	$1,024	-	-	$1,024	$0	$3,600	3.5	yes	274
Showerhead	0	0	0	0	$0	$0	$0	$0	$0	$0		yes	0
Clothes washer	1	6	50	15	$46	$4	$1	$52	$0	$150	2.9	yes	11
Dishwasher (residential)	0		0	0	-	$0	$0	$0	$0	$0		yes	0
Dishwasher (commercial)	2	42	857	478	$316	$68	$37	$421	$0	$1,540	3.7	yes	42
Ice machine	0	0	0	0	$0	$0	$0	$0	$0	$0		yes	0
Steam cooker	2	168	10,122	0	$1,252	$800	$0	$2,052	$0	$1,260	0.6	yes	168
Food disposal	0	0	-	-	$0	-	-	$0	$0	$0		yes	0
Cooling tower	0	0	-	-	$0	-	-	$0	$0	$0		yes	
Custom Project	0	0	0	0	$0	$0	$0	$0	$0	$0		yes	
Total of All Measures		**975**	**11,028**	**1,130**	**$7,274**	**$871**	**$88**	**$8,234**	**$0**	**$22,075**	**2.7**		

Attachment 1: Indoor Assessment Excel Tool Outputs

CII Water Assessment Tool - Results — Trail Ridge MS — v 1.3

Measure	Quantity	Water Savings (kgal)	Electricity Savings (kWh)	Natural Gas Savings (therm)	Water Cost Savings* ($)	Electric Cost Savings* ($)	Natural Gas Cost Savings* ($)	Total Cost Savings* ($)	Estimated Rebate*** ($)	Installed Cost** ($)	Simple Payback (years)	Include Measure in Report?	Estimated Water Consumption (kgal)
Faucet	0	0	0	0	$0	$0	$0	$0	$0	$0		yes	0
Aerator	72	259	0	540	$1,935	$0	$42	$1,978	$0	$360	0.2	yes	493
Pre-rinse spray valve	1	1	0	3	$9	$0	$0	$10	$0	$80	8.2	yes	4
Toilet	41	119	-	-	$891	-	-	$891	$0	$21,525	24.2	yes	597
Urinal	18	105	-	-	$783	-	-	$783	$0	$7,200	9.2	yes	210
Showerhead	0	0	0	0	$0	$0	$0	$0	$0	$0		yes	0
Clothes washer	1	6	50	15	$46	$4	$1	$52	$0	$150	2.9	yes	11
Dishwasher (residential)	0		0	0	-	$0	$0	$0	$0	$0		yes	0
Dishwasher (commercial)	1	23	458	255	$169	$36	$20	$225	$0	$770	3.4	yes	23
Ice machine	0	0	0	0	$0	$0	$0	$0	$0	$0		yes	0
Steam cooker	1	90	5,409	0	$669	$427	$0	$1,096	$0	$630	0.6	yes	90
Food disposal	0	0	-	-	$0	-	-	$0	$0	$0		yes	0
Cooling tower	0	0	-	-	$0	-	-	$0	$0	$0		yes	
Custom Project	0	0	0	0	$0	$0	$0	$0	$0	$0		yes	
Total of All Measures		**604**	**5,916**	**814**	**$4,504**	**$467**	**$63**	**$5,034**	**$0**	**$30,715**	**6.1**		

Attachment 1: Indoor Assessment Excel Tool Outputs

CII Water Assessment Tool - Results — Westview MS — v 1.3

Measure	Quantity	Water Savings (kgal)	Electricity Savings (kWh)	Natural Gas Savings (therm)	Water Cost Savings* ($)	Electric Cost Savings* ($)	Natural Gas Cost Savings* ($)	Total Cost Savings* ($)	Estimated Rebate*** ($)	Installed Cost** ($)	Simple Payback (years)	Include Measure in Report?	Estimated Water Consumption (kgal)
Faucet	0	0	0	0	$0	$0	$0	$0	$0	$0		yes	0
Aerator	46	284	0	592	$2,120	$0	$46	$2,167	$0	$230	0.1	yes	478
Pre-rinse spray valve	1	2	0	3	$12	$0	$0	$13	$0	$80	6.4	yes	4
Toilet	48	125	-	-	$933	-	-	$933	$0	$25,200	27.0	yes	625
Urinal	9	159	-	-	$1,185	-	-	$1,185	$0	$3,600	3.0	yes	269
Showerhead	0	0	0	0	$0	$0	$0	$0	$0	$0		yes	0
Clothes washer	1	6	50	15	$46	$4	$1	$52	$0	$150	2.9	yes	11
Dishwasher (residential)	0		0	0	-	$0	$0	$0	$0	$0		yes	0
Dishwasher (commercial)	1	12	1,259	140	$93	$99	$11	$203	$0	$2,050	10.1	yes	12
Ice machine	0	0	0	0	$0	$0	$0	$0	$0	$0		yes	0
Steam cooker	1	81	4,900	0	$606	$387	$0	$993	$0	$630	0.6	yes	81
Food disposal	0	0	-	-	$0	-	-	$0	$0	$0		yes	0
Cooling tower	0	0	-	-	$0	-	-	$0	$0	$0		yes	
Custom Project	0	0	0	0	$0	$0	$0	$0	$0	$0		yes	
Total of All Measures		**670**	**6,209**	**751**	**$4,996**	**$490**	**$59**	**$5,545**	**$0**	**$31,940**	**5.8**		

				Approximate Number of Fixture, by type, that do not meet water efficiency standards					Number of Appliances, by type, that do not meet water efficiency standards											
School	**City**	**Assessment Date**	**Assessment Contact**	**Handwash Sink Faucet Aerators**	**Kitchen-type Faucet Aerators**	**Toilets**	**Urinals**	**PRSVs**	**Clothes Washer**	**Residential Dishwasher**	**Commercial Dishwasher**	**Steam Cooker**	**Ice Machine**	**Water Savings (kgal)**	**Electricity Savings (kWh)**	**Natural Gas Savings (therms)**	**Water Cost Savings**	**Electirc Cost Savings**	**Natural Gas Cost Savings**	**Total Cost Savings**
Centennial Elementary	Firestone	4/1/2015	Patrick	14	1	21	6		1			1		449	4976	413	$1,333	$448	$33	$1,814
Central Elementary	Longmont	3/19/2015	Tim	30		40		1	1		1	1		255	5667	428	$1,903	$448	$33	$2,384
Coal Ridge MS	Firestone	4/1/2015	David	41	11	34	15		1		1	1	1	532	6003	641	$1,579	$540	$51	$2,171
Columbine Elementary	Longmont	3/19/2015	Rosa	10		29	7	1	1	1	1	1		280	5385	376	$2,087	$425	$29	$2,542
Fall River Elementary	Longmont	3/18/2015	Kerri Tanner			18	8	2	1		1	2		397	11437	279	$2,964	$904	$22	$3,889
Legacy Elementary	Fredrick	4/2/2015	Larissa	5	1	26	7	2	1		1	1		746	6161	1147	$1,007	$701	$92	$1,800
Longmont Estates Elementary	Longmont	3/19/2015	Kyle Houghton (teacher)	6	25	18	8	1	1	1	1			249	664	459	$1,855	$52	$36	$1,943
Lyons MS/HS	Lyons	3/25/2015	Bobby	31	13	17	11	1	1	1	1		2	261	1334	417	$1,670	$120	$33	$1,824
Prairie Ridge Elementary	Firestone	4/1/2015	Patrick	19	5	19	8	2			1	1		416	20086	81	$1,235	$1,808	$7	$3,049
Spark Elementary	Fredrick	4/2/2015	James	15	2	24	11							502	0	436	$678	$0	$35	$173
Thunder Valley K-8	Fredrick	4/2/2015	Alan	2		47	9	1	1		1	1		496	5841	578	$670	$665	$46	$1,381
Timberline K-8	Longmont	3/18/2015	Sean	23	5	29	9	2	1		2	2		975	11028	1130	$7,274	$871	$88	$8,234
Westview MS	Longmont	3/25/2015	Mike	31	15	48	9	1	1		1	1		678	5365	842	$5,056	$424	$66	$5,545
Black Rock Elementary	Erie	3/4/2015	Ophelia	21		26	6		1					543	236	679	$7,564	$24	$54	$7,643
Trail Ridge MS	Longmont	3/18/2015	Bill	33	39	41	18	1	1		1	1	1	604	5916	814	$4,504	$467	$63	$5,034
Erie Elementary	Erie	3/4/2015	Buddy			23	13		1		1	1		220	5190	239	$3,059	$537	$19	$3,615
Erie High School	Erie	3/4/2015	Pete	10		42	11		1		1	1		769	2423	1569	$10,707	$251	$126	$11,083
Erie Middle School	Erie	3/4/2015	Callow			23			1		1	1		235	5190	239	$3,269	$537	$19	$3,825
Niwot Elementary	Longmont	3/25/2015	Tim	31	15	48	9	1	1		1	1		364	6530	427	$2,714	$516	$33	$3,263
Red Hawk Elementary	Erie	3/4/2015	VP			13								79	0	0	$1,095	$0	$0	$1,095
Totals				322	132	586	165	16	17	3	17	17	4	9,050	109,432	11,194	$62,223	$9,738	$885	$72,307
Mean				20	12	29	10	1	1	1	1	1	1	453	5,472	560	$3,111	$487	$44	$3,615
Median				20	11	26	9	1	1	1	1	1	1	433	5,375	432	$1,995	$458	$34	$2,796
Min				2	1	13	6	1	1	1	1	1	1	79	0	0	$670	$0	$0	$173
Max				41	39	48	18	2	1	1	2	2	2	975	20,086	1,569	$10,707	$1,808	$126	$11,083

2015

ST. VRAIN VALLEY SCHOOL DISTRICT WATER EFFICIENCY REPORT

Morgan Shimabuku

Center for ReSource Conservation

11/12/2015

Table of Contents

Project Overview 2
Indoor Assessments 2
Methods 2
Results 4
Recommendations 9
Outdoor Assessments 9
Methods 9
Results 10
Outdoor Water Use Analysis - Update 18
Recommendations 19

Project Overview

Starting in the spring of 2015 St. Vrain Valley School District (SVVSD) and Center for ReSource Conservation (CRC) partnered to bring water conservation efforts to the district. The CRC provided the district with experience around commercial water conservation assessments and irrigation system consultations. In the spring CRC visited 20 schools, selected by the district, to perform indoor water conservation assessments. During the summer CRC revisited 10 of these schools (one which did not receive an indoor assessment) to perform outdoor irrigation consultations. CRC also engaged students in the conservation assessment process and provided the district with water conservation and water-focused lesson plan database that will be offered through the district's website for teachers to use at all grade levels.

Funding for the project is supplied by the Colorado Water Conservation Board, through CRC. The grant for this project includes $12,500, to be matched in an equal amount by SVVSD, for implementing water conservation measures. The main goals of the project include:

- To provide the school district staff with information about cost effective water efficiency upgrades that can be made and/or process changes that it can implement indoors and outdoors, to cause significant reduction in water use and cost of water bills.
- To implement major water efficiency upgrades and/or operational changes within the district. Major is defined by demonstratable and significant water savings associated with the upgrades and/or changes.
- To provide educational lessons and opportunities to students in each school in the district on water conservation concepts and methods.

This report contains information on the methods, results and recommendations from both the indoor and outdoor assessments. This report is intended to provide a starting point for choosing several opportunities for direct and relatively quick changes that can be made within the school district that will create measureable water savings. CRC and SVVSD have agreed to work together to make the decision as to what will be implemented to achieve the measurable savings. SVVSD is under no obligation to follow the recommendations provided in this report, however CRC must agree to the final decisions made by SVVSD as to what the plan is for creating water savings.

Indoor Assessments

Methods

The indoor water conservation assessments involved flow rate testing of all faucets in restrooms, kitchens and some classrooms (classrooms with classes in session were not visited) and pre-rinse spray valves in the school kitchens. A very small number of gym

showerheads were tested due to frequent reports by school staff that showers were almost never used by students nor staff. For other water-using fixtures including toilets and urinals CRC either recorded the stated gallons per flush (gpf) as labeled on each fixture, or, if none were found, made a best assumption based on fixture age and/or reported age[1] by school district staff. Appliances that use water were recorded and designated as either Energy STAR[2] or Non-Energy STAR, as Energy STAR labels currently mark appliances with the highest level of efficiency from both an energetic as well as a water-use perspective.

The recommendations presented in this report are most directly based off of the standards set by EPA's WaterSense program, which uses 3rd party certification to ensure that the products are at least 20% more water efficient without sacrificing performance. Current WaterSense specifications include:

- 0.5 gpm for hand wash faucets/faucet aerators
- 1.5 gpm for kitchen faucets/faucet aerators
- 2.0 gpm for showerheads
- 1.28 gpf for tank-type toilets (flushometer toilet specification in development)
- 0.5 gpf for urinals
- 1.28 gpm for pre-rinse spray valves
- Energy STAR certified for all appliances

gpm = gallons per minute
gpf = gallons per flush

To calculate the potential water, electricity and natural gas savings CRC uses an Excel-based tool developed by the Brendle Group, a sustainability-focused engineering firm in Fort Collins. The tool includes several different factors in it's calculation to estimate current water, energy and/or natural gas consumption and then it compares that to what would be used if all fixtures and appliances were upgraded to WaterSense and Energy STAR labeled products. To calculate estimated water, electricity and natural gas usage the tool requires flow rate or flush volume of fixtures, number of daily users and number of days of operation. The number of daily users and the number of days of operation were provided to CRC by SVVSD for all schools[3]. The tool also calculates the cost savings and return-on-investment (ROI), in years, of implementing the upgrades to the fixtures and appliances. It is able to

[1] Fixture age can be used to make a reasonable approximation of water use by fixture due to known plumbing code changes over time (i.e. National Energy Policy Act 1992, 2009 Baseline Plumbing Code, 2012 'Green Code' Requirement).
[2] Energy STAR is a program of the U.S. EPA that uses third-party testing to label energy efficient appliances, homes, and other buildings, ensuring that these products are not only efficient, but that they also perform as well or better than non-Energy STAR appliances and buildings in the same class.
[3] SVVSD provided CRC with 2014 enrollment data. Staff numbers were estimated using the assumption of 1 staff:30 students. Teacher work days and summer school were counted as ½ days to account for the smaller number of users during those time periods..

calculate the ROI from the input of the utility rates for the water, electricity and natural gas into the data sheet. Labor and fixture costs are included in the ROI estimates.

Results

During the indoor assessments the CRC technician met with at least one school district staff (e.g. school janitor, maintenance staff, etc.) at each school and visited every restroom and kitchen in each building. At most schools only a representative sample of classrooms were visited in order to not disturb classes in session. All indoor assessments were performed in March and April of 2015.

In general, the indoor assessments revealed that there are significant opportunities for water savings at nearly every school visited. The table below shows both the total (sum) as well as the mean (average) for the categories of water, electricity, and natural gas savings per unit, and cost savings. These are only the savings potentially available through indoor upgrades to fixtures and appliances within the 20 schools included in the assessments.

	Water Savings (kgal)	Electricity Savings (kWh)	Natural Gas Savings (therm)	Water Cost Savings	Electric Cost Savings	Natural Gas Cost Savings	Total Cost Savings
Total	9,050	109,432	11,194	$62,223	$9,738	$885	$72,307
Mean	453	5,472	560	$3,111	$487	$44	$3,615

The next table presented below shows the number of non-WaterSense fixtures by type (hand wash faucet aerators, kitchen-type faucet aerators, toilets, urinals and PRSVs) by school. The Grand Total (Sum) of all included in the assessments is at the bottom of the table. Zeros and blanks indicate that either all fixture types in that class were meeting WaterSense standards, or that type of fixture was not present or tested.

School	Hand Wash Faucet Aerators	Kitchen-type Faucet Aerators	Toilets	Urinals	Pre-Rinse Spray Valves
Black Rock Elementary	21		26	6	0
Centennial Elementary	14	1	21	6	0
Central Elementary	30	0	40	0	1
Coal Ridge MS	41	11	34	15	0
Columbine Elementary	10	0	29	7	1
Erie Elementary	0	0	23	13	
Erie High School	10		42	11	0
Erie Middle School	0	0	23	0	0
Fall River Elementary	0	0	18	8	2
Legacy Elementary	5	1	26	7	2
Longmont Estates Elementary	6	25	18	8	1
Lyons MS/HS	31	13	17	11	1
Niwot Elementary	31	15	48	9	1
Prairie Ridge	19	5	19	8	2
Red Hawk Elementary	0	0	13	0	0
Spark Elementary	15	2	24	11	0
Thunder Valley K-8	2	0	47	9	1
Timberline K-8	23	5	29	9	2
Trail Ridge MS	33	39	41	18	1
Westview MS	31	15	48	9	1
Grand Total	**322**	**132**	**586**	**165**	**16**

The second table shows the number of appliances that do not meet water efficiency and energy efficiency standards as set by Energy STAR by type (clothes washers, residential dishwashers, ice machines, steam cookers and commercial dishwashers) by school. The Grand Total (Sum) of all included appliances from all assessments is at the bottom of the table. Zeros and blanks indicate that either all fixture types in that class were meeting water efficiency standards, or that type of fixture was not present.

School	Clothes Washers	Residential Dishwashers	Steam Cookers	Ice Machines	Commercial Dishwashers
Black Rock Elementary	1	1	1		1
Centennial Elementary	1	1	1		1
Central Elementary	1	1	1		1
Coal Ridge MS	1	1	1	1	1
Columbine Elementary	1	1	1		1
Erie Elementary	1		1		1
Erie High School	1		1	1	1
Erie Middle School	1		1	1	1
Fall River Elementary	1		1		1
Legacy Elementary	1		1		1
Longmont Estates Elementary	1	1	1		1
Lyons MS/HS	1	1	1	1	1
Niwot Elementary	1		1		1
Prairie Ridge	1		1	1	1
Red Hawk Elementary	1	1	1	1	1
Spark Elementary					
Thunder Valley K-8	1		1		1
Timberline K-8	1		1	1	1
Trail Ridge MS	1		1	1	1
Westview MS	1		1		1
Grand Total	**19**	**8**	**19**	**8**	**19**

Based on these two tables, the most needed fixture and appliance upgrades in the district include:

- Flushometer toilets (only 5% met WaterSense)
- Clothes washers (only 11% met Energy STAR)
- Steam Cookers (only 15% met Energy STAR)
- Dishwasher (only 17% met Energy STAR)

CRC recommends that as these fixtures and appliances come to the end of their useful life, to replace them with WaterSense and Energy STAR labeled devices.

Presented below are the potential water, electricity and natural gas savings from implementing upgrades to all non-WaterSense and non-Energy STAR fixtures and appliances at each school.

School	Water Savings (kgal)	Water Cost Savings ($)	Electricity Savings (kWh)	Electric Cost Savings ($)	Natural Gas Savings (therm)	Natural Gas Cost Savings ($)	Total Cost Savings ($)
Black Rock Elementary	543	$ 7,564	236	$ 24	679	$ 54	$ 7,643
Centennial Elementary	449	$ 1,333	4976	$ 448	413	$ 33	$ 1,814
Central Elementary	255	$ 1,903	5667	$ 448	428	$ 33	$ 2,384
Coal Ridge MS	532	$ 1,579	6003	$ 540	641	$ 51	$ 2,171
Columbine Elementary	280	$ 2,087	5385	$ 425	376	$ 29	$ 2,542
Erie Elementary	220	$ 3,059	5190	$ 537	239	$ 19	$ 3,615
Erie High School	769	$ 10,707	2423	$ 251	1569	$ 126	$ 11,083
Erie Middle School	235	$ 3,269	5190	$ 537	239	$ 19	$ 3,825
Fall River Elementary	397	$ 2,964	11437	$ 904	279	$ 22	$ 3,889
Legacy Elementary	746	$ 1,007	6161	$ 701	1147	$ 92	$ 1,800
Longmont Estates Elementary	249	$ 1,855	664	$ 52	459	$ 36	$ 1,943
Lyons MS/HS	261	$ 1,670	1334	$ 120	417	$ 33	$ 1,824
Niwot Elementary	364	$ 2,714	6530	$ 516	427	$ 33	$ 3,263
Prairie Ridge	416	$ 1,235	20086	$ 1,808	81	$ 7	$ 3,049
Red Hawk Elementary	79	$ 1,095	0	$ -	0	$ -	$ 1,095
Spark Elementary	502	$ 678	0	$ -	436	$ 35	$ 173
Thunder Valley K-8	496	$ 670	5841	$ 665	578	$ 46	$ 1,381
Timberline K-8	975	$ 7,274	11028	$ 871	1130	$ 88	$ 8,234
Trail Ridge MS	604	$ 4,504	5916	$ 467	814	$ 63	$ 5,034
Westview MS	678	$ 5,056	5365	$ 424	842	$ 66	$ 5,545
Grand Total	**9050**	**$ 62,223**	**109432**	**$ 9,738**	**11194**	**$ 885**	**$ 72,307**

The savings may vary in real life if usage rate assumptions do not match actual usage, however this data show that nearly every school has significant potential for improving water efficiency, and saving money.

For detailed information on each school's potential savings, by fixture and appliance, see **Attachment 1**.

Other issues with water use were identified during visits that are not captured by the fixture and appliance lists. These issues are listed below, by school. These notes are not meant to provide a comprehensive picture of water usage at each school, but rather, they reflect the variety of observations made by CRC technicians while performing the assessments. 6 of the 20 schools did not have additional observations.

School	Issue/Comments
Trail Ridge Middle School	Have summer school Cooling towers present, high water use Scotsman brand ice machine, not Energy STAR
Lyons Middle and High School	Metered sinks > 10 sec flow Barb fitted faucets in science classrooms were reported to leak often No summer school Kohler, autoflush toilets in several locations Very old toilets in locker rooms
Longmont Estates Elementary	All faucets were tested by student "helpers" Miniature toilets present
Columbine Elementary	One faucet dripping in the sink in the boys bathroom near 2nd grade classrooms Miniature toilets present Fisher brand PRSV
Westview Middle School	No aerator on 2 7th grade classroom sings in E-wing No aerator on 7th grade science classroom sinks Reported to CRC that "no one drinks the water" due to odd color and bad taste/odor Brush attachment on PRSV
Timberline K-8	Has summer school Girls restroom sinks near room 404 have sinks that run for more than 30 sec before shutting off Mop sink in cafeteria had a leak American Standard flushometer toilets Toilet clogs found
Fall River Elementary	Has summer school No brush on PRSV
Central Elementary	Has summer school Health room staff report that the hot water does not work in their room T&S Brass PRSV
Coal Ridge Middle School	7th grade boys restroom aerators running longer than 10 sec Art classroom has several sink faucets with leaks Crane brand toilets
Prairie Ridge	Kitchen did not have any aerators on the 3 compartment sinks Metered faucets in general ran for more than 10 sec Brush attachment on PRSVs
Centennial Elementary	Sink in room 306 was missing an aerator

Legacy Elementary	Metered sink in boys and girls restrooms did not turn off Kohler brand toilets Fisher brand PRSVs
Spark Preschool	Have summer school Kitchen is not used No aerator on sink in the staff/office space Miniature toilets in some locations here
Thunder Valley K-8	No aerator on 5 sinks in the science room Kenmore brand dishwasher, not Energy STAR Cleveland brand steamer American Standard and Kohler brand toilets Zurin brand urinal

Recommendations

The recommendation list for all changes and upgrades is at the end of the report. This list was created for staff of SVVSD to use when considering upgrades for the water-using fixtures and appliances in schools, primarily related to the grant from the Colorado Water Conservation Board for $12,500 plus the matching funds provided by the District, to total $25,000. However this list could be used for future purchases as well as it offers advice on a wide variety of fixture and appliance upgrade opportunities and best management practices for water and energy efficiency.

Outdoor Assessments

Irrigation system consultations were provided by the Center for ReSource Conservation to 10 SVVSD schools in the summer of 2015. Trained technicians spent anywhere from half a day to two days working at each of the schools doing a thorough analysis of the efficiency of the irrigation system. Methods and results from these audits are presented below.
In addition to the on-site irrigation assessments, CRC did an analysis of historical water use at the same 10 schools to compare outdoor water use to water demand of those landscapes based off of historical weather data. This analysis was used to augment the irrigation system audits and provide the school with information as to whether or not they should consider purchasing a weather based irrigation control system.

Methods

Every irrigation system audit was performed by two technicians. The steps of each audit included:

- A visual inspection of each sprinkler zone while running to pinpoint any issues in the system
- Pressure tests on a representative sample of sprinkler heads
- Tests to measure precipitation rates and distribution uniformity within several representative zones

- Soil samples to determine root depth and soil type within tested zones

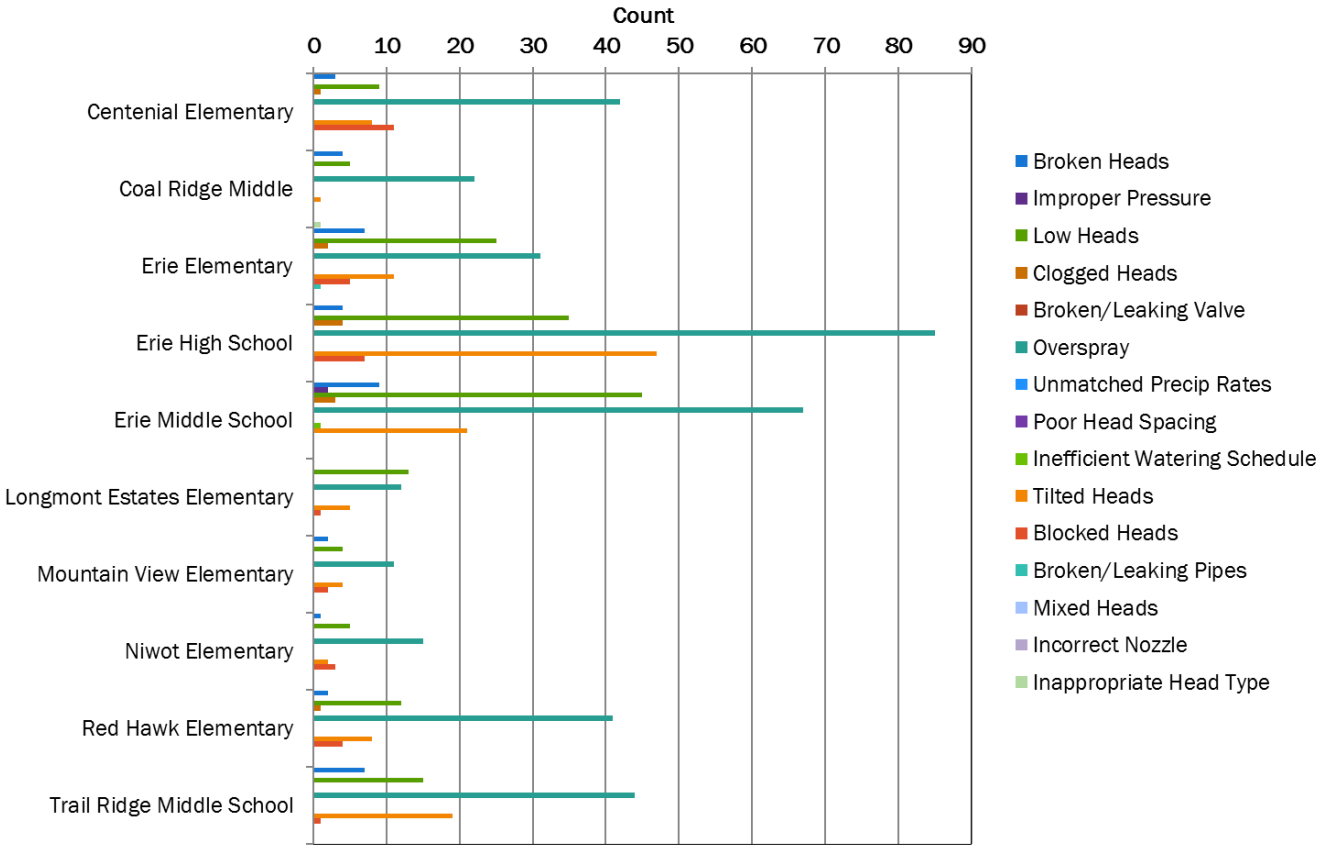
This data set is intended support the maintenance staff to asses which issues are most frequent across all sites.

The methods used for the analysis of historical water use was presented to SVVSD in a short report titled "Irrigation Comparison Analysis Report for SVVSD by CRC." By using landscape area, provided to CRC by the district, weather data from Northern Colorado Water Conservation District's weather station network (northernwater.org), and the data collected in the field, we were able to calculate how much irrigation water was needed for each school, for the 2012 and 2013 growing season (March-Nov). We compared this number to the total irrigation water used during these same years (calculated following the minimum month method). Finally, the application ratio, a value that represents the efficiency of water use, or the ratio of what was used compared to what was needed on the landscape. If the exact amount of water needed is applied, then the application ratio is 100%. If more water is applied than is needed then the application ratio is greater than 100% and if less water is applied than is needed, then the application is less than 100%.

Results

A team of two CRC technicians met with District staff at each school between June 25th and July 16th, 2015. Overall, the irrigation systems at the 10 schools visited were found to be in good working order. The designs of the systems were often good and no major recommendations will be made with regard to this aspect. The SVVSD staff working with the CRC technicians did not permit the staff to evaluate the watering times or schedules for the different zones and therefore this aspect will not be reported on either.

Visual inspections of the running irrigation systems at each school reveled some basic problems are common across schools. The top three issues identified were **overspray**, **clogged heads**, and **low heads**. The graph below shows the count of each issue at each of the 10 schools visited.



The majority of these issues are relatively simple and inexpensive to fix. Clearing out clogged heads and raising low heads will reduce overspray significantly, leading to improved spray coverage and improved distribution uniformity.

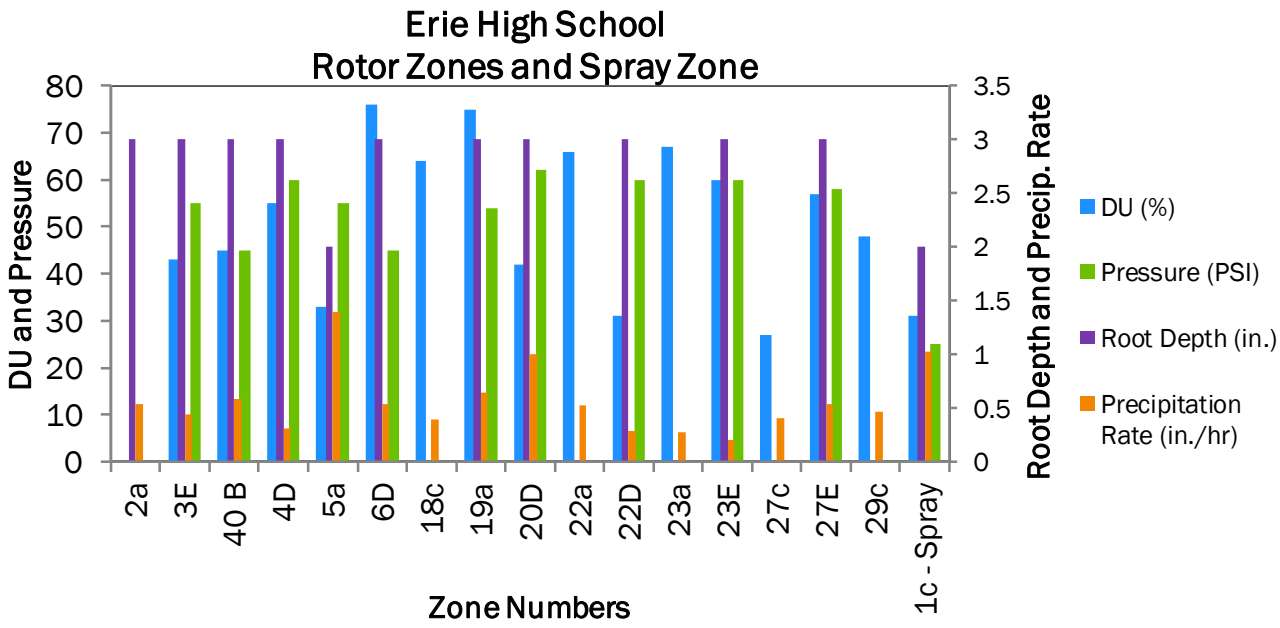
Tests were performed on several spray and rotor zones at each school to measure the distribution uniformity, precipitation rate, pressure and root depth. Overall, 58 rotor zones and 14 spray zones were tested. The table below details the average value for each of these categories between spray and rotor zones, as well as the ranges of the values.

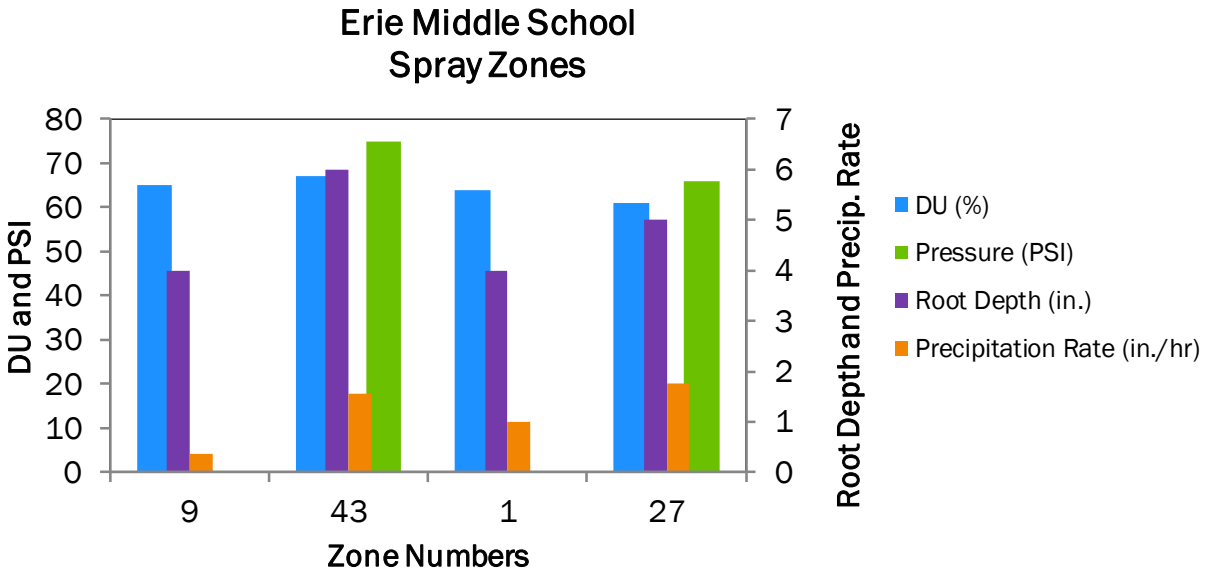
	Distribution Uniformity (%)	Precipitation Rate (in./hr)	Pressure (PSI)	Root Depth (in.)
		Spray Zones		
Average	52	1	32	3
Range	31 to 69	0.4 to 8	25 to 75	2 to 6
		Rotor Zones		
Average	64	1	53	4
Range	27 to 80	0.2 to 1.4	25 to 66	2 to 6

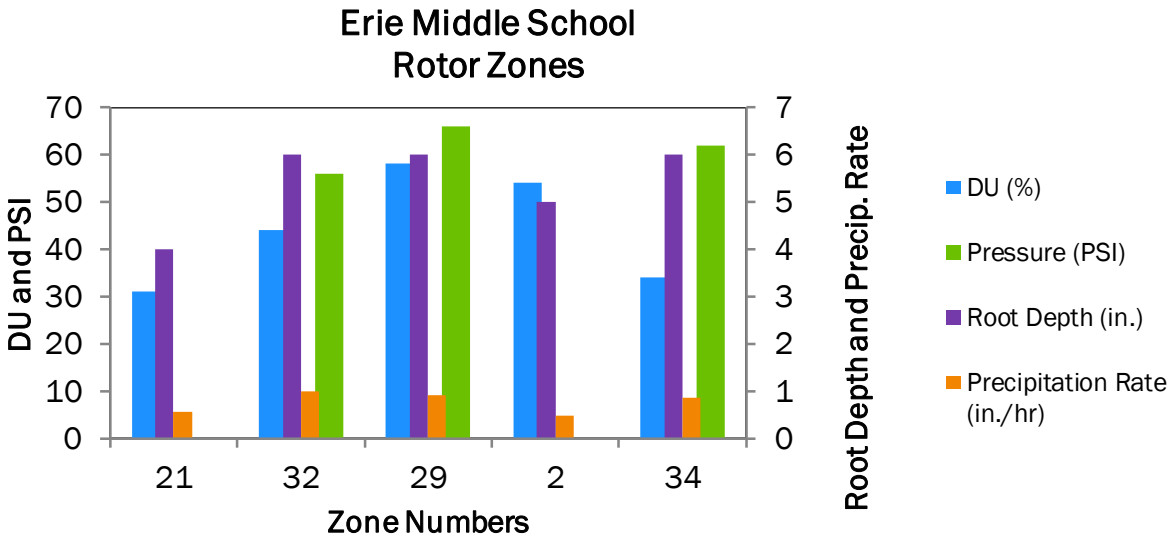
From this data, several opportunities for efficiency improvements are evident.

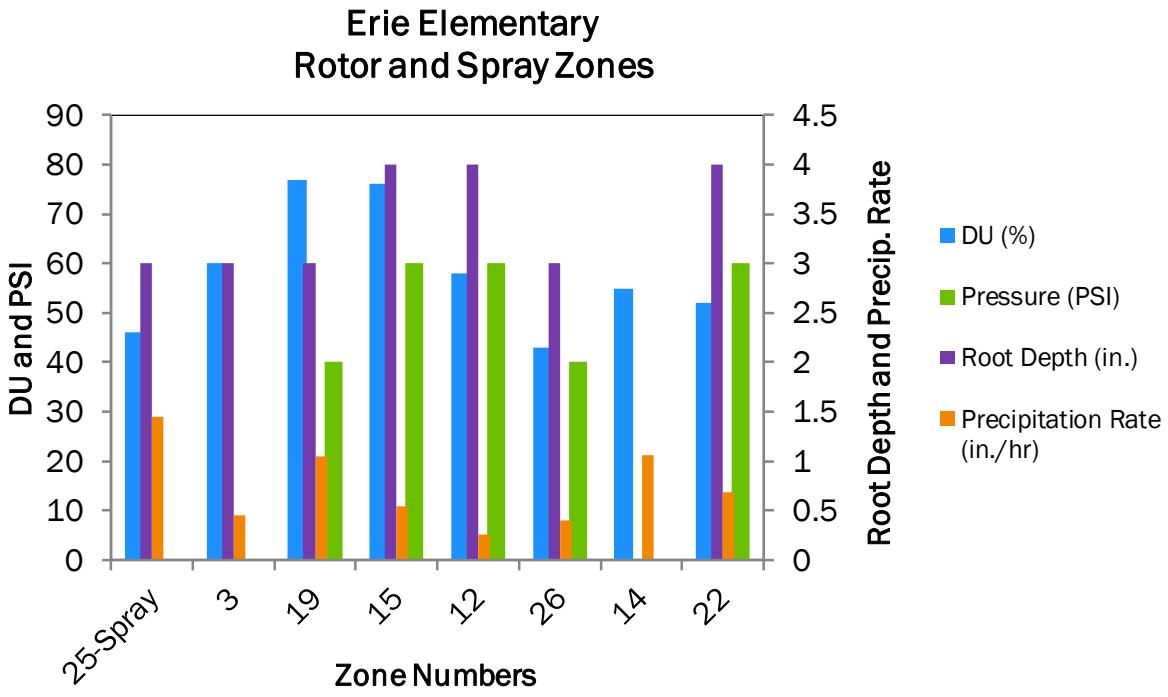
- Distribution uniformity should be at a minimum of 70% for all zones, and therefore this is an area that could be improved across the majority of zones in the district.
- The design pressure for spray heads ranges from 20 to 30 PSI and from 25 to 80 PSI for rotor heads. Work should be done to reduce the pressure in spray zones across the district.

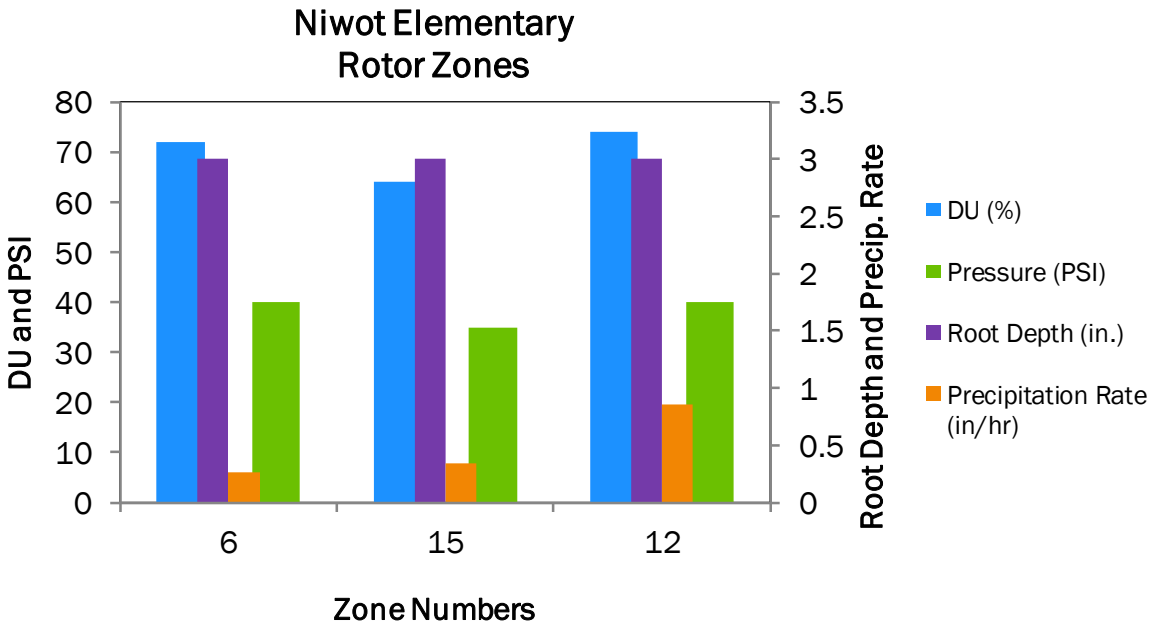
School specific results are shown in the graphs below. These graphs display the measured distribution uniformity (DU) (%), pressure (PSI), root depth (inches) and precipitation rate (inches/hour) for all tested rotor and spray zones. DU and pressure bars correspond with the left-hand y-axis and the root depth and precipitation rate bars correspond with the right-hand y-axis. This display of the data is intended to allow the reader to compare these four categories across each zone tested. Test results for Mountain View Elementary were lost and are therefore not included.

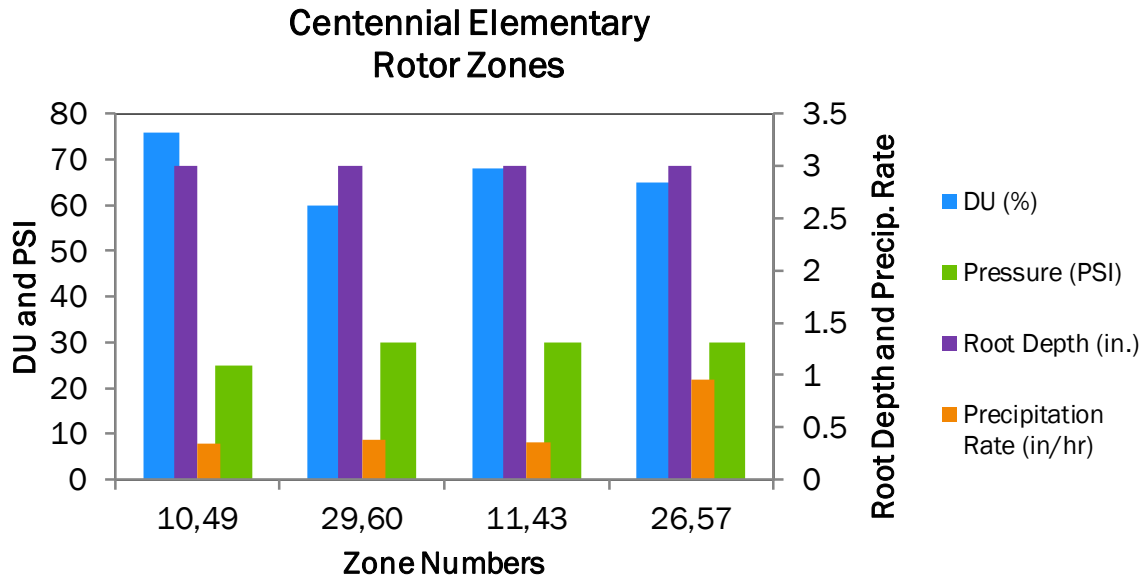


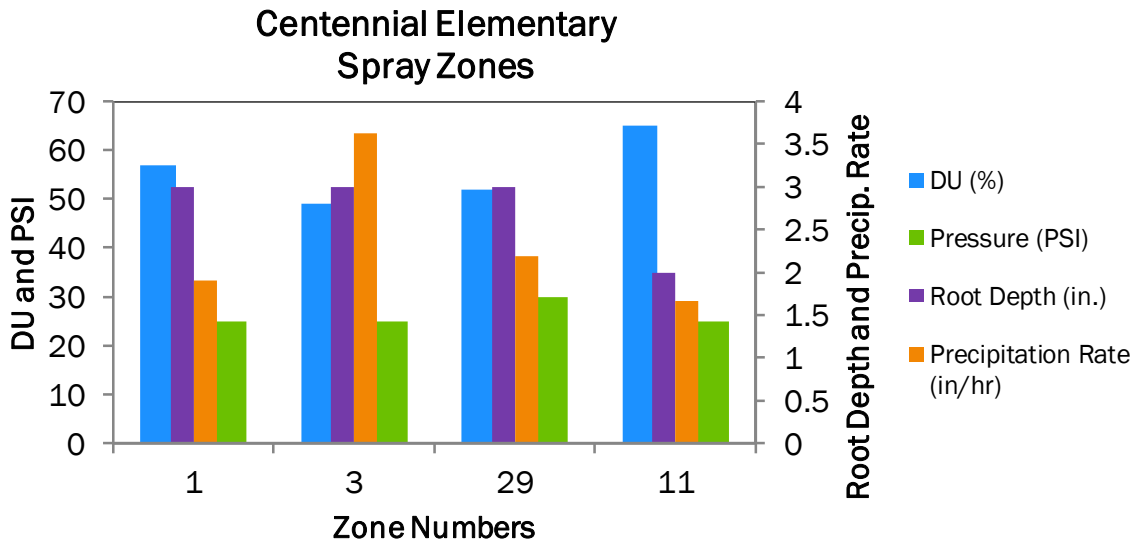

Erie Middle School
Spray Zones
DU and PSI
Root Depth and Precip. Rate
Zone Numbers
9
43
1
27
DU (%)
Pressure (PSI)
Root Depth (in.)
Precipitation Rate (in./hr)

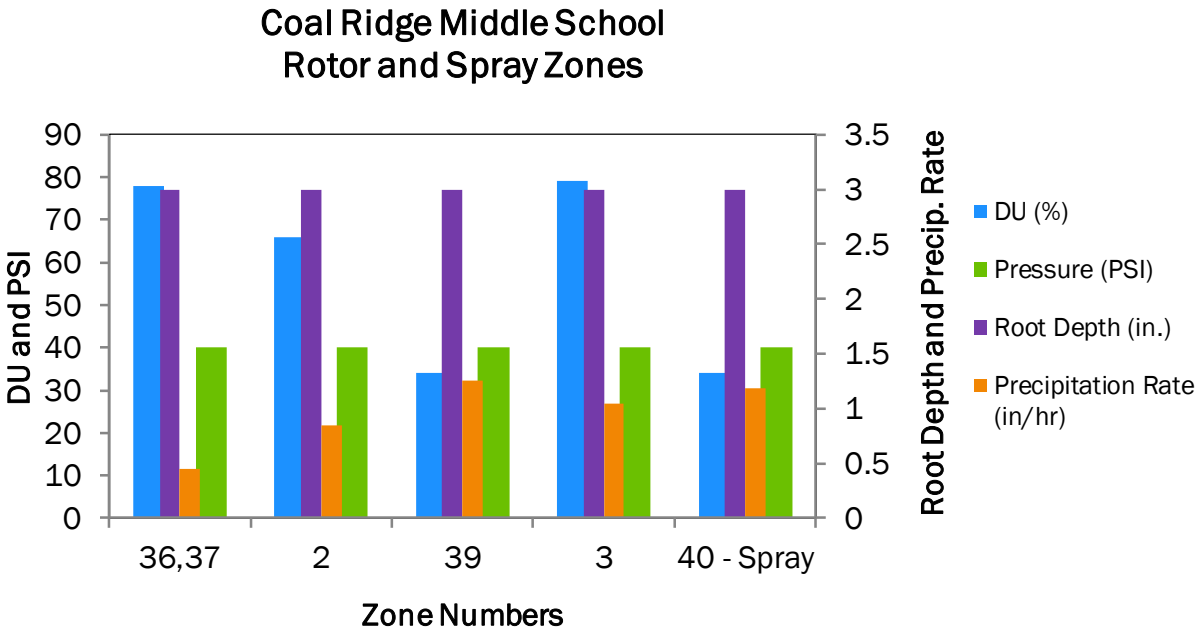

Erie Middle School
Rotor Zones
DU and PSI
Root Depth and Precip. Rate
Zone Numbers
21
32
29
2
34
DU (%)
Pressure (PSI)
Root Depth (in.)
Precipitation Rate (in./hr)

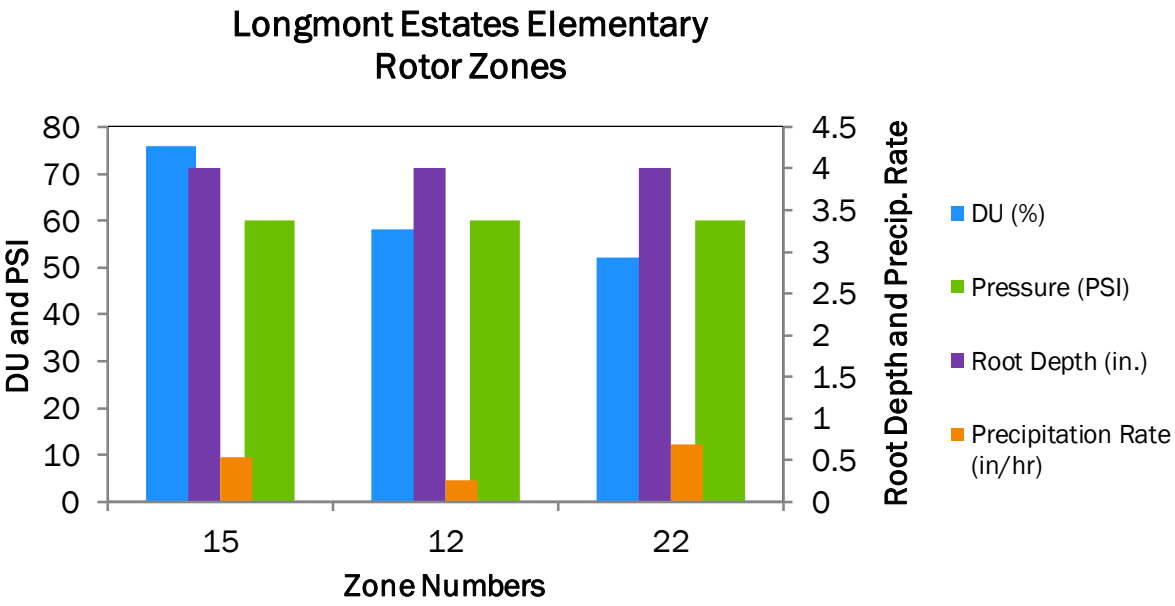

Erie Elementary
Rotor and Spray Zones
DU and PSI
Root Depth and Precip. Rate
Zone Numbers
25-Spray
3
19
15
12
26
14
22
DU (%)
Pressure (PSI)
Root Depth (in.)
Precipitation Rate (in./hr)

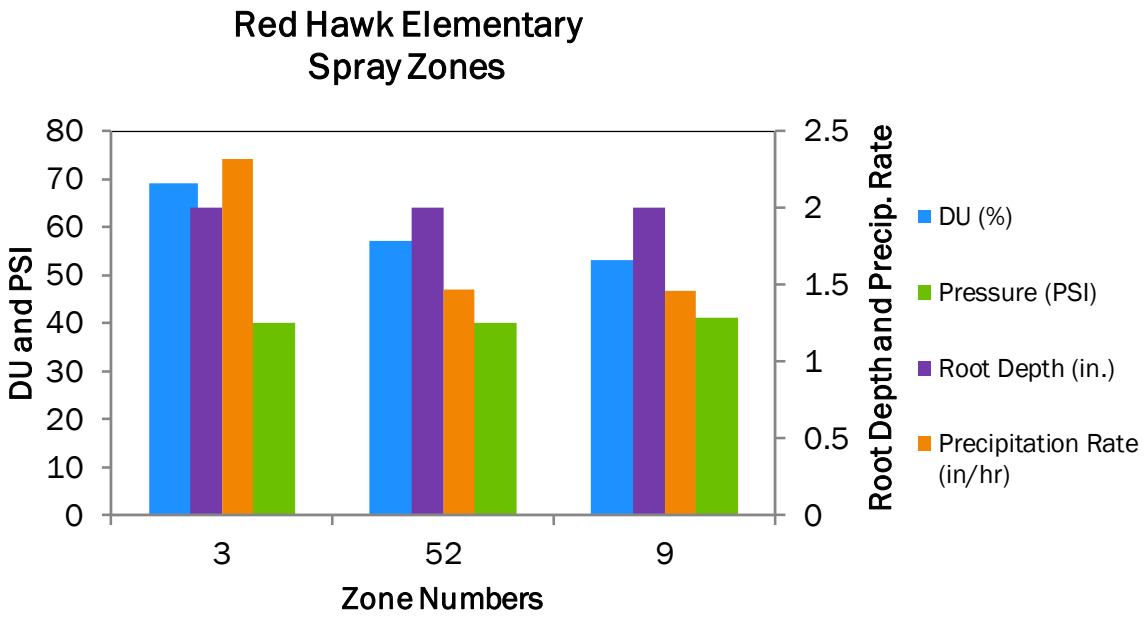

Niwot Elementary
Rotor Zones
DU and PSI
Root Depth and Precip. Rate
Zone Numbers
6
15
12
DU (%)
Pressure (PSI)
Root Depth (in.)
Precipitation Rate (in/hr)

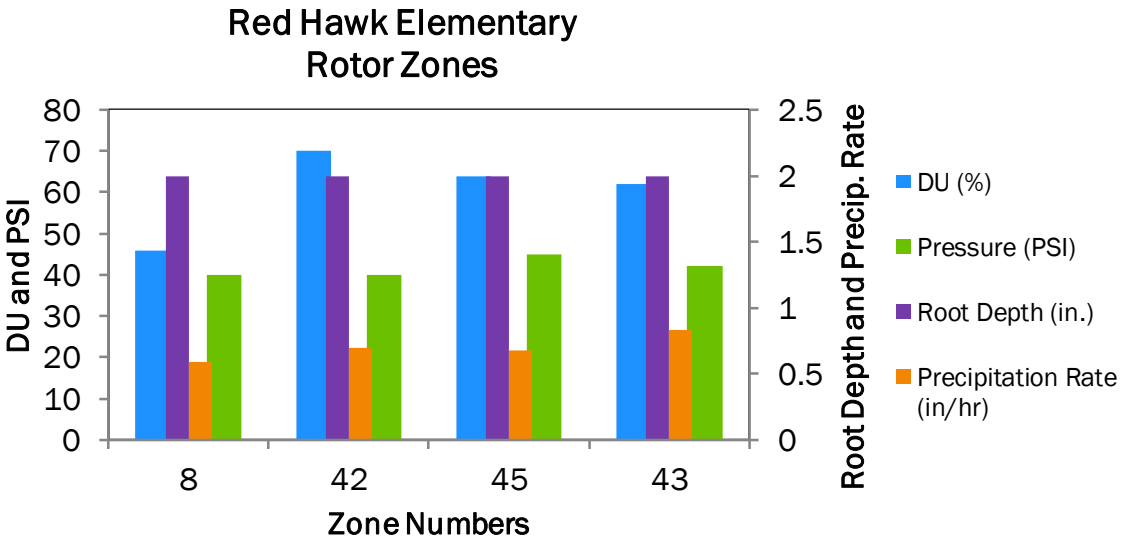

Centennial Elementary
Rotor Zones
DU and PSI
Root Depth and Precip. Rate
80
70
60
50
40
30
20
10
0
3.5
3
2.5
2
1.5
1
0.5
0
10,49
29,60
11,43
26,57
Zone Numbers
DU (%)
Pressure (PSI)
Root Depth (in.)
Precipitation Rate (in/hr)

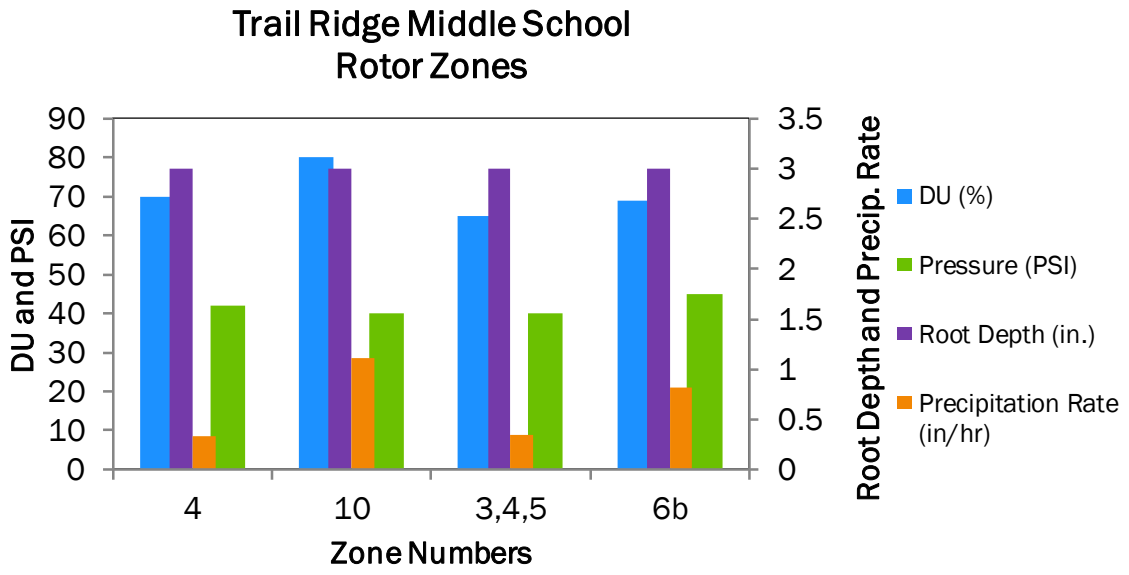

Centennial Elementary
Spray Zones
DU and PSI
Root Depth and Precip. Rate
70
60
50
40
30
20
10
0
4
3.5
3
2.5
2
1.5
1
0.5
0
1
3
29
11
Zone Numbers
DU (%)
Pressure (PSI)
Root Depth (in.)
Precipitation Rate (in/hr)


Coal Ridge Middle School
Rotor and Spray Zones
DU and PSI
Root Depth and Precip. Rate
90
80
70
60
50
40
30
20
10
0
3.5
3
2.5
2
1.5
1
0.5
0
36,37
2
39
3
40 - Spray
Zone Numbers
DU (%)
Pressure (PSI)
Root Depth (in.)
Precipitation Rate (in/hr)


Longmont Estates Elementary
Rotor Zones
DU and PSI
Root Depth and Precip. Rate
80
70
60
50
40
30
20
10
0
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
15
12
22
Zone Numbers
DU (%)
Pressure (PSI)
Root Depth (in.)
Precipitation Rate (in/hr)


Red Hawk Elementary
Spray Zones
DU and PSI
Root Depth and Precip. Rate
80
70
60
50
40
30
20
10
0
2.5
2
1.5
1
0.5
0
3
52
9
Zone Numbers
DU (%)
Pressure (PSI)
Root Depth (in.)
Precipitation Rate (in/hr)


Red Hawk Elementary
Rotor Zones
DU and PSI
Root Depth and Precip. Rate
80
70
60
50
40
30
20
10
0
2.5
2
1.5
1
0.5
0
8
42
45
43
Zone Numbers
DU (%)
Pressure (PSI)
Root Depth (in.)
Precipitation Rate (in/hr)



Outdoor Water Use Analysis - Update

By using landscape area, provided to CRC by the district, weather data from Northern Colorado Water Conservation District's weather station network (northernwater.org), and the data collected in the field, we were able to calculate how much irrigation water was needed for each school, for the 2012 and 2013 growing season (March-Nov). We compared this number to the total irrigation water used during these same years (calculated following the minimum month method). Finally, the application ratio, a value that represents the efficiency of water use, or the ratio of what was used compared to what was needed on the landscape. If the exact amount of water needed is applied, then the application ratio is 100%. If more water is applied than is needed then the application ratio is greater than 100% and if less water is applied than is needed, then the application is less than 100%.

All of the schools with the exception of Mountain View Elementary and Trail Ridge Middle School were watering efficiently, and in some cases were actually watering less than the estimated amount that was needed. Mountain View Elementary had an application ratio of 143% in 2012 and 123% in 2013. Trail Ridge Middle School overwatered in 2012 by approximately 38% and in 2013 75%. Erie High School was the school with the lowest application ratio of the schools audited with an AR of 49% in 2012 and 45% in 2013. On average, the schools audited had an application ratio of 96% of the water needed in 2012 and 95% in 2013.

The results of this analysis have changed since the report was issued earlier in 2015. Information supplied by SVVSD staff indicated that not all landscape area was accounted for

at Erie High School and Erie Middle School in the original data supplied the CRC and therefore these records have been removed from the analysis. The major impact of this update was to increase the average application ratio to 108% and 103% from 96% and 95%.

School	Actual Water Usage 2012	Needed Water Usage 2012	Application Ratio	Actual Water Usage 2013	Needed Water Usage 2013	Application Ratio
Centennial ES	4,532	4,392	103%	2,829	3,310	85%
Erie ES	5,991	5,965	100%	4,317	4,170	104%
Niwot ES	3,043	3,167	96%	2,552	2,387	107%
Longmont Estates ES	5,082	4,759	107%	3,247	5,641	58%
MountainView ES	3,671	2,566	143%	2,387	1,934	123%
Coal Ridge MS	9,305	13,639	68%	7,323	10,703	68%
Trail Ridge MS	7,499	5,425	138%	7,162	4,089	175%
Average	5,589	5,702	108%	4,259	4,605	103%
Sum	39,123	39,914		29,816	32,234	

*All water volumes in thousands of gallons (kgal)

Recommendations

The recommendations for SVVSD to improve outdoor watering efficiency are also included on at the end of this report with the recommended changes to indoor appliances and fixtures.

Water Conservation OUTSIDE

Summary: This sheet was created for St. Vrain Valley Schools, based in Longmont, Colorado, to use for water conservation and efficiency lessons, for grades 2-5, to better understand how sprinklers work and evaluate the sprinkler system efficiency.

Background: Sprinklers are used to water plants around buildings where people live, work, go to school and play. These systems can be built many different ways, but typically they involve pipes underground connected to small sprinkler heads that pop up when the water runs through the pipes.

What makes the water run through the pipes? Either a person or a computer turns on the control clock, and as you can guess, in today's world, it's often a computer turning on the water and making the sprinkler system run. People, like your parents or the school district maintenance staff, program the computer so that it turns on at the right time and waters for a certain length of time (for example, 10 min). The challenge, and our whole goal today, is to figure out how much water is being used to water the plants at your school, and, to try to figure out if that's the right amount (or too much or too little)? If you water too little, the plants may die. If you water too much, they also may die AND you're wasting water - a very precious resource!

Materials

Per Student

Sprinkler Inspection Data Collection Form
Clip board
Pencil

Sprinkler Inspection Step-by-Step Instructions

Please read through the instructions below. Each step has information on where it should be performed, what materials students and staff will need, questions to ask students and the activity associated with the step.
Note: Sprinkler heads need to be numbered, we suggest using flags and putting the numbered flags in the ground directly next to each head. Catch cups do not need to be numbered and can be recorded in any order.

1. **Sprinkler System Overview** - Go to the area outside where the sprinkler inspection will be, show students the area, and ask them all the following questions. Letter "C" will require students to have the Data Collection Form and pencil.
    a. Where is the sprinkler zone we are looking at in relation to the school?
    b. What is growing in the sprinkler zone we are looking at? Does it look healthy and alive?
    c. Draw a map/picture of the sprinkler zones on the Data Collection Form. The maps should be from a "bird's-eye-view" perspective, as if you are above the ground, looking down at the sprinkler zones from above.
2. **Visual Inspection of Sprinklers -** Have all of the students stand outside of the sprinkler zone, on pathways or sidewalks. Prepare students to write in their Visual Inspection Sheet. Explain to them that it's their job to look at every sprinkler head and carefully note if they find any problems.
    a. Review the types of problems found on sprinkler systems in the visual inspection sheet. This allows the students to be familiar with what they're looking for.
    b. Turn on the sprinkler zone (maintenance staff will be available to do this). Have the students go to each sprinkler head, individually or in groups of 2-3, and assess for common issues. But be careful! Keep papers and writing materials dry! The Visual Inspection Sheet has pictures of common issues and their names so that the students can try to see if the sprinklers they are looking at have these same issues. If in groups, one student can be the "inspector" and the other can be the "data recorder."
    c. After students have gone around to each sprinkler head, turn off the sprinkler zone. Gather together as a class and discuss what issues were found at what sprinkler heads.
        i. What issues did you find?
        ii. Where did you find them?
        iii. Why do you think that/those issue(s) are bad for the grass or water efficiency?
    d. If any issues are easy to fix, show students how to fix them.
3. **Catch Cup Test -** Place the catch cups out across the entire zone, in a grid pattern with equal spacing of the catch cups.
    a. Before turning on the catch cups, explain to the students that the zone will run for 5 min, after which they will need to check the depth of water in each cup. Ask them:
        i. Do you think that at the end of the 5 min that each cup will have about the same amount of water or a different amount of water?
    b. Turn on the sprinklers and allow for them to run for 5 min exactly.
    c. After you turn off the sprinkler, have the students carefully read the depth of water in each cup, with a "data recorder" writing down the numbers that are read by the "inspectors". If in teams, each team should look at 3-5 cups, depending on the number of teams.
    d. Each team should then report the depths to you, and from there, use the following formula to calculate the precipitation rate, in inches per hour.

(Average of all cup measurements x 60) / 5 = _____ inches per hour

---

Calculating Gallons of Water Used to Water the Area every Year
Once you have the Precipitation Rate calculated, you just need a few more values to calculate the gallons of water used every year on the sprinkler zone that you're looking at. This number will be in gallons, which is a more familiar unit than inches per hour and will therefore be easier to visualize.

Variables Needed
Precipitation Rate (inches per hour) _____

Amount of Time Sprinkler Runs (hours per week) _____

Number of Weeks per Year Sprinkler is Run_____

Size of irrigated area (square feet)_____

7.48 is a conversion factor to convert from square inches to gallons.

Equation
(Precipitation Rate x Amount of Time Sprinkler Runs x Number of Weeks Per Year) x Size of Irrigated Area x 7.48 = Gallons of Water Used Per Year

_____ Gallons of Water Used Per Year

But this number is meaningless if you don't compare it to how much water is needed on that landscape. To calculate how much water is needed:

(27/12) x Size of Irrigated Area x 7.48 = Gallons Needed Per Year

_____ Gallons of Water Needed Per Year

The difference between the Gallons of Water Needed and Gallons of Water Used = _____

This is how much water that could be saved by simply adjusting the watering schedule!

Data Collection Form

Name:_____
Date: _____

Questions: Does the sprinkler system water the grass effectively and efficiently? How much water is used to water the grass?

Materials: clipboard, pencil/pen

Sprinkler Location: _____

Short Description/Diagram of Sprinkler Zone - describe/draw shape, orientation (where is North?), other items besides grass, and distinguishing features.

Visual Inspection Sheet - when the sprinklers turn on, walk around to each sprinkler head and make observations.

Check to see if the heads are broken, low, clogged, overspraying on concrete/buildings/fences, spaced too close together, etc.

Titled sprinkler head

Clogged Sprinkler head

Overspray

Overspray

Sunken sprinkler head

Misting sprinkler head

Geyser! (broken head)

Sprinkler spraying at another object (and not on the grass)

Sprinkler Head Number	Notes/Issues/Problems
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	

Catch Cup Tests - 5 min for spray zones

Catch Cup #	How much Water in Cup?	Comments/Problems?
1		
2		
3		
4		
5		
6		

Average Catch Cup Reading: _____

ST. VRAIN VALLEY SCHOOLS

academic excellence by design

Water Conservation Survey Report

Spring 2016

This report discusses the results of the water survey conducted in January 2016. It was sent out to all staff and the response ratio was sufficient to provide statistically significant data. The hope is that the report offers an understanding of the district's perspective on water conservation, education and procedures as we strive to continuously improve efforts.

Dara Ward
Energy & Sustainability Manager
Ward_Dara@svvsd.org

Introduction

In the fall of 2015, the Center for Resource Conservation (CRC), through a Colorado Water Conservation Board grant, partnered with SVVSD's Energy & Sustainability Manager and staff from the grounds and plumbing departments to assess the water use both indoors and outdoors at 20 schools across the district and provided recommendations for upgrades. To read the full report of these findings, visit https://blogs.svvsd.org/water/st-vrain-schools-report/.

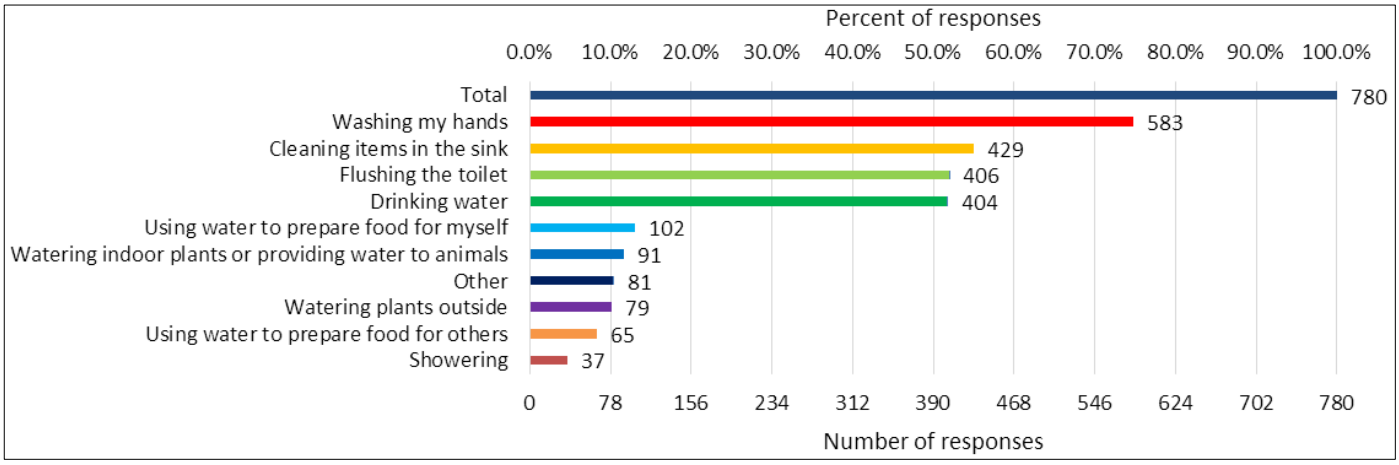
In addition, SVVSD set out to better understand how our schools interact with water. Therefore, in January of 2016, we sent out a survey to all staff and gathered information on water usage and perceptions in order to improve conservation efforts, education, and gaps in addressing problematic areas.

Seven-hundred and eighty five (785) staff responded to the survey. Please read on to learn the results of the survey and the district's response and planned action items.

1. This chart depicts the breakdown of responses by site.

School/Building	Respondents		School/Building	Respondents
All Buildings	6		Legacy	12
Alpine	14		Lincoln	3
Altona	23		Longmont Estates	11
APEX	4		Longmont HS	30
Black Rock	10		Longs Peak	16
Blue Mountain	20		LSC	8
BRES	1		Lyons ES	13
Burlington	9		Lyons MS/HS	8
Career Development Center	3		Mead ES	9
CBESC	14		Mead HS	23
CDC	11		Mead MS	15
Centennial	14		Mountain View	12
Central	9		Multiple Buildings	10
Clover Basin	12		Niwot ES	11
CNEL	1		Niwot HS	32
Coal Ridge MS	5		Northridge	8
COEL	1		Olde Columbine HS	3
Columbine	10		Prairie Ridge	10
CRMS	8		Red Hawk	8
Eagle Crest	13		Rocky Mountain	7
East Bus Terminal	1		Sanborn	10
ECES	1		Silver Creek HS	24
Education Services Center	22		Skyline	24
Erie ES	12		Spark!	7
Erie HS	19		Student Services	24
Erie MS	18		Sunset	15
Fall River	12		Thunder Valley	24
Frederick HS	24		Timberline	25
Hygiene	9		Trail Ridge	15
Indian Peaks	10		Unidentified	31
Learning Services Center	4		Westview	19

2. Select the activities below during which you think about water conservation at your school. Select all that apply.

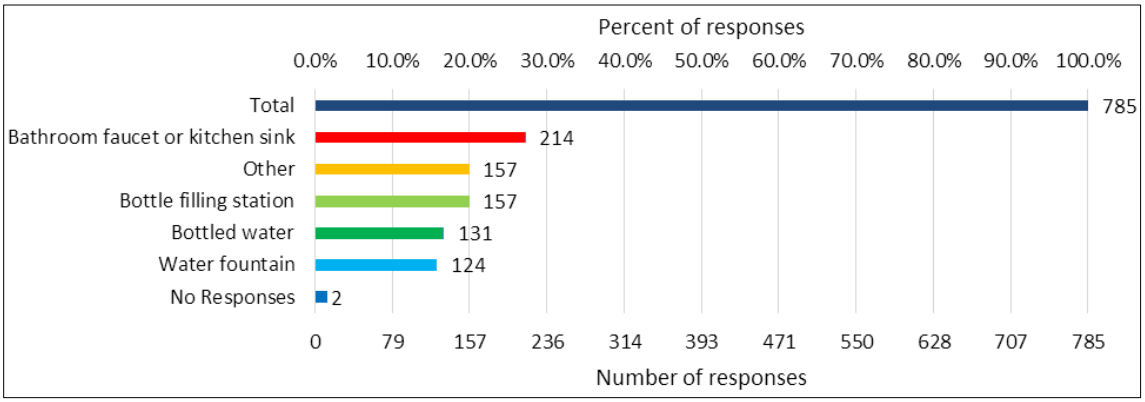


Responses indicate that a significant number of respondents think about water conservation when washing their hands, drinking water, cleaning items in the sink, and flushing the toilet. Below is a list of ways to be more water-efficient in day-to-day work activities.

<u>Suggestions to be more water-efficient in your day-to-day work activities</u>:

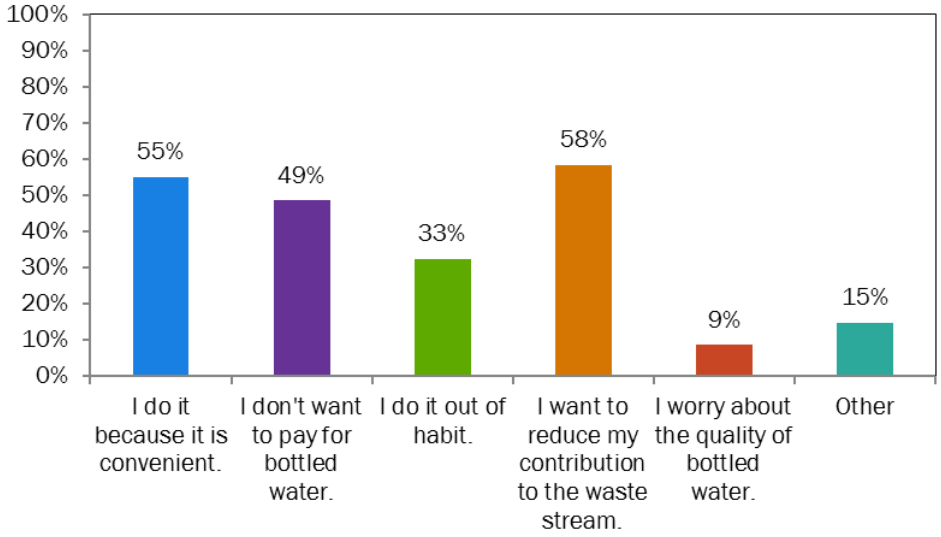
- ✓ When washing your hands, if possible, turn the water off when you are lathering up with soap.
- ✓ Often, the root-cause of needing to re-flush a toilet is over-filling it with toilet paper. Use only what you need.
- ✓ If you have to clean items in the sink while at work, consider using a tub or bowl to fill with the hot, soapy water, rather than just allowing the water to run while cleaning each item individually.
- ✓ Use a dishwasher if available. When run at full capacity, dishwashers are typically more efficient than hand-washing dishes.
- ✓ Rather than dumping out the last few swigs of your water bottle into the sink, why not give that to your plants? Or pour it outside on the landscape?

3. What is your primary source of drinking water at work?



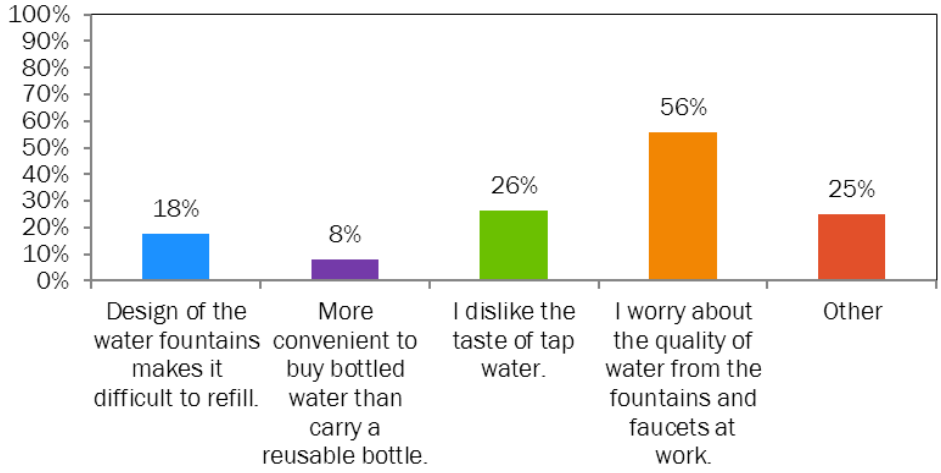
Responses indicate that 83% (652 respondents out of 785) choose to drink water from a source other than bottled water (mainly refilling bottles at various stations). There are many reasons to steer clear of bottled water: it's costly, has a carbon footprint, and is not necessarily better than tap water. Refilling a reusable bottle is affordable, better for the environment, and often convenient.

4. **If you REFILL a reusable water bottle at work, select the answers below that most closely describe the reasons that you refill your water bottle. Select all that apply.**



Out of 785 respondents, 642 refill a reusable water bottle for three main reasons: convenience, affordability and the environment.

5. **If you do NOT refill a reusable water bottle at work, please select the answers below that most clearly describe the reasons why you do not. Select all that apply.**



Out of 785 respondents, 254 do NOT refill a reusable water bottle **at work** for the above reasons (they choose to bring bottled water or filtered water from home). The chart indicates that 56% (142 respondents) worry about the quality of water from the fountains and faucets. While this is a very small fraction of the entire district staff population (about 3%) we take this feedback seriously.

Facilities within the SVVSD receive its drinking water from one of three providers depending on its location; The City of Longmont, Left Hand Water District, or Longs Peak Water District. In order to ensure that our tap water is safe to drink, the Environmental Protection Agency (EPA) strictly enforces federal regulations which limit the contaminant concentration in water provided by public water systems. All water treatment plants, when operating properly, reduce the amount of contaminants in the source waters to levels that meet, or exceed, all Federal and State regulations. Drinking water, including bottled water, may reasonably be expected to contain at least small amounts of some contaminants. The presence of contaminants does not necessarily indicate that the water poses a health risk. For more information on your drinking water quality, please see the annual report links below.

SVVSD is committed to providing safe drinking water and continually seeks to maintain a high-level of confidence within the community, by keeping staff, students, and parents well-informed regarding water quality, water supply and conservation issues.

Here are links to different water quality reports from the municipalities across the district.

- City of Longmont Water Quality Report
- City Lyons Water Quality Report
- Town of Erie Water Quality Report
- Town of Firestone Water Quality Report
- Left Hand Water District Water Quality Report
- City of Boulder Water Quality Report

By the end of 2017, every site should have at least one bottle filling station. To date, we have received very positive reviews of the existing units and we look forward to providing more throughout the district.

6. If you are an educator within the district, do you currently teach any lessons about or related to water (e.g. water cycle, water quality, history of water/environment, etc.)? If you do, please describe the lesson topic/focus in the space provided below.

About one-fourth of the survey respondents currently teach lessons related to water – which is great! Visit the SVVSD water blog for access to many water-based topics and information for classroom resources: https://blogs.svvsd.org/water/.

Examples of lesson topics being taught in SVVSD (and lots of others!):

- The Water Cycle
- Role of Water in the Body
- Wastewater Treatment
- Water Conservation/Preservation (Big Thompson River Project)
- Watersheds
- Water Contamination/Pollution
- Water Quality & Access
- Water Law
- Water Usage & Rights
- Chemistry of Water
- States of Water

7. Are you aware of any signs at your school that promote water use awareness? If so, please detail what they say and where they are in the space provided below.

Out of the 785 responses, 85% said they were not aware of signs promoting water awareness. There are no standard signs used by the district but we encourage each school to motivate water conservation based on what works best for their unique culture and needs. If we can offer any help or guidance, please contact Dara Ward at Ward_Dara@svvsd.org.

Signs that exist:

- Turn off the water
- Green Star School messages
- Bottle filling stations state how many bottles eliminated from the waste stream
- Students design posters about conserving water distributed around the school
- How to use low-flow toilets
- STEM projects connected to saving natural resources

8. If you were to find a water leak at your school, do you know how to report it so that it can be fixed?

We are pleased to learn that 77% of the respondents know how to report a water leak.

The process to report a water leak is as follows:
Identify the fixture location and let your Head Custodian or Secretary know so he/she can submit a work order.

9. If you were to find a leak outdoors, including a broken sprinkler head on district property, do you know what to do to report it?

Sixty-seven (67) percent of respondents know what to do if they spot a leak outdoors.

The process to report a water leak that's outdoors is as follows:
Identify the location of the leak and let your Head Custodian or Secretary know so he/she can submit a work order.

10. Do students know what to do if they discover a water leak at school?

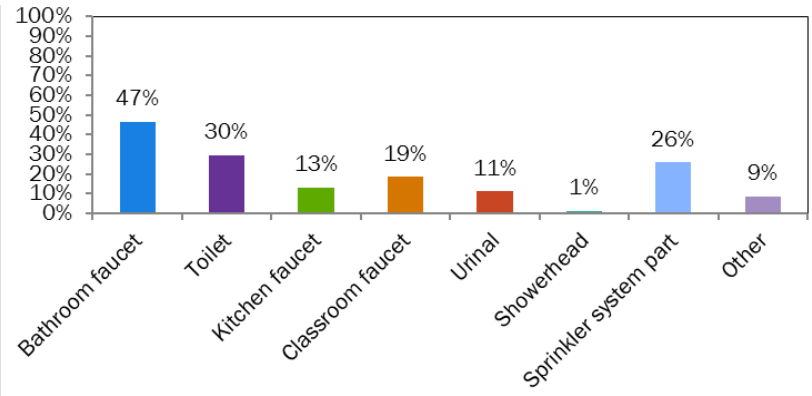
About half of the respondents selected 'I do not know'. Students can be leak detectives too! If you are an educator, consider providing your classroom with an outlet for reporting water waste and leaks. It will be a great learning opportunity for the students, and it will help to conserve our precious resource. Empower students to identify and report problem areas either to a teacher or staff member or directly to the Head Custodian or Secretary.

11. Have you ever noticed water leaking from a faucet, water fountain, sprinkler system or other fixture at school?

Leaks happen and we are grateful for building occupants letting us know if you notice one right away. Even if the leak seems small, it can quickly add up to a lot of wasted water if it goes unfixed. About half of the respondents have noticed a leak.

12. If you have noticed water leaking from a fixture, what kind of fixture was it (choose all that apply) and please describe what you did about the leak in the space provided below.

Bathroom faucets, sprinkler systems and toilets are the most common fixtures noted for leaks in the district. While our maintenance and custodial team work hard to catch these leaks, they likely won't find all of them without the issues being reported.



13. If you have reported a water issue, was the response adequate?

It appears that the response rate of our maintenance and custodial team is generally adequate with 62% stating 'yes', 13% stating 'no' and 25% stating 'I don't know'. If there are concerns about work orders, please

ask your Head Custodian or Secretary to look up the status. From time to time, a work order may have been marked closed because the problem was believed to have been resolved. However, if the issue persists, do not hesitate to submit another work order with further details.

Responding to your comments:

- Irrigation Systems
  - The district is unique in that 45% of sites are irrigated with ditch (non-potable) water. We are fortunate to have established water rights a long time ago. The remaining 55% use domestic water. Often, the water being used to irrigate our grounds is ditch water as we are downstream from agriculture land.
  - District irrigation specialists visit sites at least once per week, and sometimes daily at larger sites, to ensure that sprinklers are operating properly and to check for broken sprinkler heads or any other issues. The team continuously reviews the system to optimize the use of rain sensors and the ability to control zones remotely.
- Bottle filler stations
  - All sites should have at least one by the end of 2017. Please note that filters are not installed on these units as our water supply meets high potable standards.
- High Efficiency fixtures
  - The district fully supports the proliferation of high efficiency faucets, toilets, and other products to optimize water use. We strive to implement these fixtures wherever possible and as opportunities arise while balancing budget, function, and district needs.
- Leaks or faulty water fixtures
  - If you see any issues, please report them via the work order system. We appreciate your help in bringing issues to our attention so we can resolve them as quickly as possible.
- Recycling is single stream – all recyclable materials can be placed in the recycling containers; these are not paper specific. Place any #1-#7 items, paper, bottles and cans in these bins. View svvsd.org/green/reduce-reuse-recycle for more information.
- Nutrition Services/Cafeteria Service Items
  - Water bottles are sold in the cafeteria so that staff and students have the option of purchasing water. This has been made available at the request of building occupants and as a healthy beverage option. Nutrition Services only stock water bottles that are recyclable. We encourage the use of water bottle filling stations and reusable water bottles when possible.
  - Nutrition Services strives to stock the cafeteria with environmentally friendly products while balancing budgets and resources. We can successfully offer environmentally friendly durable products if schools are responsible with these items and do not throw them away as they cost considerably more than disposables. Contact Nutrition Services if you would like to discuss options for your cafeteria products. We support the transition to reusable trays and silverware as long as schools take ownership and commit to the longevity of these items.

Further Information & Classroom Resources:

- SVVSD water blog: https://blogs.svvsd.org/water/
  - Vast array of educational resources and information
- Green SVVSD website: www.svvsd.org/green
  - Showcases the Energy & Sustainability Department's offerings, programs, achievements and more!
- SVVSD science blog: https://blogs.svvsd.org/science/

Conclusion:

Our district strives to use water efficiently and effectively at our facilities both indoors and outdoors. The study and survey has validated many of our practices and has also shed light on areas for improvement. We welcome your feedback and appreciate your help in advancing efforts to use our natural resources wisely.