Walden 3-D, Inc.
Continuing to make a positive difference!

Kent Jones, P.E.
Utah State Engineer
Utah Division of Water Rights
646 North Main street
P.O. Box 506
Cedar City, Utah
waterrights@utah.gov

Dear Kent,

This letter summarizes current questions and comments about the announced Ground Water Management Plan for Cedar Valley.

It was surprising to learn of your retirement, so soon after announcing the mandatory water reallocation plan for Cedar Valley.

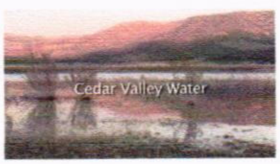
I request a meeting with your replacements and their staff to discuss the following 5 points in detail, either in Cedar City, or at DNR offices in Salt Lake:

1. Limit water reallocation to the Cedar Valley Aquifer, where all UGS and USGS modeling was done, and not to the entire Cedar Valley Drainage Basin.
2. Transfer Water rights from the Cedar Valley Unconsolidated Fill Aquifer to Bedrock Aquifers in the Cedar Valley Drainage Basin in order to reduce 7,000 acre-feet overproduction and the 50,000 acre-feet over-allocation within Cedar Valley Unconsolidated Fill Aquifer.
3. Age date water in wells in Cedar and Parowan Valleys, and map the ages to define relationships between the different producing zones within the Valley Fill Aquifers and Bedrock Aquifers.
4. Encourage Bedrock Aquifer well tests to prove up the untapped bedrock Quartz Monzonite Aquifer and the untapped Cretaceous Aquifer.
5. Have the Water Management Committee and CICWCD look into condensation, horizontal drilling, train transportation of water, and related technologies before the $500,000,000 bond.

Video summarizing key points in this letter, was made during a Field Trip conducted for candidates running for Cedar City Council on the 10th of August 2019. The resulting movie can be downloaded from

http://www.walden3d.com/water/Cedar_Valley_Water_sm.mov or by going to

https://youtu.be/Eqj7thwB7KA.



The rest of this letter expands on each of the five summary points above with details and examples, mostly derived from a presentation given before the Cedar City Chapter of the Sons of the Utah Pioneers Pot Luck lunch on Monday, 04 November 2019. Download the SUP Presentation as a pdf file from

http://www.walden3d.com/water/191104_Cedar_Valley_Water_Issues_and_Solutions.pdf

or as a PowerPoint file, with the above-mentioned movie, embedded at

http://www.walden3d.com/water/191104_Cedar_Valley_Water_Issues_and_Solutions+low_res_movie.pptx.

Each section starts with the abstracted point in bold, and then has a descriptive expansion on concepts behind the abstracted point, including figures, to illustrate the concepts to non-technical citizens to whom this letter will be made available.

<u>First: limit the reallocation plan to the Cedar Valley Aquifer, where all modeling was done, and not to the entire Cedar Valley Drainage Basin.</u>

There is a difference between the unconsolidated sediments in the Cedar Valley Fill Aquifer (and Parowan Valley Fill Aquifer), and untapped bedrock aquifers surrounding these valleys. This difference for Cedar Valley is summarized on Figure 1, from Figure 1 of the 2005 USGS report [Hydrology and Simulation of Ground-Water Flow in cedar Valley, Iron County, Utah](#).

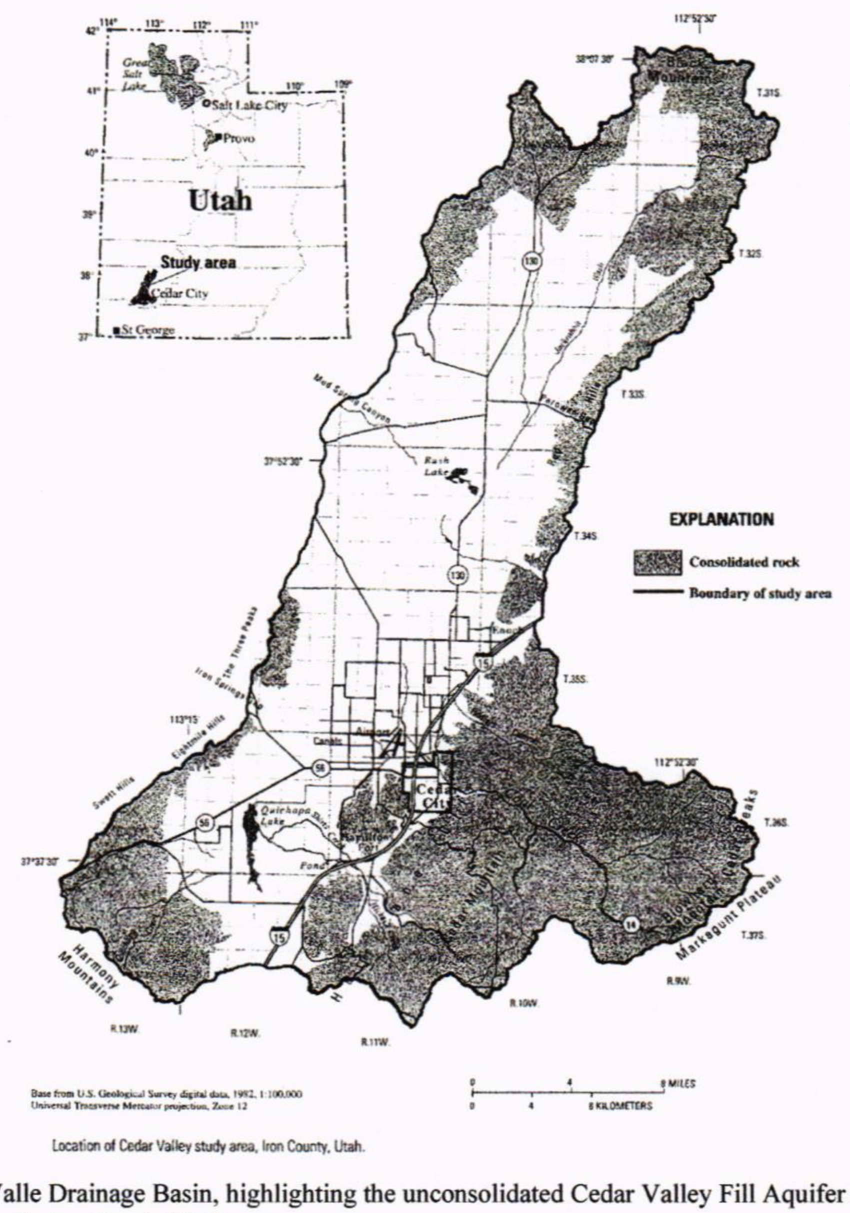


Figure 1. Cedar Valle Drainage Basin, highlighting the unconsolidated Cedar Valley Fill Aquifer in white, and the surrounding Bedrock Aquifers in black.

This same report (Figure 4) includes a map showing estimated percentage of sand/gravel bearing intervals in the unconsolidated basin fill, which appears to have provided control points for modeling groundwater flow, and which is included below as Figure 2. Note there is no data samples in the Bedrock Aquifers.

12 Hydrology and Simulation of Ground-Water Flow in Cedar Valley, Iron County, Utah

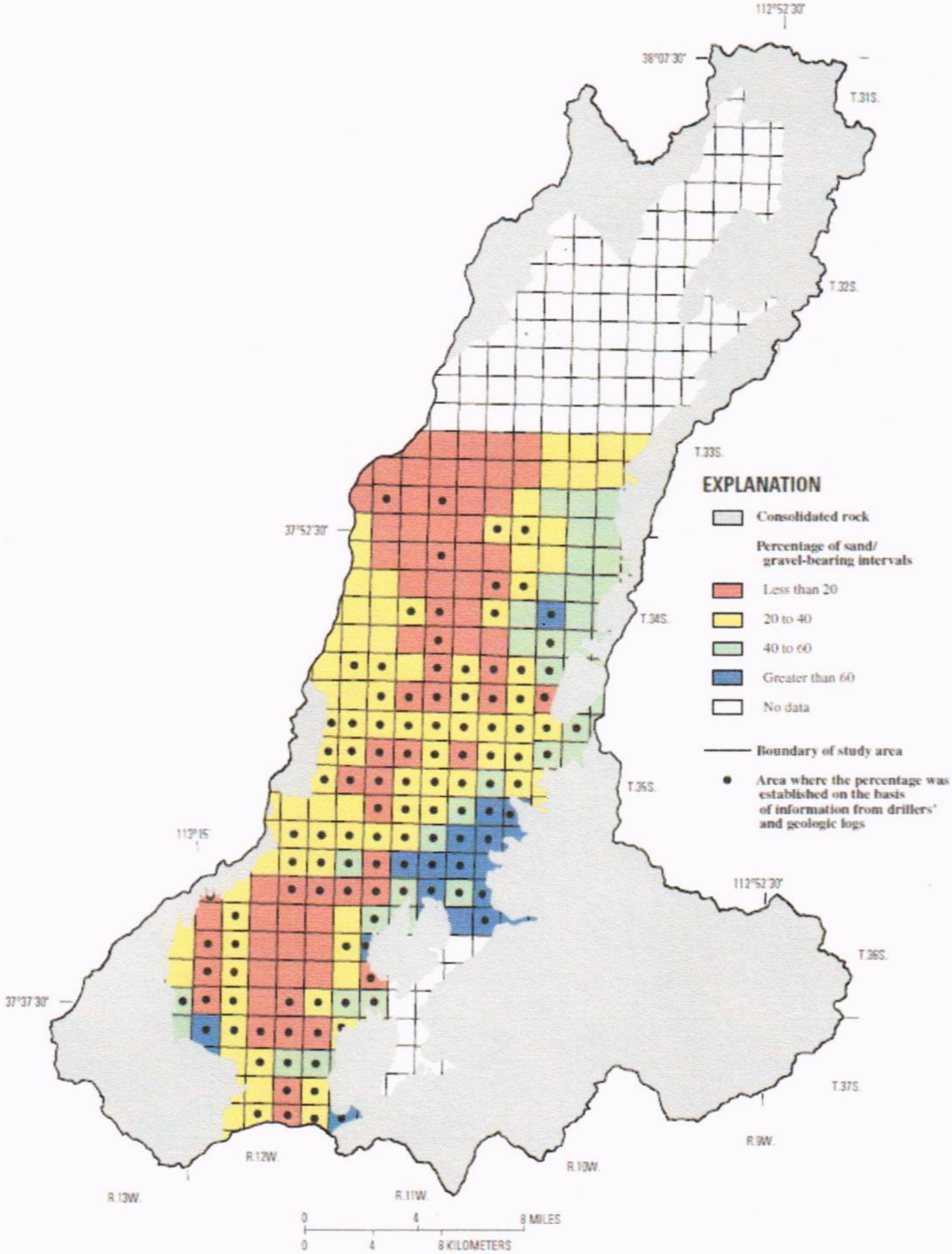
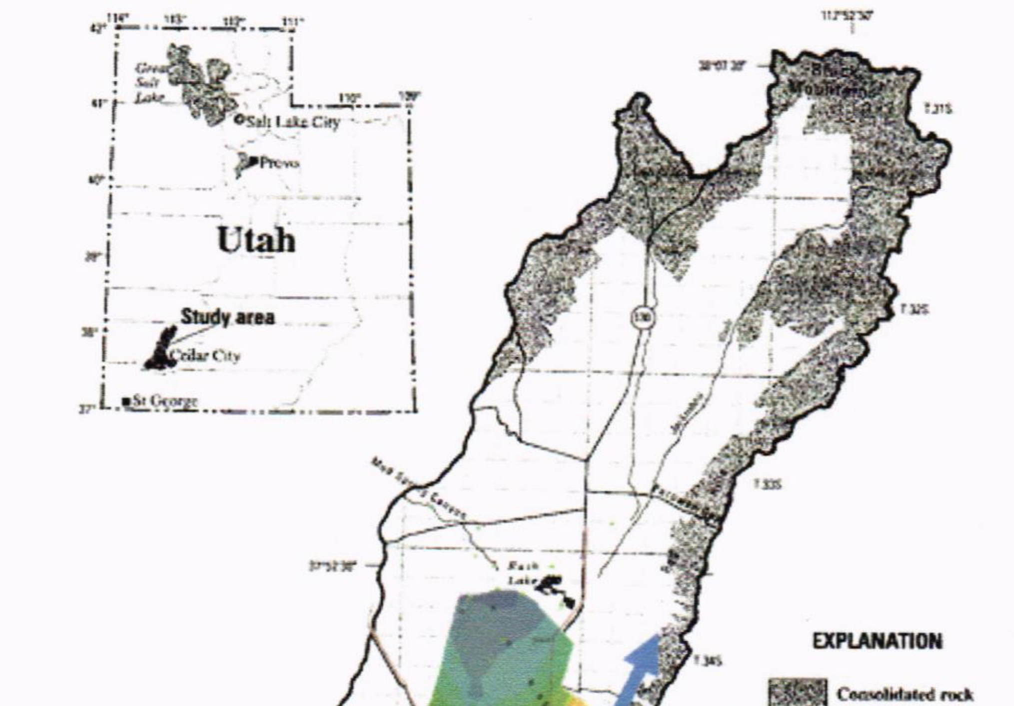


Figure 4. Estimated percentage of sand/gravel-bearing intervals in the unconsolidated basin fill, Cedar Valley, Iron County, Utah.

Figure 2. Estimated percentage of sand/gravel bearing intervals in the unconsolidated basin fill.

Figure 3 below overlays the 2014 UGS map of land subsidence on the map of the Cedar Valley Drainage Basin (from UGS_Land-Subsidance_Fissures_Cedar-Valley.pdf). Also note the blue arrows are a cartoon to indicate probable flow of water out of the Cedar Valley Fill Aquifer and from surrounding Bedrock Aquifers out of Cedar Valley.



Location of Cedar Valley study area, Iron County, Utah.

Figure 3. UGS map of land subsidence overlain on map of the Cedar Valley Drainage Basin, with probable water flow along the faults bounding Cedar Valley (not included in USGS model of water flow).

The Cedar Valley Fill Aquifer is composed of unconsolidated layers and channels of clay, silt, sand, cobbles, and boulders, with better flowing water at different levels in the subsurface, as shown in the summary display of a 2006 analysis I did of 145 well logs in Cedar Valley, shown here as Figure 4. Note the deepest well at that time was 820 feet deep.

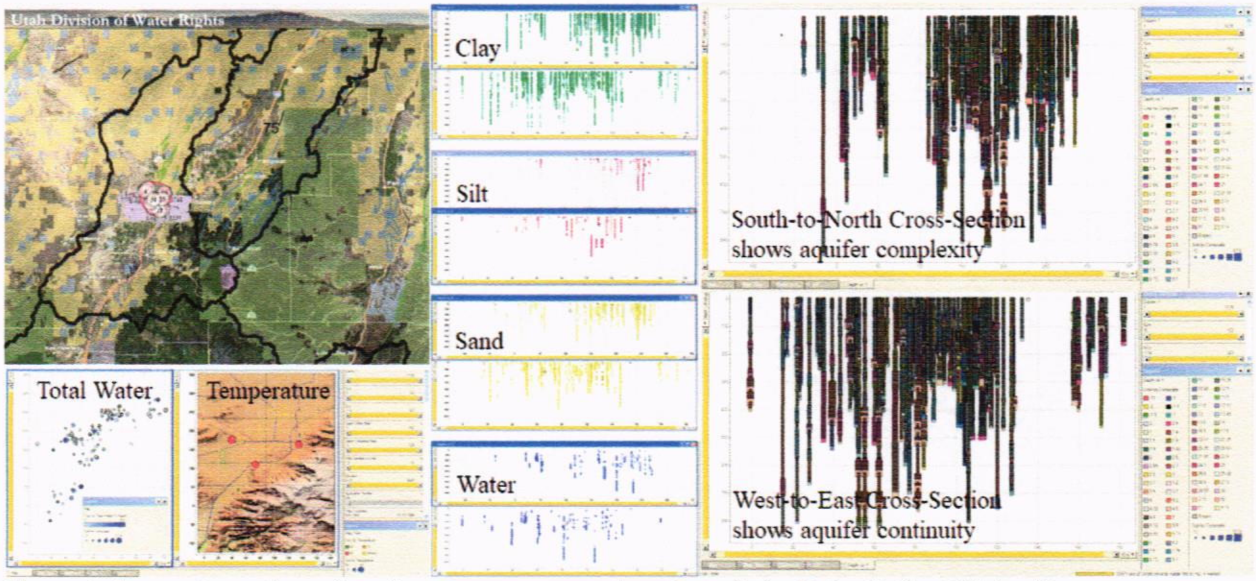


Figure 4. Composite north-south and west-east cross-sections through the Cedar Valley Fill Aquifer.

These unconsolidated sand channels and valley fill sediments continue down several thousand feet, as shown on a seismic section I collected when running a Mobil Oil seismic crew in Cedar City in 1978-1979 and cross-sections from a follow-up USGS report on the geology of Cedar Valley and its relation to ground-water conditions (see https://ugspub.nr.utah.gov/publications/special_studies/ss-103.pdf), as shown in Figure 5. There is 7,000 feet of sediment and consolidated rock in the center of Cedar Valley.

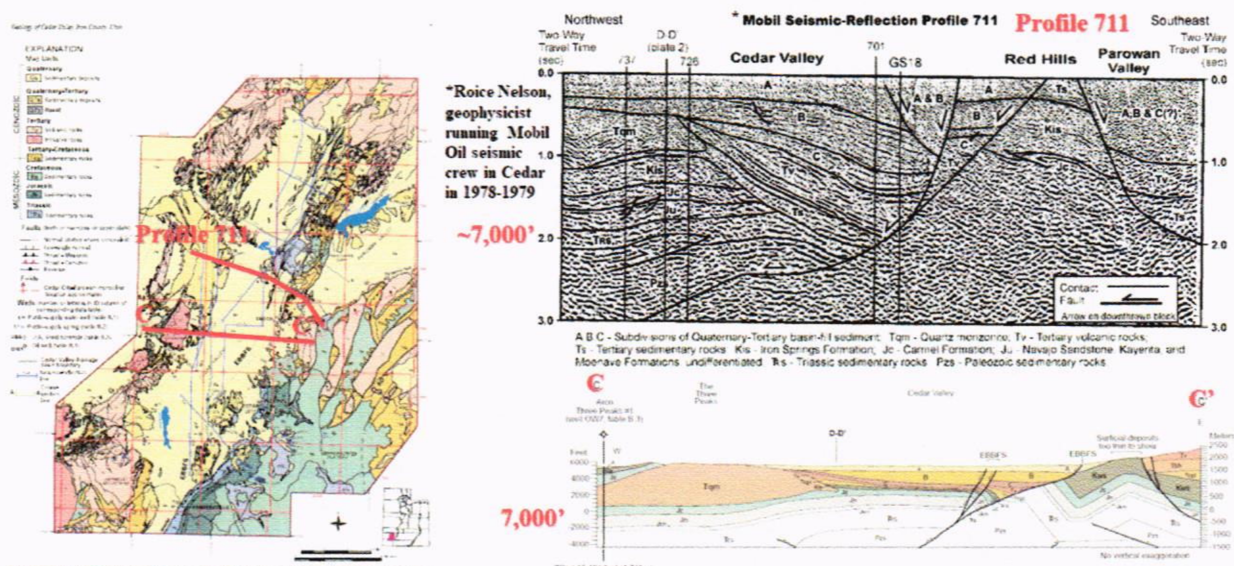


Figure 5. Map, seismic cross-section, and geologic cross-section across the Cedar Valley Fill Aquifer.

As water is withdrawn from the unconsolidated sediments, the aquifers collapse, and can never be recovered. This same kind of collapse will not occur in the Bedrock Aquifers. I agree production of groundwater from the Cedar Valley Fill Aquifer, must be restricted, to stop lowering the level of producible water and the collapse of unconsolidated aquifers. However, it is important to acknowledge these unconsolidated valley fill aquifers are distinct and separated from the bedrock aquifers surrounding Cedar Valley. The models by the USGS and UGS are models. They are estimates. There is no measured relationship between the Bedrock Aquifers surrounding the Cedar Valley Fill Aquifer, and the Cedar Valley Fill Aquifer itself, except for flow down the streams entering the valley.

And the stream flow measurements are probably not accurate. The largest stream entering Cedar Valley is Coal Creek. Coal Creek runs across the steeply dipping and highly porous Navajo Sandstone beds (see Figure 6). At least one local water expert, Joseph Armstrong, has estimated that 50% of the water flowing down Coal Creek is lost as it travels across the red Jurassic Sandstone beds. Note these beds dip away from Cedar Valley up to 60 degrees. Most of the beds up Cedar Canyon dip away from the valley at least 10 degrees. The USGS has a flow meter at the base of the canyon. However, they do not have a flow meter above the Navajo Sandstone beds. They tell me it will cost $10,000 to put in another measuring station. Money to put in this measuring station would be well spent as it would provide a way to estimate how much water is reaching the Cedar Valley Aquifer from the Bedrock Aquifers up Cedar Canyon. Based on these measurements, it is possible to define steps to allow significant additional water to be brought down canyon streams to recharge aquifers.

Figure 6. Water migrates down bedding planes, and through highly porous Jurassic Sandstone layers.

Second: Transfer Water rights from the Cedar Valley Aquifer to Bedrock Aquifers in the Cedar Valley Drainage Basin to reduce 7,000-acre-feet of overproduction and the 50,000 acre-feet over-allocation within Cedar Valley.

The Bedrock Aquifers are composted of consolidated rock. It will not collapse and create fissures like the unconsolidated sediments in the Cedar Valley Fill Aquifer. If produced too hard, these Bedrock Aquifers could stop producing, for a while. They will refill. Just like transferring water rights from Parowan Valley to the 800-1000 gallons per minute (580-725 acre-feet per year) Brian Head water well did not cut down on any water production in Parowan Valley, transferring water rights out of Cedar Valley to the surrounding Bedrock Aquifers will remove the 7,000 acre-feet of overproduction and help reduce the 50,000 acre-feet of over allocation in the Cedar Valley Fill Aquifer.

There are two primary untapped Bedrock Aquifers Gary Player and I have identified. These will be discussed more in the fourth section below. By way of introduction, these are the Quartz Monzonite Aquifer to the west of Cedar Valley, and the Cretaceous Aquifer to the east of Cedar Valley. Figure 7 summarizes the spatial extent of these two untapped aquifers, as well as the Cedar Valley Fill Aquifer.

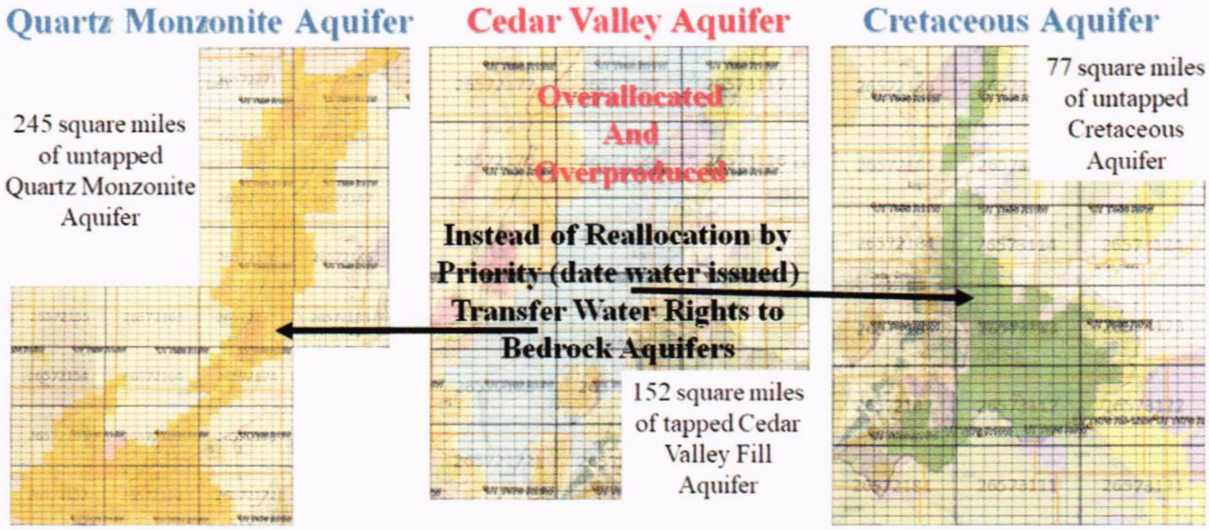
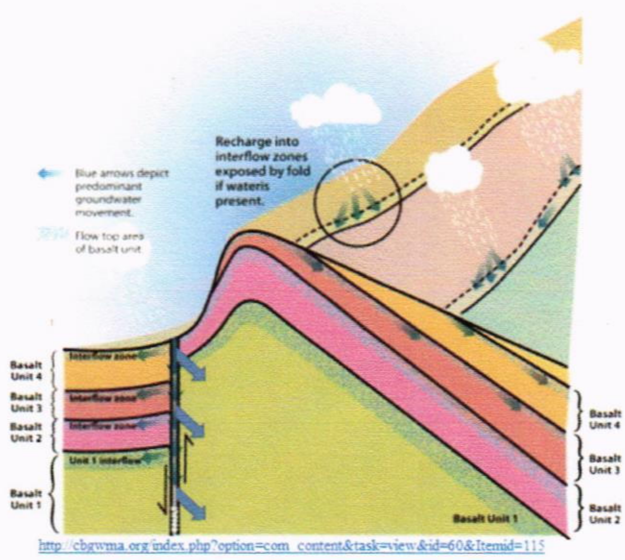


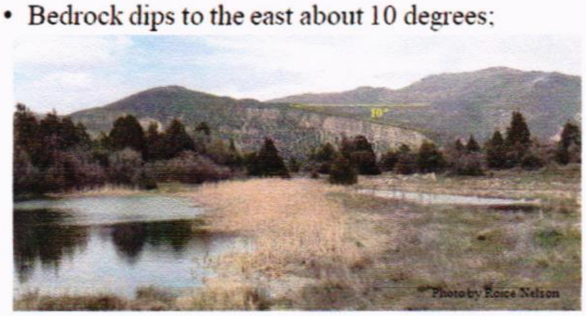
Figure 7. Spatial extent of the untapped Quartz Monzonite Aquifer, the overallocated and over produced Cedar Valley Fill Aquifer, and untapped Cretaceous Aquifer.

Safe Yield, a primary consideration for your office, requires the amount of water withdrawn from a basin or aquifer system not produce undesirable effects. These undesirable effects include reducing discharge of groundwater to surface water features, reducing ecological base flows, overlapping of drawdown cones, depletion of reserves, and land subsidence due to pore pressure reduction. Springs are already being monitored, and so if producing water from the bedrock aquifers impacts springs, it will be noted and production rates can be adjusted. The ecological base flows from the Bedrock Aquifers are to the east and to the south, as described on Figures 8 and 9. There is no overlapping of drawdown cones in the Cedar Valley Aquifer, nor will there be with proper planning of Bedrock Aquifer wells. The Bedrock Aquifers occur where there is 2 to 3 times the natural recharge as in the Cedar Valley Fill Aquifer, and thus these water reserves will be replenished quicker than those in the valley. Because Bedrock Aquifers are consolidated rock, there will not be the same kind of subsidence which occurs in the unconsolidated sediments of the Cedar Valley Aquifer.



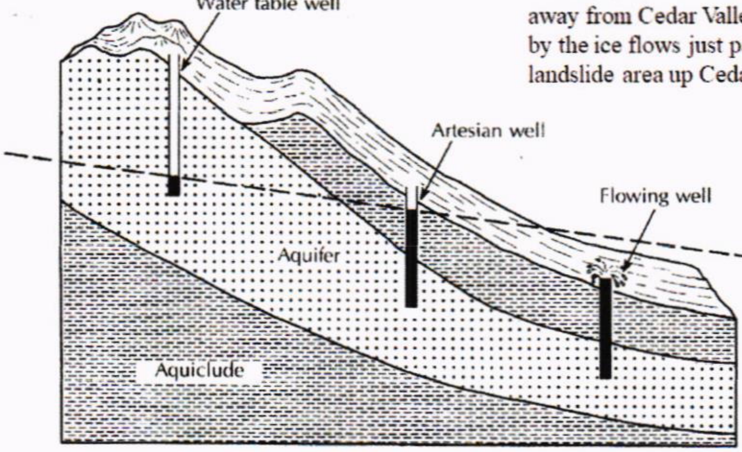
http://cbgwma.org/index.php?option=com_content&task=view&id=60&Itemid=115

- Bedrock dips to the east about 10 degrees;



- Faults bounding the valley disrupt baseflow, especially into the Cedar Valley basin fill aquifer.
- Aquifer overproduction is very shallow (less than 800 feet depth) and except for water flowing down Coal Creek and Fiddler's Canyon these shallow layers are isolated from mountain recharge by layers of clay and the potentiometric surface dip.

Figure 8. Faults and Dip Force Water Flows from Cedar Mountain to the East and South, so as to not reach the Cedar Valley Fill Aquifer.



Cedar Mountain water flows east, away from Cedar Valley, as shown by the ice flows just past the landslide area up Cedar Canyon

Both photos west side of Highway 14
No ice flows on east, due to east dip.

Photos by Gary F. Player

FIGURE 4.21 Artesian and flowing well in confined aquifer.

https://www.slideshare.net/VISHNUBARUPAL/types-of-aquifer-by-bablu-bishnoi-65855846, slide 16 of 24.

Figure 9. Potentiometric Surface and Aquifers on the edge of a mountain, and photos of ice flows on the west side of Highway 14 (ice flows do not occur on the east side of Highway 14), showing water flow direction.

Then there is the issue of impacting interbasin underground water flow. For the most part, natural interbasin water flows happen over thousands or more likely hundreds of thousands of years (see section on age dating water below), and realistically have no impact on the time-frames involved in human development. Western civilization has been in Cedar Valley since 1851, or 168 years. If it takes water 500 or 1,000 or 16,500 years or much longer to move between basins through natural flows, this has little impact on planning current water usage. English Common Law, dating back to the Norman Conquest in 1066, or 953 years ago, and which is what Utah laws are based on, includes The Law of Capture. The Law of Capture states that the first person to capture a natural resource owns that resource. This Law of Capture helps determine the ownership of captured natural resources like groundwater, oil, and gas, encouraging an owner to drill as many wells as possible on their land so as to extract available natural resources before they are captured downstream or on neighboring property. Producing water from bedrock aquifers is a logical use of water natural resources, and has a basis in the science of hydrology, as well as a basis in the law.

As Gary Player said in his letter to you, "virtually no bedrock aquifer water has been produced, except from the development of natural springs on the western edge of the Markagunt Plateau and from springs along Quichapa Creek at the eastern edge of the Harmony Hills. The best way the priority regulation schedule could be revised would be by development of bedrock aquifers with water rights transferred into the mountains from the Cedar City Valley aquifer system. Production of additional water from within the mountainous portions of Area 73 would not deplete the Cedar City Valley aquifer system. Quantities of water from bedrock aquifers now crossing faults, if any, into the valley aquifers are not known. However, the boundary faults are lined with clay-rich gouge materials of low permeability and most groundwater is retained in the bedrock where it flows away from the valley aquifer system along bedding planes and fracture systems."

Third: Age date every well in Cedar and Parowan Valleys, and map the ages to define relationships between the different producing zones within the Valley Fill Aquifers and with any sampled Bedrock Aquifers.

There are three Cedar City municipal wells, which are the only wells in Cedar Valley I am aware of which have had the water age dated. The location of these wells is shown on Figure 10. The well closest to Harmony Hills, at Quichapa Springs, had the youngest water, stored in the Harmony Hills 500 years ago, or approximately 27 years after Columbus arrived in the New World. The next municipal well tested to the east is at Quichapa Creek, and the water in it is dated 1,000 years ago. The third municipal well tested farther to the east has water in it dated to 16,500 years ago. This is water which was deposited when Lake Bonneville was covering most of Utah, and when it was a much wetter time than it is now. There are a couple of hundred water wells in Cedar Valley. If water from each well in the valley is age dated, we can take map the relationships and identify relationships between different wells and different producing zones in the unconsolidated Cedar Valley Fill Aquifer. In addition, by age dating all wells and springs it will demonstrate Bedrock Aquifers can be produced under the Law of Capture without impacting Safe Yield to other basins over the next 500-1,000 years.

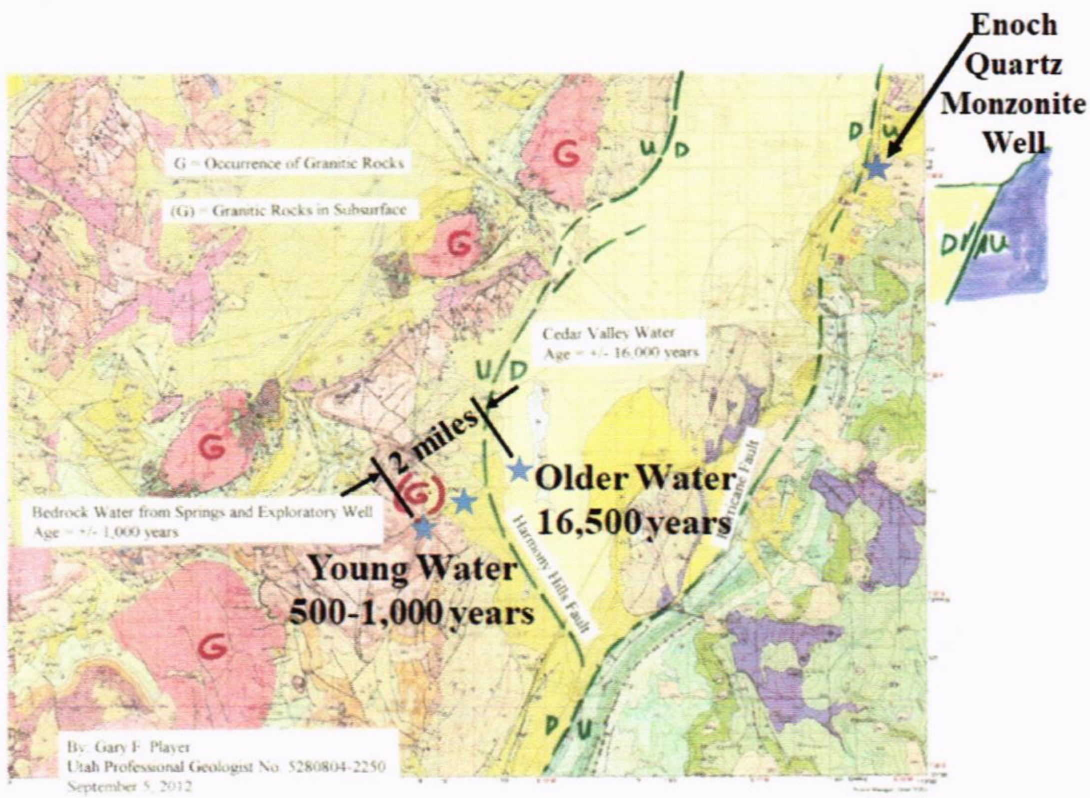


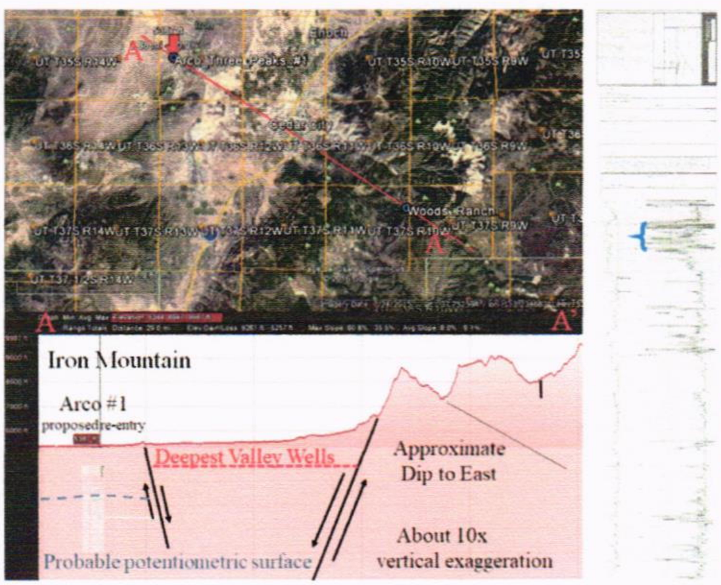
Figure 10. Age Dated Water at Cedar Municipal Wells at Quichapa Springs, Quichapa Creek, and west of Quichapa Lake on the west side of the Cedar Valley Drainage Basin.

I gave a presentation on these water age dating concepts to the Parowan Valley Water Management Committee on the 22nd of August 2019. The committee accepted the idea that water isotopes and water age would enable mapping of aquifer geometries. The approach requires a clean sample of water at the point of origin (at the well head or as close as possible), that the water be stored in an HDPE bottle with a gas-tight closure, that there be no evaporation, and that the bottle be kept in a dark environment to limit biological activity until it is taken to the University of Utah for analysis. They took all 50 containers I brought with me, and said they would individually cover the cost of analysis. None of the bottles nor the money to pay for the analysis have been returned yet. I anticipate that if your office were to confirm the value of this information in making your decisions, there would be movement both in Parowan Valley and in Cedar Valley to get the samples to me so I can create the maps and provide you, the UGS, and the USGS with results. I did find maps and tables with about 45 Hydrogen and Oxygen Isotope results in Parowan Valley (see https://pubs.usgs.gov/sir/2017/5033/sir20175033.pdf, Table 7, page 37), but no water age date information. It seems to me like this age date information would be very valuable.

Fourth: Encourage Bedrock Aquifer well tests to prove up the bedrock Quartz Monzonite and Cretaceous Aquifers wells.

The fractures in the Quartz Monzonite form a 245 square mile untapped aquifer to the west of Cedar Valley. When the Pacific Plate and the North American Plate were colliding, prior to force being diverted by the strike-slip San Andreas Fault, a there was a weakening in the crust from Pine Valley Mountain to Minersville, and quartz monzonite carrying iron and silver came to the surface from the mantle along this line of weakness. Figure 7 shows the extent of the Quartz Monzonite Aquifer. There are many places at Three Peaks where parallel fractures, ½ inch to 3 inches apart are exposed at the surface.

About a mile west of Iron Springs Resort, Arco drilled a 15,590 oil and gas exploration well in 1984-1985. Logs from this well show fresh water in Fractured Quartz Monzonite from 2,490-foot to 2,610-foot depths (see Figure 11). Frank Nichols owns this well, and has committed to spend $70,000 to reopen the well and test the water in this interval when he can afford it. Cedar City started a new water well along Quichapa Creek a few miles to the south of the Arco well. This well was testing 150 gallons per minute about 200 feet into the Quartz Monzonite. There were very few fractures at this depth. The budget ran out, and the well was shut in. For $25,000 more the well could have gone another 500 feet, and would have become a successful well. Cedar City had already spent $150,000 to $200,000 on this well.



Water Table on top of untapped quartz monzonite aquifer at Blowout Pit, Iron Mountain.

To the left are Schlumberger well log results dated 30 Jun 1984, 20 Sep 1984, and 17 Jan 1985 from a well Arco drilled at Iron Springs. The high porosity, highlighted with { in blue, is from fresh water in the fractured quartz monzonite. This fractured quartz monzonite is the same geology as the successful well drilled in Enoch against the dipping Cretaceous beds.

Figure 11. Location of the Arco Well in relationship to the proposed Woods Ranch well, the Arco Well Log, and water in the Bowout Pit, which water table sits on top of the Quartz Monzonite Aquifer.

An 800 gallon per minute well was drilled by Enoch in Quartz Monzonite on the other side of Cedar Valley in 2017. There are 200 milligrams per liter dissolved solids in this well. The location of this well is shown in Figure 10. It appears there is fractured quartz monzonite all along the side of the mountain to the north of Fiddler's Canyon. This means there are basically untapped Fractured Quartz aquifers on both sides of the north end of Cedar Valley, as well as the south of Parowan Valley. Like any fractured reservoir, and I have worked fractured oil reservoirs in New Zealand, Mexico, and Saudi Arabia, if you produce fluids too fast, they will stop producing. The good news is, these types of reservoirs will also refill much faster than traditional consolidated rock reservoirs. A series of wells on both sides of the valley in the fractured quartz monzonite will relieve water overproduction at less than 5% of the cost of the proposed pipeline to Wah Wah Valley and Pine Valley in Beaver County.

The untapped Cretaceous Aquifer on the east side of Cedar Valley is about 1/3rd the areal extent of the Quartz Monzonite, as shown in Figure 7. However, all of this aquifer is within the Cedar Valley Drainage Basin. Figure 12 shows the Dakota to Straight Cliff Cretaceous outcrop near the landslide area on Highway 14, as well as the spatial extent of the Cretaceous outcrop and two cross-sections across Cedar Valley. Gary Player has had samples of Cretaceous rock tested for porosity and has found it to range from 20% to 45% porosity. These mountains, with up to 36 inches of precipitation are where there is the most rainfall and snowfall occurs in the Cedar Valley Drainage Basin. The ice flows in Figure 9 demonstrate there is considerable water in these rocks. It seems appropriate to age date this water and to compare the age dating of water draining out of these same formation into Zion Canyon, Cow Creek Falls, and the Grand Canyon. I anticipate it takes geological timeframes for this water to leave the Markagunt Plateau.

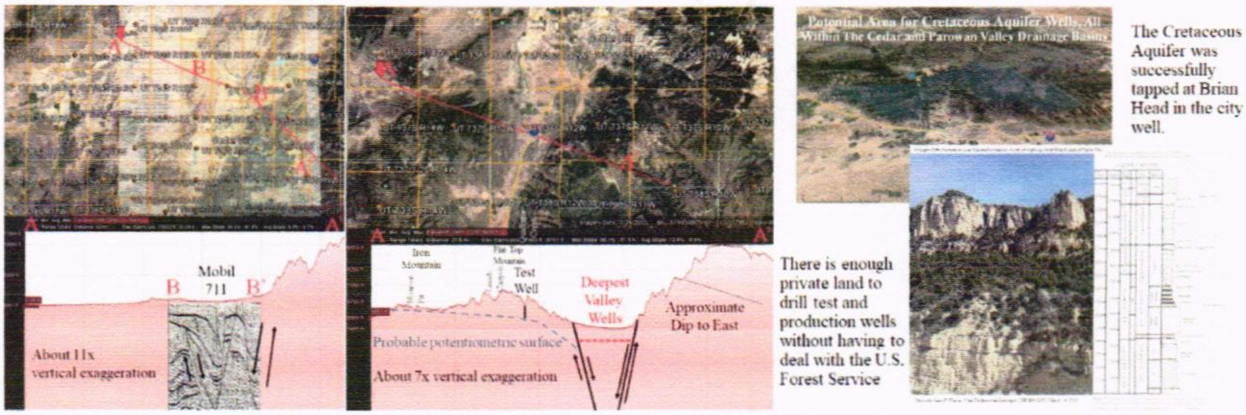
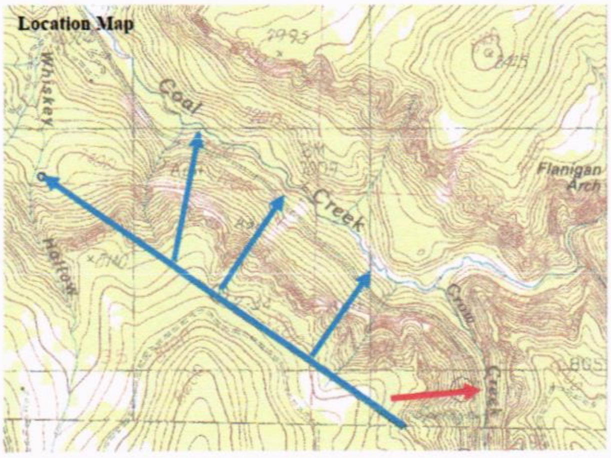


Figure 12. Composite image, showing a cross section across the Cedar Valley Aquifer on the left, connecting Blowout Pit and Woods Ranch in the middle, and showing the extend of the Cretaceous rocks in map view and in cross-section on the right.

There are several places identified on private land where this Cretaceous Aquifer can be tested and produced. These include at Woods Ranch, at Sheepherder's Cabin, and at the landslide area. A key advantage of each of these test sites is they sit just above Coal Creek, water can be run into Coal Creek, and distributed to farmers throughout Cedar Valley with the existing irrigation water distribution system. A little bit more needs to be included about the landslide area. When the Coal Mine was shutdown in this area, the government agency in charge wanted the water to no longer be drained into Coal Creek, for fear of contamination of the water by materials in the coal mine. This decision is largely responsible for the landslides which have closed Highway 14 in 1989, the mid 1990's, 2009, most recently in 2011. Since the water has no place to drain, it builds up in the Straight Cliffs and the rubble beds below, then when saturated, starts to move until it becomes a major landslide. The next landslide will likely cost over $15 million to fix. This can be alleviated by drilling horizontal wells into the rubble beds and on into the Straight Cliffs, and draining the water that is building up in these cliffs (see Figure 13). I have not been able to find mine maps. Once we locate them, there should be air ducts which go down to the mine, and these air ducts will provide a way to measure and sample the water collecting in the mine. Given the water will not contaminate Coal Creek, for a few hundred thousand dollars the landslide can be alleviated, and a new source of water to make up for overproduction and overallocation brought on line. It makes sense for the Department of Natural Resources, and specifically your office, to work with the DOT to fund this work.



Well to drain Cretaceous sandstones. Surface location to right of Whiskey Hollow. Horizontal Well Length = 5,665'. Surface Elevation = 7,380'. Well direction = S 60° E.

Scale: 5.5" = 1 mile.
G.F. Player 2/8/2018

The landslides are not because the coal mine used to be there, rather they occur because the coal mine is no longer there, and so water is not being drained out of the Straight Cliffs.

Potential Cretaceous Water:
10,000,000 acre-feet
Probable Annual Recharge:
15,000 acre-feet per year

Figure 13. Proposed horizontal wells into the rubble beds beneath the Straight Cliffs at the landslide area on Highway 14.

<u>Fifth: Have the Water Management Committee look into condensation, horizontal drilling, train transportation of water, and other related technologies before creating a $500,000,000 bond.</u>

As Gary Player stated in his letter to you: "Importation of large quantities of water from Pine and Wah Wah Valleys would be prohibitively expensive compared to development of surrounding bedrock aquifer systems. Each well and its related facilities in the bedrock near Woods Ranch, Ashdown Gorge, and surrounding areas would cost on the order of $150,000 to produce 441.8 acre-feet per year, if pumped into Coal Creek and its tributaries at 1,000 gallons per minute for 100 days each year. The initial capital cost of each acre-foot would be only $340. To pump 23 bedrock wells, each at 1,000 gallons per minute for 100 days each year, and would provide more than 10,000 acre-feet of new water to reverse the Cedar Valley aquifer depletion for a capital cost of less than $3.5 million." If the actual costs were proven to be twice what Gary estimated, then the CAPEX (capital expense) would still be less than $7 million, or about $700 per acre-foot. People who might otherwise lose their water rights under the proposed Water Management Plan, might be interested in transferring their water rights up the canyon and funding development of these wells.

In addition, there are other technologies which it seems would be appropriate to evaluate as alternative ways to overcome 7,000 acre-feet of overproduction and 50,000 acre-feet of overallocation. Figure 14 shows a technology developed in Iran about 1,000 B.C. The idea is to drill or tunnel through the Hurricane Fault and into the Bedrock Aquifers, to drain water into Cedar Valley. Similar mines north of Minersville have tapped into aquifers and provide a new source of renewable water to Minersville Valley.

There are some even more basic opportunities, which historical and modern technologies have and are using to mine water from the atmosphere. I think the long-term future of water in Cedar Valley and other desert environments is through condensation. If condensation is done at the top of the mountains, water can be transported to the valley in a deviated well. Turbines can be placed in these wells, resulting in a new source of both water and energy (see Figure 15). An interesting fact tied to Southwestern Utah is the number of springs which are located at the base of volcanic flows. Black volcanic flows absorb heat in the day, and radiate that heat at night. The dew point at elevations where these flows are is such that the surfaces of rocks in these flows are covered with dew in the mornings. Historically and in modern times condensation has been and is used as a sustainable source of water.

A Qanat is a gently sloping underground channel to transport water from an aquifer to users

- Qanat technology was developed in ancient Iran about 1,000 BC.
- The water in the Granite Vault (think Quartz Monzonite) is a Qanat.

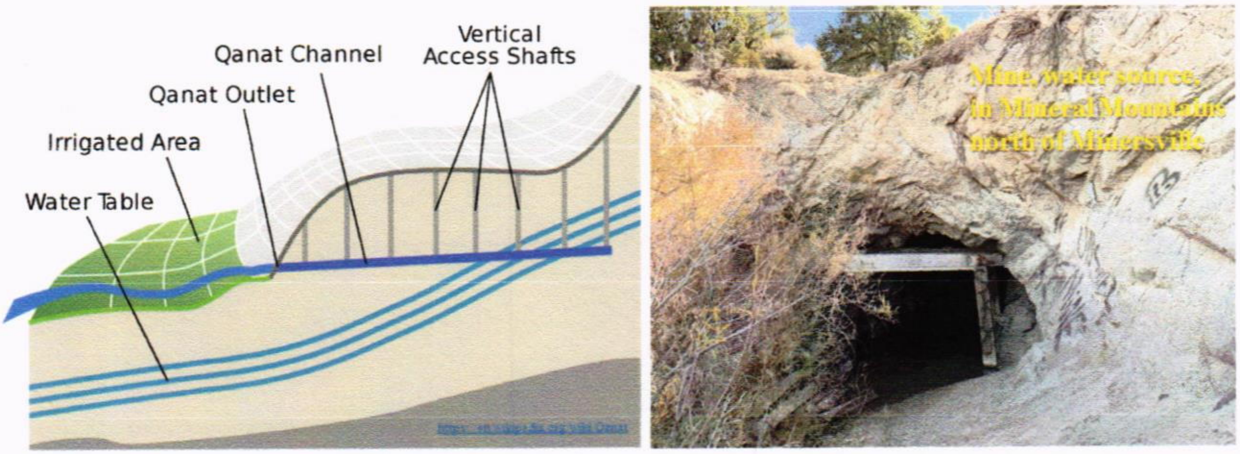


Figure 14. Qanat Technology, developed in ancient Iran about 1,000 B.C. provides another alternative for tapping Bedrock Aquifers outside of the Cedar Valley Fill Aquifer.

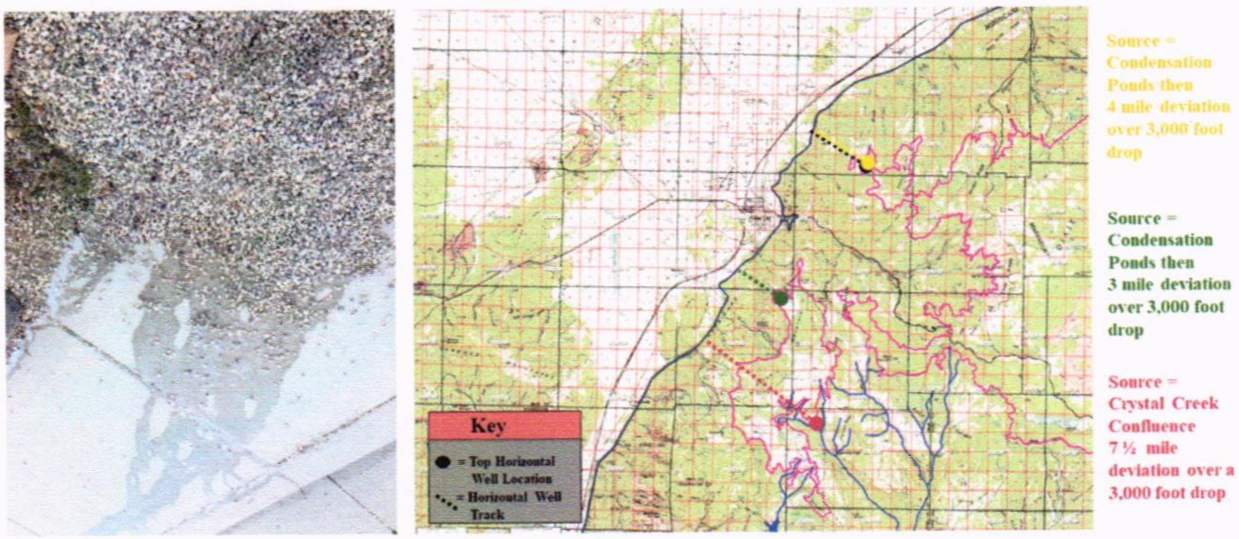


Figure 15. Condensation off of gravel on Leigh Hill in Cedar City.

Historical condensation approaches include Limestone Pyramids, Air Wells, Dew Ponds, and Dew Fences, as illustrated in Figure 16. Condensation Pyramids, Air Wells, and Dew Ponds could be built above the road that goes to the "C" and to Kolob. Dew Fences could be built to capture the cold air coming down Cedar Canyon each morning. In addition, there are floating and stationary dew collectors, condensation in a shipping container, new materials to enhance condensation, and Water Harvesting Machines, as illustrated in Figure 17. Again, those of these approaches which prove most viable could be at the top of the mountains, water can be transported to the valley in a deviated well. Turbines can be placed in these wells, resulting in a new source of both water and energy. It seems to always come down to what burden taxpayers are willing to bear.

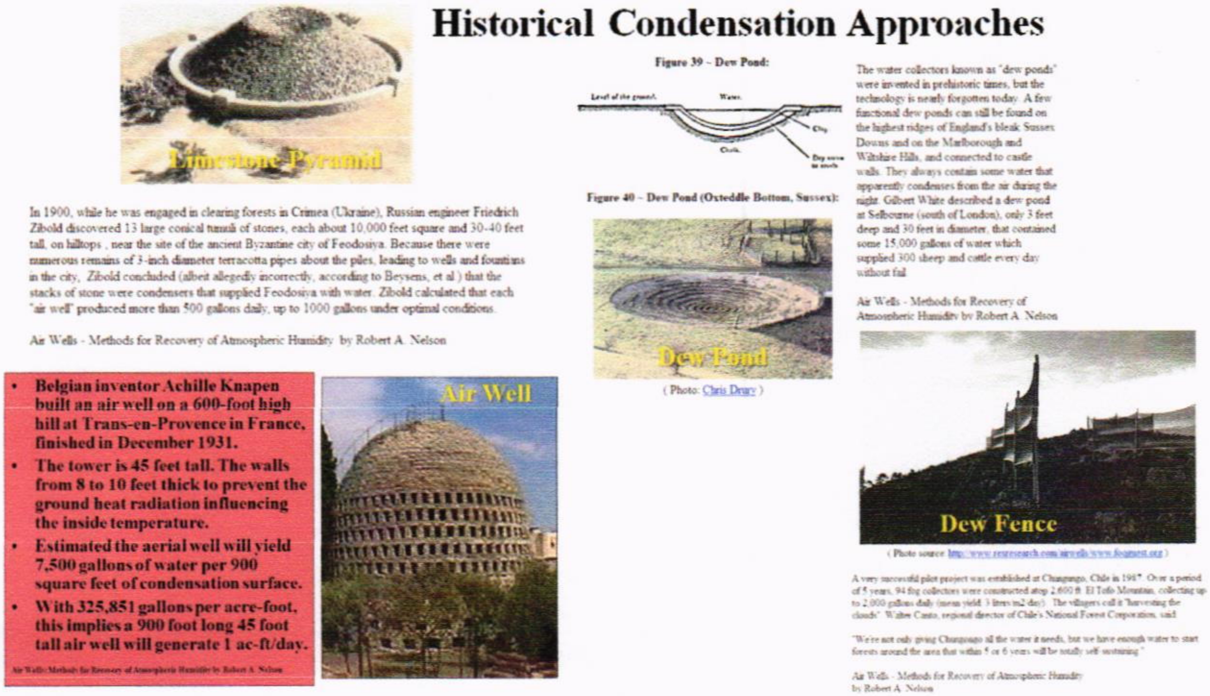


Figure 16. Historical condensation approaches: Limestone Pyramids, Air Wells, Dew Ponds, and Dew Fences

Figure 17. Floating Dew Collectors, Stationary Dew Collectors, Condensation in a Shipping Container, new materials to enhance condensation, and Water Harvesting Machines.

Back in 2006, 8-years before moving back home to Cedar City, the Central Iron County Water Conservancy District was planning on participating in the multi-billion Lake Powell Pipeline. A key issue with this approach is the cost to pump water 3,000 feet uphill over the Black Ridge. This ongoing pumping cost was cost prohibitive. I presented the display in Figure 18 to Eldon Schmutz, President of the CICWCD in 2006. It suggested only pumping the water from Lake Powell up to Highway 89, and then putting the water in the Virgin River and flowing it down to St. George. It also suggests Cedar City tap into the "MX Missile Aquifer" talked about so much when the Mx Missile was being designed for this part of Utah. Later in 2006, CICWCD filed on water in Pine Valley, Wah Wah Valley, and Hamblin Valley in Beaver County. CICWCD has won lawsuits giving the water rights in Wah Wah and Pine Valleys, which is a good and significant accomplishment.

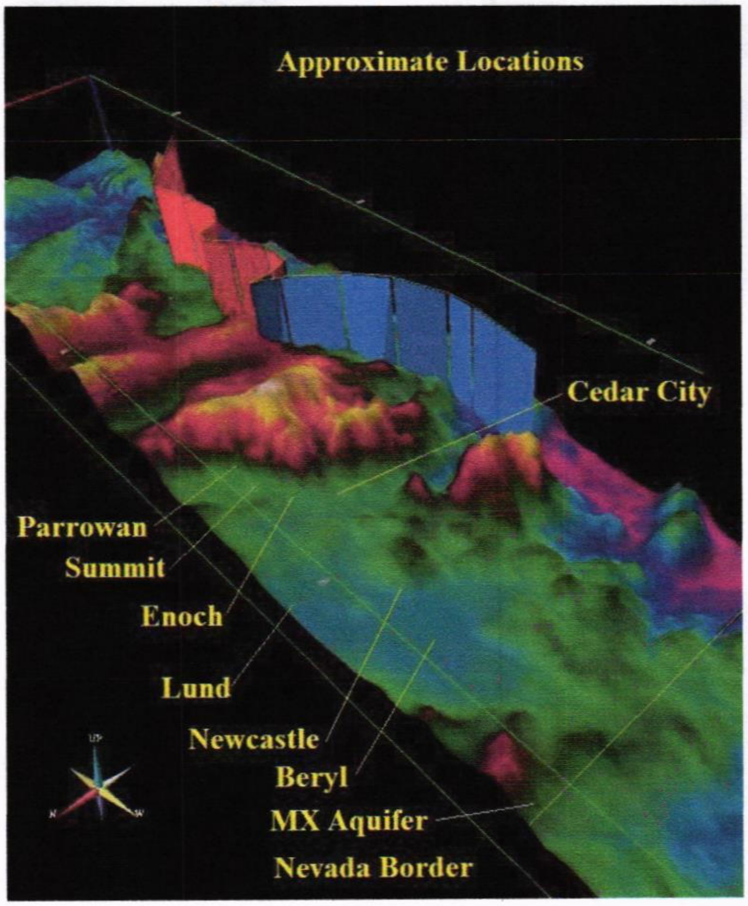


Figure 18. 2006 illustration suggesting pursuit of MX Aquifers instead of pursuing the Lake Powell Pipeline.

However, contrary to what the CICWCD Engineer Kelly Crane says, which is what this letter specifies, Pine Valley and Wah Wah Valley water is NOT the only source that will provide a new source of water for Cedar Valley. In addition to Bedrock Aquifers described in this letter, a search on the web shows that 12% of hay and 30% of grassy hays are exported overseas to Saudi Arabia, China, and other places needing these commodities. This is in effect exporting water from Cedar Valley. A tax on this type of oversea water exporting could help fund the proposed pipeline, or some of the much less expensive alternatives presented in this letter, in order to meet the mandatory reallocation Water Management Plan proposed by the State Engineer's office.

Another less expensive option for transporting water from Pine Valley and Wah Wah Valley to Cedar Valley is to build a rail line into Pine Valley and transport the water by train (see Figure 19). Given taxpayers build the tracks, and purchase the trains, this water could be sold and transported to anyplace with a water emergency, for example Flint, Michigan, for humanitarian purposes or for profit. This would also provide a train for other uses in Cedar Valley, including to transport workers to use water at the origin, in Pine Valley and Wah Wah Valley. The assumptions behind this suggestion are 20 or 30 miles of new track, 2 SD 70 DC or SD900MAC locomotives, 100 or 200 40,500-gallon DOT 117 Tank Cars, 1 trip 300 days per year transporting between 2,285 and 4,330 acre-feet of water total, with diesel at $3 per gallon and getting 5 gallons of diesel per mile.

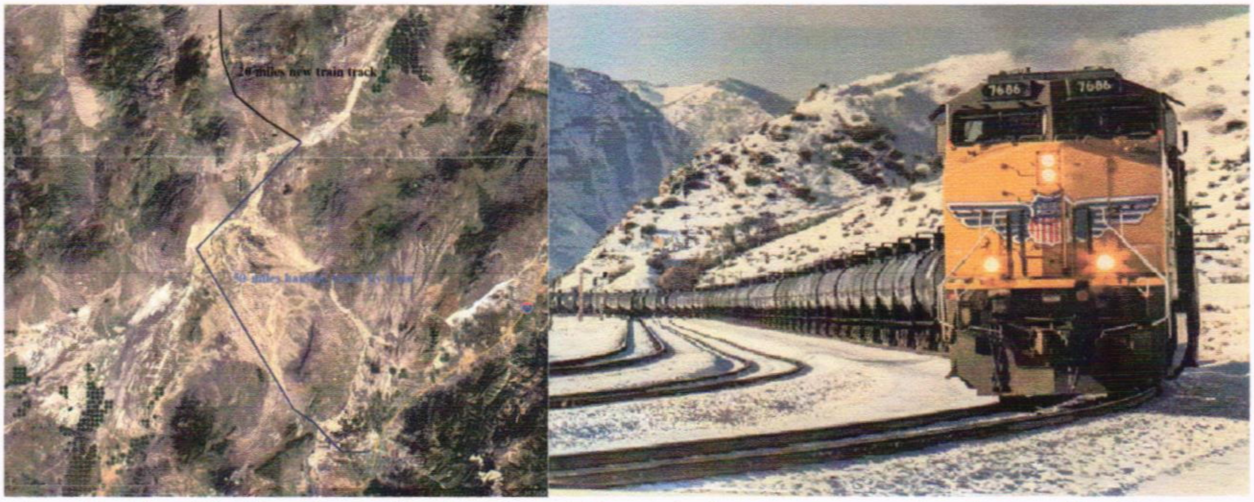


Figure 19. About 20 miles of new railroad track would be required to transport water by train from Pine Valley or from Wah Wah Valley to Cedar City. Rough estimates show costa about 1/5th the price of the latest pipeline costs.

Summary

Again, I request a meeting with your replacements and their staff to discuss the 5 points presented in this letter in detail, either in Cedar City, or at DNR offices in Salt Lake, namely:

1. Limit water reallocation to the Cedar Valley Aquifer, where all UGS and USGS modeling was done, and not to the entire Cedar Valley Drainage Basin.

2. Transfer Water rights from the Cedar Valley Unconsolidated Fill Aquifer to Bedrock Aquifers in the Cedar Valley Drainage Basin in order to reduce 7,000 acre-feet overproduction and the 50,000 acre-feet over-allocation within Cedar Valley Unconsolidated Fill Aquifer.

3. Age date water in wells in Cedar and Parowan Valleys, and map the ages to define relationships between the different producing zones within the Valley Fill Aquifers and Bedrock Aquifers.

4. Encourage Bedrock Aquifer well tests to prove up the untapped bedrock Quartz Monzonite Aquifer and the untapped Cretaceous Aquifer.

5. Have the Water Management Committee and CICWCD look into condensation, horizontal drilling, train transportation of water, and related technologies before the $500,000,000 bond.

Thank to you, your replacements, and their staff for their review of, consideration of, and discussion about these ideas over the coming months as the Water Management Plan for Cedar Valley is finalized.

Best Regards,

H Roice Nelson

H. Roice Nelson, Jr.
Texas Professional Geoscientist No. 5120
2155 W 700 S #31
Cedar City, Utah 84720
713.542.2207
rnelson@walden3d.com

STATE OF TEXAS
H. Roice Nelson, Jr.
Geophysics
5120
LICENSED
PROFESSIONAL GEOSCIENTIST