

# **“Water Checks”- Free Water Audits for Homeowners and Large Public and Private Properties**

## ***Slow the Flow, Save H<sub>2</sub>O***

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### **Abstract**

The water check program has been a well received public relations campaign enabling residential homeowners and managers of large public and private properties to successfully cut back on water waste. The water check program was initiated in 1999 as part of Utah's *Slow the Flow, Save H<sub>2</sub>O* water conservation program and has continued to grow through 2006. The program was made free to the public by the partnering agencies of the Central Utah Water Conservancy District, serviced by Utah State University Extension. Between 1999 and 2005, a total of 7,960 residential sites and 382 large water use properties have been evaluated for distribution uniformity, precipitation rate, sprinkler head pressure, turf root depth, soil type, and irrigation scheduling. Water use records were tracked for the year before the irrigation audit and at least three years after the initial audit for the residential participants. The average residential property reduced water consumption by 9.6%, 12.4%, 22.2% and 25.6% respectively for the audit year and the following three years. The large properties were divided into nine categories, with each category responding somewhat differently to the audit (usually dependent upon the budget for a system tune-up). Small businesses hardly saved any water, while parks, schools and churches saved about 20% over a two year period. Large public and private properties reduced outdoor water consumption over the growing season by an overall average of 15% during the audit year combined with the year following the audit.

### **Introduction**

The *Slow the Flow, Save H<sub>2</sub>O* water check program has been instrumental in facilitating the state of Utah's long-term water conservation goals. Water checks offered free to the public for both residential and large public and private properties followed the methods for water audits outlined by the National Irrigation Association. Information about operational irrigation systems obtained from water checks as well as water savings realized from the program was collected and compiled by Utah State University Extension and funded by the Central Utah Water Conservancy District. The compilation of the data collected from the 7,960 residential sites and the 382 large properties is shown in the first two tables. Comprehensive and detailed reports outlining program need and background, methodology, and results as well as special studies for both the residential and large water check programs can be obtained in the following Utah State University Extension Publications: NR/Water Conservation/2006-01, *Data Summary of Water*

*Audits Conducted for Large Water Users Through 2005; NR/Water Conservation/2006-2, Residential Water Check Summary 1999 Through 2005.*

Data from the Utah Division of Water Resources in 1999 indicated that about 50% of Utah's culinary, treated water was used outdoors, primarily in the landscape (*Utah Division of Water Resources, 2003*). Outdoor water waste was targeted by offering irrigation system audits or "water checks" free to the public under a grant provided to Utah State University Extension by the Central Utah Water Conservancy District and its partnering agencies. The water check program was initiated in 1999 as part of Utah's *Slow the Flow, Save H<sub>2</sub>O* water conservation program and has continued to grow through 2005 (*Jackson and Rosenkrantz, 2004*). The *Slow the Flow, Save H<sub>2</sub>O* water conservation program, including water checks was adopted and endorsed as the statewide water conservation program in 2003 by Utah's Governor, Mike Leavitt (*Jackson and Mohadjer, 2003*). Water audits that were performed for commercial, institutional, industrial, large private and public properties were coined "large water audits" for the purpose of differentiating the large water use properties from a residential water check program also serviced by Utah State University Extension. (*Jackson, 2000; Lopez and Jackson, 2004*).

### **Information on Irrigation Systems**

Data collected for operational irrigation systems for both residential properties (**Table 1**) as well as large water use properties (**Table 2**) is summarized in the tables below.

**Table 1** shows the characteristics of an average residential site receiving a water check along the Wasatch Front Mountains. Operational sprinkler head pressure, irrigation system distribution uniformity (irrigation system efficiency) and precipitation rate (system output) were particularly useful indicators of how water could be saved in the landscape. Residents received advice on water conservation based on the results of these indicators. Information from the number of people per household was useful in calculating the *per capita* water use.

**Table 1 Residential Water Check Participant Sprinkler Summary**

<b>Characteristics of an Average Residential Water Check</b>			
<b>Criteria</b>	<b>Average</b>	<b>High</b>	<b>Low</b>
# in Household (Summer)	3.6	18	1
# in Household (Winter)	3.6	18	1
Lot Size (Sq. Ft.)	14,242	43,560	560
Landscape Size (Sq. Ft.)	8,631	33,461	299
Hardscape Size (Sq. Ft.)	5,612	23,444	90
Percentage of Lot Landscaped	60%	91%	12%
Root Depth (inches)	5.8	26.8	0.5
Head Pressure Fixed (psi)	48.8	132.6	9.6
Head Pressure Rotor (psi)	50.4	140.3	15.8
Distribution Uniformity Fixed (%)	58%	93%	7%
Distribution Uniformity Rotor (%)	59%	95%	5%
Precipitation Rate Fixed (in/hour)	1.4	4.4	0.1
Precipitation Rate Rotor (in/hour)	0.7	3.5	0.1

1999-2005 Water Check Database of 7,960 Water Checks

PSI= pounds per square inch

Fixed= small, non rotating fixed sprinkler heads

Rotor= large, rotating sprinkler heads

**Table 2 Large Water Check Participant Sprinkler Information Summary**

<b>Large Water Check Sprinkler Data Averages 2001-2005 Participants</b>							
<b>Property Type</b>	<b>Rotor Data</b>			<b>Fixed Data</b>			<b>Root Depth</b>
	<b>PSI</b>	<b>PR</b>	<b>DU</b>	<b>PSI</b>	<b>PR</b>	<b>DU</b>	
<b>Apartments</b>	53	0.6	53	44	1.6	57	4.9
<b>Businesses</b>	58	0.6	56	52	1.6	57	4.3
<b>Churches</b>	55	0.7	61	70	1.8	59	4.7
<b>Golf Courses</b>	71	0.6	67	n/a	n/a	n/a	3.5
<b>HOA'S</b>	58	0.7	57	53	1.6	55	4.7
<b>Public Facilities</b>	52	0.6	59	52	1.5	53	4.6
<b>Parks</b>	65	0.5	55	60	1.5	46	5.2
<b>Schools</b>	56	0.5	55	55	1.6	53	5.1
<b>Database AVG</b>	<b>59</b>	<b>0.6</b>	<b>58</b>	<b>55</b>	<b>1.6</b>	<b>54</b>	<b>4.6</b>

PSI= pounds per square inch

PR= Precipitation Rate, system output rated in inches per hour

DU= Distribution Uniformity, system efficiency as percentage from 0-100%, with 70% or greater considered efficient

Fixed= small, non rotating fixed sprinkler heads

Rotor= large, rotating sprinkler heads

For the purposes of data summarization, the 382 participants in the large water audit program were placed into categories. Number of audits completed within each category is listed in parentheses: Apartments (21), Businesses (57), Churches (19), Golf Courses (6), Homeowner Associations (60), Public Facilities (57), Parks (107), and Schools (53), along with two private properties deemed as “Others.” **Table 2** provides a comprehensive comparison of sprinkler and landscape characteristics among the various property types that were among the large private and public properties audited. This information will continue to increase in importance as water conservation practices in the state become more prolific.

Catch cup tests from the large properties revealed that the average precipitation rate (system output) for rotor heads (large, rotating heads) was 0.6 inches per hour with an average distribution uniformity (system efficiency) value of 58%. The average precipitation rate for fixed heads (small, non-rotating heads) was 1.6 inches per hour, with an average distribution uniformity value of 54%. This data for sprinkler precipitation rate and distribution uniformity values represents 830 total catch cup tests for rotor heads and 534 total catch cup tests for fixed heads from the properties tested.

## Water Conservation

The following tables show the water savings realized as participants in both the residential and large water check programs followed recommendations provided for outdoor water conservation. Water use records from both property types were obtained and evaluated over several years and were compared to water use prior to the properties receiving a water check. **Tables 3 and 4** show savings realized by residential properties and **Tables 5 and 6** show savings from large private and public properties.

### Residential Water Savings

Irrigation system audits concentrated on outdoor water conservation. The first column in **Table 3** shows the actual year the water check evaluation was completed for the residential properties. The second column shows the number of 1,000 gallon units used on the average, of all water check participants for the year before the audit. Column 3 shows the average number of gallons used by all the participants during the year of the audit and continues for the following four years after the audit in the remaining columns. These numbers include both indoor and outdoor water use and vary by the size of the irrigated landscape. By this method, the 4,366 participants in the water consumption database saved an average of 9.6% the year of the audit followed by an additional reduction of 3.1% the year following the audit. The bottom line of **Table 3** shows that the water check program participants conserved about 20% over a five year period. Water conservation continued after the year of the water check. A year of wait time will be needed to determine if the water conservation trend will continue into the wet years of 2005 and 2006.

**Table 3 Residential Participant Water Savings Total Water Use – May through October**

<b>Total Water Use - May through October</b>					
<b>YEAR</b>	<b>YEAR BEFORE</b>	<b>AUDIT YEAR</b>	<b>1st year after audit</b>	<b>2nd year after audit</b>	<b>3rd year after audit</b>
<b>2000</b>	197.9	195.5	201.3	161.6	151.2
<b>2001</b>	227.1	222.2	194.3	167.4	171.6
<b>2002</b>	237.2	193.1	187.9	183.1	171.7
<b>2003</b>	215.8	193.6	192.8	177.9	
<b>2004</b>	218.4	202.9	194.8		
<b>2005</b>	233.4	195.2			
<b>AVERAGE</b>	<b>221.7</b>	<b>200.4</b>	<b>194.2</b>	<b>172.5</b>	<b>164.8</b>
<b>% SAVED FROM PREVIOUS YEAR</b>	<b>100.0%</b>	<b>9.6%</b>	<b>3.1%</b>	<b>11.2%</b>	<b>4.5%</b>
<b>% SAVED FROM YEAR 2000</b>	<b>100.0%</b>	<b>9.6%</b>	<b>12.4%</b>	<b>22.2%</b>	<b>25.6%</b>

Data is in 1,000 Gallon Units

Data includes both Indoor and Outdoor Water Consumed Each Year

Year Before Audit Data is Specific for the Participants by Year

Before the Water Check

Database (4,366 records) Sorted by Year of Water Check

**Table 4** uses the same format (summarizing water use before the water check and after a water check) demonstrating water conservation in the landscape over the entire growing season for residential properties. With this method, the amount of water used outdoors required calculation. This was not always an easy task since some water providers did not always read the water meters on a monthly basis. Often times, the water consumption values provided by the water districts for the winter months was an estimate with corrections made in later months. With this method of calculation (outdoor water use) the results indicate a saving of 8.2% the year of the audit and 2.0% the year following the audit. The final result was about an 18% reduction in water use over a five year period. In the Water Consumption database, outdoor water use is separated from indoor water use. The *Slow the Flow, Save H<sub>2</sub>O* water conservation program includes both indoor and outdoor programs along with demonstration gardens, alteration of landscapes at residential sites, rebate options and other programs. The residential water check program was specifically designed to improve irrigation systems and alter the lawn watering

schedule. When comparing **Table 3** and **Table 4** it is evident that some water was conserved indoors as well as outdoors.

**Table 4 2005 Database Before and After for Residential Water Check Records**

<b>Outdoor Water Use – May through October</b>					
<b>YEAR</b>	<b>YEAR BEFORE</b>	<b>AUDIT YEAR</b>	<b>1st year after audit</b>	<b>2nd year after audit</b>	<b>3rd year after audit</b>
<b>2000</b>	168.2	151.0	173.1	160.1	167.0
<b>2001</b>	179.8	175.3	151.7	146.0	147.2
<b>2002</b>	186.8	171.3	151.1	152.9	139.8
<b>2003</b>	165.8	149.7	155.8	145.3	
<b>2004</b>	159.0	135.8	133.4		
<b>2005</b>	160.2	152.8			
<b>AVERAGE</b>	<b>170.0</b>	<b>156.0</b>	<b>153.0</b>	<b>151.1</b>	<b>151.3</b>
<b>% SAVED FROM PREVIOUS YEAR</b>	<b>100.0%</b>	<b>8.2%</b>	<b>1.9%</b>	<b>1.3%</b>	<b>-0.2%</b>
<b>% SAVED FROM YEAR 2000</b>	<b>100.0%</b>	<b>8.2%</b>	<b>10.0%</b>	<b>11.1%</b>	<b>11.0%</b>

Data in 1,000 Gallon Units  
 Database (4,366 records) Sorted by Year of Water Check

### **Water Savings by Large Properties**

Large private and public properties were able to save a significant amount of water as well. Outdoor water consumption records were available for 189 of these large water use properties. Large water users were able to reduce outdoor water use by an average of 8.2% the year of the audits. These water and landscape managers continued to conserve water by 11.1% the following year and by 18.4% the second year after the audit. This is a total of about 37% reduction during the drought over a three year period.

### **Data Summarization**

Calculation of water conserved from irrigation water audits can vary by the methods used for calculation. Three-year water records for 189 properties were evaluated in several ways as shown in **Table 5** which includes: 1) total gallons used per property 2) total

gallons used per acre 3) outdoor gallons used 4) outdoor gallons used per acre 5) inches of water used per acre 6) percent reduction in evapotranspiration (ET).

**Total Gallons Used per Property:** The first row in **Table 5** shows the evaluation using the total number of gallons used per property for each of the three years. This number includes both indoor and outdoor water use and varies by the size of the irrigated landscape which ranged from 0.2 of an acre for a small business up to 388 acres for a golf course. By this method, the 189 properties in the water record database saved an average of 7.8% the year of the audit and followed by another reduction of 7.4% the year following the audit. By this method of calculation, the large golf courses and parks had more influence on the average than the smaller businesses and apartment complexes.

**Total Gallons Used per Acre:** The second method of evaluation reduces the variation caused by property size through calculating the total gallons used per season per one acre of landscape. Results from line two of **Table 5** indicate a reduction in water use by 5.8% the year of the audit. The year following the audit, water was reduced by 2.0% and shows less savings than total gallons alone.

**Outdoor Gallons Used:** As irrigation system audits concentrated on outdoor water conservation, line three of the table is based only on outdoor water used during the growing season. With this method, the amount of water used outdoors required calculation. This was not always an easy task since some water districts did not read the water meters on a monthly basis. Often times, the water consumption values provided by the water districts for the winter months were estimated with corrections made in later months. This method of calculation (outdoor water use) indicates a savings of 8.2% the year of the audit and 11.1% the year following the audit resulting in 19.4% reduction in water use over a two year period.

**Outdoor Gallons Used per Acre:** Line 4 shows outdoor gallons used on a per acre basis. Again this method lessens the influence of property size on average savings, indicating that properties were able to save 14.8% over two years.

**Inches of Water Used per Acre:** The fourth set of calculations converted outdoor gallons of water used into inches for use in comparison to evapotranspiration values. The results of calculation through this method were very close to the outdoor gallons of water used.

**Percent Reduction in Evapotranspiration (ET):** Outdoor water use can be evaluated through comparing usage to the turfgrass water requirement (net  $ET_{turf}$ ). This comparison is valuable because it accounts for variability in weather patterns which may influence irrigation schedules. For this study a comparison was made to the net  $ET_{turf}$  value for each year of water use. Since net  $ET_{turf}$  values change each week, month and year, this set of calculations has the most room for error due to the number of calculations and conversions required. Additionally, the method is not as consistent as the others due to the fact that ET changes yearly, thus the comparison the year before, of and after the audit are not compared to the same standard. The average property in the database saved



2.7% of ET the year of the audit and only 3.9% the following year indicating a total savings of 6.6% over the two year period.

**Table 5 Large Water Checks: Water Saved by Different Calculation Methods**

<b>2001-2004 Water Savings Summary</b>			
<b>Percent Water Saved by Different Calculation Methods</b>			
<b>Calculation Method</b>	<b>Percent Water Saved Audit Year</b>	<b>Percent Water Saved Year After Audit</b>	<b>Percent Saved Over 2 Years</b>
<b>Total Gallons Used per Property (indoor + outdoor)</b>	7.8%	7.4%	15.1%
<b>Total Gallons Used per acre (indoor + outdoor)</b>	5.8%	2.0%	7.8%
<b>Outdoor Gallons Used</b>	8.2%	11.1%	19.4%
<b>Outdoor Gallons Used per acre</b>	7.2%	7.6%	14.8%
<b>Inches of Water Used per acre</b>	7.3%	7.6%	14.9%
<b>Percent Reduction in Evapotranspiration (ET)</b>	2.7%	3.9%	6.6%
<b>Database of 189 complete water use records with information before audit, year of the audit and the year following the audit</b>			

Properties audited saved the most water the year of and the year after the water audit, **Table 6**. One concern among those involved with the water audit program was if participants would be able to maintain water savings in the future. Preliminary data for properties with more than three years of data indicate that properties should be able to maintain the savings as shown in **Table 6**. For this table the average outdoor gallons per acre used per property was summarized by the number of years for which data were available. Properties with four and five years of data show that water consumption varies by an average of only 3% following the initial two years of savings.

The data in **Table 6** is calculated as outdoor gallons consumed per acre over the growing season. This table also demonstrates how values can change as the size of the database increases. As more information is obtained from properties receiving water audits, the conclusion from the 34 audits with four years of post-audit consumption numbers should be sustained showing that properties continue to save water after an audit. At this point it appears that water conservation from the water audits is sustained for more than one year.

**Table 6 Maintained Water Savings**

<b>2001-2004 Maintained Water Savings</b>					
<b>Water Saved by Year: Average Outdoor Gallons per Acre</b>					
<b>Summary Category</b>	<b>Year Prior to Audit</b>	<b>Year Of Audit</b>	<b>Year After Audit</b>	<b>Two Years After Audit</b>	<b>Three Years After Audit</b>
<b>189 Audits With 3 Years of Data</b>	1,699,770	1,576,665 <b>(7.3%)</b>	1,457,169 <b>(14.3%)</b>	n/a	n/a
<b>72 Audits With 4 Years of Data</b>	1,848,402	1,693,937 <b>(8.4%)</b>	1,580,821 <b>(14.5%)</b>	1,509,859 <b>(18.3%)</b>	n/a
<b>34 Audits with 5 Years of Data</b>	1,691,297	1,446,174 <b>(14.5%)</b>	1,298,550 <b>(23.2%)</b>	1,291,730 <b>(23.6%)</b>	1,261,078 <b>(25.4%)</b>

**Actual Acre Feet of Water Saved by the Water Check Program**

The following tables summarize the water saved from both types of water checks (water checks for residential and water audits for large properties) as shown in acre feet.

Water savings realized from residential water checks is shown in **Table 7**. If each of the 7,960 participants in the residential water audit program from 2000-2005 saved the average amount of water per acre discussed above, a total of 386,152 gallons per acre could be saved each year. When multiplied by the 1,577 total acres maintained by the 7,960 participants, a total of 1,869 acre feet of water could be saved each year (Utah State University Extension Summary, *Residential Water Check Summary 1999 Through 2005*).

Likewise, if each of the 382 participants in the large water audit program from 2001-2005 saved the average amount of water per acre discussed above, a total of 121,300 gallons per acre could be saved each year. When multiplied by the total acres of 3,046 maintained by the 382 participants, a total of 1,134 acre feet of water could be saved each year. The average amount of water per acre indicates the average savings from the participants evaluated from 2001-2004 for which water use records could be obtained (Utah State University Extension Publication NR/Water Conservation/2006-01, *Data Summary of Water Audits Conducted for Large Water Users Through 2005*).

**Table 7** Water Savings by Residential Water Check Participants Shown in Acre Feet

<b>Average Yearly Water Savings by Residential Water Check Participants</b>	
<b>Total Number of Audits</b>	7,960
<b>Total Landscaped Acres for 7,960 Audits</b>	1,577
<b>Average Gallons Saved per Acre per Year</b>	386,152
<b>Total Savings (Acre Feet)</b>	1,869

**Table 8** Water Savings by Large Water Check Participants Shown in Acre Feet

<b>Average Yearly Water Savings by Large Water Check Participants</b>	
<b>Total Number of Audits</b>	382
<b>Total Landscaped Acres for 382 Audits</b>	3,046
<b>Average Gallons Saved per Acre per Year</b>	121,300
<b>Total Savings (Acre Feet)</b>	1,134

## Conclusions

An extensive radio and television water conservation campaign was initiated in 1999 when a dry year turned into a six year drought. Irrigation system audits of residential and commercial properties were made free to the public by the Central Utah Water Conservancy District and its partners.

The results of this water conservation study are unique as they reflect tangible, real-life situations where beneficial changes were made to watering habits and where data was collected for existing, functioning irrigation systems. Although the nature of this study made it impossible to control all aspects of the data collection process from six counties and 32 cities in the state of Utah, adaptability as well as consistency and quality from all contributors to this project proved effective.

The overall objective of this study was to determine the practicality of reducing landscape water use through recommending irrigation scheduling for turf based on actual irrigation system precipitation rates and historical evapotranspiration data. Data demonstrates that landscape water use could be reduced as participants followed the site specific recommendations provided to them through participation in the water check program (*Jackson and Leigh, 2004; Lopez and Jackson, 2004*).

Both the residential (water check) and the large property (water audit) programs were successful in terms of educating the public on preventing outdoor water waste. The water districts determined them to be an effective public relations campaign. The program enabled both residents and managers of large landscapes to successfully cut back on water waste by at least 15%.

Modified irrigation water audits are now being conducted in several other states with similar results (*Mecham, 2004; Graham and Lander, 2005*).

## Bibliography

- Graham, T., and Lander, P. 2005. Slow the Flow Colorado Irrigation Audits. 2005 Proceedings, National Irrigation Association, 2005 Conference, Phoenix, Arizona.
- Jackson, E. K. 2000. Culinary Water Waste Along the Wasatch Front. 2000 Proceedings, Utah Water Users Association, 2000 Conference, St. George, Utah.
- Jackson, E. K., and Leigh, J.R. 2004. Irrigation Scheduling for Large Water Users.
- Jackson, E. K., and Mohadjer, P. 2003. Saving Utah Water in the Fifth Year of Drought. 2003 Proceedings, National Irrigation Association, 2003 Conference, San Diego, CA.
- Lopez, R. M., and Jackson, E. K. 2004. Ten Schools Tune-up Irrigation Systems.

Proceedings, Extension Western Region Professional Improvement Conference. 2004, Woodland, California.

Mecham, B. 2004. Using Distribution Uniformity to Evaluate the Quality of a Sprinkler System. Proceedings, National Irrigation Association, 2004 Conference, Tampa, Florida.

Utah Division of Water Resources, Utah's M&I Water Conservation Plan - Investing in the Future, Salt Lake City, Utah 2003.