

Risks of Depending on the Colorado River for the Lake Powell Pipeline

By Jane Whalen, revised January 2018

The State of Utah (Utah) wants to develop about 361,000 acre feet of its remaining share of the Colorado River and a portion of this 86,249 acre feet is allocated for the Lake Powell Pipeline (LPP). But, there are risks depending on this remaining share because it may not be present in the river system due to evaporation from rising temperatures reducing flows; over allocation; junior priority of pipeline's water right; and unsettled Federal Reserve Water Rights claims. According to Bureau of Reclamation (BOR) water demand for Colorado River water has already outstripped supply since 2002. The Colorado River is over allocated and there is not enough water present to meet all of the current obligations. The Bureau of Reclamation indicated in a study the "apportioned water in accordance with the Law of River exceeds the approximate 100 year average flow of river of 15 million acre feet year (MAFY) at Lee Ferry and is 16.4 MAFY."¹ "The Basin faces a wide range of plausible future long-term imbalance between supply and demand. This imbalance computed as a 10-year running average, ranges from no imbalance to 6 million acre feet (MAF) with a median of 3.2 MAF in 2060."² Compounding the problem is river flows at Lee Ferry during last 15 years have only been 12.5 -13 (MAFY). Yet the lower flows are not used in planning for water for the LPP and it is making the over allocation worse.

The risks of lower flows for the Upper Basin states are explained in Bradley Udall and Jonathan Overpeak's 2017 study. *The Twenty-First Century Colorado River hot drought and implications for the future.*³

An excerpt from the study:

"The Upper Basin also has serious issues, one of which ripples into the Lower Basin. Under such low reservoir conditions, there is also a high likelihood that the Upper Basin states would have to curtail existing water deliveries to cities such as Denver, Colorado Springs, Albuquerque and Salt Lake City in order to make required deliveries to Lake Mead. Heretofore, largely because of the structure of the Colorado River Compact, the Upper Basin and Lower Basin have been managed separately. With permanent flow declines of approximately 20%, however, the required deliveries to Lake Mead would become a hardship on the Upper Basin, as well as create Lower Basin delivery shortages [Reclamation, 2007; Barnett and Pierce, 2009; Rajagopalan et al., 2009]. The original compact, signed during one of the wettest periods in the last 450 years [Woodhouse et al., 2006], did not envision how large scale flow declines

¹ Colorado River Basin Stakeholders *Moving Forward* to address Challenges identified in the Colorado River Basin Water Supply and Demand Study, Phase 1 Report: Executive Summary, Bureau of Reclamation, May 2015.

² Colorado River Basin Stakeholders *Moving Forward* to address Challenges identified in the Colorado River Basin Water Supply and Demand Study, Phase 1 Report: Executive Summary, Bureau of Reclamation, May 2015, page 3.

³ See at http://conserveswu.org/wp-content/uploads/Udall_et_al-2017-Water_Resources_Research.pdf.

would be managed between the basins, and such declines could cause an allocation crisis between the Upper and Lower Basins [Adler, 2008].”

Doctrine of Prior Appropriation

This fundamental principal of *First in time, First in right* in Utah Water Law is known as the Doctrine of Prior Appropriation. This means those holding water rights with the earliest priority dates, and who have continued beneficial use of the water, have the right to water from a certain source before others with water rights having later priority dates. As water declines this principal will decide who get shut off and who can remain using the water. This 1956 Lake Powell Pipeline water right is junior to senior water right holders.

Over Allocation of Utah’s Water Rights

Utah’s water managers explain the over allocation of water.

Excerpts from a Deseret News article:⁴

The Water Question: The staggering problem of determining water rights.

“Many of the files are outdated, which means there could be a big difference between what is in the file — paper water — and the actual water that exists or is available — wet water.

“We are growing so much as a state and there is so much demand for water, it is critical we know where these existing uses are and protect them,” said Mike Styler, executive director of the Utah Department of Natural Resources. “And there is really no new water to be had.”

Why should Utahns care? Because the nature of water rights is that there are far more rights than the water that actually exists, so the task is to determine what is real and what is not.

“Your paper water right may look very big and supply everything you are asking, but the wet water, in reality, can be very different,” Kent Jones, the state engineer over water rights, said. The Colorado River, for example, holds 1.4 million acre-feet of water for Utah to put to use. There are applications approved for more than 2 million acre-feet, and about one half of that is currently in use. Jones said the imbalance has yet to be a problem because the water has not been developed — but the struggle will come with time, and those holding “junior” rights will go wanting.”

Of the 15 major watershed areas in Utah, just two of them have been researched and adjudicated, which means that the investigation and documentation work was carried out and a judge then issued a decree.” ”

⁴ <http://www.deseretnews.com/article/865617715/The-water-question-The-staggering-problem-of-determining-water-rights.html>; 2014 by Amy Joi O’Donoghue

The Adjudication process validates water rights in a court proceeding. It is a long, tedious process of verifying water rights and making a formal determination about the volume of water available and whether it is being put to "beneficial" use. Time and resources are necessary to involve all claimants and collect sufficient data to complete the adjudication process. With growing demands for water, it is imperative the adjudication process be expedited to determine current use and what water might yet be available. As the value of water continues to increase, water right files need to be up to date and accurate through use of the adjudication process. Current funding for State Engineer's office is insufficient to complete the adjudication process in a timely manner. A water official mentioned at this pace it could take a 150 years to complete the process. The Adjudication process does not take into account lower flows in the future due do a warming climate. This will impact wildlife, fish and recreation and there will be less water supply to divide among water rights users. In Utah the rivers, streams and aquifers are over allocated. Disputes will become more frequent. Unfortunately, it is the wildlife, the fish and recreation that will suffer the most because they are not recognized as a *beneficial use in Utah Law*.

1922 Colorado River Compact

The Colorado River Compact was created in 1922 and negotiated during a historically wet period at about 17 million acre feet a year (MAFY) at Lee Ferry, Arizona. Lee Ferry is the dividing line between the Upper and Lower Colorado River Basin States. It was decided 15 MAFY would be equally divided with 7.5 MAFY for the Upper Basin states of Utah, Colorado, New Mexico and Wyoming and 7.5 MAFY for the Lower Basin states of Nevada, Arizona and California.

In Article III (d) of the Compact requires: "The States of the Upper Division will not cause the flow of the river at Lee Ferry to be depleted below an aggregate of 75,000,000 acre-feet for any period of ten consecutive years reckoned in continuing progressive series ...", which means 7.5 MAFY a year.

In a shortage Article III (c) of the Compact states that Upper Basin must provide half of deficiency of water for Mexico. Utah is not planning for this in its allocation.

Compact ARTICLE III (c) (*water for Mexico*)

"If, as a matter of international comity, the United States of America shall hereafter recognize in the United States of Mexico any right to the use of any waters of the Colorado River System, such waters shall be supplied first from the waters which are surplus over and above the aggregate of the quantities specified in paragraphs (a) and (b); and if such surplus shall prove insufficient for this purpose, then, the burden of such deficiency shall be equally borne by the Upper Basin and the Lower Basin, and whenever

necessary the States of the Upper Division shall deliver at Lee Ferry water to supply one-half of the deficiency so recognized in addition to that provided in paragraph (d)."

1928 Boulder Canyon Project Act

The Boulder Canyon Project Act of 1928 authorized construction of a dam in Boulder, or Black, Canyon, construction of the All-American Canal to connect the Imperial and Coachella Valleys with the Colorado River, and divided the lower basin waters among the lower basin states. The Lower Basin States divided 7.5 MAFY and agreed to state allocations for Arizona 2.8 MAFY, Nevada 300,000 acre feet and California 4.4 MAFY which, are fixed allocations and draw their water supply from Lake Mead.

1948 Utah's Water Rights are only 23%

In 1948 the Upper Basin Compact was agreed to by Utah, Colorado, Wyoming and New Mexico. The states realized a state's water right couldn't be a fixed amount like the lower basin. Consequently, each state divided the 7.5 MAFY upper basin share by a percentage depending on how much the state's watershed contributes to the Colorado River.

Under the Law of the River (the 1922 Colorado River Compact and the 1928 Boulder Canyon Project Act), the Upper Basin states (Colorado, Wyoming, Utah and New Mexico) were allocated 7.5 MAF annually. This 7.5 MAF was divided, 51.75% was allocated to Colorado, 23% to Utah, 14% to Wyoming and 11.25% to New Mexico. In times of shortage/drought, these percentages apply to any reductions. In a drying climate, Colorado gets 51.75% of the water -- meaning there is not much left over for Utah and the other two Upper Basin states to divide. Given that the State of Colorado is allocated the lion-share (51.75%) of the Upper Basin allocation, in times of drought, Utah's 23% remaining share of the Colorado River is particularly vulnerable. There are additional "upstream" aspect of the Law of the River that might affect the amount of water for the Pipeline, particularly in times of drought. These Upper Basin rights are more uncertain and variable because they are allocated only a percentage of what is left after obligations to the Lower Basin, and higher priority water rights are met.

In 1988 the Department of Interior determined the upper basin share 7.5 MAFY was reduced to 6 MAFY due to lower flows and that lowered Utah's share of river.

1988 Hydrologic Determination (safe yield)

The 1988 hydrologic determination by the Department of Interior determined the upper basin states share of 7.50 MAFY should be reduced to 6 MAFY. The State of Utah portion is 23% of that or 1.36 MAFY. Over time the 6 MAFY called safe yield will likely be lowered again because of predicted less snow pack feeding the river; or the Department of Interior adopting a lower annual flow. Utah is currently using about 1.008 million acre foot a year (MAFY) and has about 361,000 acre feet left to develop.

According to various agreements, 8.25 million acre-feet per year MAFY, on average, must pass the “Compact Point” (the gage one mile downstream of Lees Ferry) every year for use by the lower basin states of Nevada, Arizona, and California. This includes 7.5 MAFY for lower basin states ⁵and 750,000 acre feet for Mexico.

2007 Hydrological Determination Upper Basin

Utah in planning is using 23% of 6 million acre feet a year that it can allocate for its share of Colorado River. But, a 2007 hydrologic determination stated the flow the Upper Basin states could reasonably plan on now is lower at between 5,550,000 and 5,720,000 million acre feet a year. Therefore, if you use 5.55 MAFY times 23% equals 1,276,500 MAFY not 1,369,000 that they are using now. Due to Utah’s water right being only 23% of what remains; their remaining water right is smaller. There wouldn’t be enough water left for the pipeline and all the other senior water rights and unsettled Federal Reserved Water Rights for Indian tribes and other Federal reservations.

For example:

6 million acre feet minus- 50,000 ac ft for AZ equals 5,950,000 acre feet.
23% of 5,950,000 acre feet= 1,368,000 ac ft; (Utah is now using this)
23% of 5,550,000 ac ft = 1,276,500 ac ft (Less water Utah can use)

Utah’s Allocation using 6 MAFY

1.369 MAFY using 23% of 6 MAFY

1.008 MAFY used

361,000 acre feet remaining in Utah’s allocation using higher flows

It has ten years since the last 2007 Hydrological Determination and a new one should be completed before the Lake Powell Pipeline is approved.

Are Utah’s remaining rights of 361,000 acre feet still there?

If you use lower flows it is not.

⁵ The 1922 Compact Article III (d) states: “The States of the Upper Division will not cause the flow of the river at Lee Ferry to be depleted below an aggregate of 75,000,000 acre-feet for any period of ten consecutive years reckoned in continuing progressive series ...”

Figure 1. (DWRe chart)

Utah's planned new users Colorado River	Utah's Total Allocation 1.369 MAFY 1.008 MAFY used
<i>Ute Tribe Reserved Water</i>	105,000 acre feet
<i>Navajo Nation Reserved Water</i>	81,000 acre feet plus
Lake Powell Pipeline	86,000 acre feet
New Ag uses	40,000 acre feet
New M & I Uses	29,000 acre feet
Total new planned uses	361,000 acre feet

As Figure 1 illustrates Utah assumes it has 341,000 acre feet of water from Colorado River Compact water left to develop. However, if lower flows of below 15 million acre feet a year (MAFY) are used in the analysis Utah's compact rights are reduced and that eliminates the availability of water for the Lake Powell.

This 2005 chart below illustrates the over allocation of Utah's remaining Colorado River share of 361,000 acre feet:⁶

Potential Depletion
Approved Applications (Undeveloped)⁷

<u>Applicant</u>	<u>Quantity (Ac Ft)</u>
San Juan County WCD	30,000
Central Utah WCD	29,500
Board of W R (et al)	158,000
Wayne County WCD	50,000
Kane County WCD	30,000
Sanpete WCD	5,600
Uintah County WCD	5,000
Others	80,000
Ute Tribe ?	<u>105,000</u>
TOTAL	493,100 (which is above 361,000 af)

⁷ Upper Colorado River Basin Current Water Rights Issues Division of Water Rights
April 2005 see at https://www.waterrights.utah.gov/meetinfo/m042005/jdo_2005.ppt

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future due do a warming climate. This will impact wildlife, fish and recreation and there will be less water supply to divide among water rights users. In Utah the rivers, streams and aquifers are over allocated. Disputes will become more frequent. Unfortunately, it is the wildlife, the fish and recreation that will suffer the most because they are not recognized as a *beneficial use in Utah Law*.

The Bureau of Reclamation (BOR) has responsibility for determining how much water is available for use in the Upper Basin before approving new water projects. The BOR should do a 2018 hydrological determination for Lake Powell Pipeline to prove the water is present in Colorado River System for this 50 year Contract with them. In our research due to lower flows, and over allocation Utah's remaining share of the Colorado River is restricted to senior water rights holders and Federal Reserve Water rights to Utah's Indian Tribes and other Federal reservations.

Federal Reserved Water Rights

Before Utah allocates a portion of its remaining allocation to the Lake Powell Pipeline it should first settle all of its Federal Reserved Water Rights claims.

When the United States reserved public land for uses such as Indian reservations, military reservations, National Parks, National Forest lands, or Monuments and other public land reservations, it also implicitly reserved sufficient water to satisfy the primary purposes for which the reservation was created. Reservations made by presidential executive order or those made by an act of Congress have implied Federal Reserved Water Rights. The date of priority of a Federal Reserved Water Right is the date the reservation was established. The United States Supreme Court has determined that the measure of a Federal Reserved Water Right is not dependent on beneficial uses to which the water has been historically applied, but should be quantified based on the water needed to accomplish the primary purpose for which the reservation was established.

While some Federal Reserved Water Rights in Utah have been settled many have not.⁹ This situation creates the potential for unknown and unquantified Federal Reserve Water Rights to disrupt long established appropriative state water rights if or when the reservation uses are developed even though the rights may have been un-quantified, undeveloped, and unrecorded under state water rights laws for decades. Utah has completed Federal Reserved Water Rights settlement agreements on 10 of the 17 National Parks and Monuments and with other federal reservations. But, Canyonlands National Park and Dinosaur National Monuments have pending Federal water rights claims in the Green River that are not included in the accounting of Utah's remaining water rights. Rainbow Bridge National Monument is also being negotiated. It is

⁹ Reserved water rights power point, Boyd Clayton DWRe, September 26, 2016. See at: https://westernstateengineers.files.wordpress.com/2016/12/clayton_2016fall.pdf

uncertain if National Forest Lands have any Federal Water Rights in the Green River. All of these unsettled Federal Reserve Water Rights need to be added to Utah's remaining Compact allocation.

Tribal Water Rights

The Indian Tribes were not at the table in the 1922 Colorado River Compact, nor in any later compacts and the compacts didn't change or reduce any of their rights. The states have to settle water rights claims with the tribes who have reservations in Utah because Indian rights have to come out of the Utah's remaining 361,000 acre feet Colorado River water right. As river flows are reduced this could become problematic for the Lake Powell Pipeline water right because tribal rights have priority over the junior water right of 1956 Lake Powell Pipeline.

The Utah Navajo Water Rights Settlement Act was introduced in Congress by Senator Hatch in 2017 see at: (<https://www.congress.gov/bill/115th-congress/senate-bill/664>). The agreement is for 81,500 acre of feet of water annually from the San Juan River; \$200 million from U.S. Congress; and \$8 million from Utah. Also, the Bureau of Reclamation shall: (1) plan, design, and construct the water diversion, delivery, and conservation features of the Navajo water development projects. This agreement must be approved by Congress and ratified by the Utah legislature and the Navajo Nation before it can be implemented.

The Northern Ute Tribe of the Uintah and Ouray Indian Reservation in Duchesne, Uintah and Grand Counties have Federal Reserved Water Right claims in Utah. Negotiations culminated in a settlement agreement approved by Congress in 1992. But it was never ratified by the tribe. Also, the proposed Ute Indian Water Compact of September 22, 2009 was never ratified either by the tribe.¹⁰ This agreement quantified water rights for the tribe limited to 470,594 acre-feet diversion rights and 258,943 acre-feet of depletion from the Upper Colorado River System of the Uinta and Lake Front Rivers and Duchesne River in Utah. Negotiation with Utah is for 105,000 acre foot of depletion out of Utah's remaining share of Compact water rights. The priority date for the Ute Tribal Water Rights when transferred to the Green River is October 3, 1861. Negotiation is also underway to resolve claims of the Confederated Tribes of the Goshute Reservation in northwestern Utah. A settlement agreement with the Shivwitts Band of Paiute Indians in southern Utah was completed and passed by Congress.

Resolving Indian water rights and the other Federal Reserved Water Rights before allocating more water projects would remove significant uncertainty to what Utah's remaining share of Colorado River water will be used for. Federal Reserved Water Rights in the Colorado River have to come out of Utah's remaining share of its Colorado River Compact rights, which is about 361,000 acre feet. With Colorado River flows declining and Utah's share being only 23% of what remains it is uncertain how Utah will meet its obligations to higher priority water rights over the 50 year term of Lake Powell Pipeline's hydropower license.

¹⁰ Compacts and agreements, See at: <https://www.waterrights.utah.gov/wrinfo/policy/compacts.asp>

Lake Powell Pipeline Junior Water Right

The priority date for Lake Powell Pipeline water right is 1956 when the Flaming Gorge reservoir and Central Utah project were approved. This means that all water rights granted prior to 1956 have a higher priority than the Lake Powell Pipeline. Also, the Lake Powell Pipeline water right is junior to the Central Utah Project and junior to the Lower Basin States water rights

As flows diminish over time Utah's junior priority water right of 1956 for the Lake Powell Pipeline will be subordinated to senior water rights holders.

For instance, the obligations having priority over the Lake Powell Pipeline water rights include:

- Water required for Mexico in the 1922 Compact, Article III (c): “If, as a matter of international comity, the United States of America shall hereafter recognize in the United State of Mexico any right to the use of any waters of the Colorado River System.....”¹¹ Requires the Upper Basin to provide one-half the deficiency in the obligation to Mexico when it can't be met through a surplus. The treaty obligation to Mexico is 1.5 MAF. Thus in theory, if there is not surplus the Upper Basin states would have to provide another 750,000 acre feet. Utah does not consider Mexico's water rights in their planning.
- Water required for the Lower Basin is 7.5 million acre feet a year. The 1922 Compact Article III (d) states: “The States of the Upper Division will not cause the flow of the river at Lee Ferry to be depleted below an aggregate of 75,000,000 acre-feet for any period of ten consecutive years reckoned in continuing progressive series ...”¹²
- The Upper Basin Compact of 1948 Article III. also includes lower basin requirement:¹³
 - Article IV – “In the event curtailment of use of water by the States of the Upper Division at any time shall become necessary in order that the flow at Lee Ferry shall not be depleted below that required by Article III of the Colorado River Compact, the extent of curtailment by each State of the consumptive use of water apportioned to it by Article III of this Compact shall be in such quantities and at such times as shall be determined by the Commission.....”
- Utah Indian Tribes and other Federal reservations such as National Parks, and National Forest Service lands

¹¹ The Colorado River Compact Article III (c); See at <https://www.usbr.gov/lc/region/pao/pdffiles/crcompct.pdf>

¹² Ibid. Article III (d)

¹³ Upper Basin Compact 1948, See at: <https://www.usbr.gov/lc/region/pao/pdffiles/ucbsnact.pdf> (emphasis added)

- Senior water rights holders

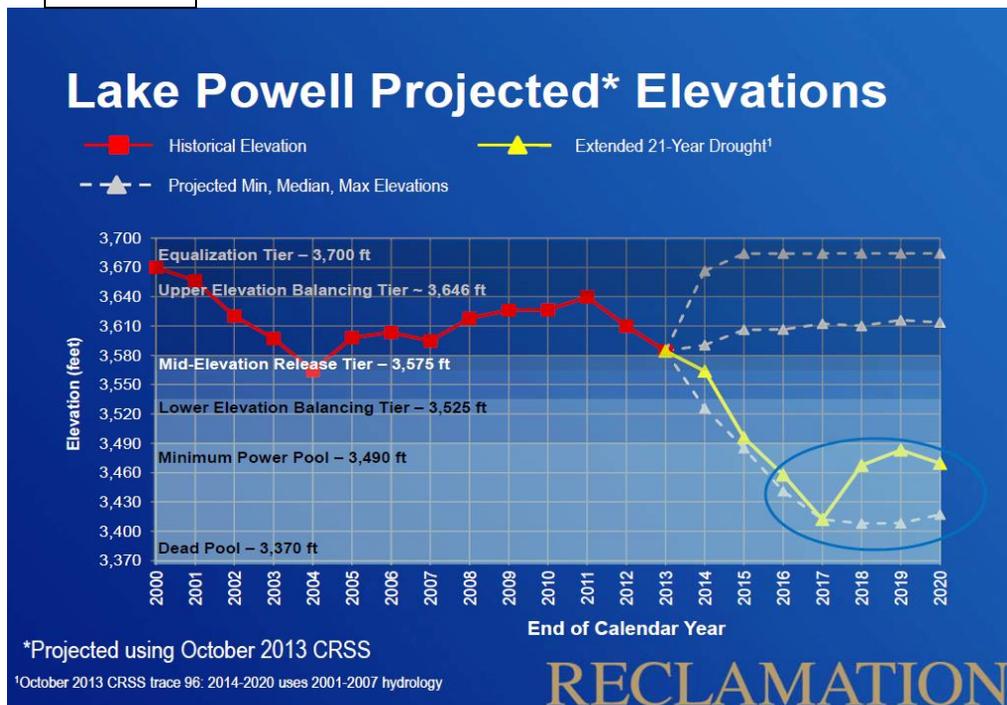
Only using 15 MAFY to Assess Risk?
The problem of over allocation continues

Another problem is the Bureau of Reclamation is using 15 MAFY as an average flow for the Colorado River to make decisions yet flows have been much less at 12.5-13 MAFY. This overestimates the flows.

The problem of over allocation of the river is continuing as new diversions are being approved by Utah and the BOR. The Colorado River Simulated System (CRSS) river model used to assess the impact of the Lake Powell Pipeline is overly optimistic in projecting reservoir and that river flows will still be as robust in the future as they have been in the past. Bureau of Reclamation's (BOR) studies have used this higher estimated flow of 15 MAFY for its 100 year average (1906-2010) of the river's natural flow at Lees Ferry below Glen Canyon Dam. Assuming flows of 15 MAFY to assess environmental impacts of the Lake Powell Pipeline is flawed by assuming that the past will predict the future. Due to the 15 year drought the flows have been about 12.5 MAFY. The BOR stated flows in years 2000-2009 the flows were only 11 million acre feet a year, the lowest ten year average in over 100 years of record keeping on the Colorado River.

In addition, historical records indicate that droughts of various severities occurred periodically. In 1878-2002 a tree ring study by Connie Woodhouse showed a 25 year drought with a natural flow of only 12.36 MAFY. Further, tree records also show that from 1584 to 1593 there was a 9 year drought averaging only 9.7 MAFY. The BOR's using 15 MAFY creates the false sense that there will be adequate water supply to keep reservoirs supplied with enough for all the demands that includes the Lake Powell Pipeline. In addition, to this flawed use of narrow

Figure 2.



piece of river flow history, there has been nothing in this view of history that includes the impact Climate Change on the Colorado River's water availability. In Figure 2, The BOR estimated what will

happen if our 15 year drought turns into a 21 year drought with Lake Powell possibility falling below the level power can be generated.

Water Demand already Outstrips Supply

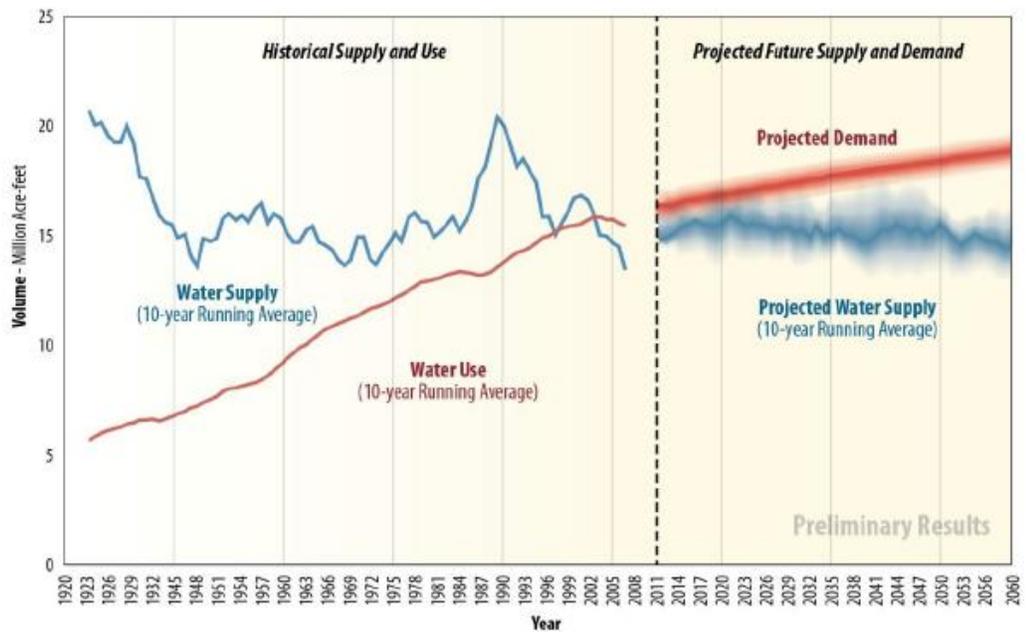
In Figure 3, the Bureau of Reclamation, depicts 10-year average supply and demand totals for the Colorado River basin, and illustrates that since 2002 demands have exceeded supply. This is nowhere more evident than in the declining volume of water in storage throughout the basin. The Lake Powell Pipeline proponents must acknowledge that while new demands for Colorado River water may be supplied out of storage in the short term, the inevitable, long-term result is that a new demand in a system already fully used will either itself be shorted, or will result in a shortage to another water use somewhere else in the system.¹⁴

The red line represents the water supply and the blue line represents water demand. This figure 3 illustrates clearly that a supply and demand imbalance currently exists the Basin. This imbalance will grow in the future if major changes are not made in how we use water.

Rising Temperatures

The main source of water for community water systems is snow pack that will be impacted greatly by the increase in temperature that will result in a drastic decrease in the snow water equivalent. The annual average temperature in the Colorado River Basin has increased 1.4 degrees C and nearly 2°C at Lee’s Ferry, AZ since 1906.¹⁵

Figure 3



Weather Station

Tony Grove Snotel, NRCS, in Cache Valley, Elevation 8474 ft

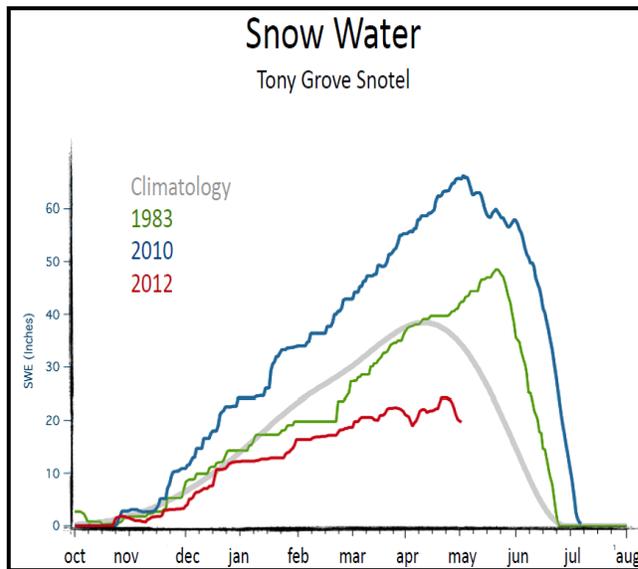
¹⁴ Doug Kenney, Rethinking the future of the Colorado River, Colorado River Governance initiative Dec 2010. See at: http://scholar.law.colorado.edu/cgi/viewcontent.cgi?article=1013&context=books_reports_studies

¹⁵ The Colorado River Basin and Climate: Perfect storm for the twenty-first Century? 2012 by Carson McMurray; See at: <https://www.coloradocollege.edu/dotAsset/74e91de4-a1ff-4062-b628-030e997b4e0b.pdf>

SWE- left legend- Snow Water Equivalent is how much water is in snow

In Figure 4, Dr. Robert Gilles from Utah Climate Center, at Utah State University in Logan, Utah found Utah's climate is getting warmer with temperatures of all Utah's cities going up. Moreover, Utah has 9% less snow since 1950 and less winter storms. His Figure 4 illustrates how much less water is in snow since 2012.

Figure 4



Utah relies heavily on mountain snowpack for its water supply. Traditionally, snowpack accumulates in mountainous regions during the winter months. Water stored in the snowpack is then released to aquifers, streams, lakes, and reservoirs as it melts primarily during spring; this fundamental snowpack hydrology will be impacted by a warming climate.

Our climate is changing because the Earth is warming and Utah is transitioning to a very different hydrological regime. As a result, our water supply will be impacted. Utah's climate has already changed and has

warmed about 2 degrees Fahrenheit, and in many parts of Utah by much more, in the last century¹⁶. In general, Utah's climate has warmed at a rate of two to four times that of the global climate^{17,18}; this is evidenced by the long-term trend of observational temperature records throughout Utah.

¹⁶ EPA What Climate change means for Utah. See

<https://www.epa.gov/sites/production/files/2016-09/documents/climate-change-ut.pdf>

¹⁷ Robert R. Gillies 2017, Director of Utah Climate Center, and state Climatologist for the state of Utah; Observational and synoptic analyses of the winter precipitation regime change over Utah. *Journal of Climate*, GILLIES, R. R., S.-Y. WANG, AND M. R. BOOTH, 2012: 25, 4670-4698; Climate change impact on the roles of temperature and precipitation in western U.S. snowpack variability. *Geophysical Research*, SCALZITTI, JASON, STRONG, COURTENAY, KOCHANSKI, ADAM, 2016: 43, 10

¹⁸ National Climate Assessment (Southwest climate assessment) 2013, See <http://www.globalchange.gov/what-we-do/assessment>;

The transition to Utah's new climate regime in terms of increasing temperatures and altering precipitation patterns has a probable effect on watershed health. Increased temperatures will drive more evaporation and evapotranspiration (ET), which is the coupled process by which water is transferred from the land to the atmosphere by evaporation from the soil and other surfaces and by transpiration from plants. Increasing air temperatures result in increasing stream temperatures, which in turn will proliferate water pollutant concentrations and so, reduce water quality; also expected is a potential loss of wetlands that purify our water. In addition, higher temperatures increases evaporation from streams and reservoirs with resultant water quality issues, depletion of soil moisture and so, increased irrigation requirements for crops and plants.

As the climate warms, Utah's precipitation receipt will be more in the form of rain than in snow^{14, 15}, especially in low and mid elevation mountain regions. Run-off due to snowmelt will occur earlier in the year with higher intensities and shorter durations. As such, late summer river flows are projected to diminish, impacting water users who rely on natural river flows during this time of year. Furthermore, water rights providing diversions from Utah's waterways may be diminished, or need to be altered, due to these changes in snowpack, timing of run-off, and streamflow hydrology.

Conclusion

In conclusion, the Bureau of Reclamation and Utah should not keep over allocating the Colorado River. They should not approve any more diversions until they do a new hydrologic study to determine how much water is present and available in the Upper Basin to reasonable use using the lower 12.5-13 MAFY annual flow.

The Lake Powell Pipeline studies do not detail the risks to the water supply for the Project. Utah incorrectly claims it can divert water in dire conditions, and that they don't have a responsibility to address the risk of lower flows. On the contrary, the studies must require a detailed analysis from Utah that proves their assumption about water availability is valid over the 50 year term of license before the EIS process begins. Further, the studies must ensure the environmental information is accurate so that decision makers can understand the consequences of their decision. The current Lake Powell Pipeline studies lack scientific accuracy that is both reasonable and objective that the agencies and the public can rely upon to make a decision and must be revised.

References:

Bureau of Reclamation 2007, “*Colorado River Interim Guidelines for Lower Basin Shortages and Coordinated Operations for Lakes Powell and Mead.*”

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