MAY 8, 2019
WATER CONSERVATION AND DROUGHT MANAGEMENT ADVISORY BOARD
REGULAR MEETING 2:00 P.M.

City Council Chambers
217 East Center Street
Moab, Utah 84532

1. Call To Order
2. Approval Of Minutes
   2.I. Minutes Of April 10, 2019 Meeting

   Documents:

   WATER BOARD MINUTES 2019-04-10 DRAFT.PDF
3. Citizens To Be Heard
4. Board And Staff Reports
5. Other Business
   5.I. HSA Water Budget--Discussion

   Documents:

   2019 HSA WATER BUDGET INTRO-CONCLUSIONS.PDF

   5.II. Digital Archive Campaign--Discussion

   5.III. Water Conservation Plan Update--Discussion
6. Adjournment

Special Accommodations:
In compliance with the Americans with Disabilities Act, individuals needing special accommodations during this meeting should notify the Recorder's Office at 217 East Center Street, Moab, Utah 84532; or phone (435) 259-5121 at least three (3) working days prior to the meeting.
Check our website for updates at: www.moabcity.org

CITY OF MOAB
WATER CONSERVATION AND DROUGHT MANAGEMENT ADVISORY BOARD
REGULAR MEETING MINUTES—DRAFT
APRIL 10, 2019

1. ***Call To Order:*** Vice-Chair Jeremy Lynch called the meeting to order at 2:02 PM in the City Council Chambers located at 217 East Center Street in Moab. In attendance were Water Board members Kyle Bailey, Arne Hultquist, John Gould and Denver Perkins. Also in attendance were Assistant City Engineer Eric Johanson, Sustainability Director Rosemarie Russo, Records/Project Specialist Eve Tallman and one member of the press. Chair Kara Dohrenwend arrived at 2:13 PM. Mike Duncan was absent due to illness.
2. ***Approval Of Minutes:*** Bailey moved to approve the Water Board Minutes of March 13, 2019. Perkins seconded the motion. The motion passed 4-0 with Boardmembers Lynch, Perkins, Bailey and Hultquist voting aye.
3. ***Citizens To Be Heard:*** There were no citizens to be heard.
4. ***Board And Staff Reports:*** Johanson reported the City Engineer won't allow sharing of the draft report from the United States Geological Survey (USGS) or information from Ken Kolm, the City's hydrogeology consultant. Tallman offered to meet with the City Manager to pursue the matter.
5. ***Other Business:***
   5.I. Outdoor Watering Campaign: Russo reported on her work. Lynch stated he had met with Communications and Outreach Director Lisa Church and reported the outdoor watering campaign ad would appear in late April. Russo remarked she had contacted the Grand Junction Pipe presenters about a workshop, proposed to be held in May. Information to newcomers to the desert environment was discussed and Lynch recapped the intent of the historical newspapers project.
   5.II. Review Of 2016 Water Conservation Plan: Several edits and recommendations were brought up including standardizing units of measurement (for example, Equivalent Residential Connection "ERC" versus gallons or Acre-Feet), the section on Future Supply Sources, Environmental Concerns, Recommendations for water conservation measures and the bibliography. The Board's role reviewing the City's Master Plans for water concerns was deliberated, along with green infrastructure planning. A proposed turnout station was mentioned and revision of the section on water rights versus "wet water."
   5.III. Discussion Regarding Water Data Facts: Russo pointed out differences between the 2016 water plan and the newer sustainability plan, with business use added along with water quality. Hultquist brought up the Governor's goal of 25 percent water use reduction by 2025 based on a 1997 baseline. He pointed out there was at least a 10 percent per capita reduction since then. The sustainability plan, Russo pointed out, required a 2016 baseline with a 2032 target year.
   5.IV. Vulnerability, Consequences, and Adaptation Planning Scenarios (VCAPS): The joint funding of this project was considered and revised.
   5.V. Discussion Of USGS Study Update: Perkins brought up a discrepancy between drafts. Tallman pointed out the report author declared there were no substantive changes in the data between drafts. Hultquist, Perkins and members of the engineering team were suggested to follow up.
6. ***Adjournment:*** Bailey moved to adjourn. Dohrenwend seconded the motion. The meeting was adjourned at 3:49 PM.

HYDROLOGIC AND HYDROGEOLOGIC ASSESSMENT OF THE SURFACE WATER AND GROUNDWATER RESOURCES AFFECTING THE MOAB CITY SPRINGS AND WELLS, MOAB, UTAH: PHASE 2: PRELIMINARY HESA-BASED WATER BUDGET AND AQUIFER STORAGE EVALUATION

Authors:
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and
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Prepared For:

City of Moab, Utah

March 2019

1 INTRODUCTION

Under an agreement with City of Moab, Utah, Hydrologic Systems Analysis LLC (HSA) of Golden, Colorado, in conjunction with Heath Hydrology, Inc. (HHI) of Boulder, Colorado, was tasked to: 1) Perform a Hydrologic and Environmental System Analysis (HESA) of the Moab City Springs and Wells (MCSW) area, supported by GIS databases and maps, to develop a comprehensive and updated understanding of hydrogeologic and hydrologic characteristics of the groundwater system, using currently available data and published analyses; 2) Collect hydrological, hydrogeological and other data necessary to construct a water budget for the MCSW area, and develop an as-accurate-as-possible water budget for the MCSW area as the region affecting the City's springs and wells; and 3) Update three drinking water source protection plans and the delineations of the drinking water source protection zones, one for the City's Skakel Spring, one for the City's Springs 1, 2, and 3 near the golf course (referred to as "City of Moab Springs", and one for the City's wells (Wells 4, 5, 6, 7, and 10), also near the golf course (see Figure 1 for the current delineation of the Moab Drinking Water Source Protection (DWSP) Zones for the wells and springs). Each of these tasks constitutes a phase of the project. This report contains the results of Phase 2: Collect hydrological, hydrogeological and other data necessary to construct a water budget for the MCSW area; and develop an as-accurate-as-possible water budget for the MCSW area as the region affecting the City's springs and wells. The results of the HESA of the MCSW area performed in Phase 1 are documented in Kolm and van der Heijde (2018).

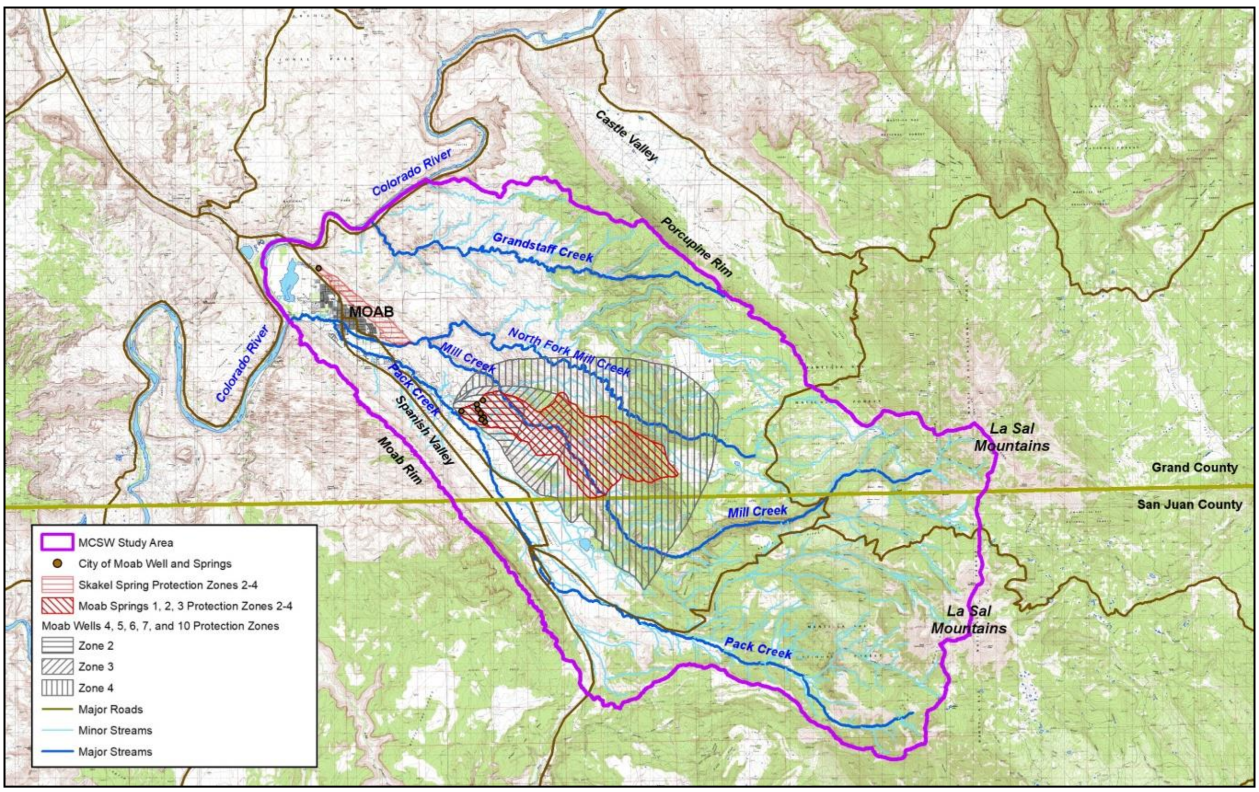

Figure 1. Topographic map showing the Phase 1 Moab City Springs and Wells (MCSW) Study Area, and the location of the City of Moab springs and wells and related Drinking Water Source Protection (DWSP) zones.

The Phase 1 study area is located between the La Sal Mountains to the southeast, the Colorado River to the northwest, the Porcupine Rim to the northeast, and the Moab Rim to the southwest (Figure 1). Based on the results of Phase 1, the combined Mill Creek Watershed and Glen Canyon aquifer underlying the Sand Flats region is chosen as the setting for the water budget developed in Phase 2 of this project, and for the updating of the Water Protection Plans for the springs and wells of the City of Moab planned for Phase 3 (Figure 2).

The HESA of the surface water and groundwater systems in the MCSW study area made extensive use of existing GIS databases and maps of geologic, hydrogeologic and hydrologic characteristics, collected specifically for this study. Additional data layers and evaluations were prepared to illustrate the HESA – particularly with respect to the hydrogeological characteristics of the rock types present and the significance of hydrostructures (i.e., hydrogeologically significant faults and fracture zones). The results of the HESA provide the conceptual basis for the development of the hydrological water budget for the City wells and springs in this second project phase. The HESA included a few scoping site visits to the study area; additional field surveys have been conducted as the project progressed.

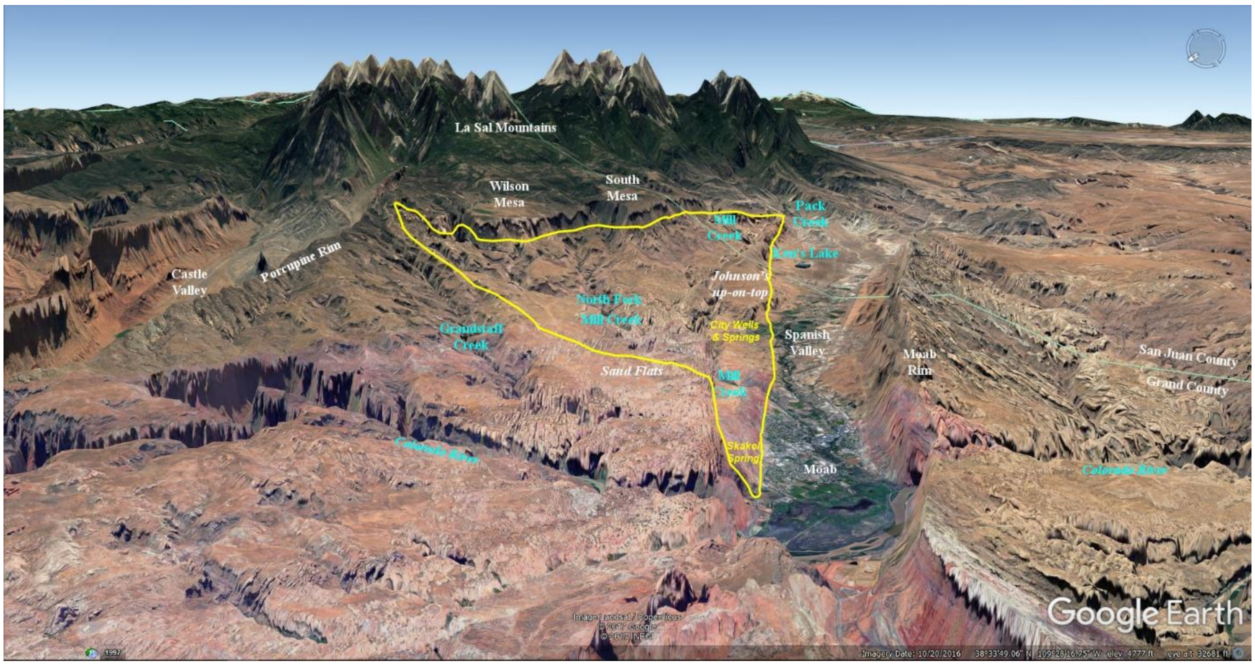

Figure 2. View of the regional setting of the Moab City springs and wells and the approximate Phase 2 Water Budget (WB) area outlined in yellow (Source: Google Earth, Imagery May 2016).

Various information sources have been consulted in preparation of the Phase 2 analysis of the hydrological water budget for the City wells and springs, including Federal, State and City reports and data bases. When applicable, data were organized in a Geographical Information System (GIS) using the ESRI® ArcMap™ software. The data sources included Utah AGRC (Automated Geographic Reference Center), Utah Division of Water Rights (UDWR), Utah Division of Environmental Quality (Utah DEQ), Utah Geological Survey (UGS), U.S. Geological Survey (USGS), Natural Resources Conservation Service (NRCS) of the U.S. Department of Agriculture, NOAA National Centers for Environmental Information, City of

Moab, and others. In addition, HSA/HHI has prepared a number of data layers specifically for this report through interpretation of existing data sets and field reconnaissance.

It should be noted that that this report will not obviate the need for additional hydrogeologic analysis on a site-specific/parcel-specific basis by developers and/or the City, or in any water right, geotechnical, or environmental study requiring due diligence. The information in this report is intended to be used as indicator only, as part of a multi-step land use or water management decision-making process, and to provide a starting point for further study of the City's surface water and groundwater resources.

5. SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

This report presents the findings of Phase 2 of a 3-phase project focused on improving the understanding of the hydrogeological setting of the water supply sources for the City of Moab, the quantification of the water resources available to the City, and updating the City springs and wells protection against contamination. In Phase 1, a Hydrologic and Environmental System Analysis (HESA) of the Mill Creek and Pack Creek watersheds was performed to identify the hydrological systems of specific importance to the sustainability of the Moab City springs and wells as a water supply for the City. It was concluded that the City's water supply was mainly dependent on the hydrologic system formed by the Mill Creek Watershed and the Glen Canyon aquifer underlying the Sand Flats region. This hydrologic system, referred to as the Glen Canyon Group Mill Creek (GCMC) hydrologic system, was chosen in Phase 2 of the project as the setting for the quantification of the water resources available to the City, resulting in a preliminary global water budget of the GCMC hydrologic system. It is a preliminary water budget as there are many uncertainties with respect to the determination of the individual components given the sparseness of relevant published data.

The Glen Canyon Group Mill Creek (GCMC) hydrologic system is a complex mix of fractured and faulted Entrada Sandstone and Glen Canyon Group, Eolian Sand, and hydro-structures (fault and fracture zones) which form the robust groundwater system and surface water system that is directly connected to the City of Moab springs and wells in the vicinity of the golf course and to the Skakel Spring. The HESA completed in phase 1 showed that the GCMC hydrologic system is a well-defined and delineated, integrated surface water and groundwater system for which the boundary conditions and internal surface water–groundwater interactions are well-understood.

To quantify the water resources available for the City of Moab's water supply, a preliminary (global) water budget (PWB) has been developed for the GCMC hydrologic system, focused on the external inputs (inflows) and outputs (outflows) of the hydrologic system. In addition, an analysis was made of the storage capacity of the Glen Canyon aquifer in this area. The area to which the PWB applies is based, among others, on the location of City of Moab springs and wells, the location of stream gages in Mill Creek, the location of the Sheley diversion, and the natural boundaries of the GCMC hydrologic system, and covers almost the entire GCMC hydrologic system. It is bounded by the Glen Canyon Group Grandstaff Creek (GCGC) hydrologic system to the north; the Morrison Formation to the east and southeast; and the Pack Creek Lower Alluvium (PCLA) hydrologic system to the west and southwest as defined in the Phase 1 HESA. The significant inputs of the PWB are: Mill Creek surface water at the SE corner of the water balance area; Mill Creek groundwater flux, called groundwater underflow, in the fractured Glen Canyon hydrogeologic units at the SE corner of the water balance area; and recharge by infiltration of precipitation (rain and snow) across the entire GCMC area. The outputs of the PWB are: Mill Creek surface water outflow into the northern end of Spanish Valley along the Mill Creek delta just downstream from the Powerhouse; evapotranspiration or consumptive use by native phreatophytes (cottonwoods, willows, tamarisk, and other riparian species); groundwater discharge from the fractured GCMC hydrogeologic units to major springs, including the Moab City springs and Skakel Spring, and domestic consumptive use by irrigation, livestock and domestic wells.

The Phase 1 HESA showed that there are two distinct periods of anthropogenic stresses in the GCMC hydrologic system: 1) pre-1980s; and 2) from early 1980s until present. During the pre-1980s limited municipal, domestic and irrigation demand left most of the system in its natural state, a period that in this report is referred to as the pre-development phase. In the early 1980s the coming on-line of the Sheley diversion, together with the initiation of a rather steady increase in municipal and domestic water use, represented a significant increase in the anthropogenic withdrawals from the GCMC hydrologic system, which continues to the present day. This latter period is in this report referred to as the post-development phase. A set of preliminary water budgets have been developed for each of these two stress periods

The pre-development GCMC water budget has as inputs: 1) Groundwater recharge from precipitation; 2) Groundwater underflow along the Mill Creek fracture zone; and 3) Mill Creek inflow at the point of entry to the GCMC hydrologic system above the Sheley diversion. Pre-development GCMC water budget outputs are: 1) Consumptive use by riparian vegetation; 2) Springs on the Kayenta Fault Zone (including Skakel); 3) Municipal water use (City of Moab Springs and Wells at the golf course); 4) Domestic consumptive use (private wells); and 5) Mill Creek outflow at the delta. The post-development GCMC water budget has the same type of inputs as the pre-development water budget, but has an additional outflow term, the Sheley diversion.

Although the existing precipitation data set for the GCMC area is extensive and spatially detailed, to use the precipitation data in calculating groundwater recharge is not straightforward. In this study, two approaches are taken: 1) evaluating a series of potential recharge scenarios to delineate the recharge bounds based on detailed knowledge of the hydrogeology using both the 1971-2000 and 1981-2010 climate data sets; and 2) using recharge as the closing or balancing term in the preliminary pre-development water budget. The latter value is then used as an input for the preliminary post-development water budget, in which the closing term is a deficit inflow assigned to water released from aquifer storage.

In order to establish the recharge bounds, to calculate consumptive use by riparian vegetation, and to determine groundwater storage characteristics, the GCMC hydrologic system was spatially divided into 5 types of hydro zones based upon the hydrogeology and geomorphology, groundwater and surface water hydrology, and distribution of phreatophytes. Hydro zone 1 is the phreatophyte zone and represents gaining stream reaches and phreatic consumptive use areas. Hydro zone 2 is the riparian high-K fracture zone (acting as a French drain) and includes the relatively rapid fractured canyon recharge and significant groundwater storage capabilities. Note that there is a partial overlap of Hydro zone 1 and Hydro zone 2. Hydro zone 3 is the matrix (non-fractured) zone and represents very slow recharge and small storage. Hydro zone 4 is the dry wash high-K fracture zone with fractured canyon/dry wash recharge and storage. This zone is noted as having insignificant phreatophyte discharge. Hydro zone 5 is the fracture-enhanced high-K matrix zone, characterized by fracture-enhanced recharge and storage. These zones have been mapped from aerial photography and added to a GIS data base to facilitate spatially distributed evaluation of water budget terms.

Two scenarios were calculated for both the pre-development and post-development water budgets based on lower and upper estimates of consumptive use by phreatophytes as listed in the literature for conditions found in the GCMC hydrologic system (PWB terms of 4009 and 6193 ac-ft/yr, respectively). In the low estimate of consumptive use by phreatophytes scenario, recharge is estimated to be 9155 acre-ft/yr, amounting to infiltration of approximately 30% of precipitation, in line with the highest calculated recharge component. In the high estimate of consumptive use by phreatophytes scenario, recharge is estimated to be 11339 ac-ft/yr, amounting to infiltration of approximately 37% of precipitation, which is well above the highest calculated recharge component. It is likely that the lower estimate of phreatophyte consumptive use is more realistic as it results in a defensible recharge rate in this fault- and fracture zones-dominated hydrologic system. Preliminary water budget terms for Mill Creek inflow and outflow were adjusted between pre-and post-development calculations in accordance with stream gage data, while municipal use terms were based on data provided by the City of Moab. Domestic use and spring runoff terms were compiled from the Utah water rights data base.

The post-development scenarios incorporate the Sheley diversion with an average annual outtake of 3665 ac-ft/yr, which is approximately 22% of the yearly budget for low estimate of consumptive use by phreatophytes, and about 19% of the yearly budget for high estimate of consumptive use by phreatophytes. The preliminary post-development water budget calculations show a deficit of 873 ac-ft/yr, representing the amount of water removed from groundwater storage in an average year. This release from storage may be compensated over time by increased recharge during above average precipitation years, or by recharge from Mill Creek (losing stretches) into the GCMC aquifer due to increased runoff in upgradient stretches of Mill Creek from larger than normal snowpack.

The PWB shows that there is a significant amount of water contributed to the GCMC hydrologic system from the La Sal Mountain hydrological systems as surface water through the upper reaches of Mill Creek, or in percentages of pre-development input into the GCMC hydrologic system: surface water (inflow into Mill Creek from La Sal Mountain system) counts for approximately 45%; local recharge from precipitation or ephemeral channel loss within the GCMC area counts for 55%; and groundwater underflow counts for less than 1%. The PWB also puts an upper bound on the total multi-year annually averaged inflow into the system of about 16,500 to 19,000 acre-ft. Any decline in upstream flows in Mill Creek from natural or man-made causes will have an immediate impact on the outflows of the GCMC hydrologic system and poses a potential threat to the sustainability of the City of Moab’s water supply.

In a preliminary assessment of the effect of the Sheley diversion on the water budget of the GCMC hydrologic system, the diversion annually takes out 22% of the total inflow to the GCMC hydrologic system and has resulted in a 40% reduction of Mill Creek outflows towards Spanish Valley, and a 20% reduction of springs and seeps discharge.

Many of the components of the PWB calculations include large uncertainties. The most reliable data are the USGS stream flow data in Mill Creek at and below the Sheley diversion, the springs and wells production data from the City of Moab, and the precipitation data from NOAA used to develop various recharge scenarios. All other data sets provide a “snap shot” of a particular variable in time as they were gathered at various, non-comparable moments in time and should be considered a first estimate, subject to refining by further field studies. Climate data can be refined by limiting the pre-development climate data set from the period 1971-2000 to the period 1971-1980. This also provides more insight in the effects of climate change on the GCMC water budget. Another area where significant cost-effective improvements to the PWB can be made, is more detailed and frequent monitoring of the Mill Creek surface water system, specifically in the vicinity of the Moab City wells and springs and above and below the area where the Skakel source protection zone intercedes Mill Creek. Finally, more detailed monitoring of selected, “representative” springs, both to the north and south of the Mill Creek delta, should be initiated to obtain an indication of the relationships over time between spring discharge, climate variations, and Mill Creek runoff, as well as an insight in the resilience of the GCMC hydrologic system to external stresses.

The Glen Canyon Group groundwater system is mostly unconfined, i.e., having a readily fluctuating water table, and the aquifer storativity is characterized by so-called specific yield. The Glen Canyon Group bedrock has both matrix specific yield (small) and fracture specific yield (large). The matrix specific yield estimates range from 1.0 – 10%; the fracture specific yield estimates range from 10 – 40%. As there is a significant presence of fracture zones in the GCMC system, fractures are the dominant feature in determining available groundwater storage.

Using the hydro zones defined for this project, each of zones 2 through 5 of the GCMC system was assigned a range for its specific yield. The minimum value for the system-wide groundwater storage was estimated using the low specific yield values for each zone, and the maximum value for the system-wide groundwater storage was estimated using the high specific yield values for each zone. Each hydro zone had an estimated volume based on a GIS-defined area multiplied by an averaged saturated depth and assigned specific yield to obtain the hydro zone storage value. These calculations show that the GCMC groundwater system has a storage minimum of about 153,000 ac-ft, and a storage maximum of about 306,000 ac-ft, indicating significant uncertainty in the actual storage available in the GCMC groundwater system. Hydro zones 2 and 5, located along the groundwater flow paths that directly affect the yields and water quality of Skakel Spring, and the City of Moab springs and wells at the golf course, had the largest amount of storage. The current City of Moab source protection plans identify these hydro zones as critical, and an update to these plans will be completed in Phase 3 of this project.