Moab Water Conservation Plan 2016
City of Moab, Utah
12/13/2016
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CHECKLIST for Moab City 2016 / Water Conservation Plan

☑️ Current population: 5235 (per census.gov for 2015)

☑️ Number of M&I water connections, categorized by type:
  Residential 1575
  Commercial & Industrial 414
  Institutional 84

☑️ Total water deliveries, categorized by type: See Table 11.

☑️ Current water supply, categorized by source: See Table 4.

☑️ Projected needed supply to Build-out: see Table 12.

☑️ Projected supply that can be delayed by implementing conservation programs and practices.
  This is not fully defined in our report. See Tables 13 and 15.

☑️ Current per capita water use in gallons per capita per day (gpcd), categorized by type:
  See Table 7.

☑️ Compare to state’s 2010 average (potable 185, secondary 55 gpcd).
  (Residential Potable 127 gpcd, Residential Secondary 40 gpcd) See Table 8.

☑️ Conservation Goals: See Table 15 and “Conservation Goals” chapter.

☑️ Your current metering situation and replacement schedule.
  All but 20 meters are now radio-read, on track to replace all manual-read.

☑️ Your current pricing and rate structure: See Table 14.

☑️ List any water conservation ordinances currently implemented:
  See “Water Conservation Policies/Ordinances”

☑️ List any conservation measures currently implemented: See “Current Water Conservation”

☐ Do you have a Water Conservation Coordinator on your staff? No

☐ Proposed conservation measures: See “Water Conservation Goals”
INTRODUCTION AND EXECUTIVE SUMMARY

The State of Utah requires that each Utah community adopt a Water Conservation Plan every five years. The City of Moab last adopted a Plan in 2011; this Water Conservation Plan Update for 2016 considers new data for water supply and demand, trends for the last five years, and future growth and consumption trends for the Moab area. Based on this information, the 2016 Water Conservation Plan Update presents goals and objectives to ensure that Moab will meet its future water demand needs through water conservation programs and practices.

Emerging data from the ongoing study spearheaded by the Utah Division of Water Rights (DWRI), and undertaken by the United States Geological Survey (USGS), will inform this Water Conservation Plan. Additional data is drawn not only from Moab City sources but also from reports prepared by neighboring agencies, including Grand Water and Sewer Service Agency (GWSSA), Moab Irrigation Company (MIC), and the Grand County Community Development Department.

After decades of water supply projections showing abundant and pure culinary water, new data suggest an over-allocation of water rights and a trend of water use that appears to be significantly depleting available resources. Until recently, population projections have not taken into account denser zoning codes or the burgeoning tourist economy and its impact on per capita water usage.

The 2016 Water Conservation Plan Update sets forth an analysis of the period of 2011-2015. Average per capita consumption for 2015 was 282 gallons per person per day, when including all culinary consumption (residential and commercial), divided by the resident Moab population. This consumption requires significant conservation measures to reduce to meet State and Federal consumption goals. If only residential use is taken into account, the figure was much lower (146 gallons per person per day), but does not portray a realistic picture of total impact on the existing water supply. Further, at current usage rates which take into account current tourism impacts, this report suggests the City will exceed water supply when the population reaches 11,552 residents.

Overall, from 1998 to 2015, the total water delivered by the City of Moab culinary system has increased by 14%. Because previous water conservation plans have indicated abundant water supply and relatively low per capita water usage rates, the City of Moab has not been aggressive in pursuing water conservation measures.

Due to new information about culinary water scarcity and the fast pace of growth in the Moab residential and overnight accommodation industry, it is recommended that the City aggressively implement the water conservation measures outlined in this plan, capitalizing on changing perceptions of what is feasible, and concentrating on reduction in outdoor use of culinary water and implementing recommendations to reduce threats to water quality.
This plan recommends that the City aim for a 25% reduction in per capita water consumption over the next five years, and that the City reduce outdoor usage of culinary water by 25% in the same time period. In addition, it is recommended that the City integrate the water conservation goals set forth here and in the existing Moab sustainability plan entitled “2020 Vision”¹ into the City’s Master Plan and adopt a Water Conservation Mission Statement. Finally, it is recommended that the Council pursue an interlocal agreement to establish a regional water authority, and call upon community citizens to form a Moab City Water Conservation and Drought Management Committee.²

The format of this Plan includes data required by the Utah Department of Natural Resources that at times makes for arduous reading. When possible, data is presented in Acre-Feet (an acre-foot is equivalent to one foot of water over an area that equals one acre of land area, and one acre-foot equals 325,850.943 gallons. The primary audience for this report is the City’s leadership. The details starting with the section entitled “Intersystem Agreements” are perhaps most critical for consideration of future directions for Moab’s Water Conservation program.


² It is recommended that the City make use of the vast knowledge of local water and conservation experts to guide water management issues into the future. Washington County formed such a committee in 1993.
THE CITY OF MOAB AND ITS WATER SYSTEM

History, Government and Population

The City of Moab was incorporated in 1902. The 2015 City population was 5,235\(^1\). The City of Moab has a Council-Manager form of government, with five elected Council members serving at large and a separately elected Mayor.

The City’s resident population has ebbed and grown slowly over the past ten years, with total growth of 5.3%. At the same time, rapid growth of overnight accommodations has increased the number of connections drawing from Moab’s water supply. In addition, the population of unincorporated Grand County has increased along with non-resident tourist facilities. Altogether, the Moab Area Travel Council currently estimates there are approximately 4,000 overnight accommodation units in the Moab Valley.\(^4\)

This chart shows the City of Moab’s slow and steady population growth trend.

**Figure 1. Moab Population**

![Population chart](image)

The City’s build-out is projected as the City’s full growth potential, which is based on existing zoning.\(^5\) The City of Moab has anticipated additional culinary water demand created by limited annexations and/or higher density rezoning to occur in the future. Because of rapid growth outside the City limits, in addition to higher density rezoning that has occurred, it is important that the City anticipate

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\(^1\) Per Zacharia Levine, Grand County Community Development Director (2016-11-16)

\(^4\) Moab Area Travel Council: 3,938 total rooms, condominiums, and commercial campsites in Grand County (2016-11-29).

\(^5\) Build-out population (Zacharia Levine 2016-11-16)
drought conditions and development patterns that are different from those contemplated in the older build-out analyses, as well as other prospective factors that may affect water supply and distribution. It should be noted that the 2014 Spanish Valley Water Conservation Plan\(^6\) anticipates a population for unincorporated Grand County in the year 2060 at fewer than 6,000 persons, which is far lower than the eventual projected build-out population. In the GWSSA Culinary Water Master Plan of 2016, it is projected that the agency will exceed culinary water supply within twenty years.\(^7\) This build-out population does not account for available water resources. Potential production capacity is detailed later in this report.

**Table 1. Projected Population at Build-out (Moab and Grand County)**

<table>
<thead>
<tr>
<th>Area (Acres)</th>
<th>Population (2.34 avg. household size)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moab City</td>
<td>2,594</td>
</tr>
<tr>
<td>Unincorporated Grand County</td>
<td>98,725</td>
</tr>
<tr>
<td>Total Build-out Population</td>
<td>94,552</td>
</tr>
</tbody>
</table>

*Courtesy of Grand County Community Development*

**Moab Water Rights/Water Source Capacity**

Through its history, the City of Moab has acquired water rights and water source capacity to meet historically anticipated build-out projections.\(^8\)

Shortly after its incorporation in 1902, the City of Moab acquired an approximate half-interest in Skakel Spring, located behind the Grand Old Ranch House about a mile south of the Colorado River. The amount of the acquisition was 0.625 cubic feet per second (cfs). Skakel Spring was used as the culinary source for the City’s drinking water system installed in the original platted town blocks to the south. Outlying farmhouses utilized wells for water.

Contemporary with formation of the City, the MIC built a diversion dam on Mill Creek where the creek enters the east side of Spanish Valley, and currently provides irrigation water throughout the City and to unincorporated areas north and west of Moab City. Many residential lots in the original Moab City town blocks still have irrigation shares with which outside watering is done, with the water being delivered down the gutters of the town streets to inlets into yards.

When the uranium boom occurred in Southeast Utah after World War II, Moab’s population suddenly jumped from about 1,500 to 8,000. The City of Moab, motivated by severe water shortages during the boom which lasted into the early 1950s, acquired rights to underground water that exceeded culinary demand at what was then considered to be the City’s expected build-out. In 1955, the City

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purchased the 1,600-acre Lloyd Sommerville Ranch, which contained Sommerville #1, #2, #3, McKonkie, and Birch springs. The City sold most of the ranch lying west of the spring area to George White, and located the Moab City Cemetery, Old City Park (which contains McKonkie and Birch springs) and the Moab Golf Course (which contains the Sommerville #2 and #3 springs) on part of the remainder.

Water rights were also purchased subsequent to the boom, further augmenting supplies beyond anticipated demand. The City drilled six wells adjacent to the Sommerville #2 and #3 springs; from 1998 through 2005 only wells #6 and #10 have been pumped into the culinary system. The springs (including Skakel) and the wells are the City of Moab water supply source today. Water from the Sommerville Ranch springs historically filled the three City water storage tanks having 3,500,000 gallons—or 10.74 acre-feet (AF)—total capacity by gravity flow. In 1999 the City acquired the remaining interest of 0.626 cfs in Skakel Spring, and afterward rebuilt the Skakel Spring diversion structure to secure it from accidental or deliberate contamination. Full rights to Skakel were acquired by the City in order to supply future demand anticipated from annexation of commercial properties in the north US 191 corridor.

The City of Moab’s total water rights total 13.930 cfs, which is 6,251.78 gallons per minute (gpm) or 27.63 AF per day. The following charts provide a summary of Moab’s acquired (perfected) water rights, for both springs and wells:

Table 2. Municipal Springs (water rights perfected)

<table>
<thead>
<tr>
<th>Name of Spring</th>
<th>Water Right #</th>
<th>cfs</th>
<th>Limits</th>
<th>AF/YR available</th>
<th>Type of Right</th>
<th>Priority Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Skakel Spring</td>
<td>a29873</td>
<td>1.252</td>
<td>453.50 AF/YR Diversion; 236.62 AF/YR Depletion</td>
<td>236.62</td>
<td>Diligence claim</td>
<td>05-2105 = 1889 05-2103 = 1898 a29873 = 2/18/2005</td>
</tr>
<tr>
<td>Skakel Spring</td>
<td>05-2740</td>
<td>1.00</td>
<td>“remainder of flow”</td>
<td>723.91</td>
<td>Fixed-time application</td>
<td>1/27/1999</td>
</tr>
<tr>
<td>McConkie Spring</td>
<td>05-2007</td>
<td>0.21</td>
<td></td>
<td>152.02</td>
<td>Diligence claim</td>
<td>05-2007 = 1903</td>
</tr>
<tr>
<td>Sommerville Spring #1</td>
<td>05-2008 a30363 changed point of diversion</td>
<td>0.2</td>
<td>102 AF/YR; Period of Use: April 1 to October 31</td>
<td>102</td>
<td>Diligence claim</td>
<td>05-2008 = 4/15/1896 a30363 = 6/21/2005</td>
</tr>
<tr>
<td>Sommerville Springs #2, 3</td>
<td>05-251</td>
<td>0.207</td>
<td>Period of Use: November 1 to March 31</td>
<td>62.438</td>
<td>Application to Appropriate</td>
<td>10/20/1958</td>
</tr>
</tbody>
</table>

Springs sub-total: 2.662 cfs or approximately 1,928.48 AF/yr. When adjusted for seasonal use limits and maximum depletion limits listed on the State Department of Water Rights website, approximately 1,277.00 AF/YR are available for use.

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9 Water rights history (Zacharia Levine 2016-11-16)
NOTES:

1) Water rights for Skakel are held under three separate rights, updated in the table above.
2) Total diversion and depletion limits are set for Skakel via change form a29873 allowing a total depletion of 236.62 AF, while right 05-2740 is for the “remainder of flow”. It is unclear at this time whether Skakel spring’s total flow capacity is 2.252 cfs or if this additional right (05-2740) is to capture the remaining diversion flows of right a29873. More information is needed to clarify.
3) Sommerville Springs have seasonal restrictions, limiting each of the two listed rights to distinct seasons as Right 05-2008 limited to 4/1 to 10/31 (7 months) and Right 05-251 limited to 11/1 – 3/31 (5 months). Also, Right 05-2008 is listed as 0.2 cfs or 102 AF, meaning total production is 42.78 AF less than Use Rate/ Potential Production of 144.78 AF/yr at the listed flow rate.
4) Total cfs is 2.662 when only one Sommerville Spring right is included at a time to reflect distinct seasonal rights. See waterrights.utah.gov for more information.
5) Total AF from springs is 1,277.00 AF when adjusted for Limits to seasonal use and maximum depletion
6) Nearly all Spring and Well rights are appurtenant (linked) to each other. More research and knowledge of water rights are needed to fully understand how this influences total water rights and available water production from the sole-source aquifer

<table>
<thead>
<tr>
<th>Name of Well</th>
<th>Water Right #</th>
<th>cfs</th>
<th>AF/YR available (approximate)</th>
<th>Type of Right</th>
<th>Priority Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wells 4a, 5, 6, 7, 9, 11</td>
<td>05-169</td>
<td>3</td>
<td>2,173.34</td>
<td>Application to Appropriate</td>
<td>9/15/1955</td>
</tr>
<tr>
<td>Same</td>
<td>05-206</td>
<td>1.63</td>
<td>1,180.85</td>
<td>Application to Appropriate</td>
<td>10/7/1964</td>
</tr>
<tr>
<td>Same</td>
<td>05-716</td>
<td>2.256</td>
<td>1,634.35</td>
<td>Application to Appropriate</td>
<td>10/24/1968</td>
</tr>
<tr>
<td>Same</td>
<td>05-101</td>
<td>1</td>
<td>724.44</td>
<td>Application to Appropriate</td>
<td>1/27/1954</td>
</tr>
<tr>
<td>Same</td>
<td>05-183</td>
<td>1.114</td>
<td>807.03</td>
<td>Application to Appropriate</td>
<td>2/21/1956</td>
</tr>
<tr>
<td>Same</td>
<td>05-336</td>
<td>1</td>
<td>724.44</td>
<td>Application to Appropriate</td>
<td>4/14/1961</td>
</tr>
<tr>
<td>Well #10</td>
<td>05-429</td>
<td>1</td>
<td>724.44</td>
<td>Application to Appropriate</td>
<td>7/23/1962</td>
</tr>
<tr>
<td>West Park Well</td>
<td>05-1540</td>
<td>0.15</td>
<td>108.67</td>
<td>Application to Appropriate</td>
<td>10/12/1978</td>
</tr>
<tr>
<td>West Park Well</td>
<td>05-1744</td>
<td>0.118</td>
<td>85.48</td>
<td>Application to Appropriate</td>
<td>4/24/1980</td>
</tr>
</tbody>
</table>

Wells sub-total: 11.268 cfs = approximately 8,163.22 Acre Feet/yr

Notes:
Several of these Rights have been segregated from each other. 05-183 originally was for 5cfs; Right 05-206 was segregated in 1959 for 3.886 cfs (a27898), from which right 05-716 was segregated in 1968 for 2.256 cfs (a27898a). The current cfs attributed for each of these rights is depicted in the table above.
1) Water Rights in blue include information (in the listing on waterrights.utah.gov) about seasonal use restrictions for Spring #1 (05-2008) and Spring 2 and 3 (05-251), which appears to infer a hydrologic connection between the wells and springs. These rights total 97.6%, or 7,963.09 AF, of Well Rights. Figure 4 in the 2011 Update listed Production values for Well 6 and 10 only, while this table above highlights the interconnectedness of the majority of available rights to wells.
2) Water Right 05-716 lists three surface springs and three wells as the source. At this time, it is unclear how this right is executed in relation to the gravity use information provided in Figure 5. See “Comparison of Total Rights and Reported Usage in 2010” for more information about how this may influence use of available rights.
3) Language indicating “perfected and proving” comes from 2011 Update; it is unclear which Rights are still proving, and this should be investigated.
Current City of Moab Water Distribution System Configuration

The City of Moab supplies drinking water to almost all of the residents and businesses within the City. As noted, not all of the above-named water rights currently provide water into the Moab water distribution system. Some of these rights are seasonal. As indicated above, Moab also holds groundwater rights to six major wells that penetrate the aquifer. Only two of these wells are currently on line, and are only utilized during peak irrigation season. Water sources in the distribution system for the City of Moab vary seasonally. Moab obtains water from three wells and three springs during the summer months. From the north end of town, water from Skakel Spring is pumped through a chlorination station and into a one-million-gallon tank, which then feeds the Northwest Low pressure zone of the city. Moab City Springs One, Two and Three plus Moab City Wells Six and Ten south of Moab are channeled into pipes and flow into two gas chlorination stations. From each of these chlorination stations, water flows downhill to the City grid. Two one-million-gallon storage tanks are not in line with the main transmission lines, but branch off at the south end of the system.

The City of Moab contracted with the University of Utah Department of Civil and Environmental Engineering in 2010 to produce a report that looked at the utilization of water sources in the Moab water distribution system. According to the report, Moab at that time used less than half of the water sources allotted and developed for the City.\textsuperscript{10} The following table provides a current view of the water production of each of the in-service water sources for the City:

Table 4. 2011 and 2015 Annual Water Production and Utilization by Source (in Acre-Feet)

<table>
<thead>
<tr>
<th>YEAR 2011</th>
<th>Source</th>
<th>Volume Used Acre Feet</th>
<th>Potential Production Acre Feet</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Springs 1 and 2</td>
<td>840.23</td>
<td>840.23</td>
</tr>
<tr>
<td></td>
<td>Spring 3</td>
<td>636.76</td>
<td>636.76</td>
</tr>
<tr>
<td></td>
<td>Skakel Spring</td>
<td>317.29</td>
<td>711.98</td>
</tr>
<tr>
<td></td>
<td>Well 6</td>
<td>258.77</td>
<td>2418.28</td>
</tr>
<tr>
<td></td>
<td>Well 10</td>
<td>253.61</td>
<td>1126.28</td>
</tr>
<tr>
<td></td>
<td>TOTAL</td>
<td>2306.66</td>
<td>5733.53</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>YEAR 2015</th>
<th>Source</th>
<th>Volume Used Acre Feet</th>
<th>Potential Production Acre Feet</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Spring 1 and 2</td>
<td>634.25</td>
<td>634.25</td>
</tr>
<tr>
<td></td>
<td>Spring 3</td>
<td>510.63</td>
<td>510.63</td>
</tr>
<tr>
<td></td>
<td>Skakel Spring</td>
<td>272.73</td>
<td>711.98</td>
</tr>
<tr>
<td></td>
<td>Well 6</td>
<td>360.53</td>
<td>2418.28</td>
</tr>
<tr>
<td></td>
<td>Well 10</td>
<td>432.41</td>
<td>1126.28</td>
</tr>
<tr>
<td></td>
<td>TOTAL</td>
<td>2210.55</td>
<td>5401.42</td>
</tr>
</tbody>
</table>

\textsuperscript{10} Moab Culinary Water Distribution System Model Description and Analysis: Recommendations for Current and Future Improvements, 2010-01-15. C.D. Houdeshel and C.A. Pomeroy, University of Utah Dept. of Civil and Env. Engineering.
Drought conditions beginning in 1998 with a shift in the Northern Pacific Decadal Oscillation system\(^{11}\) in ocean currents caused a shift from water production from gravity sources to pumped sources. The amount of water pumped as a percentage of total water diverted changed dramatically in 2000. It was noted in the 2011 plan that diminished pressure due to reduced infiltration due to drought conditions takes two years to reach the point of discharge. Further research may be needed to determine this two-year assumption figure. The chart on the following page shows the City’s total water production over time, along with the percentage breakdown of pumped versus gravity sources and a comparison to pre-drought conditions:

Table 5. Total Water Production from Gravity and Pumped

<table>
<thead>
<tr>
<th>Year</th>
<th>Gravity - AF</th>
<th>Annual Gravity as % of 1998</th>
<th>Pumped - AF</th>
<th>Annual pumped as % of 1998</th>
<th>Total diversion - AF</th>
<th>Annual Diversion as % of 1998</th>
<th>% pumped</th>
</tr>
</thead>
<tbody>
<tr>
<td>1998</td>
<td>1,589.3</td>
<td>8</td>
<td>295.26</td>
<td>100.0%</td>
<td>1,884.63</td>
<td>100.0%</td>
<td>15.7%</td>
</tr>
<tr>
<td>1999</td>
<td>1,547.3</td>
<td>3</td>
<td>288.38</td>
<td>97.7%</td>
<td>1,835.72</td>
<td>97.4%</td>
<td>15.7%</td>
</tr>
<tr>
<td>2000</td>
<td>1,567.5</td>
<td>9</td>
<td>861.19</td>
<td>291.7%</td>
<td>2,428.78</td>
<td>128.9%</td>
<td>35.5%</td>
</tr>
<tr>
<td>2001</td>
<td>1,422.4</td>
<td>6</td>
<td>1,051.0</td>
<td>356.0%</td>
<td>2,473.52</td>
<td>131.2%</td>
<td>42.5%</td>
</tr>
<tr>
<td>2002</td>
<td>1,306.9</td>
<td>5</td>
<td>735.00</td>
<td>248.9%</td>
<td>2,041.95</td>
<td>108.3%</td>
<td>36.0%</td>
</tr>
<tr>
<td>2003</td>
<td>1,220.6</td>
<td>5</td>
<td>861.50</td>
<td>291.8%</td>
<td>2,082.15</td>
<td>110.5%</td>
<td>41.4%</td>
</tr>
<tr>
<td>2004</td>
<td>1,292.6</td>
<td>5</td>
<td>845.97</td>
<td>286.5%</td>
<td>2,138.62</td>
<td>113.5%</td>
<td>39.6%</td>
</tr>
<tr>
<td>2005</td>
<td>1,295.1</td>
<td>0</td>
<td>865.89</td>
<td>293.3%</td>
<td>2,160.99</td>
<td>114.7%</td>
<td>40.1%</td>
</tr>
<tr>
<td>2006</td>
<td>1,385.9</td>
<td>7</td>
<td>1,086.8</td>
<td>368.1%</td>
<td>2,472.85</td>
<td>131.2%</td>
<td>44.0%</td>
</tr>
<tr>
<td>2007</td>
<td>1,376.7</td>
<td>6</td>
<td>877.64</td>
<td>297.2%</td>
<td>2,254.40</td>
<td>119.6%</td>
<td>38.9%</td>
</tr>
<tr>
<td>2008</td>
<td>1,518.3</td>
<td>6</td>
<td>1,060.7</td>
<td>359.3%</td>
<td>2,579.09</td>
<td>136.8%</td>
<td>41.1%</td>
</tr>
<tr>
<td>2009</td>
<td>1,424.3</td>
<td>3</td>
<td>934.81</td>
<td>316.6%</td>
<td>2,359.15</td>
<td>125.2%</td>
<td>39.6%</td>
</tr>
<tr>
<td>2010</td>
<td>1,434.4</td>
<td>3</td>
<td>900.69</td>
<td>305.1%</td>
<td>2,335.12</td>
<td>123.9%</td>
<td>38.6%</td>
</tr>
<tr>
<td>2011</td>
<td>1,794.2</td>
<td>9</td>
<td>512.38</td>
<td>173.5%</td>
<td>2,306.67</td>
<td>122.4%</td>
<td>22.2%</td>
</tr>
<tr>
<td>2012</td>
<td>1,766.8</td>
<td>2</td>
<td>677.15</td>
<td>229.3%</td>
<td>2,443.97</td>
<td>129.7%</td>
<td>27.7%</td>
</tr>
</tbody>
</table>

\(^{11}\) An internet search produces numerous academic reports on this topic. A good starting point is: [https://en.wikipedia.org/wiki/Pacific_decadal_oscillation](https://en.wikipedia.org/wiki/Pacific_decadal_oscillation)
<table>
<thead>
<tr>
<th>Year</th>
<th>Gravity</th>
<th>Gravity %</th>
<th>Pumped</th>
<th>Pumped %</th>
<th>Total</th>
<th>Total %</th>
</tr>
</thead>
<tbody>
<tr>
<td>2013</td>
<td>1,534.2</td>
<td>96.5%</td>
<td>679.54</td>
<td>230.2%</td>
<td>2,213.74</td>
<td>117.5%</td>
</tr>
<tr>
<td>2014</td>
<td>1,171.6</td>
<td>73.7%</td>
<td>644.47</td>
<td>218.3%</td>
<td>1,816.14</td>
<td>96.4%</td>
</tr>
<tr>
<td>2015</td>
<td>1,263.7</td>
<td>79.5%</td>
<td>892.83</td>
<td>302.4%</td>
<td>2,156.60</td>
<td>114.4%</td>
</tr>
</tbody>
</table>

**Gravity**

**Pumped**

**Total**

**Average Acre-Feet Per Year 1998-2015**

| Average Acre-Feet Per Year 1998-2015 | 1,439.77 | 781.74 | 2,221.51 |
Figure 2. Total Water Production (Gravity and Pumped) Compared

Table 6. Water Production Trends 2010 - 2015 (in acre feet/ year)

<table>
<thead>
<tr>
<th>Year</th>
<th>Springs - AF</th>
<th>Wells - AF</th>
<th>Total Use - AF</th>
<th>% Spring</th>
<th>% Well</th>
<th>Total % of 2010</th>
<th>Spring % of 2010</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010</td>
<td>1,773.82</td>
<td>586.16</td>
<td>2,359.97</td>
<td>75%</td>
<td>25%</td>
<td>100%</td>
<td>100%</td>
</tr>
<tr>
<td>2011</td>
<td>1,794.29</td>
<td>512.38</td>
<td>2,306.67</td>
<td>78%</td>
<td>22%</td>
<td>98%</td>
<td>101%</td>
</tr>
<tr>
<td>2012</td>
<td>1,766.82</td>
<td>677.15</td>
<td>2,443.97</td>
<td>72%</td>
<td>28%</td>
<td>104%</td>
<td>100%</td>
</tr>
<tr>
<td>2013</td>
<td>1,534.20</td>
<td>680.13</td>
<td>2,214.32</td>
<td>69%</td>
<td>31%</td>
<td>94%</td>
<td>86%</td>
</tr>
<tr>
<td>2014</td>
<td>1,481.78</td>
<td>680.86</td>
<td>2,162.64</td>
<td>69%</td>
<td>31%</td>
<td>92%</td>
<td>84%</td>
</tr>
<tr>
<td>2015</td>
<td>1,417.61</td>
<td>792.94</td>
<td>2,210.55</td>
<td>64%</td>
<td>36%</td>
<td>94%</td>
<td>80%</td>
</tr>
<tr>
<td>AVERAGE</td>
<td>1,628.09</td>
<td>654.94</td>
<td>2,283.02</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Trends from 2010 – 2015:
- Use of Skakel has decreased by 11% of potential production (See Table 4)
- Use of Springs 1, 2, and 3 has remained 100% of Potential Production, while Potential Production has decreased 80% since 2010. This data requires further investigation.
- Use of Springs 1,2,3 remains several times higher than amount available through Rights to springs. The relationship of Right 05-716 must be better understood.
- Total Use has decreased 6% since 2010, while total use provided by ground water has risen 11%
- Compared to 2010 figure, water use from well 6 has increased 21% and well 10 increased 50%

**Secondary Water (Irrigation Sources)**

With the loss of cultivated farmland to residential development, 308.79 of the 1,086.897 shares of the MIC stock were acquired in 1979 by the Grand County Water Conservancy District, which diverts Mill Creek upstream into Ken’s Lake for irrigation delivery above Moab in Spanish Valley. Since then, 66.5 shares of MIC stock have been leased or purchased and transferred by private owners upstream to the Mill Creek Diversion for Ken’s Lake. Seventeen years ago, the MIC put in pressurized irrigation pipelines to replace their original open ditch system within Moab.

With a motivation to reduce culinary water use on outdoor landscaping, the City should explore the possibility of acquisition of water shares from the MIC that could be used for outdoor watering. Most of the remaining MIC water shares that are delivered in Moab, north and west of Moab, and on Wilson and South Mesas above Mill Creek to the east of Spanish Valley could be bought and transferred to the Ken’s Lake diversion on Mill Creek. Inside the City limits and in the north US 191 corridor, a number of orchards, hay fields, pastures and gardens are currently irrigated with these shares. Recharge from this irrigation may be largely responsible for inflow to the Matheson Wetlands Preserve operated by the Nature Conservancy at the north end of Spanish Valley. Over the years, some of the agricultural parcels were converted to residential or commercial development, and the predominant pattern has been to cluster buildings, leaving landscaped open areas. The 2011 Water Conservation plan called for the City to explore and define ways in which parcels developed with large open spaces could obtain and/or retain MIC water shares for more widespread outdoor landscaping irrigation. The 2011 report noted that acquisition of water shares by the Nature Conservancy to maintain recharge of the Matheson Preserve should be considered in this planning; City discussion with the Nature Conservancy to date has considered additional treatment of Wastewater Treatment Plant effluent so it can be discharged into the Sloughs. It is possible that reuse could be preferable to higher quality water for that purpose. It is not recorded whether any discussions with the MIC or private shareholders has occurred in the last five years.

It will be to the City’s benefit to implement a secondary water system to preserve pristine groundwater demand savings since growth patterns indicate that the total culinary demand on the City’s water system is greater than anticipated supply\(^{13}\), or the City finds it profitable to “swap” conserved pristine groundwater for irrigation water from the Grand Water and Sewer Service Agency because the Agency is unable to divert enough pristine groundwater out of the same aquifer the City is using to meet growth demands in the Agency’s service area.\(^{14}\) In 2005, it appeared that 180,641,000 gallons of pristine groundwater were consumed by 31 City customers for irrigation; another 185,075,000 gallons were apparently used by 2,121 residential customers for outdoor watering. Although dated, this statistic provides an idea of the total amount of pristine groundwater that could be conserved by the City if it was replaced by water from a secondary irrigation water

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13 See “Demand Projections to Build-Out” later in this report.
14 See 2014 and 2016 GWSSA documents cited earlier in this report.
system. Options for a secondary water system constitute the greatest potential for future water sources. Another scenario for the use of secondary water includes the more complex prospect of utilizing secondary water for flushing toilets and other non-potable uses. This is most likely a project that would involve municipal facilities such as park restrooms. More research needs to be done to determine the costs and benefits of such a proposal.

Moab Area Geology and Origin of Water Sources

The City of Moab is located at the north end of Spanish Valley to the south of the Colorado River. Spanish Valley is a salt collapse graben, formed when a dome of Paradox Formation salts bulged up, fracturing the overlying sedimentary formations. The fractured formations and part of the salt dome eroded away, largely from runoff from the La Sal Mountains through the Pack Creek drainage. The La Sal Mountains compose a small mountain range southeast of Moab that rises approximately 12,000 feet above sea level. The Glen Canyon Group (Navajo, Kayenta and Wingate) of sandstones conducts water downward from the mountains, which then surfaces in springs at various points along the Eastern Moab Fault complex on the edge of Spanish Valley. The City’s water source, consisting of wells and springs, is a large aquifer contained in the highly porous Wingate sandstone to the east of the city. This aquifer is fed by the snowmelt from the La Sal Mountains. This water is classified as Pristine Ground Water by the Utah DEQ Division of Drinking Water.

Water harvesting practices over the decades have disrupted the hydrology of Spanish Valley over time, affecting discharge into Pack Creek and the riparian zone. Please see “Environmental Concerns” later in this report.
Current water use in the past five years reflects an ongoing trend of increased water consumption for residential users and fluctuating consumption for commercial water consumers. Peak water usage in 2013 and 2014 may be attributed to “Shop Water” deliveries to tankers for oil and gas drilling.

15 http://www.riversimulator.org/Resources/farcountry/Graphics/MoabAreaWatershedGraphic.jpg
practices. Previous Water Conservation Plans indicate that delivery of water through residential meters decreased from a 1996-2000 average of 4.16 Acre-Feet per day to a 2006-2010 average of 2.69 Acre-Feet per day; and a further reduction to approximately 2.35 Acre-Feet per day in 2015 could be due to changing designations for water use\textsuperscript{16}. Note that per capita numbers are gallons per day. Total consumption is Acre-Feet.

Table 7. Per Capita Water Consumption Trends. (Does not include Shop water deliveries)

<table>
<thead>
<tr>
<th>Years</th>
<th>Per Capita – Dwellings (GPD)</th>
<th>Per Capita – Dwellings + Commercial (GPD)</th>
<th>Per Capita – Dwellings + Commercial + Winter Overflow (GPD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2006 – 2010</td>
<td>171.67</td>
<td>311.40</td>
<td></td>
</tr>
<tr>
<td>2011- 2015</td>
<td>146.58</td>
<td>313.05</td>
<td>394.72 (average for 2011-2013 only)</td>
</tr>
<tr>
<td>Change</td>
<td>- 25.10</td>
<td>+ 1.65</td>
<td></td>
</tr>
<tr>
<td>% Change</td>
<td>- 15%</td>
<td>+ 0.53%</td>
<td></td>
</tr>
</tbody>
</table>

Table 8. Average Gallons Per Day Water Consumption Residential versus Commercial 2011-2015

<table>
<thead>
<tr>
<th>Year</th>
<th>Population</th>
<th>Per Capita Average GPD – Dwellings</th>
<th>Average GPD Dwellings</th>
<th>Average GPD Commercial and Other</th>
<th>Total GPD Delivered</th>
<th>Per Capita Average GPD – All Uses</th>
</tr>
</thead>
<tbody>
<tr>
<td>2011</td>
<td>5,088</td>
<td>131</td>
<td>667,930</td>
<td>803,270</td>
<td>1,471,200</td>
<td>289</td>
</tr>
<tr>
<td>2012</td>
<td>5,116</td>
<td>145</td>
<td>740,503</td>
<td>863,774</td>
<td>1,604,277</td>
<td>313</td>
</tr>
<tr>
<td>2013</td>
<td>5,121</td>
<td>146</td>
<td>745,907</td>
<td>1,076,572</td>
<td>1,822,479</td>
<td>355</td>
</tr>
<tr>
<td>2014</td>
<td>5,140</td>
<td>165</td>
<td>848,436</td>
<td>816,332</td>
<td>1,664,768</td>
<td>323</td>
</tr>
<tr>
<td>2015</td>
<td>5,235</td>
<td>146</td>
<td>765,041</td>
<td>715,096</td>
<td>1,480,137</td>
<td>282</td>
</tr>
</tbody>
</table>

Table 9. Average consumption in Acre Feet Per Year and percent by type (not including winter overflow)

<table>
<thead>
<tr>
<th>Year</th>
<th>Dwellings</th>
<th>Commercial and Other</th>
<th>Total</th>
<th>% use by Dwellings</th>
<th>% use by Commercial and Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>2011</td>
<td>748.18</td>
<td>899.78</td>
<td>1,647.96</td>
<td>45%</td>
<td>55%</td>
</tr>
<tr>
<td>2012</td>
<td>829.47</td>
<td>967.55</td>
<td>1,797.02</td>
<td>46%</td>
<td>54%</td>
</tr>
<tr>
<td>2013</td>
<td>835.52</td>
<td>1205.92</td>
<td>2,041.44</td>
<td>41%</td>
<td>59%</td>
</tr>
<tr>
<td>2014</td>
<td>950.37</td>
<td>914.41</td>
<td>1,864.78</td>
<td>51%</td>
<td>49%</td>
</tr>
<tr>
<td>2015</td>
<td>856.96</td>
<td>801.01</td>
<td>1,657.97</td>
<td>52%</td>
<td>48%</td>
</tr>
</tbody>
</table>

Table 10. Table showing Acre-Feet adjustments to include winter overflow volumes in Water System Totals and per capita estimates, 2011- 2013\textsuperscript{17}

<table>
<thead>
<tr>
<th>Year</th>
<th>Winter Overflow AF</th>
<th>Adjusted – Dwell+Comm + Overflow AF</th>
<th>Per Capita – All sources + overflow\GPD</th>
<th>% Total - Dwellings</th>
<th>% Total - Commercial</th>
<th>% Total - Overflow</th>
</tr>
</thead>
</table>


\textsuperscript{17} Data from Water Systems PowerPoint presented by Donna Metzler. http://www.riversimulator.org/Resources/farcountry/Moab/MoabWaterSystem.pdf
<table>
<thead>
<tr>
<th>Year</th>
<th>Total Shop Water Billed (gallons)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2011</td>
<td>4,298,250</td>
</tr>
<tr>
<td>2012</td>
<td>8,858,325</td>
</tr>
<tr>
<td>2013</td>
<td>7,174,290</td>
</tr>
<tr>
<td>2014</td>
<td>13,098,811</td>
</tr>
<tr>
<td>2015</td>
<td>3,789,275</td>
</tr>
</tbody>
</table>

Winter overflow needs to be considered in the water supply budget as this water moves from its source through municipal piping and eventually overflows into Mill Creek further down valley. Prior to the development of the City water infrastructure, more of this water would have infiltrated into the aquifer and moved down valley slowly in the sub-surface soil matrix. Winter overflow ranged from 14% - 24% during the three-year period for which data was compiled.

While Per Capita usage based on gallons per day consumed at dwellings has decreased, the total per capita water usage has increased when commercial water use is included. Factoring in winter overflow and shop water sales increases the average per capita water use even further.

**Number of Water Connections**

The number of water connections in the City of Moab system as of November 2016 is 2073. This is an approximate 8.5% increase from 2010. For 2016, there were 1575 Residential connections, 414 Commercial connections, and 84 Institutional connections.

**Retail Water Deliveries (Shop Water)**

Moab sells culinary water at the City Shop, mainly by the tanker-load to off-grid agencies such as the National Park Service and Dead Horse Point State Park. In the last five years, there was a significant uptick in shop water deliveries due to a boom in oil and gas drilling, which required culinary water for drilling purposes. The City took action to revise the billing structure for this impact on the water supply system\(^\text{18}\).

**Table 11. Retail Water Deliveries (Shop Water)**

<table>
<thead>
<tr>
<th>Year</th>
<th>Total Shop Water Billed (gallons)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2011</td>
<td>4,298,250</td>
</tr>
<tr>
<td>2012</td>
<td>8,858,325</td>
</tr>
<tr>
<td>2013</td>
<td>7,174,290</td>
</tr>
<tr>
<td>2014</td>
<td>13,098,811</td>
</tr>
<tr>
<td>2015</td>
<td>3,789,275</td>
</tr>
</tbody>
</table>

**Demand Projections to Build-out**

It is important that a water conservation plan not only consider the five-year time frame called for by the plan, but a longer time horizon. This plan looks to Build-out, which is currently set at 24,000 persons.

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In 1996, future build-out considering zoning at the time accounted 4,298 additional units to be added to the 2,051 then existing. Annexation of unincorporated “islands” would add 288 additional existing residences to the 32 existing in these islands in 1995. At build-out, total residential units were estimated to be 6,669, housing a projected population of 18,473.\(^\text{19}\)

In 2010, the City’s Water Conservation Update stated that the City would meet build-out in approximately 130 years. Water demand would be 5,135,494 gallons per day at the build-out population potential of 18,473. With a source capacity of 9,136,958 gallons per day in hand, the report stated, the City possessed 44% more in water rights and source capacity than what would be needed at build-out. Further, the report went on to state that the City’s population would reach approximately 7,438, by 2050, and would put water demand at 2,067,764 gallons per day in 2050. Given that the City has water rights of 9,157,009 gallons per day, the report stated, the City would not need to acquire more water rights any time before build-out potential is reached.

Since then, Moab’s zoning has been upgraded for more dense housing. As stated earlier in this report, the City’s build-out population is now estimated to be 24,000. The acute uptick in overnight accommodations has also increased daily water usage that must be accounted for in a reasonable water budget.

The 2010 Moab Water Distribution System Report reviewed future development scenarios and provided recommendations regarding the City system’s ability to accommodate the anticipated developments. Regarding the Lionsback development, the report recommended that the City allow development itself but recommended against utilizing the water storage tank contemplated for the project for City storage. The report also examined other potential commercial and residential development, and indicated that water sources were more than adequate to meet the demands of the planned developments. The 2010 Moab Water Distribution System Report maintained that the “data indicate that the City of Moab can double its current population before new sources need to be developed or administrative constraints need to be placed on water use” and that “currently the greatest motivation for water conservation is energy conservation.” Further, the report maintained that “total water availability...is not a limiting factor for growth in the foreseeable future.”

At issue and of extreme importance to City leaders and regional water managers is the deceptive notion that water rights equal water supply. Actual data pertaining to water levels in the aquifer as established by the USGS study and data measuring water supplied by the City’s springs and wells are far more crucial to determining future supply than water shares.

The tables below show water demand anticipated at build-out, and Moab’s “carrying capacity” based on well and spring supplies.

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\(^{19}\) 1996, Public Facilities Analysis, Grand County/City of Moab.
Table 12. Build-Out Water Demand, as a percentage of Paper Rights and reported 2015 Potential Production, based on average Per Capita use (2011-2015)

<table>
<thead>
<tr>
<th>Build Out Water demand:</th>
<th>Build-out - AF/day</th>
<th>AF per YR at current GPD</th>
<th>Total Water Rights (AF/yr)*</th>
<th>Build-out AF/yr as % of Rights</th>
<th>2015 Potential Production (AF/yr)</th>
<th>Build-out as % of Potential Production (AF/yr)</th>
<th>Surplus or Deficit Water Rights at Build Out</th>
<th>Surplus or Deficit Potential Production at Build Out</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dwellings Only</td>
<td>10.80</td>
<td>3,940.96</td>
<td>9,434.10</td>
<td>41.77%</td>
<td>5,401.43</td>
<td>72.96%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dwellings + Commercial^</td>
<td>23.06</td>
<td>8,416.85</td>
<td>9,434.10</td>
<td>89.22%</td>
<td>5,401.43</td>
<td>155.83%</td>
<td>10.78%</td>
<td>-55.83%</td>
</tr>
</tbody>
</table>

NOTES:
* Based on 2016 Updated Figure 2 and 3 per Water Rights review
^ Dwellings + Commercial is the figure to use, as this represents the majority of water used in the municipality
^ Does not include Winter Overflow or Shop Water sales

These projections assume that water supply will remain constant, while climate scientists predict increasing climate uncertainty in the Southwest. See https://en.wikipedia.org/wiki/Pacific_decadal_oscillation as a starting point.

Table 13. Maximum Population of Moab at current rates of consumption, based on potential production and paper water rights

<table>
<thead>
<tr>
<th>Potential Production</th>
<th>Paper Rights</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acre feet per year</td>
<td>5,401.43</td>
</tr>
<tr>
<td>Safety factor</td>
<td>25%</td>
</tr>
<tr>
<td>Available Production (AF/yr)</td>
<td>4,051.07</td>
</tr>
<tr>
<td>Per Capita Use (GPD)-Total</td>
<td>313.05</td>
</tr>
<tr>
<td>Maximum Population</td>
<td>11,552.75</td>
</tr>
</tbody>
</table>

NOTES:
1) Assumes current rates of water use are continued
2) Does not account for Colorado River Basin-wide reductions that may be needed
3) Assumes Potential Production from 2011 figure 4 can be sustained without harming the aquifer
4) The safety factor can be adjusted to look at different scenarios

Future Supply Sources

Preliminary information from the USGS report indicates the City should begin to consider the Colorado River as an alternate source of culinary water. This prospect is complex and costly, not only because of the great expense to process river water to culinary quality, but also because of the gravely politicized battle for the river water in both the Upper and Lower Colorado River basins.

Distribution System^20

The City of Moab water distribution system requires some replacement of water mains. A schedule for replacement of these mains should be developed. The system is sized to meet current and projected demand, with the exception of new service lines needed for new development. Each water connection is serviced by a meter. The City has nearly completed its meter replacement program, with all but 20 meters now part of a radio-read meter system.

During the period of this report, there was a 50 gallon per minute leak where the City’s water system connected with the GWSSA system at an emergency connect point near the golf course. That point is now disconnected and the leak was stopped. In the event of an emergency where one water system is required to augment the other, the connection will be made manually by crews.

**Treatment System**

Treatment for the City of Moab water system consists of minimal chlorination. USGS water sampling in 1997 found the drinking water of the City of Moab, before treatment, equals or exceeds the quality of 80 percent of brands of bottled drinking water from springs sold in stores (comparison data is from the published Natural Resources Defense Council study of bottled water quality).

**Reuse Potential**

In the City’s 2020 Vision: A Sustainable Moab Plan, Water Reuse was addressed with an actionable goal to allow Utah residents to reuse clean, safe “gray water” to expand outdoor landscaping and gardening while at the same time conserving Utah’s scarce culinary water sources. City officials were encouraged to work with other Utah communities to foster State of Utah changes to rules and regulations to allow more flexible gray water use. Graywater pilot projects are now underway in Moab, due to a successful collaboration between state officials, permaculture designers, and USU faculty.

**Emergency Action Plan**

The City’s on-file emergency plan can be considered a water conservation plan for circumstances in which pumped culinary water from City wells is not available. In event of emergency, such as the main well pump failure that occurred in 1998 at the Moab Golf Course, citizens are asked through the media to discontinue all outside watering until adequate water flow is restored. City Public Works staff go in the field to identify customers who haven’t gotten the message. If citizens refuse to stop outside watering when asked, their water meter is turned off and locked. Gravity flow from the Sommerville springs to the City storage tanks is sufficient to keep the storage tanks full while meeting inside culinary water needs; during the winter months, spring flow normally exceeds water usage in the system and the well pumps are not operated. Under emergency conditions, the City’s concern is to maintain the storage tanks full so that water is available for firefighting.

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Intersystem Agreements

There are currently no significant intersystem agreements for culinary water. The Grand Water and Sewer Service Agency, which serves Spanish Valley and is uphill and to the south of the City, does not have sufficient water sources in hand to meet its service area’s build-out demand. It is suggested that the City of Moab work to establish a regional water authority that will include all water systems in the watershed including include Moab City, Grand Water and Sewer Service Agency, Castle Valley, and water systems in southern Spanish Valley and Pack Creek. In lieu of the unlikely annexation of the San Juan County users into Grand County, a regional water authority can help to mitigate threats to the water system in the years to come. The Southern Nevada Water Authority set a good example.

With regard to the new Manti-La Sal Forest Plan in development, it should be noted that Grand County has cooperating agency status and the City of Moab does not. It is advised that the City leadership have a “seat at the table” by engaging with federal land management agencies to oversee potential impacts on Moab’s watershed.

*Figure 4. Moab area watershed boundaries as defined by the hydrological unit codes for Mill and Castle Creek*

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Water Quality

Water quality in the Moab water system meets all state and federal standards\(^{23}\). All drinking water supply for the City of Moab is Pristine Ground Water from wells and springs discharging from a sandstone aquifer. This aquifer enjoys the protections of U.S. Environmental Protection Agency designation as a Sole Source Aquifer. [Sole Source Aquifer Determination for Glen Canyon Aquifer System, Moab, Utah, published in the January 7, 2002 *Federal Register*, volume 67 #4, pp. 736-738.]

Recently, citizens residing near the GWSSA’s Chapman Well and just to the west have raised concerns about declining water quality in their wells. One resident has noted that the Chapman Well is slightly higher in elevation and the cone of depression from the Chapman Well is allowing Pack Creek Aquifer water to flow into nearby wells. It is claimed that the quality of the water in nearby wells is declining.\(^{24}\) The possibility of Pack Creek Water intruding into Glen Canyon Aquifer is something that should be investigated in the ongoing USGS study. Specifically, it is recommended to explore whether the USGS study can verify that pumping on the edge of the Glen Canyon Aquifer is reducing the outflow of water from the Glen Canyon Aquifer and allowing water from the Pack Creek aquifer to intrude into the Glen Canyon Aquifer. There is a question of whether Pack Creek water is moving into or close to the Moab City’s wells during heavy pumping in the summer. Additionally, he asks if this is an indication that nearly all of the total available underground water near the Chapman Well is being utilized and whether any new allocations should be made from the Chapman well.

In addition to this possible depletion or invasion of the system, it is recommended that the City take action to protect the aquifer from potential threats posed by proposed developments throughout the watershed. This includes SITLA land at Johnson’s Up-On-Top\(^{25}\), as well as upgradient public and private land administered by counties, the BLM, and the USFS. It is recommended that the City participate directly in federal land management agency planning efforts which include the Moab area watershed, and cover activities which may impact the quantity or quality of water percolating into the aquifer, including oil and gas drilling, and vegetation management.

Institutional and Political Factors

There are several institutional and political factors relevant to the City of Moab Water Conservation Plan. It will be important to review any water rights applications submitted by adjacent water agencies such as the Grand Water and Sewer Service Agency and other water providers in the past five years to ensure that applications that involve such things as a change in points of diversion do not negatively affect the quantity or quality of Moab’s water sources. In addition, the ability of the City to work with the Moab Irrigation Company (MIC) and its shareholders to keep surface-diverted irrigation water flowing to areas within the City, rather than being moved away from these lands for


\(^{24}\) Emailed from William Love copied to City Council 2016-11-15.

\(^{25}\) [A Look at Johnson’s Up-On-Top.](http://www.livingrivers.org/pdfs/Johnsons.pdf)
application elsewhere is key. A large part of the MIC’s water shares are currently used by homeowners for yard irrigation, so it functions as a de facto secondary irrigation water system for residences in older portions of town. The City must look to the future of utilizing MIC water for outdoor uses within the City limits.

Also, the potential development of a new water system in northern San Juan County should be of great concern to the City leadership. The San Juan Spanish Valley Special Service District has already changed a point of diversion from the San Juan River to Spanish Valley for 500 Acre Feet (not to be used until after USGS study) and have another right to 5000 Acre Feet to the Colorado River that could potentially have a change in point of diversion filed.26

Environmental Concerns

Environmental concerns for the culinary system are growing; as stated earlier in this report, the USGS water study may reveal less water in the aquifer than assumed, and private wells near the golf course are reporting degraded water quality. Also, the potential development of SITLA land above the aquifer at Johnson’s Up-On-Top could be a threat, along with potential hydraulic fracturing used in oil and gas drilling within the watershed. It is likely the City of Moab will need to develop new water supply sources or water rights, and does not yet have a water treatment facility for lower-grade water such as Colorado River water. The City will need to continue to monitor water quality to ensure the long-term sustainability of Moab’s abundant water sources.

Also of importance is climate change and how it affects our local aquifer. The City should consider scientific modeling to inform watershed policy. Global Climate Models (GCMs) are computer representations of the global climate system—the atmosphere, the oceans, ice sheets and sea ice, and the land surface—based on both physical laws and parameters derived from observation. The consensus of projections from about 35 GCMs is that the Intermountain West will warm by +2°F to +6°F by mid-century, relative to the 1971–2000 baseline. The range of projections reflects both greenhouse gas emission scenarios and differences among the models in how future climate will unfold under a given emissions scenario. The projections show summers warming more than winters, and typical summer temperatures by 2050 will be as warm or warmer than the hottest 10% of summers that occurred in the 20th century. The individual GCM projections have less agreement about whether average annual precipitation will increase or decrease in our region by 2050. The multi-model average shows little change in annual mean precipitation by 2050. Further, the models also suggest a seasonal shift in precipitation, with the combined effects of a northward-shifting storm track, potentially wetter storms and a drying of the sub-tropical regions globally resulting in more mid-winter precipitation, and in some areas, a decrease in late spring and summer precipitation. Together, the uncertain changes in precipitation and the more certain impacts of warming lead to a broad range of plausible futures for water in the Intermountain West. Consistent themes across those

26 Mark Stilson, Regional Engineer, USGS Presentation 2016-11-08.
futures include snowmelt and runoff occurring earlier in the spring, decreased late-summer stream flows, and increased water use by crops and other vegetation.\textsuperscript{27}

Although the analysis in this document does not include allowances for climate change, it may be prudent for City water policy to err on the conservative side to account for possible decrease in water supply relative to demand in the context of the changing climate.

**Fiscal Structure and Financial Resources**

The City recently issued bonds to complete the new Wastewater Treatment Plant, due to be completed in 2018. It is recommended that the City plan for expanded water rights, irrigation water rights, and incentive programs for commercial and residential projects to enhance water conservation to meet the City’s conservation targets. One avenue for potential funding is the “WaterSMART Grants” program administered by the Department of Reclamation.\textsuperscript{28}

The City leadership should determine a realistic budget for Water Conservation. At the low end, the City should maintain an educational page on the City’s website. In the medium range of funding, the City should coordinate public workshops, pilot and demonstration projects, and dedicated sustainability staff. At the high end of fiscal commitment, the City should consider financial rebates and incentives and technical assistance for retrofits of residential and commercial systems.

The City’s current water rate structure was updated in 2016. The following is the City’s current water rate structure:

**Table 14. Current Water Rate Structure for the City of Moab (Revised 7/1/2016)**

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\footnotesize{\textsuperscript{27}Western Water Assessment, Intermountain West Projection \url{http://wwa.colorado.edu/climate/change.html}}

\footnotesize{\textsuperscript{28}\url{https://www.usbr.gov/watersmart/grants.html}}
WATER CONSERVATION GOALS

Why Conserve?

Several sources were consulted to gather suggestions for water efficiency programs that may be adopted for Moab, including The City of St. George29, the State of California30, the Alliance for Water Efficiency31, and the Utah Governor’s Office32.

There are important benefits to increasing water use efficiency, including:

- Reduced stress on the environment of the watershed
- Reduced landscape runoff (contaminated with fertilizers, pesticides, and road debris) to surface waters
- Ability to stretch existing water supplies
- Ability to provide water for surface or groundwater storage in wet years
- Delayed capital cost of new infrastructure to treat and deliver water
- Reduced water-related energy demands and associated greenhouse gas emissions
- Better capacity to meet the water demand of Moab’s growing population

Current Water Conservation

In the last few years, the overburdened wastewater treatment plant made robust water conservation campaigns difficult. More water has been needed to lessen the strain on the aging facility. Water conservation campaigns may need to delay a large-scale roll-out until the new wastewater treatment plant comes online in 2018 or beyond.

Another challenge related to implementation of water conservation measures is that the City of Moab has a very small Water Department staff. The City does not have a Water Conservation Coordinator or Sustainability staff, although there is a Community Development Director and a Public Works Director. It is recommended that the City consider creating such a role on the City staff. Regardless, the City should embrace initiatives that are cost effective and not staff intensive, and that the effectiveness of water conservation efforts be simple to measure. This situation is another motive

29 City of St. George Water Conservation Plan Update 2013


to call upon community citizens to form a Moab City Water Conservation and Drought Management Committee, which can provide advice and guidance to staff and report to the City Council regularly with recommendations and actionable water conservation objectives.

The City of Moab is poised to ramp up public efforts with respect to water conservation. Past water conservation efforts, a relatively dry climate, public perception, a high percentage of outdoor water usage, impacts on the City Waste Water Treatment Plant, and uncertainty with respect to the long-term availability of water sources are just a few of the challenges to be addressed.

The idea of water conservation has not been thoroughly institutionalized and culturally accepted within the community. People are under the impression that water is a readily available resource with no need for conservation efforts, and adjusting this perception may be difficult. However, the population in general is changing perceptions of what is feasible. Also, the easy access to low-flow plumbing fixtures and other water-saving technologies will make a City-wide water conservation program understandable and palatable to the local populace.

Water conservation measures such as progressive rate structures are difficult when trying to address outdoor use only, but the City has recently implemented a new rate structure.

It is important to address the challenges and constraints in the development of short and long term water conservation goals. The fact that the City of Moab has not implemented intensive conservation efforts in the past, the overall public perception about the availability of water, the fact that Moab’s outdoor water use is relatively high, the need to maintain water flow into the wastewater treatment plant to ensure its efficient operation, and the issues related to preserving and promoting the secondary water system all must be taken into consideration.

Lastly, it is important to recognize that there is uncertainty associated with understanding the City’s water sources. There are issues such as water quality, drought conditions and unknown factors that may affect our water sources. These issues point to the need for conservation.

Public Education on Wise Water Use

The City should rekindle the former campaign on wise water use, specifically, the following: (1) Renewal of City public education through the media and bill enclosures, reminding people to not water in the heat of the day; to water for a long period of time at intervals to get deep penetration of water and encourage deep rooting of landscaping, rather than for brief periods often; and to encourage low-water-demand plant selection for non-edible landscaping (xeriscaping)\(^3\). There are

\(^3\) Water conservation advocates tend to ignore the distinction between edible and non-edible landscaping. Moab is dependent on what are possibly even more drought stressed agricultural areas for shipped-in food, including produce from California and Arizona, and which utilize Colorado River water which suffers significant evaporation losses. Local agriculture and self-reliance are valued in our community. Local ag with conscientious irrigation, while less conserving in a conventional sense than xeriscape, may represent a regionally more appropriate response to limited water supplies.
numerous topics that can and should be included, including water harvesting (on-site stormwater management to offset irrigation demand and provide additional benefits), and graywater reuse.

(2) Sponsoring of public workshops on water-efficient irrigation and landscaping as a public service.

(3) Revision of landscaping standards in residential and commercial site development zoning regulations to require water-efficient landscaping cultivar selection and irrigation systems.

(4) Development and placement of placards in restrooms reminding visitors that they are visiting an arid climate in which water is limited, and stating ways to conserve water during their stay.

The Travel Council should fund and publicize water saving tips in all overnight accommodations and commercial restrooms, as well as at the MRAC. It is very common for tourists to ignore or not understand the water challenges faced in a hot and dry climate. It can be an everyday occurrence to observe a line of rental jeeps at the carwash, or notice campers taking 20 minute showers at the pool. Even seemingly small savings can add up, when magnified by the 25,000 average visitors in peak summer months\textsuperscript{34}. For example, turning off the tap after wetting a toothbrush or while lathering hands with soap; reusing towels; taking five-minute showers; sweeping patios instead of hosing them down; and wiping down a mountain bike with a dry cloth instead of using water.

An aggressive public information campaign directed toward residential, commercial, and institutional outdoor water use, commercial use in restaurants and hotels, and tourism-related water use is needed. The Transient Room Tax (TRT) is a likely source for publicity funds to mitigate the impacts of the tens of thousands of tourists the City hosts on a daily basis in the peak months of the year.

Promoting strategies to convert landscapes from high water use to drought tolerant plantings and high efficiency irrigation systems can greatly reduce outdoor water usage. Further, incorporating landscape-based stormwater retention strategies, roof water catchment, and greywater reuse can further decrease the amount of outdoor water used for landscaping while producing additional benefits to water quality, decreased energy use and more.

Another public education challenge, faced by communities throughout the west, is that Moab is in an arid climate. The 2005 Water Conservation Plan showed that approximately 60% of the water that is delivered to customers from City sources is used for outdoor irrigation, and this number is in line with

\textsuperscript{34} Analysis of TRT & Sales Tax statistics from the City of Moab Treasurer for 2014-2016, compared January (with little or no outdoor water use and few tourists) with peak demand in August (with outdoor water use and the highest tax revenues per year) resulting in a figure representing consumption generated by tourists and outdoor water use that is approximately 2.5 times the indoor usage of residents alone. Assuming that some portion of the Moab population spends significantly in Grand Junction, online, or elsewhere, then this ratio would increase and there would be more average tourists per day using the infrastructure. For example, in 2015 if half of March sales were actually tourists (to establish baseline of 41,805), then it would be 360% (3.6x), or an additional 26,000 people per day. So, likely we are somewhere in between this 2.5x and 3.6x population much of the time. Deborah Barton, Grand County’s Solid Waste Special Service District manager, reported on December 1, 2016, a 3.5x increase in volumes to landfill/recycling facilities during tourist season vs. baseline, so the water-use estimates have this additional credence.
the range for communities throughout the West.\textsuperscript{35} This means that conservation efforts need to be aimed toward outdoor use.\textsuperscript{36}

**Water Conservation Policies/Ordinances**

In 2009, the City of Moab adopted Resolution #18-2009, A RESOLUTION ADOPTING THE 2020 VISION: A SUSTAINABLE MOAB PLAN. This plan recognizes the leadership role of the City of Moab in “championing volunteer efforts to preserve and conserve natural resources and promote a cleaner, healthier environment.” It also acknowledges “new paradigms of natural resource utilization, [to] ensure the health and well-being of future residents while at the same time meeting the needs of our current residents\textsuperscript{37}.”

The first part of the plan presents goals for water conservation, to ensure the long-term productivity of The City of Moab’s aquifers. It calls for reduction of per-household, per-business and City-owned facilities’ water use by 20 percent by the year 2020.

The Action Steps proposed included these measures:

- Adopt a new water rate structure that rewards culinary water conservation. (Completed 2016)
- Investigate how other communities have implemented successful water conservation plans and implement productive programs.
- Implement water use reduction and water reuse programs at City-owned facilities.
- Expand public awareness of the City of Moab and Grand County culinary water resources.

The City staff has embraced several water conservation measures for City-owned properties, including elimination of mid-day watering of landscapes (when possible, watering between midnight and four AM). In addition, the City Hall landscape, along with a few other “demonstration gardens” at the public library, the hospice garden, and at USU, present water-wise landscapes and plants for citizen education.

The Moab City Water Conservation and Drought Management Committee can embrace these objectives and make recommendations for public education campaigns and revisions to the City Code.

Another element of Vision 2020 addresses sustainable construction practices. While the goal is far-reaching in its effort to utilize renewable energy sources and green building elements in residential and commercial building projects, a simple piece of this is codifying water-efficient plumbing fixtures, landscaping, and graywater systems to cut down on culinary water use City-wide. The Water

\textsuperscript{35} Annual water use for 1,000 houses in each of 12 cities. [http://bcn.boulder.co.us/basin/local/heaney.html](http://bcn.boulder.co.us/basin/local/heaney.html)


Conservation and Drought Management Committee can research what is feasible, what other jurisdictions have already adopted, and tailor a campaign that fits Moab’s needs.

“Retrofitting for Sustainability” provides existing home and business owners incentives to reach the goal of increasing energy efficient retrofits by 40% by 2020. This goal called upon collaboration with the Southeast Utah Association of Local Governments to identify and retrofit energy inefficient dwellings owned or occupied by low and moderate income households, and to work with utility companies to promote energy efficiency and renewable energy incentives for homes and businesses.

Moab City and the City Hall in particular have been models for the community with solar projects, low-water landscaping, energy efficient fixtures, and more. The City can continue its impact by embracing the existing action steps of providing regular commentary to local news outlets regarding sustainable practices and Moab’s success in achieving the goals of the Vision 2020 Plan; assigning staff and a citizens’ committee to provide regular reports to the Moab City Council on the progress of this plan; provide regular reports to community groups and organizations on the progress of this plan as well as information on sustainable “best practices” in other locales that can be successfully implemented here; and utilize the City of Moab’s website and internet-based written, audio and video networks to encourage sustainable practices.

Future Planning and Zoning ordinances should be required to balance the “water budget” to ensure water conservation measures do not compete with development and to ensure Moab City remains drought and flood resilient.

**Numerical Goals for Water Conservation**

As stated earlier in this report, current water supply can optimistically sustain a total Moab population of approximately 11,552. Capping the population would be the easiest numerical goal to ensure adequate water resources. However, the always-growing tourist market may further alter this level. As stated earlier, the average number of daily visitors in peak months has already topped about 25,000 visitors on top of the Moab resident population of about 5,000. The Moab-Area Travel Council mission to promote Moab as a year-round destination threatens the City’s ability to “make up” for record usage in summer during the low-use winter months.

In lieu of capping the population, the table below shows the estimated conservation rates needed to match the build-out projections. One column shows the high percentage of reduction needed based on reported potential production of available sources; the other column shows the more modest rates of conservation that is needed if all water rights exercised resulted in “wet water” delivered:
Table 15. Estimated Conservation Rates to match Build Out population projections

<table>
<thead>
<tr>
<th></th>
<th>Potential Production*</th>
<th>Paper Rights</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conservation Rate to achieve Build-Out population:</td>
<td>51.87%</td>
<td>15.94%</td>
</tr>
<tr>
<td>Per Capita GPD to achieve Build-Out (Dwellings + Commercial)</td>
<td>150.67</td>
<td>263.16</td>
</tr>
</tbody>
</table>

NOTES:
Conservation rates estimated as ratio of population for Carrying Capacity to projected Build Out, based on 2015 rates of consumption and safety factor used in carrying capacity estimates.
*Potential production may be revised when final USGA report is issued.

As stated earlier in this report, it is recommended that the City embrace an initial goal of 25% reduction in culinary water consumption for both indoor and outdoor use over the next five years. By comparison, the current goal for the City of Albuquerque is 40%.

RECOMMENDATIONS FOR IMPLEMENTATION OF WATER CONSERVATION MEASURES

The City of Moab is primed to embrace water conservation efforts in light of our high per capita use due to the heavy burden of tourism, which drives the local economy. There are several areas where conservation measures are needed, and many are relatively easy to embrace.

- Appoint a Citizens’ Water Conservation and Drought Management Committee.
- Create a Sustainability Coordinator role on the City staff.
- Implement a public education campaign as detailed above.
- Ensure plumbing codes require more efficient fixtures.
- Adopt a water efficient landscape ordinance.
- Reward new technologies in the commercial/industrial sector, including waterless or 0.5 gallon urinals, high-efficiency toilets, commercial washing machines, and pre-rinse spray valves in restaurant kitchens, and commercial dishwashers.
- Mitigate existing inefficiencies in residential plumbing, including Toilets, Showers, Leaks, Faucets, and Clothes Washers.
- Revise codes to allow graywater systems and composting toilets within City limits.
- Prohibit hosing down sidewalks and washing cars with hoses that do not have a shut-off valve.
- Reduce impact on current supply: The approvals of large new developments in Moab must be linked to assurances that there is an adequate water supply over a twenty year period. Without assurances that there is a reliable source of water, even in dry years, large development projects cannot proceed.

http://www.harvesth2o.com/alb.shtml
• Adopt a green infrastructure ordinance for stormwater management to protect water quality, increase localized groundwater recharge and offset landscape irrigation through matching plantings with green infrastructure treatments.
• Prohibit outdoor watering between the hours of 10:00 am and 6:00 pm. and introduce practical solutions for staff to enforce corrections for over-watered lawns, poorly maintained systems with unnecessary overspray, and etc. More research is needed to determine what level of water savings can be realized if all irrigation is shifted to night.
• Ensure all City-owned facilities adhere to the Governor’s Executive Order No. 2015-4 and encourage all governmental facilities located within Moab City limits (Federal, State, and County) to adhere to the same39.
• Study feasibility and effectiveness of allowing winter overflow to recharge the aquifer as high as possible.
• Pursue implementation of a secondary water system for outdoor watering and other secondary uses to preserve pristine groundwater.
• Update Vision 2020 to acknowledge what has been accomplished, and reset targets as part of the revised General Plan.
• The City should work with other governmental users in taking measures to reduce application of culinary water to large lawn and other planted areas.
• In addition to work already done by the City’s Water Department staff, The City should conduct water usage audits of City and other facilities to determine more efficient water application and lawn maintenance practices. In addition, the City should continue to consider alternatives to grass and other high water plants when developing new parks and to re-landscape “wasted turf” (not playing fields and etc.) in existing park areas. In addition, the City should work with Moab Irrigation to determine if it is feasible for the City to acquire water shares. This could potentially reduce the City’s reliance on culinary water for City use, and add more City control over the use of runoff water for irrigation purposes.
• The long-term viability of the Moab Irrigation Company (MIC) should be of concern to the Council. It has been mentioned several times that the ability of city residents to use MIC water is important for preservation of culinary water for indoor use. It is important to maintain a positive relationship with MIC to ensure continued operation of the irrigation system within city limits. It is also important to recognize that the MIC system, while recently upgraded to a pressurized system, is an old system with constant maintenance challenges.
• Integrate water conservation with issues at the Wastewater Treatment Plant – include education on composting to minimize use of garbage disposals and create a soil amendment that helps with landscape water retention, and promote composting toilets. The State of Arizona has been a leader in innovation in this area.40

39 See Governor Herbert’s WATER CONSERVATION, UTAH EXEC. ORDER NO. 2015-4, Issued: June 3, 2015.

40 Arizona code on “maximum water conservation:”

MOAB WATER CONSERVATION PLAN 2016
As stated earlier, it is recommended that the City take action to protect the aquifer from potential threats posed by proposed developments throughout the watershed. This includes SITLA land at Johnson’s Up-On-Top\textsuperscript{41}, as well as upgradient public and private land administered by counties, the BLM, and the USFS. It is recommended that the City participate directly in federal land management agency planning efforts which include the Moab area watershed, and cover activities which may impact the quantity or quality of water percolating into the aquifer, including oil and gas drilling, and vegetation management.

\textsuperscript{41} A Look at Johnson’s Up-On-Top. [http://www.livingrivers.org/pdfs/Johnsons.pdf](http://www.livingrivers.org/pdfs/Johnsons.pdf)
Stormwater Management: A Scenario

Rainwater is a resource, and when not managed properly can become a nuisance and liability. The potential to manage precipitation as part of the water supply portfolio should be explored. Pursuing site-scale water harvesting through green infrastructure best practices would simultaneously improve stormwater management.

Table 16. Water Falling on Moab City at different precipitation levels:

<table>
<thead>
<tr>
<th>Area (sq ft)</th>
<th>Precip/YR (in)</th>
<th>Constant</th>
<th>Coefficient</th>
<th>Gallons/YR</th>
<th>AF/YR total</th>
<th>AF/YR avail for Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>112,994,640.00</td>
<td>4</td>
<td>0.623</td>
<td>0.75</td>
<td>211,186,982.16</td>
<td>648.11</td>
<td>324.05</td>
</tr>
<tr>
<td></td>
<td>6</td>
<td></td>
<td></td>
<td>316,780,473.24</td>
<td>972.16</td>
<td>486.08</td>
</tr>
<tr>
<td></td>
<td>9</td>
<td></td>
<td></td>
<td>475,170,709.86</td>
<td>1,458.25</td>
<td>729.12</td>
</tr>
</tbody>
</table>

Calculated as:

Area in square feet is Acres within City Limits (2,594) x square feet per acre (43,560)
Precipitation per year is average total rain and snow, in inches. Average precipitation in Moab is 9 inches, and 3 scenarios were estimated
Constant is used to convert to gallons, based on 7.48 gal/cubic ft x 1ft/12inches
Coefficient is the percent of precipitation running off surfaces. 0.75 was selected to reflect high levels of imperviousness in built environment. A more thorough analysis of land use would inform the best coefficient to use.
The percent put to use reflects a selected target for the amount of precipitation that could be captured or directed to offset existing or future water demand

Table 17. Estimated Total Water Use and potential conservation through Landscape Conversions, per 1,000 square feet

<table>
<thead>
<tr>
<th>Landscape Type</th>
<th>PF</th>
<th>IE</th>
<th>ETWU</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conventional turf and sprinklers</td>
<td>0.8</td>
<td>0.75</td>
<td></td>
</tr>
<tr>
<td>Water-wise plantings and drip</td>
<td>0.3</td>
<td>0.81</td>
<td></td>
</tr>
<tr>
<td>Potential water conservation:</td>
<td></td>
<td></td>
<td>28,110</td>
</tr>
<tr>
<td>Percent reduction:</td>
<td></td>
<td></td>
<td>65%</td>
</tr>
</tbody>
</table>

Based on the above values and assumptions, 1 acre foot/ year of water conservation could be achieved for every 11,600 square feet of landscape conversion. Additional benefits would accrue when landscape conversion projects are designed to harvest runoff, build healthy soil, and/or reuse greywater on-site.
Calculation based on CA Water Efficient Landscape Ordinance, where:
ETWU = PF x ET x 0.623 / IE
ETWU = Estimated Total Water Use, in gallons per year
PF = Plant factor, with 1 being an open pan evaporation test. Expressed in decimal form as percent water use relative to open pan
ET = evapotranspiration (inches per year) less effective precipitation (0.75 * average precipitation per year)
IE = Irrigation efficiency. The percent of water applied that is beneficially used by the plants. Rates from 2015 CA WELO update.
Additional Readings on Water Conservation
(Courtesy of John Weisheit, Executive Director of Living Rivers)


2016 - Grand County Water Master Plan. GWSSA.


1998 - National Drought Policy Act

2005 - Grand Challenges for Disaster Reduction (emphasis on drought and floods). National Science and Technology Council.


2010- Forest and Water Climate Adaption: A case Study of Moab and Castle Valley, Utah. CWC.

2012 -Crossroads Utah. URC.

2013 - Hydrologic Assessment of the Surface Water and Groundwater Resources of Castle Valley, Utah: Part 1: Hydrologic and Environmental Analysis (HESA) and Preliminary Water Budget