Moab Area Watershed Partnership

Draft Meeting Minutes September 16, 2020 from 1:00 – 3:00
Virtual meeting using Google Meets
Meeting # 76

Stakeholders Present	Affiliation	Others
Kara Dohrenwend	Grand Conservation District	Arne Hultquist, Watershed Coordinator
Dana Van Horn	GWSSA	
Jeff Adams	CWC	
Ryan Jones	UDAF	
Marc Stilson	UDWRi	
Lucy Parham	UDWQ	
Chris Wilkowske	USGS	
Ann Marie Aubry	BLM	
Gabriel Woytek	Grand County	
Jessica Pierson	UDWRe	
Levi Jones	Moab City	
Russell Seeley	UDEQ	
Rebecca Weissinger	Herself	
Mike Duncan	City of Moab	
Janae Wallace	UGS	
Jeff Mattson	Himself	
Jonathan Dutrow	SEUHD	
Mack McDonald	San Juan County	
Philip Gardner	USGS	
Sarah Stock	CWC	

ACTIVITY	DISCUSSION	ACTION
Introductions, Review Agenda and accept July Minutes	Introductions were made and that also allowed everyone to turn on and off their microphone. The agenda was slightly changed to accommodate Philip Gardner's participation in the discussion on his paper. Gabriel of Grand County also had an addition to the agenda, a discussion on a comment letter from Grand County to the Manti-La Sal National Forest on the proposed Forest Management Plan. The July minutes were accepted.	July's minutes and today's agenda were approved.
Watershed Coordinator's Report	There weren't any questions on the Watershed Coordinators report.	Arne will continue submitting WC reports.
Gardner, Et, Al Paper, "Rethinking a groundwater flow system using a multiple-tracer geochemical approach: a case study in Moab-Spanish Valley":	Arne invited Philip Gardner, lead author of fore-mentioned paper to discuss the paper and have a question and answer dialogue with MAWP attendees. Philip informed the group that this paper was a subsequent paper to the USGS report that would "distill" down the USGS report. He also informed the group that when the lumped parameter model was considered as another way to estimate recharge to the 'deep' Glen Canyon Group (GCG) aquifer it was too late in the process of writing the USGS report to include it in that report. Arne had sent him a total of four questions and Philip answered them as follows: **Please note these responses are summaries of Philip's answers, hopefully in a layman's vernacular, For his complete written**	Arne provided a copy of the paper in the email with the agenda. Arne will also put Philips complete written answers as an appendix to these minutes. Philip is willing to answers to other questions. You can email him directly, or pass your questions through Arne.

	responses see the appendix to these minutes. Also, since our meeting, Mike has asked Philip a question, (well it's kind of a three part question) and Philip has responded. That questions and response is also in the appendix. **First question,** actually a two part question: The report uses the area above 2,750 meters to estimate recharge. This area includes the headwaters of Brumley Ck, a tributary to Pack Creek. I realize groundwater paths do not always follow surface water feature's pathways, but often they do because of the underlying physical geology. I realize we can't see underground, but how confident are you that the precipitation falling in the Brumley Creek headwaters is recharging the Deep GCGA instead of the Pack Creek drainage? Second part, What percentage of the area above 2,750 meters is in the Pack Creek surface water drainage? **Answer:** The area above the 2,750 meter contour that contains the headwaters of Brumley Creek in the Pack Creek Drainage is 25%. The authors feel confident that since the underlying geology is composed of the fractured GCG that the water infiltrating an aquifer would recharge GCG group and following the fractures instead of the surface topography. **Second Question:** Correct me if I'm wrong, but the lumped parameter model doesn't use precipitation to determine recharge. Recharge is empirically derived. Current estimates of precipitation that will be unavailable for recharge is 17% due to increased use of water by vegetation necessitated by climate change. What are the consequences of decreased water availability due to increased use of water by vegetation as it relates to the lumped parameter model? **Answer:** There is a lot of concern of numerous entities on how climate change will effect aquifer recharge and groundwater levels. If there is an increase in uptake of surface water by 17%, there will be 17% less water available to recharge an aquifer. The lumped parameter model doesn't contain a precipitation component but the amount of recharge is dependent upon the amount of time it takes water to travel through the aquifer. If less water were recharging the aquifer, the amount of travel time in the aquifer would increase due to a decrease in pressure at the up gradient end of the aquifer and the model would predict less recharge. **Third Question:** There has been some discussion about modeling the decrease in aquifer storage associated with water withdrawals and depth to groundwater/discharge from springs. The modeling suggests that "aquifer levels" sometimes take years to come to equilibrium without regard to whether the withdrawals are more or less than the recharge. What is your experience with these kinds of models? **Answer:** The properties of the aquifer determine how long it takes for the effects of withdrawal to come to equilibrium. The transmissivity of the aquifer is the biggest determinate of how long it takes. We haven't done any modeling on the aquifers in	

	Spanish Valley to determine how long it would take to come into equilibrium. Our experience is that depending upon the aquifer it could take 100's of years to come to equilibrium. **Fourth Question:** Groundwater and surface water pathways are dependent upon structural/physical geology as well as the physical properties of the geology. For instance, surface and groundwater flow in the direction of least resistance and the permeability of geological layers can determine in what direction water will travel. Fractures are mentioned as conduits and confining layers are mentioned as barriers in this paper. Is there a fracture/fault that extends to the area of recharge for the deep GCGA and is it connected with fractures/faults associated with the springs where deep GCGA water is discharged to the surface? **Answer:** This question was partially answered with the answer to the 1st question. Yes there is, looking at geological maps and google earth images there are the structures associated with fracture transport of water from high in the La Sal mountains to the City of Moab owned springs and wells that are located in the GCG.	
Project Progress Presentations by Sponsors	BLM Phase IV presented by Jeff Adams and Ann Marie. Jeff presented several pictures of the gully work that he has been performing. Kara asked what kind of monitoring was being performed for those efforts. Ann Marie stated photo monitoring. Arne asked if the CYC was going to come and continue the invasive removal and prevention that has been happening annually. She said most likely but the dates haven't been set. Arne also inquired whether MIM's monitoring will be necessary prior to starting Phase V. Ann Marie said it will need to be done, but we don't have to schedule it yet as we won't be working on that phase till next year. Rim to Rim Mill and Pack Creek Revegetation Improvements by Kara. Kara has been working with the schools having students doing volunteer work and getting educated on river restoration at the same time. She also stated she had a crew do a large amount of clearing on Pack Creek where the restoration project will be taking place and other sites on Mill Creek. Arne and Kara informed the group that they have received confirmation that the NRCS will help with the engineering associated with the Pack Creek Restoration project and will be pursuing the appropriate permits in a timely fashion such that we can begin on the ground work next spring or summer! Southeast Utah Health Department On-Digitization by Jonathan. Jonathan presented slides of the maps of on-site waste water systems in Castle Valley. The maps will help SEUHD manage the maintenance of the systems as well as help planners maintain enough spacing between sites to prevent aquifer degradation. He also stated this project is complicated by the age and upkeep of the records associated with the original hard copy records. He said the project also covers Emery and Carbon Counties. He has	

	hired an intern to work on the project and it is progressing rather well at this time. Arne asked him about the Human Waste Initiative that received funding this year. Jonathan answered they received some help from USU Water Resources Department as they have already developed a web site with information on how to properly handle human waste where there aren't any developed facilities. He also said he would be getting another intern to help with the educational component of this project. They may work with USU to find the appropriate intern.	
Watershed Management Plan Revisions Section 3, Water Quality Data Analysis:	Arne presented the current draft of Section 3. Arne had incorporated all the comments he received on the Section from the reviewers. There were several good questions and comments posed by reviewers. Arne kept those questions as comments in the draft we reviewed today and they were answered to the best of his and the attendees abilities. Arne first explained the data analyses separated samples into two time periods. The first time period is everything prior to 2009 and the second is the last ten years, 2010 through 2019. Arne explained he did so because UDWQ only uses the last 10 years for their assessments. Arne reviewed the highlights in this section which included overall improvement in water quality exceedences for the watersheds as a whole. In another analyses, he showed Pack Creek has supported it's use designation for irrigation with TDS concentrations less than 1200 mg/L in over 90% of all samples. Arne also said the analysis showed that selenium concentrations were also less than the standard in over 90% of all samples. Rebecca was concerned that the drop in Selenium concentrations could be analysis related as UDWQ relatively recently changed the analytic methodology that appears to provide results of lesser concentrations than the previous methodology. Lucy agreed to look into that. Arne suggested that even with the differences in the new methodology, TDS and selenium correlate in Pack and Castle Creek and that lower TDS values confirm the lower concentrations in selenium. Arne also pointed out that there was a much large number of E. coli samples with high concentrations because of increased sampling efforts, i.e. more E. coli samples, more opportunities for samples with high counts. The attendees considered the Section finalized with the understanding that the document is a living document and can be changed at any time.	Arne will make some small changes to Section 3 and add it to the Watershed Management Plan.
MAWP letter of endorsement for CWC's financial support grant applications:	Arne presented a letter of support for CWC's grant proposals. The attendees were supportive of the concept and the majority of the letter, but one sentence appeared to be open in terms of what types of grants the MAWP supports. Kara and Arne will refine that sentence and run it through the Chair and Vice Chair prior to sending it to the CWC.	Arne will make the suggested changes to the letter send it to Kara for input. After that review it will be reviewed by the Chair and Vice Chair and Arne will send it to the CWC.

Manti-La Sal NF Management Plan and a comment letter from Grand County:	Gabriel informed the group that Grand County is a cooperator and they were informed that a draft Management Plan was available and the Red Rocks 4Wheeler association provided some comments to the County they would like included in the County's comments. Gabriel suggested that other entities have comments also and the MAWP would be an appropriate place to gather other material for their letter. This came as a surprise to Arne and others in the group because we were not aware of a current comment period being open and we were not aware there was a draft plan available to consider. Unfortunately nobody from the USFS was on line at this meeting. Arne presented the last comment letter the MAWP had written during the scoping process for this plan. Arne said the MAWP partners were general concerned with land use plans that protected the Sole Source Aquifer for Spanish Valley and Castle Valley. Arne will look into the Management Plan status and get inform Gabriel and attendees that information.	Arne will ask the Manti-La Sal MAWP partners that generally attend these meetings about the Plan's status and pass that information on to the attendees.
Other Business Vision Committee update. Future meetings for the development of a Spanish Valley Groundwater Management Plan and other groundwater matters.	Kara informed the group that the Vision Committee has a survey available on proposed alternatives to the current management of recreation associated with Mill Creek. They are hoping to get 500 responses and encouraged everyone to pass on the link to the survey. The link is bit.ly/MillCCSurvey. Marc informed the group that the Division of Water Rights is currently planning on holding a public meeting on **November 4 at 4 pm** to present an evaluation of the United States Geologic Survey, Scientific Investigations Report 2019-5062 entitled *"Evaluation of Groundwater Resources in the Spanish Valley Watershed, Grand and San Juan Counties, Utah".* This meeting will focus on how the USGS report and its finding will inform water right policy development including development of a groundwater management plan. We have reserved the Old Spanish Trail Arena but depending on circumstances, they may change it to an all virtual meeting. Details are still being worked out in regards to how they can satisfactorily present the information and receive comments.	Attendees were encouraged to participate in the survey and pass the opportunity along to other Moabites. Attendees were encouraged to attend the November 4 Groundwater Management Plan Meeting
Adjourn	The next meeting will be at 1:00pm November 18, 2020 location to be determined, but the meeting will most likely be virtual. The focus of the meeting will be the annual monitoring report reports.	Adjournment

Appendix to the September MAWP meeting containing Philips written answers to Arne's questions associated with the latest journal article on Spanish Valley's groundwater. The title is *"Rethinking a groundwater flow system using a multiple-tracer geochemical approach: a case study in Moab-Spanish Valley"* and will appear in the Journal

Here are the longer -version answers to your questions. Since I already had them typed up I figured I might as well send them:

Main 3 motivations of new paper:

1. Attempt to tell the story of Moab-Spanish Valley are hydrology in a clearer more concise version
2. Add distinction of Shallow vs Deep Glen Canyon Group aquifers
    1. Deep GCGA is the source of Moab municipal water
    2. If I had it to do all over again, we might make a distinction between the Navajo and Wingate aquifers – it seems the intervening Kayenta Fm is generally a decent confining unit
3. Add the LPM-based independent estimate of flow through the Deep GCGA

Arne's Question #1 answer:

The concept of the recharge area is that the chemistry of

Quick answer-

Yes, some of the DGCGA recharge area is in the Brumley / Pack Creek surface water Drainage (about 25%). But, as you know, in fractured bedrock mountain systems, assuming groundwater flowpaths follow surface water drainages is an oversimplified. More likely, they follow connected fractures, possibly through multiple geologic units where the preferentially permeable units abut each other, often regardless of faults or geologic contacts, and these pathways are guided by large-scale impermeable/confining units more than faults. Since no water sampled from the pack creek drainage isotopically resemble the high altitude precip signal of the DGCGA, we're pretty confident. We've scratched out head over this and thought it through for years but this distinct isotopic difference is really compelling (see figure 3 in the paper).

More answer with some examples:

In the Bear River range in Utah – tracer tests have show groundwater clearly recharged in one drainage resurfacing at springs two drainages over – lateral to surface water drainage direction.

I'm working in a drainage in great basin national park that is at least as geologically complex as the La Sals. There has been a long-standing question as to the fate of water lost across a karstic Limestone Bedrock stream reach high in the draining. All previous thinking was that it cannot continue down gradient in the drainage from discharge at springs in other geologic units – mostly because it couldn't cross a large-scale highly deformed detachment fault and large quartzite & shale units. A dye tracer test done last summer shows that the stream loss finds permeable pathways through the highly faulted mountain block and across the detachment fault to discharge at springs on both sides of the drainage located 1.5 miles and 6 miles from the losing reach in less than a week. If you saw the area and thought about where the water was likely to go in the subsurface – you wouldn't have guessed this.

We think there are clear connections from the recharge area above 2,750 m to the Deep GCGA by way of highly fractured sandstone units sandwiched between effective confining units as shown in an admittedly over-simplified way on figure 10 in the paper. You can see this also in the 30x60 Moab geologic map (very complex) and in the associated cross section E-E' (over simplified but similar to out figure 10.

Arne's Question #2 answer:

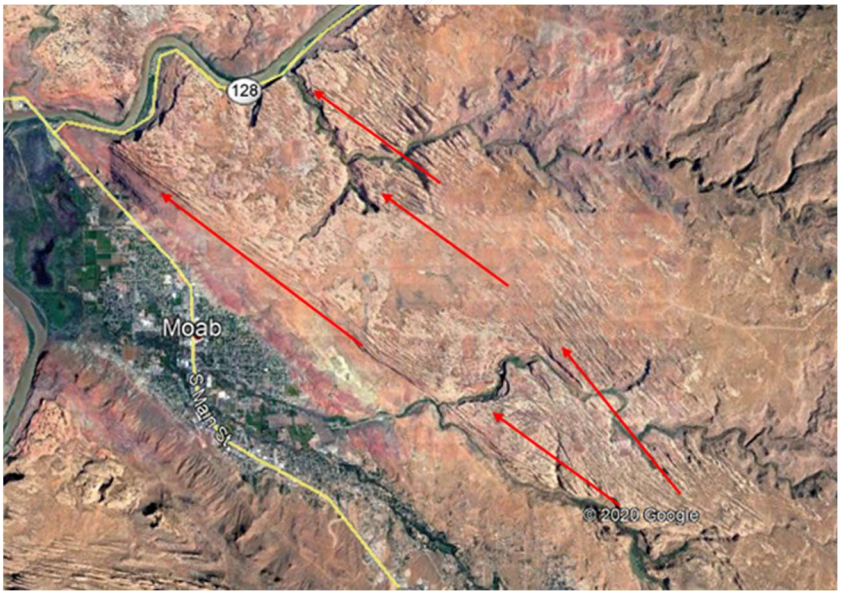
You are correct that the LPM does not rely on precipitation to estimate recharge. It related a recharge rate to the geometry of the aquifer and a transit time (which we get from the carbon-14 groundwater age dating). If mountain precipitation consumes more precip in the future than it does today, then with respect to the LPM, recharge *(R)* would go down and the transit time that you would measure (τ) would, correspondingly go up. Questions about climate-change related effects on mountain recharge are complicated. Sure, growing seasons will be longer and more precip will fall as rain than snow and the snow melt runoff season will start earlier (it already is), but the dynamics of how that precip gets into the ground (recharge) are still up for debate and probably depend on case by case details related to the infiltration mechanisms, geology, vegetation, etc. of different areas.

Arne's Question #3 answer:

Yes, groundwater level declines due to pumping can take a long time to recover or stabilize. Levels in some parts of the aquifer will continue to decline even after pumping has stopped as water far from the pumping moves in to fill the void left in the cone of depression around the pumping center at a rate raster than recharge can replenish to water removed from storage. The time it takes for drawdown and recover to occur away from pumping depends on the aquifer diffusivity (ratio of transmissivity to storage coefficient in an aquifer). In a bedrock aquifer like the GCGA, most flow occurs through highly transmissive fractures that have a low capacity to store water (D = T/S) meaning drawdown and subsequent recovery will happen fast. A basin fill aquifer will typically be less transmissive but can store much more water that fractured rock – so drawdown and recover are likely to be slower. These are generalities but you get the idea. For the models you are talking about, I would have to see them to see how they are set up and what hydraulic properties are assumed and where they come from to see if I could chime in on whether I agreed with them or not.

Arne's Question #4 answer:

Groundwater pathways are driven by the hydraulic gradient (strength and magnitude of the force driving the flow) and the hydraulic properties of the rock / sediment that are moving through (which I think is what you are referring to). There is clearly a huge hydraulic gradient between the La Sal highlands and the discharge points of the Deep GCGA. If most of the flow occurs though GCGA sandstones, it will be both in the matrix (primary porosity) and fractures (secondary porosity). More information needs to be obtained from aquifer testing in these rocks to be able to rely less on assumptions and be able to make more certain predictions, but it is likely that most water in the DGCGA moves through and most water-level responses to recharge and pumping propagates through large-scale fracture networks. And while the characteristics of the fractures is surely different where it is concealed high in the mountains, **there is a clear well-developed and large-scale SE-NW trending fracture network in the GCG rocks where they are exposed NE of the valley.** The fractures are probably associated with the stresses on these rocks that occurred with the development of the Spanish Valley an Castle valley salt - cored anticlines. See Image below.



Mike Duncan's questions that weren't asked at the MAWP meeting, but have been asked and answered since then.

M. Duncan question # 1:

Re Fig. 10, high on the west side of the La Sals I visualize a 5 x 9 km "hopper" into which infiltrates precip at the rate of 4.2E6 m^3/yr. The hopper empties into a long sloped downgradient rectangular pipe with some porosity and conductivity 9 km wide x 300 m deep and 25 km long whose other end is at Skakel springs and/or the golf course. En route, the pipe's cross section can vary widely (depending on how it's confined) from the nominal 9 km x 300 m, giving rise to paths of varying transit time, but if it's all full of water it doesn't much matter (except for storage volume considerations).

If this is conceptually accurate, where's the (DGCGA) "aquifer" ? Just the hopper? The hopper and the piping down to the springs? If there were no city wells, wouldn't all 4.2E6 m^3/yr discharge at the springs? If the wells pump some fraction of that discharge, then under equilibrium wouldn't the springs show only the remainder? This is the "water cooler" model I've used to illustrate principles, except that the time constant to equilibrium is on the order of 2700 years.

Suppose the argument is made that should we (knowingly elect to) mine (with new withdrawals > recharge, i.e. violate the safe yield rule) the aquifer, we still have a lot of storage volume at our disposal. Is that true? Is that wise? I personally would rather err on the side of caution, not to mention obey the (wise) safe yield rule, since local governments must make "will serve" commitments far into the future.

Answers:

I'm glad you're finding the report useful. We could have a long discussion about the potential nuances of all of this but I'll try to answer your questions as simply and clearly as I can and emphasize what I think the important points are.

If this is conceptually accurate, where's the (DGCGA) "aquifer" ? *You can think of the DGCGA as being the saturated portion of GCG rocks mostly below the Kayenta Fm. I say mostly because there are bound to be varying degrees of connection & isolation between the Navajo and Kayenta that we can't predict. The reported uncertainty in the DGCGA recharge(+/- 53%) is designed to account for all of the unknowns. The main point of presenting this analysis and estimate of recharge is to support the estimate made from flow measurements and the analysis of potential GCG water underflowing the wetlands (the one unmeasurable component). This shows that when you go about estimating the DGCGA recharge in two completely independent ways, you come up with just about the same value.*

Just the hopper? *Not just the hopper - see previous response.*

If there were no city wells, wouldn't all 4.2E6 m^3/yr discharge at the springs? *Yes.*

If the wells pump some fraction of that discharge, then under equilibrium wouldn't the springs show only the remainder? This is the "water cooler" model I've used to illustrate principles, except that the time constant to equilibrium is on the order of 2700 years. *Yes you are correct, and this is the current situation.*

Suppose the argument is made that should we (knowingly elect to) mine (with new withdrawals > recharge, i.e. violate the safe yield rule) the aquifer, we still have a lot of storage volume at our disposal. Is that true? *Yes you*

have water in storage that can be withdrawn. It' s difficult to calculate what the stored amount of water is without a transient numerical model that is calibrated to a decent amount of pumping and water-level response data in the DGCGA. If you can simulate that with a model and are comfortable with how well it matched observed responses to pumping, then you can use it to make predictions and use the model-estimated storage values to calculate storage volumes. You can always make a quick and dirty estimates of the saturated volume of rock using approximate thickness, areal extent, and effective porosity but what you really want to know for management is how the aquifer responds to doing this. - for instance how fast does drawdown from pumping propagate through this fractured & confined aquifer? how quickly will it pumping dry up springs and capture baseflow to the forks of Mill Creek? how hydraulically connected is the DGCGA to the valley fill aquifer? How quickly will water levels recover if pumping is relaxed? etc.

Is that wise? *I think the previous answer gets at this. Once all the hydrologic data have been analyzed and preferably used to calibrate a transient groundwater model, How comfortable are water managers with the predicted effects of removing water from storage?*