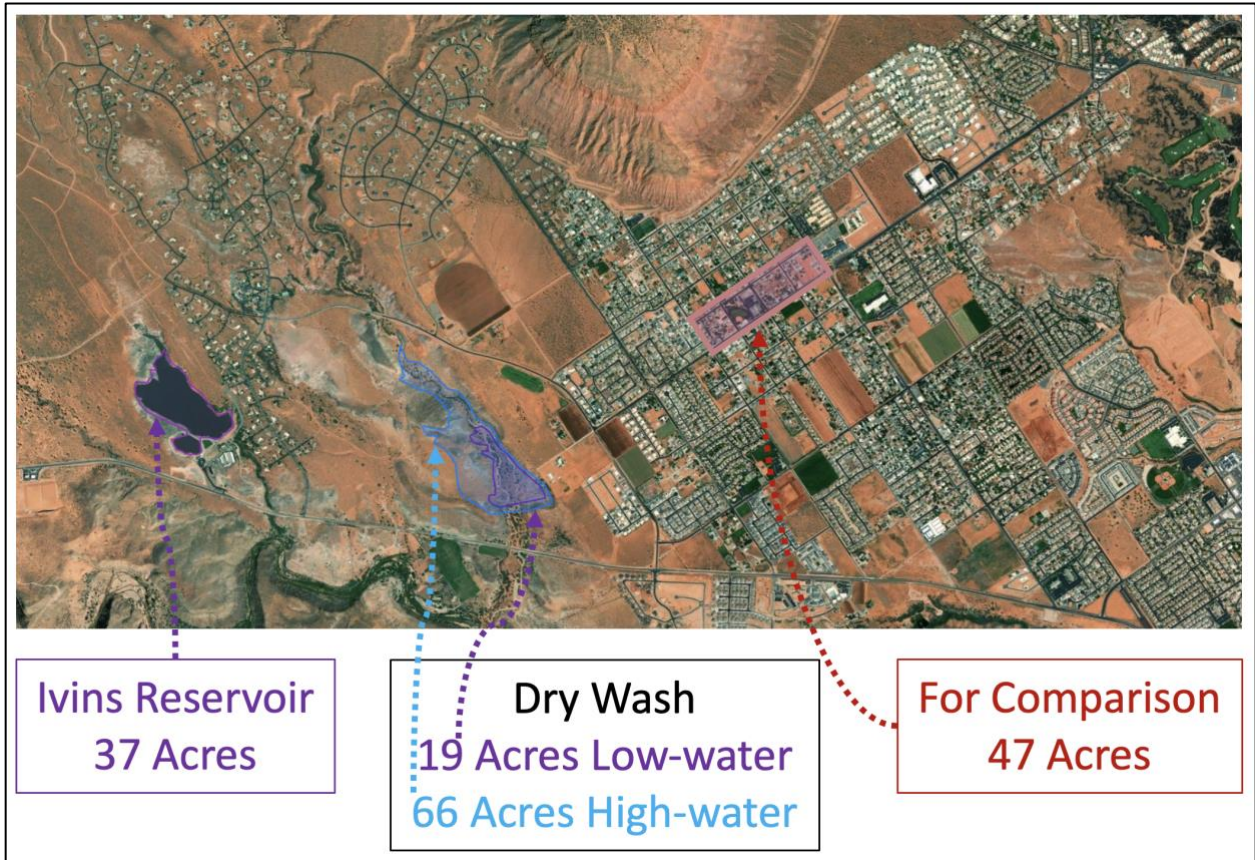


# A White Paper on Technical Plans for a Proposed Reuse-Water Reservoir in Dry Wash, Ivins, Utah

By Wayne Pennington, PhD  
14 January 2024



# A White Paper on Technical Plans for a Proposed Reuse-Water Reservoir in Dry Wash, Ivins, Utah

By Wayne Pennington, PhD

## Executive Summary

Plans for a small reservoir to contain reuse water in Ivins, UT, resulted in an Environmental Assessment (EA), published in 2004. In order to allow the reservoir to proceed prior to an anticipated “expiration” of the 2004 EA, the Ivins City Council passed a resolution in late 2021 authorizing the purchase of land required, with certain stipulations.

As the plans for the reservoir evolved within the Washington County Water Conservancy District (WCWCD), the design departed significantly from the original design as specified in the 2004 EA, with a high-water level of 3044’ compared with the 3040’ specified in the 2004 EA. This resulted in a larger capacity, but also a much larger surface area due to the shallow slope along the west side, leading one to question the validity of the current design as related to the EA. This design also results in a large number of issues that must be addressed, which were not, for the most part, addressed in the 2004 EA.

Problems with the current design include the requirement of a large dike (to avoid flooding the community planned to the west); a water table associated with the high-water elevation that is higher than some of the homesites planned for that community; and a vast area (47 acres) that will be alternately submerged and exposed as the reservoir is cyclically filled and drained, leading to the potential for winds to carry dust to populated areas of Ivins and Santa Clara.

Most of these issues can be resolved if the reservoir design is based on that which was stipulated by the 2004 EA, but not all of them. A slightly lower high-water level of 3038’ would eliminate the need for a dike, drop the water table to avoid concern for new construction, and greatly reduce the area that will be alternately submerged and exposed. Excavation of some sediment beneath the reservoir may return the capacity to nearly that considered by the 2004 EA. I recommend the design with 3038’ high-water level.

The following table summarizes differences between designs considered here.

	WCWCD	2004 EA	3038ft design
High-water level (ft above mean sea level):	3044	<b>3040</b>	3038
Total capacity when full (acre-ft):	1500	<b>1335</b>	1150
Dike needed (Y/N/?)	Y	<b>Y</b>	N
Surface area (acres):	66*	<b>63 (50*)</b>	45**
Area of submergence & exposure (acres):	47*	<b>31**</b>	25**

\*estimated using simple maps

\*\*wild guess

## Background documents: 2004 Environmental Assessment

As background, I reproduce the relevant portion of the 2004 Environmental Assessment (hereafter "2004 EA") concerning specifications of the Dry Wash Reservoir:

St. George Water Reuse Project  
Appendix C Project Description

### Stage III

#### Construction of Dry Wash Reservoir

Dry Wash is located on undeveloped land northwest of Graveyard Wash near Ivins Reservoir and is also accessible from State Route 8. The proposed storage reservoir would provide additional storage of the reuse water for use by the City of St. George in addition to the Shivwits Band's requirements. Construction of the Dry Wash Reservoir would consist of the following:

Legal Description of Dry Wash Reservoir Location:	Sections 25 of Township 41 South, Range 17 West Section 1 of Township 42 South, Range 17 West
Approximate Location:	0.5-mile northwest of Ivins City, Utah
Current Land Owners:	Utah State Trust Land (61.6 acres) bordered by Private (1.4 acres)
Reservoir Manager:	St. George; land would be purchased by St. George
Reservoir Access:	Via Highway 91/State Route 8
Capacity:	1,335 acre-feet of water
Inundated Area:	63 acres
High Water Elevation:	3,040 ft msl
Low Water/Conservation Pool Elevation:	3,016 ft msl
Reservoir Depth at Center Point at High Water:	50 ft
Conservation Pool Depth at the Center Point of Dam:	26 ft
Construction Duration:	Approximately 240 calendar days
Construction Activities:	Clearing and grubbing, grading, cut-off trench excavation, drilling, blasting, earth fill, drain fill, rock fill, outlet structure, spillway construction, and other miscellaneous items associated with dam construction
Note:	The reservoir must be permitted under Section 404 of the Clean Water Act because Dry Wash and the Santa Clara River are jurisdictional waters of the U.S.
Fencing:	The reservoir would not be fenced unless required by the State of Utah
Post-construction:	Native desert riparian or riparian species would be planted below the dam to reduce visual contrasts

An earthen dam would be constructed on the south side of this reservoir and would be 300 feet long. The dam would be constructed with a thin, impervious clay core bounded by either sand and gravel or rockfill and require 174,789 cubic yards of fill. The dam would also have a spillway designed to accommodate 100-year storm events. Basalt rock would be used to reduce visual contrasts with the environment, and riprap would be randomly placed across the dam face to protect it from erosion and provide irregularity for blending with the environment. A dike would be constructed at the western end of this reservoir and would require 1,300 cubic yards of fill. This dike would be 1,600 feet long and have a height of 20 to 25 feet. The dam at the

## Background: Actions of Ivins City Council in 2021

The Ivins City Council had been informed that the “expiration” of the 2004 EA after 20 years was a driving force in requesting quick action on the reservoir. Portions of the City Council Minutes are copied here, with my comments italicized in brackets [ ].

The following is from the Ivins City Council minutes of 28 November 2021:

One of the urgencies with the Dry Wash site is that the Final Environmental Assessment is expiring. That assessment said this is a site and the District now has a deadline to get the reservoir built or under significant construction by 2024. [*This implies that the 2004 EA<sup>1</sup> is indeed the controlling document for specifications of the reservoir, with small modifications as additional information or improved data become available.*]

Recall, from the previous page, the specifications for the reservoir in the 2004 EA:

**Capacity: 1335 acre-ft**  
**Surface area: 63 acres**  
**High water: 3040 ft (above mean sea level)**  
**Low water: 3016 ft**

Deliberations, summarized in Ivins City Council minutes of 02 December 2021 include:

... discussion moved forward [*between the District, the City, and landowners*] and a resolution was reached for a reservoir that would hold approximately 1900 acre feet of water.. [*A 1900 acre-ft reservoir was not part of the 2004 EA; it is unclear to me how this could have been considered.*]

Relevant portions of the Ivins City Resolution No. 2021-17R relating to the reservoir include:

... Ivins City would also agree that once said reservoir is completed and in use that Ivins City would be responsible for the control of any dust, gnats or other insects that are a direct result of said reservoir;

... no part of the dam or water held therein come within 100 feet of the existing Kwavasa Drive road... [*This seems to preclude any reservoir larger than about 1500 acre-ft.*]

---

<sup>1</sup>Some confusing details: A regional map in the 2004 EA (its Figure 3-6) is inconsistent with the text in that document. Dry Wash Reservoir as shown in that map seems to have been modeled after “Alignment 3” with high-water elevation of 3067’ from a separate (and non-binding) geotechnical feasibility study performed by Alpha/RB&G Engineering in 2004 (their Figures 1 and 2 and text on their pages 17 and 18). That alignment called for a 3000+ acre-ft reservoir, while other alignments called for smaller reservoirs, and it extended well north of Kwavasa Drive. On the other hand, “Alignment 2” is clearly the basis for the 2004 EA. Rather than rely on that crude regional map, the text and detailed specifications of the 2004 EA are considered here to be the valid representation of the reservoir evaluated.

## Various designs of the proposed Dry Wash Reservoir

The Washington County Water Conservancy District (WCWCD) investigated a number of possible reservoir configurations. In this document I will refer to these designs by their high-water level, in feet above mean sea level: 3040' (the 2004 EA specification); 3044' (the current WCWCD design); and 3038' (my recommendation). One chart (Figure 1) compares the capacity (volume in acre-ft) as a function of high-water level for each of these designs as well as the capacity remaining at the low-water level ("conservation level") specified by the 2004 EA.

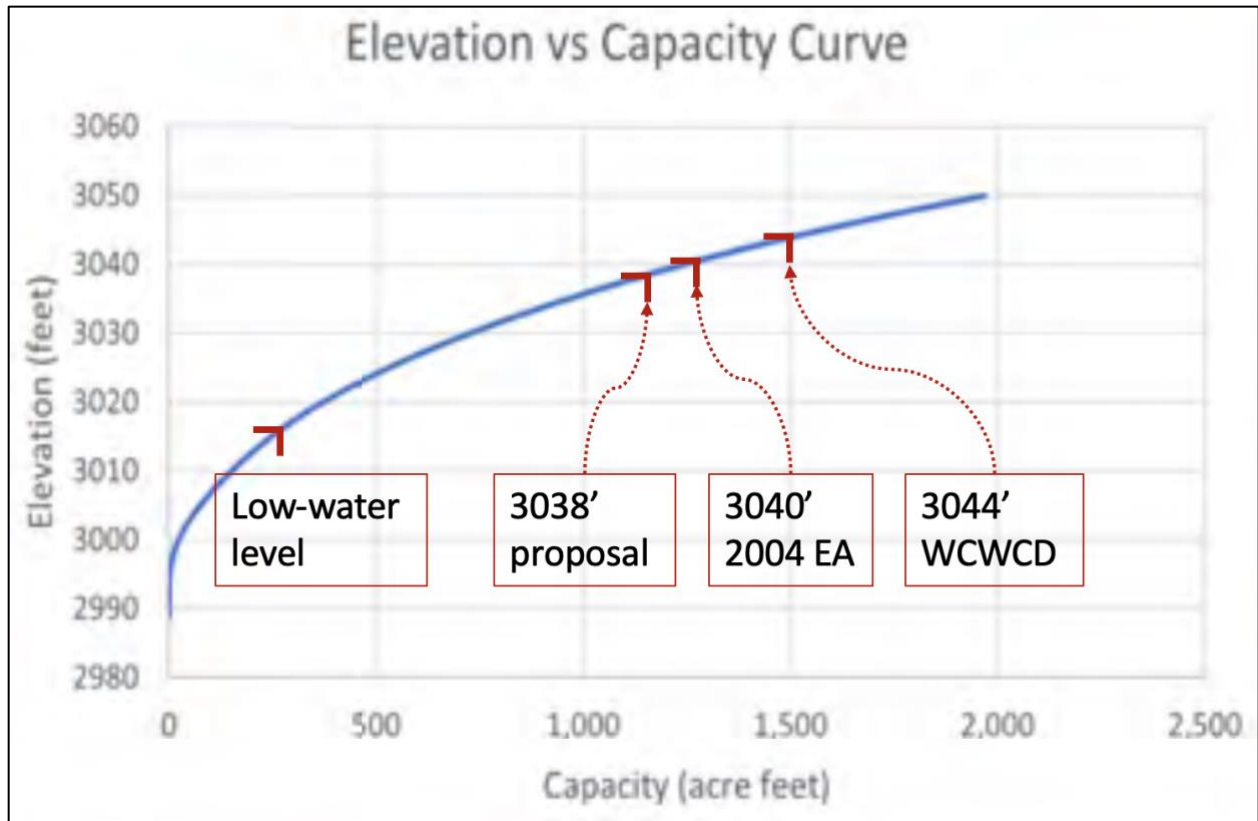


Figure 1. Chart showing capacity in acre-feet compared with elevation of water level. One acre-ft is the volume of water equivalent to one acre flooded to depth of one foot. (From a WCWCD graphic provided in 2021, associated with the 3044' design.)

Also of interest to the Ivins community would be the surface area (in acres) of each proposed reservoir design. While I have requested this information from the WCWCD, their engineers are focusing on other issues, and cannot provide this data now; I have computed values for surface area from simple mapping programs, but recognize that the estimates contain large errors at this time.

The 3044' design being used by the WCWCD and the 3038' design that I recommend will be compared against the 3040' design of the 2004 EA. While the 2004 EA cited a surface area for the 3040' design of 63 acres, my mapping routines suggest a surface area of about 50 acres; for consistency with other designs measured by my mapping, we will use the 50-acre value for comparison.

**The WCWCD current design with 3044 ft high-water level:**

The most-recent dam and reservoir model for the 3044' design available to me was provided by the Washington County Water Conservancy District to the City of Ivins in 2021 (Figure 2).

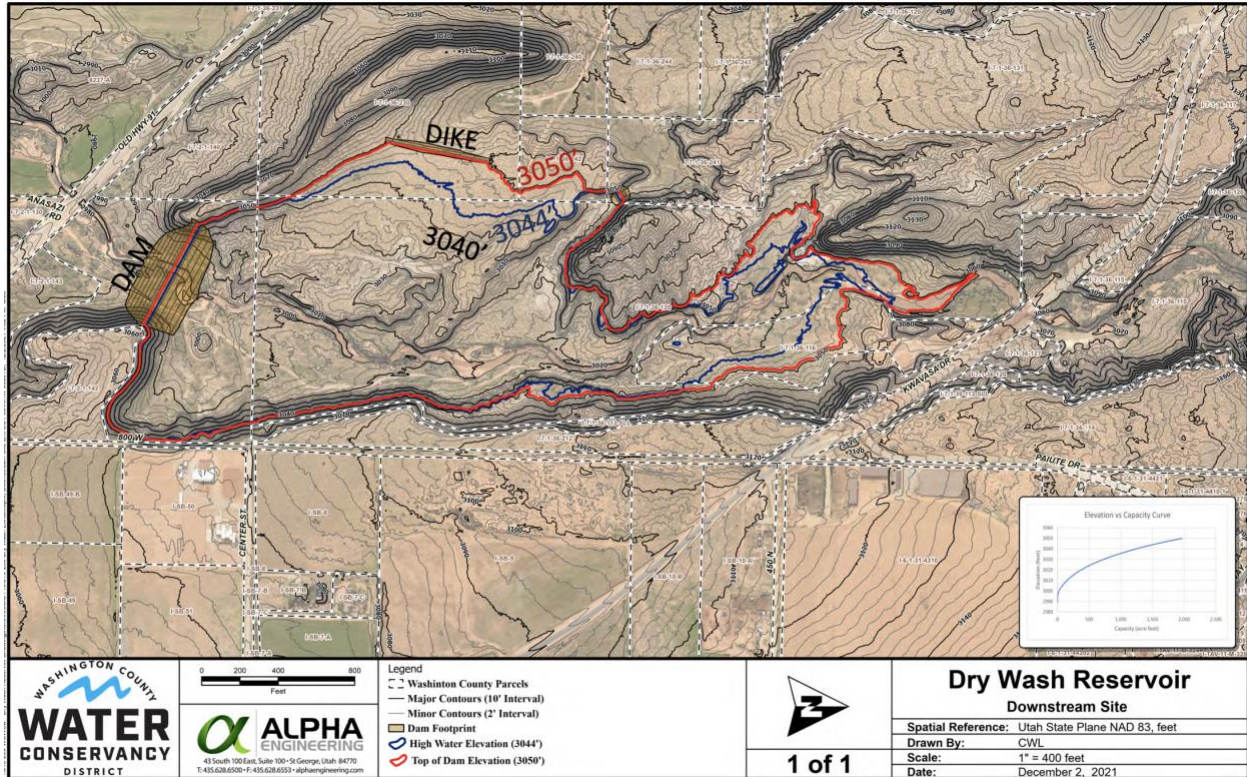


Figure 2. Map showing design of dam and reservoir as of December 2021.<sup>2</sup> The dam is to the south (left in the image). The red line is at the elevation of the top of the dam, 3050', six feet higher than the anticipated maximum water elevation, shown by the blue line at 3044'. The higher 3050' elevation is that of the spillway, which would provide relief from floodwaters should a major flooding event occur. The "dike" shown at the western side of the 3050' elevation line is needed to prevent overflow to the west (up in this image), which will be a residential community, in the event of major flooding. The black 3040' contour shows the outline of the reservoir specified in the 2004 EA.

The 3044' reservoir design provides a capacity of 1500 acre-ft, and occupies an estimated 66 acres of surface area. The low-water level (common in all designs) occupies a surface area of 19 acres. The difference of 47 acres represents the area that is alternately submerged (when the reservoir is full) and subaerially exposed (when the reservoir has been drawn down to conservation level).

<sup>2</sup> Note: The engineers involved told me, on 07 June 2023, that this was no longer the design that they were using, and the WCWCD told me on 03 January 2024 that no updates are available now. While the details for the dam itself may have changed, the topography and area inundated would not be changed. (As explained to me, the dam itself would no longer simply reach the left, eastern, abutment as shown, but would extend along the northern side of the ridge in order to avoid some problematic geologic features.)

Figure 3 shows a sketch of the reservoir at 3044' (light blue) and at 3016' (dark blue). The difference, 47 acres, which will be muddy and harboring insect populations part of the time, or dry and enabling dust to be dispersed by winds, is an area of concern to all residents and a potential source of large expense to the City of Ivins, which will be responsible for mitigating these issues.

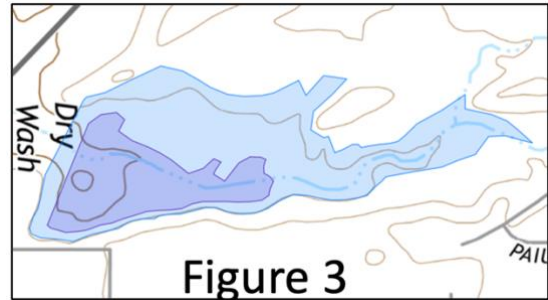


Figure 4 shows an expanded view of the western side of the reservoir, where a broad shallow area exists.

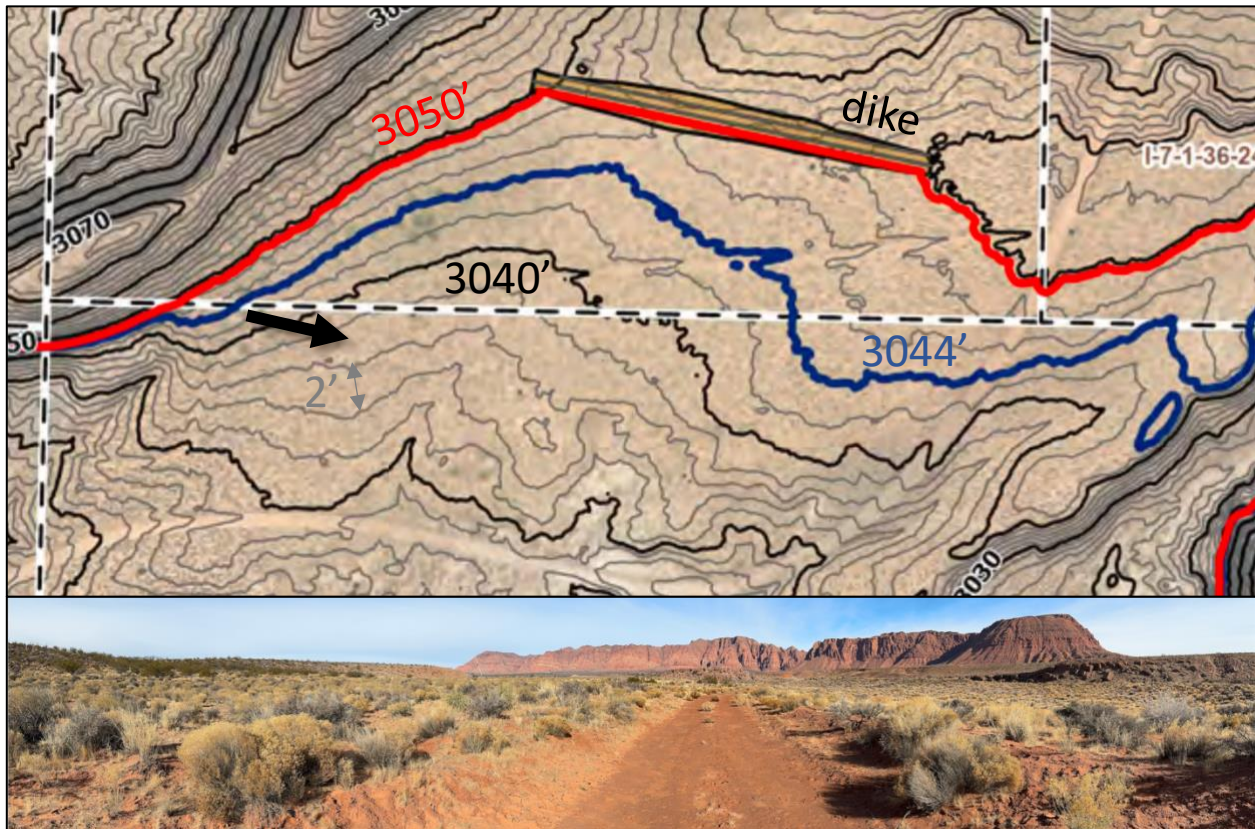


Figure 4. Top: Close-up map of broad flat area on west side of proposed reservoir. The contour interval (thin lines) is 2 ft. The black arrow shows the approximate location from which the picture at bottom was taken.

Bottom: This wide-angle photo shows part of the broad, nearly flat, area that would be alternately submerged and exposed in the current WCWCD design. Within a year of filling the reservoir, all the vegetation shown here will be gone, and, when dry, the soil and precipitate from the reservoir will be subject to dispersal by wind.

Notice on the map in Figure 4 that by increasing the maximum water elevation from 3040' to 3044' the broad shallow area (and other places) increases in the area exposed to alternate wetting and drying by 16 acres, from 31 acres to 47 acres (using simple maps). Notably, the 2004 EA did not evaluate the environmental effects of having the large area exposed to alternate submergence and exposure of the 3044' design.

It has been proposed that the broad shallow area may be reduced by excavation under parts of it, and depositing the excavated material on other parts of it. This may be feasible, but a huge volume of material required to be moved in order to resemble the 2004 EA design.

While not shown in these figures, it is worth noting that long-standing plans for development west of the reservoir includes nearby properties that are at an elevation lower than 3040'. At a high-water level of 3044', these properties could arguably be at risk for water incursion.

**Recommended 3038 ft design:**

The 3038' high-water design is shown in Figure 5 below, representing an earlier consideration presented by the WCWCD in November 2021.

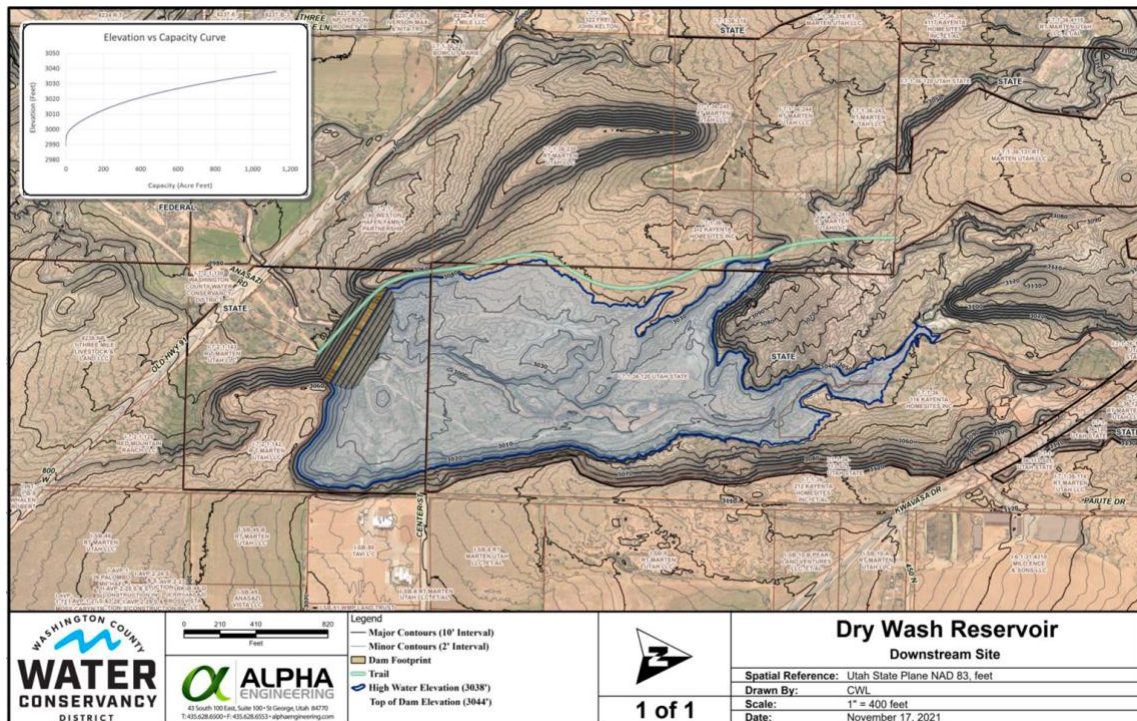


Figure 5. Reservoir design using 3038' high water elevation. The thick blue line in this map is the 3038' contour. A potential hiking trail is shown in green.

The 3038' reservoir design has a capacity of about 1150 acre-ft. This design removes the need for a large dike and greatly reduces the surface area that would be alternately submerged and subaerially exposed, to perhaps 25 acres, but it also reduces the storage capacity by 14% compared with the reservoir in the 2004 EA. Some manageable excavation of the smaller remaining shallow area could restore some of this capacity. The reservoir would also be further removed from the development planned to the west, reducing concern for water incursion there.

I recommend consideration of this design, with a high-water level of 3038', if a reservoir is to be constructed at this site.



## **Tentative Recommendations**

- 1) Abandon design using 3044' high-water level
  - a. It was not considered by 2004 EA
  - b. It causes many environmental problems due to large areas exposed annually
  - c. It may place the planned neighborhood to the west in some jeopardy
- 2) Either use a 3040' or a 3038' high-water level.
  - a. If 3040' level, excavate a large fraction of the broad shallow area
    - i. Dike is still required
    - ii. Impact of natural area is large, requiring mitigation
    - iii. This was the specification of the 2004 EA
  - b. If 3038' level, a small area may be excavated to improve capacity
    - i. No dike is required
    - ii. Impact of natural area is smaller, perhaps enabling hiking trails
    - iii. Impact on nearby communities is reduced
    - iv. Cost is reduced, impact reduced, but capacity is reduced

## **Summary**

The 2004 EA was used as the reason that action by the Ivins City Council was required quickly, and it was on this understanding that the Council approved a resolution moving toward establishing the Dry Wash Reservoir. The 2004 EA specifically addressed a reservoir of a certain high-water level and capacity, but this is not the reservoir that the Ivins City Council was told to consider. The reservoir currently under consideration by the WCWCD (3044' high-water level) presents many environmental and community issues that may be extremely expensive or impossible to resolve, while also not being consistent with the 2004 EA.

The reservoir design that the 2004 EA addressed (3040' high-water level) is one that presents fewer problems than the one currently being considered by the WCWCD. It may or may not require a dike to protect the community to the west from flooding. It still presents a fairly large area of alternately submerged and exposed ground, which could be reduced in size by excavation and shoreline modification.

A slightly smaller reservoir, with a high-water level of 3038', removes the need for a dike (saving considerable expense) and significantly reduces the area of alternate submergence and exposure while also reducing the potential for ground-water problems for the low-lying community planned to the west. The reduced capacity could be improved by some excavation which would also further reduce the impact on the environment and nearby communities, and is the design that I currently recommend, if a reservoir is to be constructed at this site.

## References

### The 2004 EA:

SWCA Environmental Consultants, 2004, UT-100-03-EA-08, Final Environmental Assessment for the St. George Water Reuse Project, Washington County, Utah, 252pp.

### The 2004 Geotechnical Feasibility Study:

Alpha/RB&G Engineering, 2004, Dry Wash Reservoir, Washington County, Utah, Geotechnical Feasibility Study, 167pp.

### Ivins City Council Records:

[https://ivins.granicus.com/MinutesViewer.php?view\\_id=2&clip\\_id=1639&doc\\_id=d6c7f6e9-5940-11ec-85e3-0050569183fa](https://ivins.granicus.com/MinutesViewer.php?view_id=2&clip_id=1639&doc_id=d6c7f6e9-5940-11ec-85e3-0050569183fa)

[https://ivins.granicus.com/MinutesViewer.php?view\\_id=2&clip\\_id=1641&doc\\_id=3bd714aa-5ec4-11ec-85e3-0050569183fa](https://ivins.granicus.com/MinutesViewer.php?view_id=2&clip_id=1641&doc_id=3bd714aa-5ec4-11ec-85e3-0050569183fa)

[https://ivins.granicus.com/MetaViewer.php?view\\_id=2&clip\\_id=1641&meta\\_id=145852](https://ivins.granicus.com/MetaViewer.php?view_id=2&clip_id=1641&meta_id=145852)

## Disclaimer and Acknowledgments

This report was based on information available to the author at the time of preparation. Additional information is known to exist, and this information will certainly reduce the uncertainty of many of the conclusions once it is made available; it may also change the conclusions of this report, at least to some extent.

This report is intended to provide a basis for discussion about the “best” reservoir for Ivins City and the WCWCD, consistent with the Environmental Assessment on which it is based. This report should not be viewed as promoting the creation of a reservoir, as there are many arguments both in favor of and opposed to a new reservoir in the City limits.

The author appreciates the cooperation of the City of Ivins, its Mayor and Engineer, and members of the City Council, both current and past. The WCWCD has shared quite a bit of information and assisted interested citizens, including the author, in understanding and witnessing first-hand some of its operations as related to reuse water, and this is greatly appreciated.

Discussions held by the Dry Wash Study Group have been encouraging and insightful, and their ongoing efforts should be followed by interested citizens as they are presented.

There are many other impacts (cost, loss of open space, etc) that must be considered before this reservoir should be approved. This report is intended only to address the technical aspects.

## About the Author

Wayne D. Pennington, a resident of Ivins City, is a PhD geophysicist and a retired Dean of Engineering at Michigan Technological University. This work has been undertaken on his own initiative and he has not received any compensation for it from any party.