



Left Fork of Dunn Creek, Park Valley, Utah

Northwestern Box Elder County Regional Water Resources Evaluation

SURFACE WATER STORAGE OPTIONS

Specific Objectives of the Project

(1) Site Identification

- Researching reports from state and federal agencies
- Using USGS 7.5 minute quadrangle maps

(2) Preferred Site selection

- Location, landownership, dam embankment, reservoir capacity, rating factor, geology, foundation design considerations, & other considerations.

(3) Screening Process

- Sites were eliminated due to *fatal flaws*, such as landslides, in abutment land administered by Forest Service, lack of water supply, remote location, too large of a dam relative to expected storage capacity, or a combination of these factors.

(4) Water Supply, Downsizing, and Cursory Cost Estimation of each site

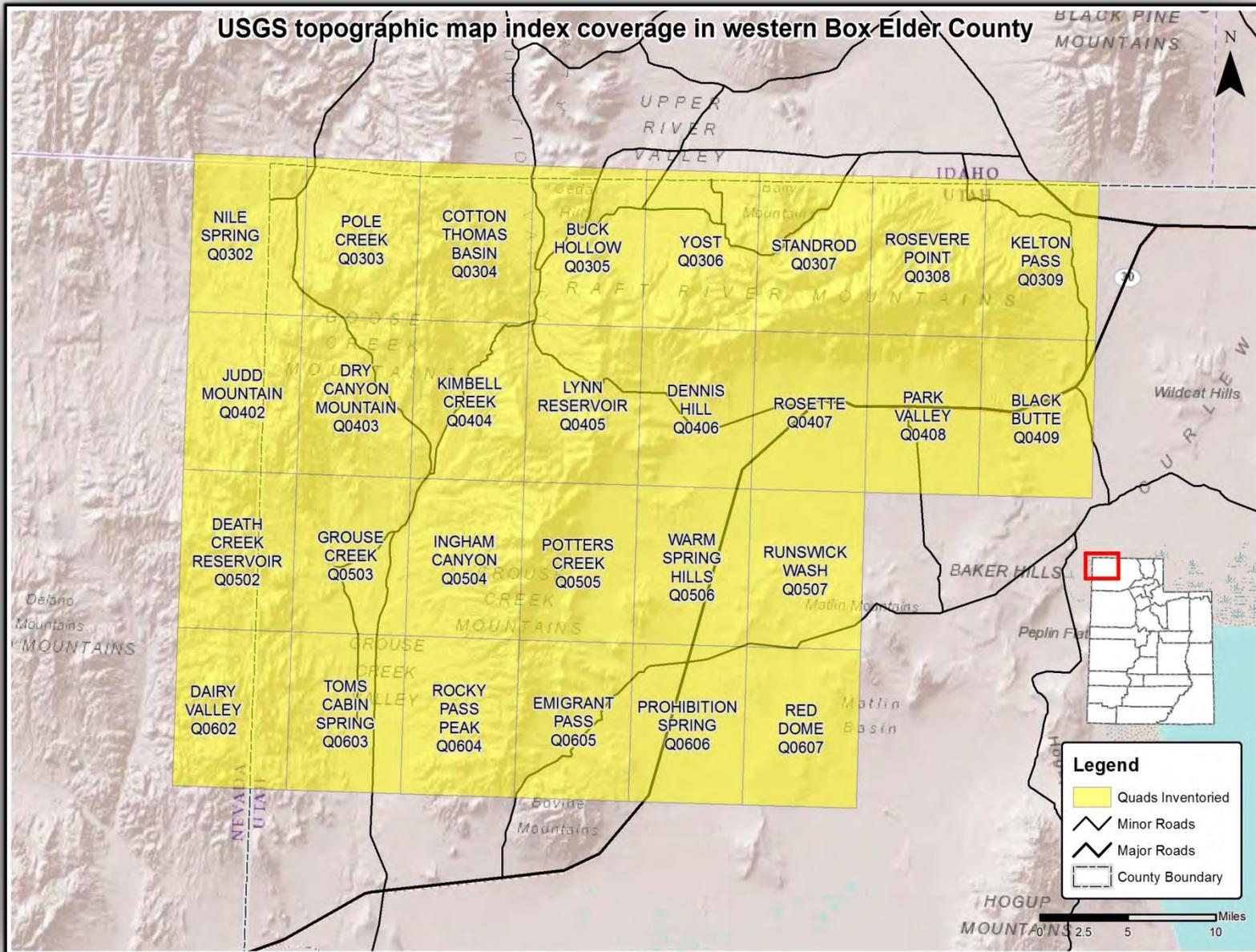
- These elements were analyzed for the final sites

(5) Final Site Selection of most favorable sites



Drilling rig located south of Grouse Creek, Utah

Phase 1 - Site Identification



Site Number & Name	Embankment Volume (cy)	Reservoir Storage (acft)	Emb. Volume (cy) / Res. Storage (acft)	Land Ownership At Damsite	Land Ownership Of Reservoir Basin
1537 Raft River	252,979	24,530	10	Private	Private
1551 Lynn Reservoir Raise	146,916	2,712	54	Private	Private
Grouse Creek – J Tanner site	1,973,163	28,373	69	Private	Private
1519 Raft River	558,407	6,949	80	Private and BLM	BLM
1520 Junction Creek	59,431	680	87	Private	Private
1550 Etna Reservoir Raise	174,013	1,901	92	Private	Private
1524 Basin Creek	189,387	1,949	97	Private	Private
1534 Upper Grouse Creek	524,977	5,081	103	Private	Private
1525 Cotton Creek	303,430	2,393	127	Private	Private
1536 Kimbell Creek	219,752	1,692	130	Private	Private
1522 Hardesty Creek	306,453	2,199	139	Private	Private
1523 Joe Dahar Creek	60,202	408	148	Private	Private
1521 Pole Creek	85,800	572	150	Private	Private
1529 Pine Creek	420,645	2,341	180	Private	Private
1516 Johnson Creek	127,033	589	206	Private	Private
1506 Indian Creek	271,227	1,278	212	Private	Private
1527 Dove Creek	176,397	463	231	Private	Private
1599 Brent Rose Dam	149,921	602	249	Private	Private
1515 Limekiln Hollow	158,657	571	278	Private	Private
1530 Cook Canyon	340,867	1,215	281	Private	Private
1526 South Fork Junction Creek	127,671	447	285	Private	Private
1531 Red Butte Canyon	371,811	1,244	299	Private	Private
1513 George Creek	110,149	323	341	USFS	USFS
1507 Indian Creek	204,734	572	358	Private	Private
1514 Lower George Creek	161,815	419	386	Private	Private
1518 Wildcat Creek	101,807	261	390	Private	Private
1510 Clear Creek	220,054	496	443	Private	Private
1517 Wildcat Creek	133,263	299	446	Private	Private
1512 Onemile Creek	377,668	708	533	Private, USFS	Private, USFS
1503 Dunn Creek	718,583	1,076	668	Private	Private
1501 Pine Creek	248,905	312	798	Private	Private
1502 Fisher Creek	44,532	52	853	Private	Private
1508 Jim Canyon	368,280	421	875	Private	Private
1511 Water Canyon	438,830	475	923	Private	Private
1509 Rice Canyon	176,927	185	954	Private	Private
Comparison – Millsite*	2,390,000	18,000	132.7	Private, BLM	Private, BLM
Comparison – Adobe Wash*	214,399	1,354	158.3	Private, BLM	Private, BLM
Comparison – Joes Valley*	1,290,000	61,538	20.96	USFS	USFS
Comparison – Jackson Flat*	831,290	4,200	197.9	Private	Private
Comparison – Clay Draw**	650,000	3,200	203.1	BLM	BLM, USFS

***Built**

****Have not been built**

35 Total Sites

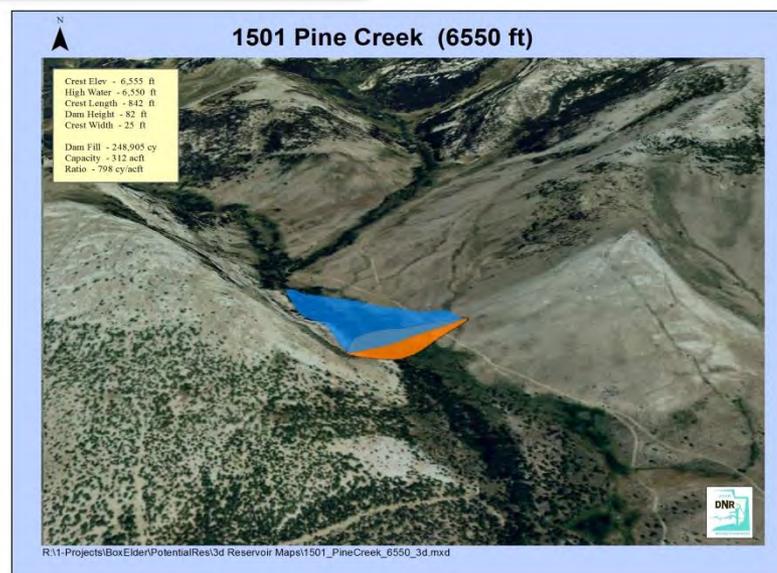
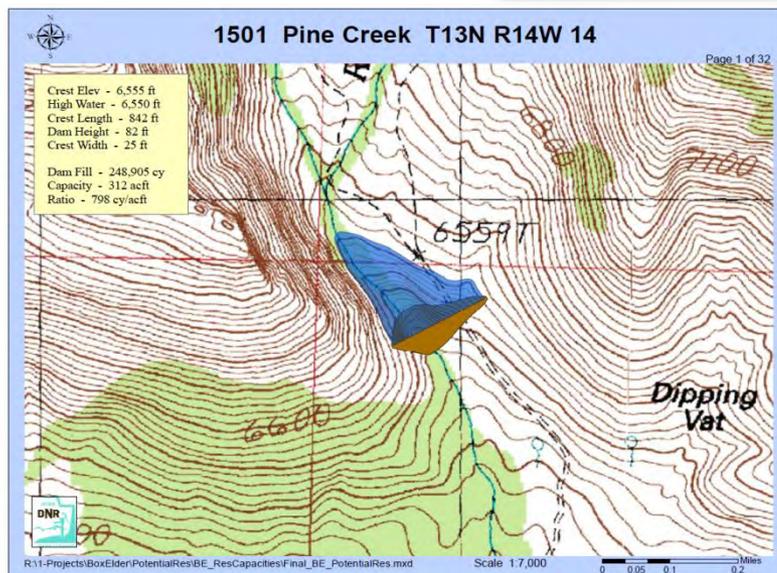


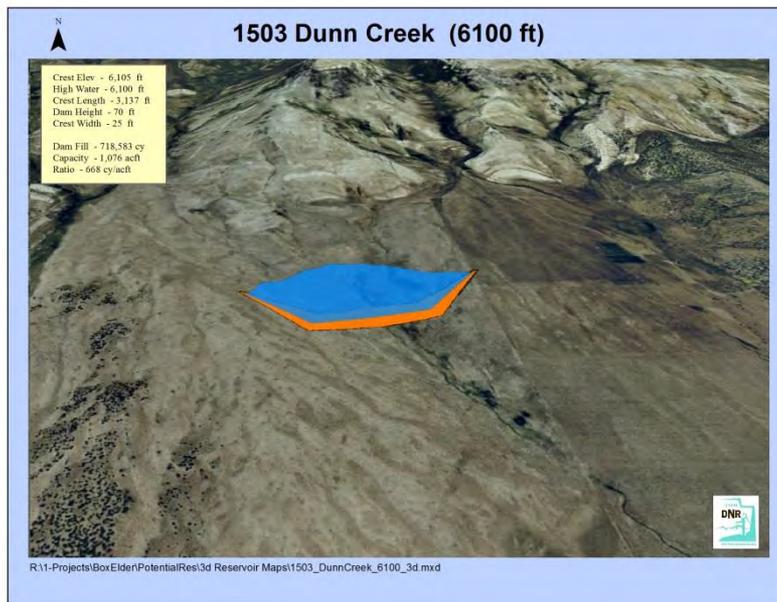
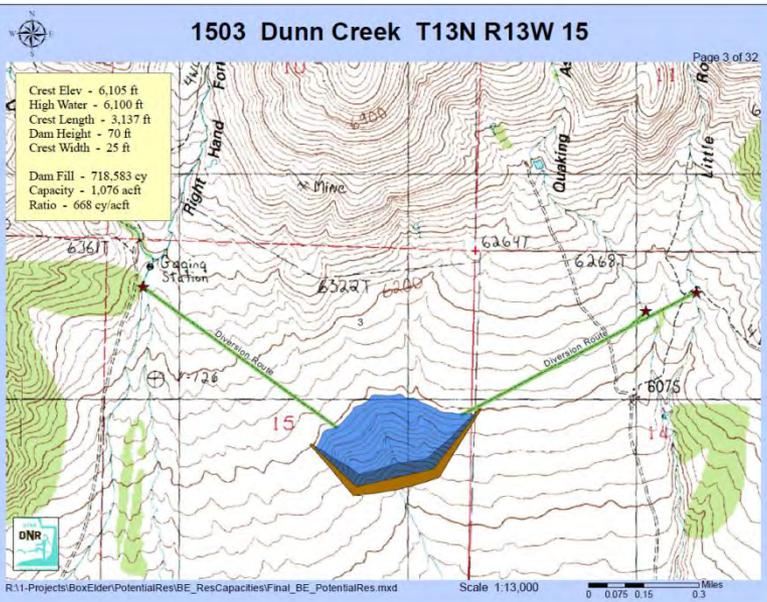
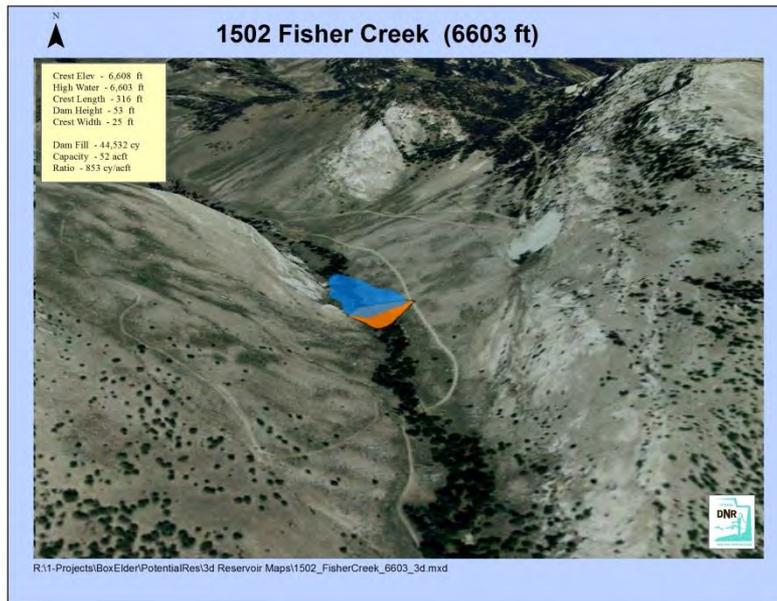
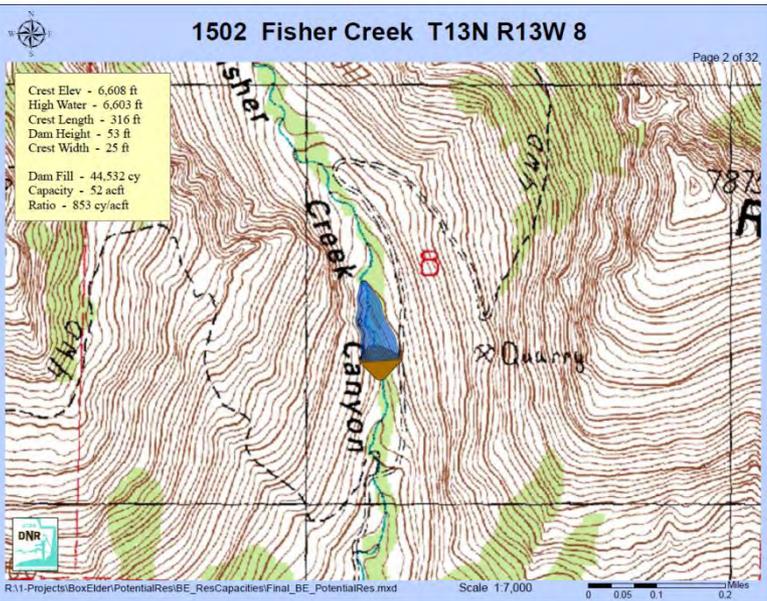
Phase 2 – Preferred Site Selection

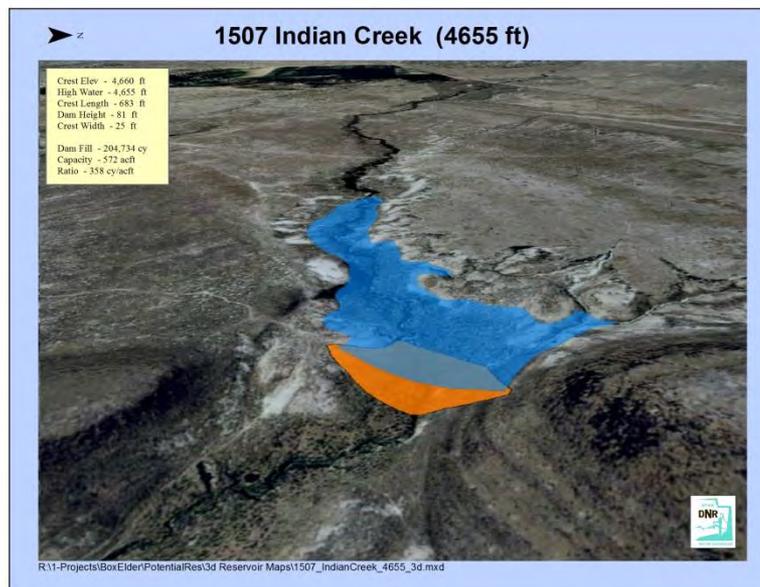
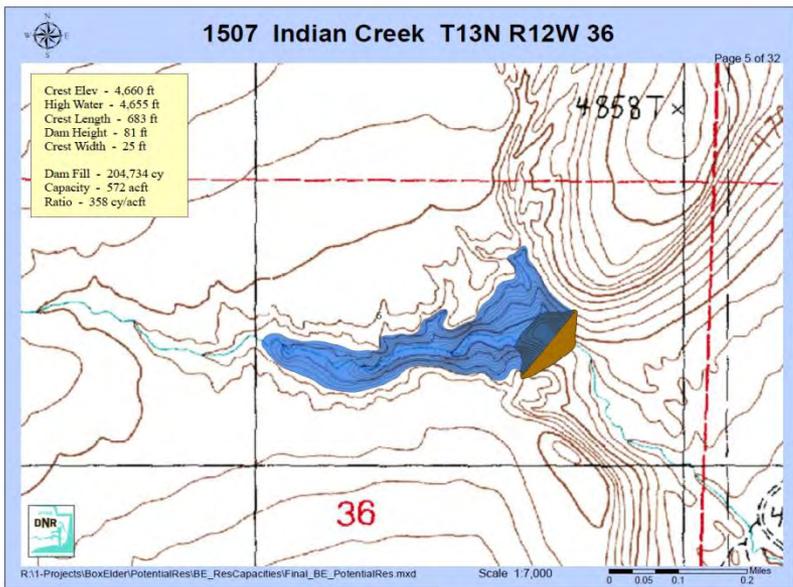
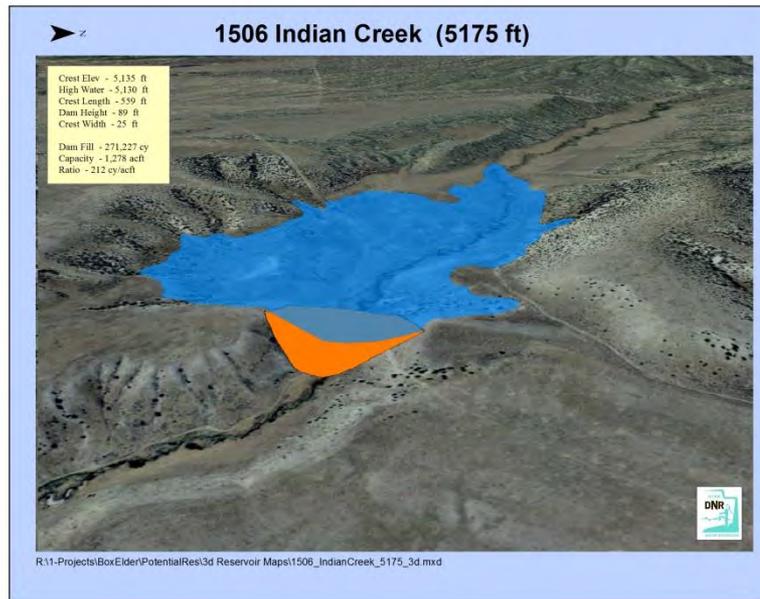
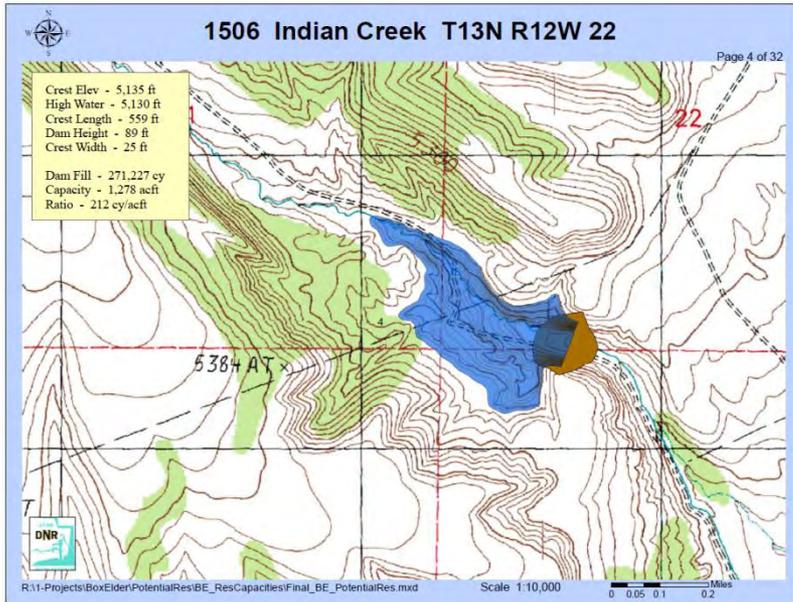
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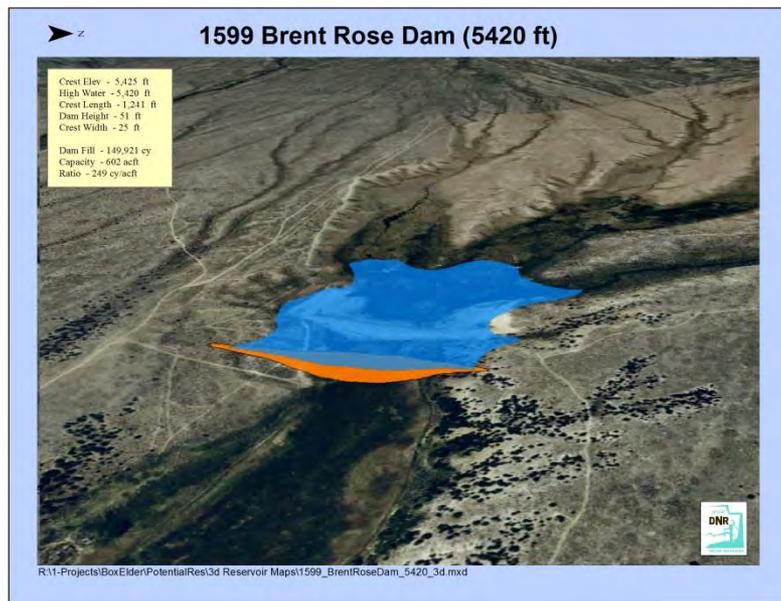
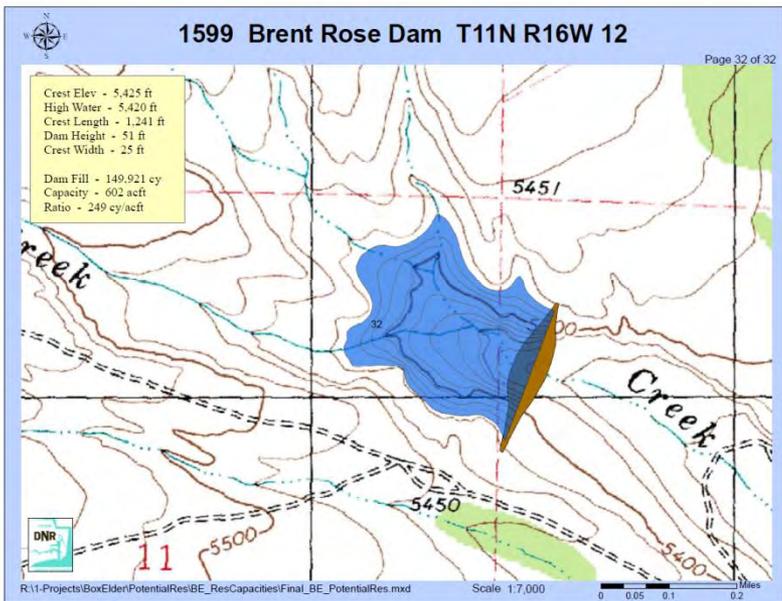
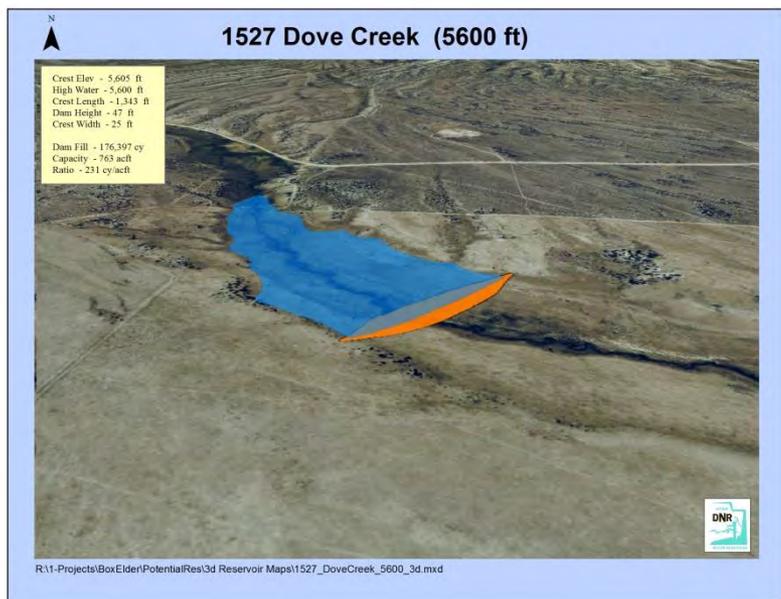
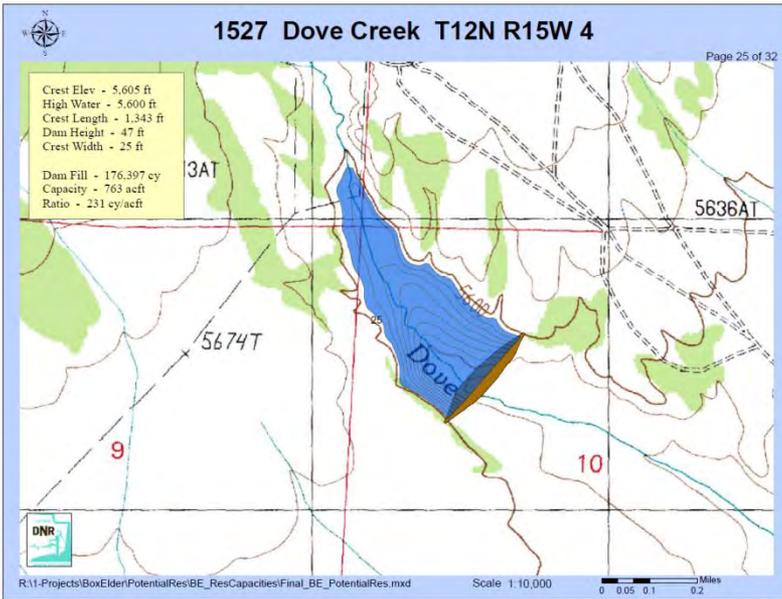
- The text includes information concerning the geology, foundation, materials available, and other conditions defined for each of the thirty-five preferred sites.
- ArcGIS tools were used to create 3D representations of ground surfaces, dam surfaces, and water surfaces. Two volumes were calculated using a variety of geo-processing tools. The first was an estimation of reservoir capacity (measured in acre feet). The second was an estimation of dam fill (measured in cubic yards).

Dam sites near Park Valley, Utah

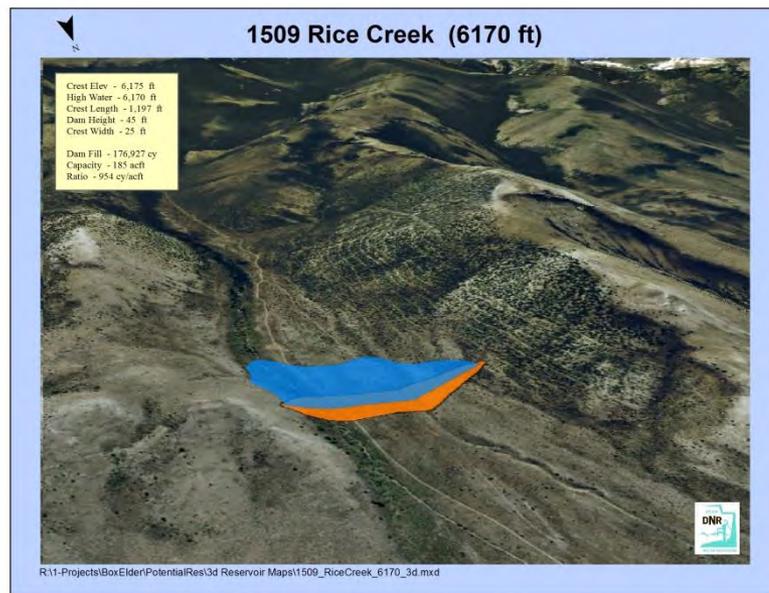
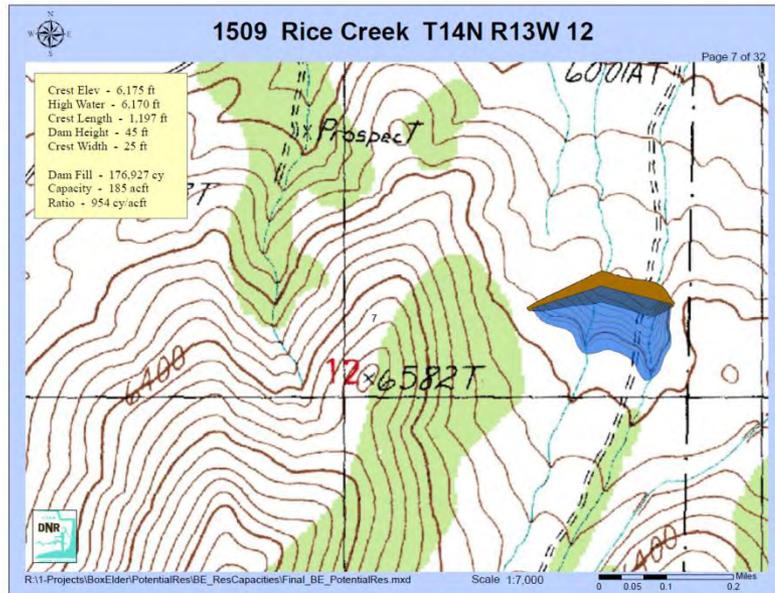
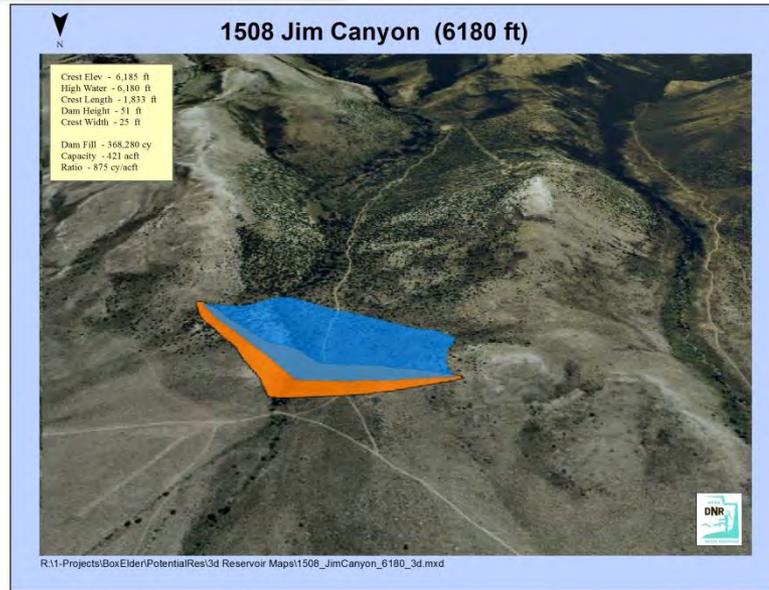
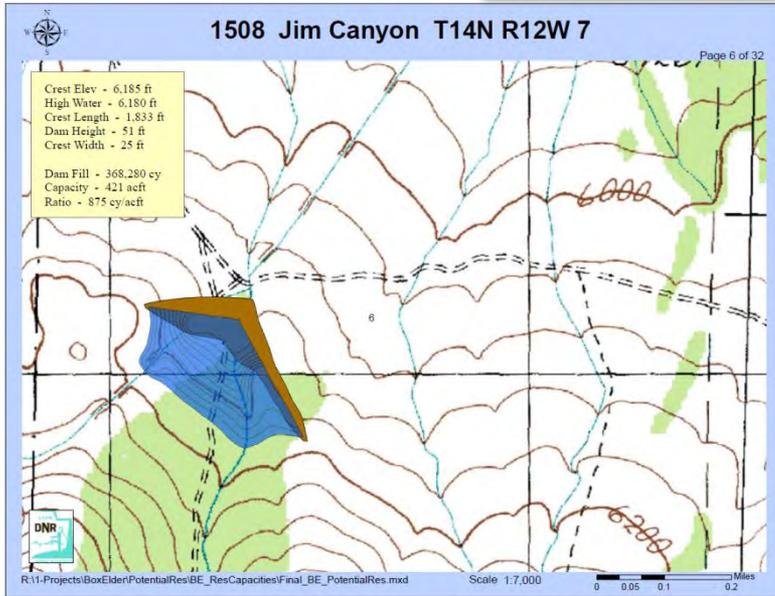








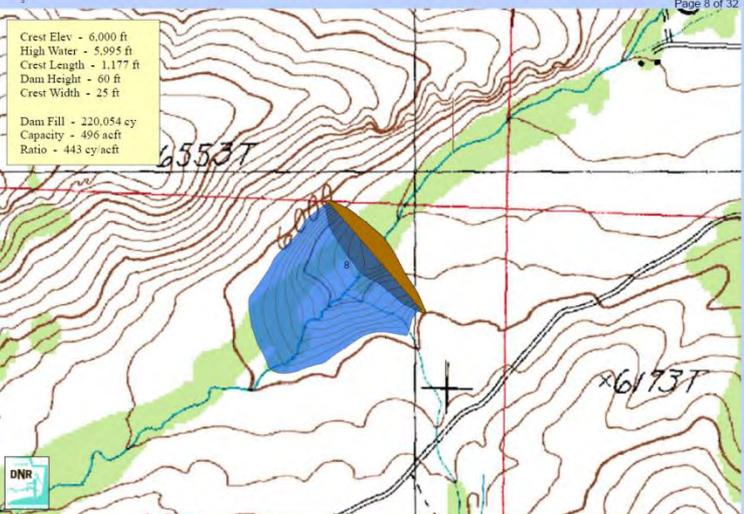
Dam sites south of Stansrod, Utah



1510 Clear Creek T14N R13W 11

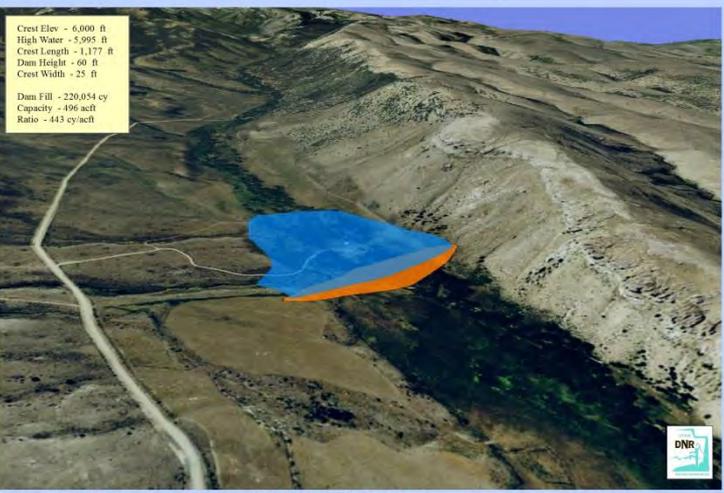
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Crest Elev - 6,000 ft
 High Water - 5,995 ft
 Crest Length - 1,177 ft
 Dam Height - 60 ft
 Crest Width - 25 ft
 Dam Fill - 220,054 cy
 Capacity - 496 acft
 Ratio - 443 cy/acft



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1510 Clear Creek (5995 ft)



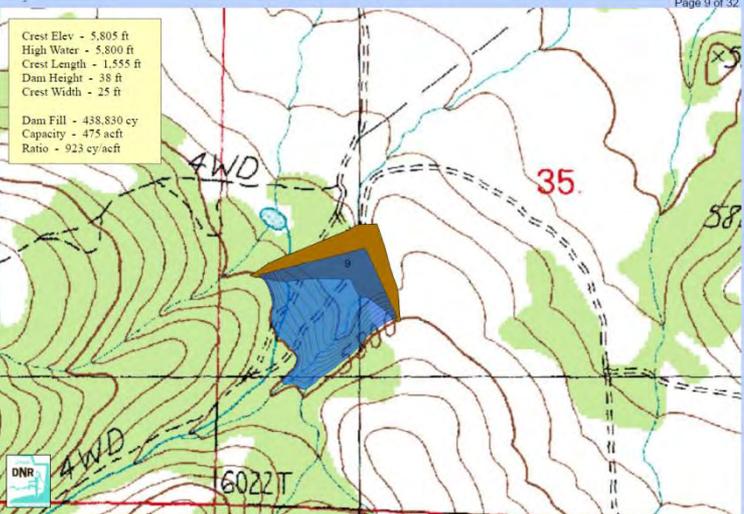
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 High Water - 5,995 ft
 Crest Length - 1,177 ft
 Dam Height - 60 ft
 Crest Width - 25 ft
 Dam Fill - 220,054 cy
 Capacity - 496 acft
 Ratio - 443 cy/acft

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1511 Water Canyon T15N R13W 35

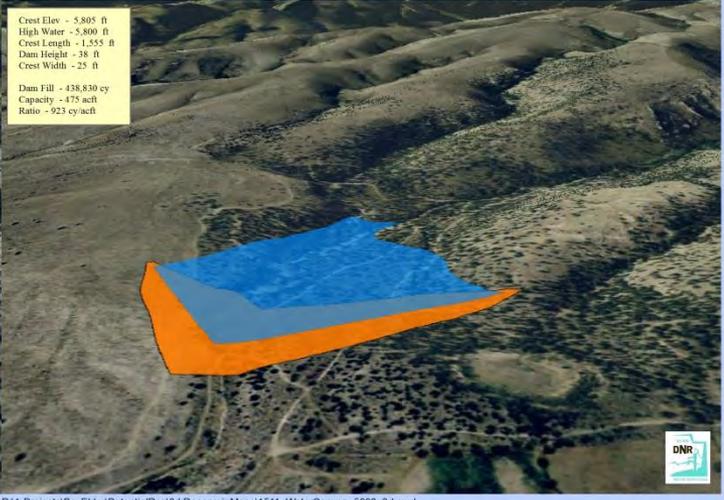
Page 9 of 32

Crest Elev - 5,805 ft
 High Water - 5,800 ft
 Crest Length - 1,555 ft
 Dam Height - 38 ft
 Crest Width - 25 ft
 Dam Fill - 438,830 cy
 Capacity - 475 acft
 Ratio - 923 cy/acft



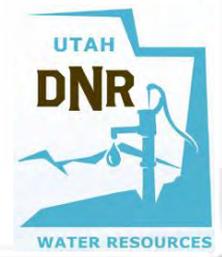
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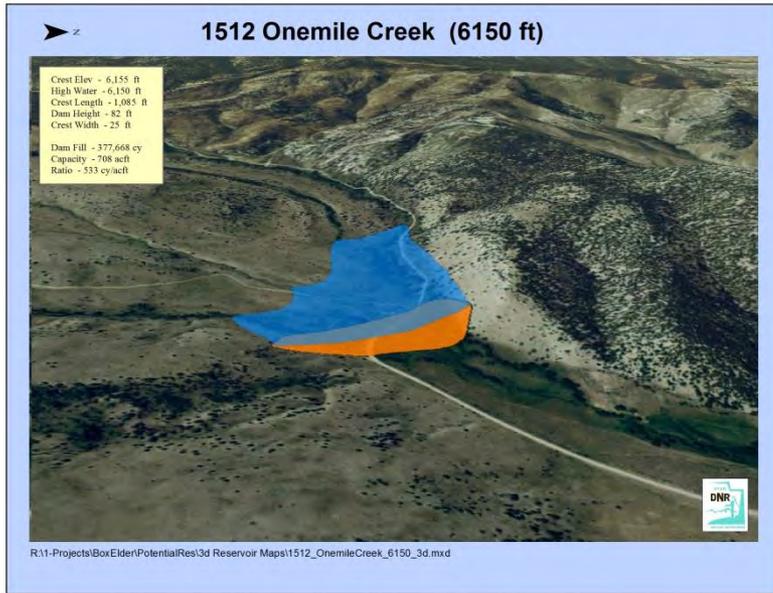
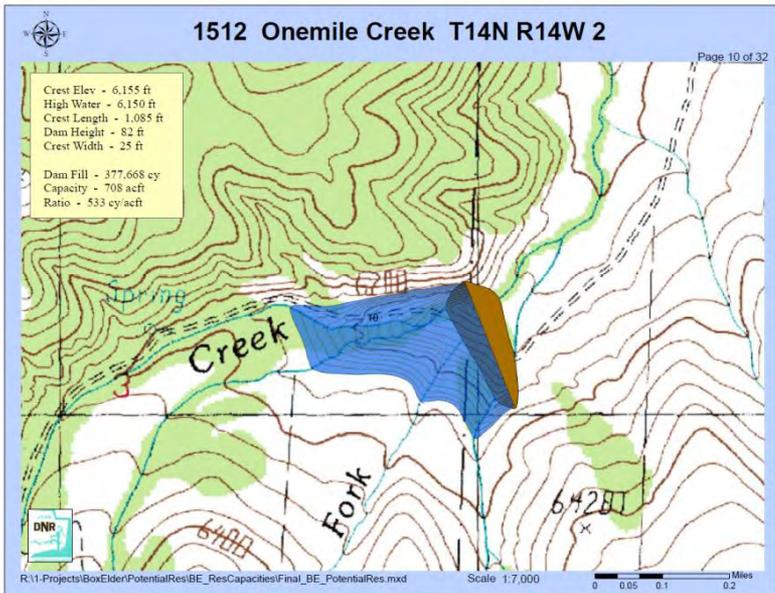
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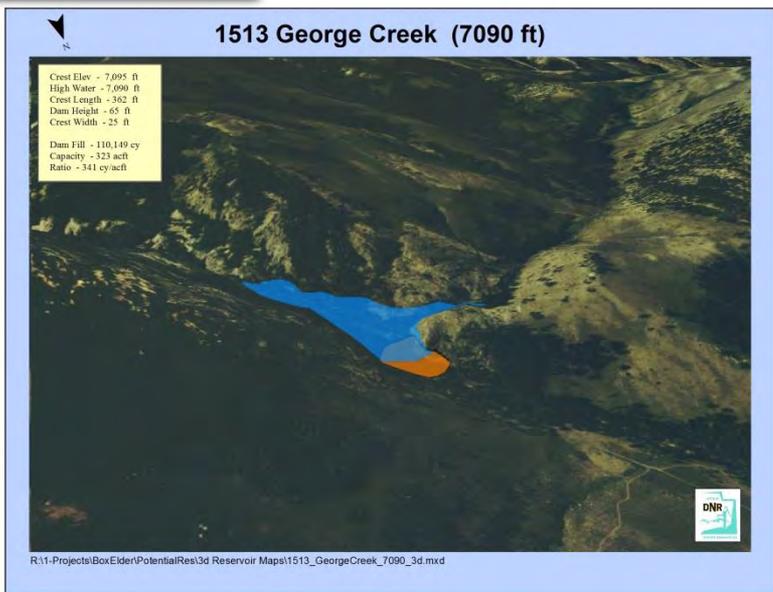
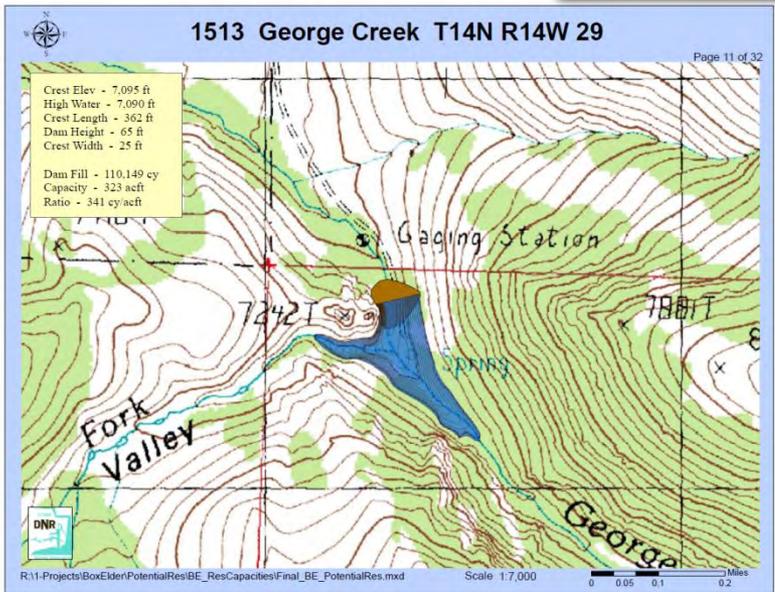
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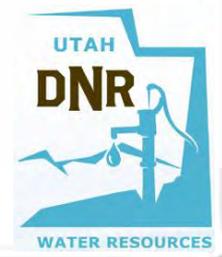
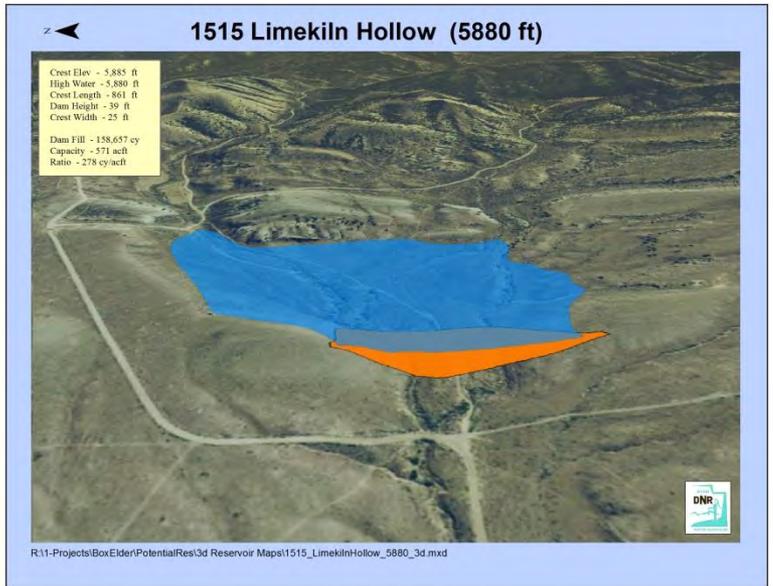
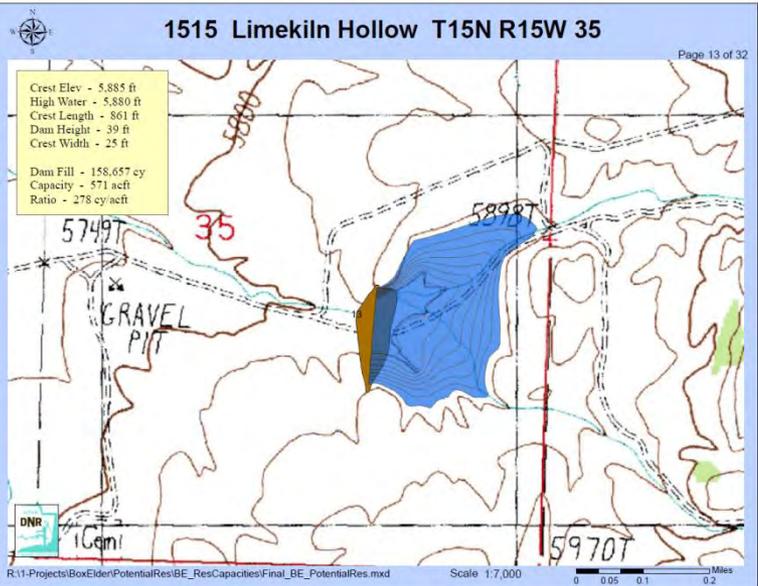
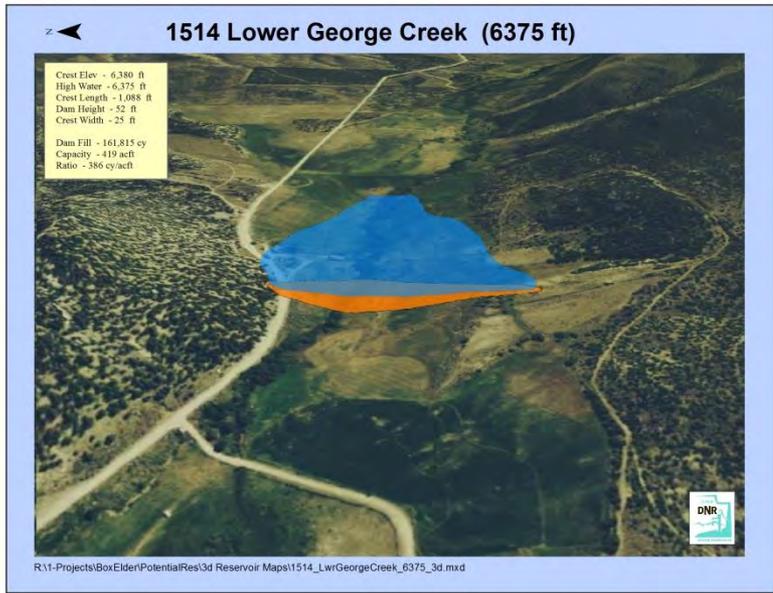
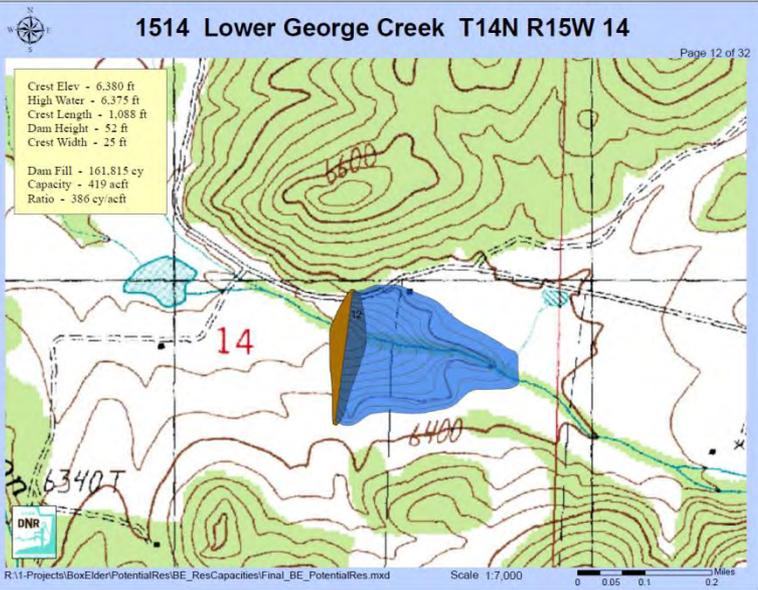
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Dam sites near Yost, Utah





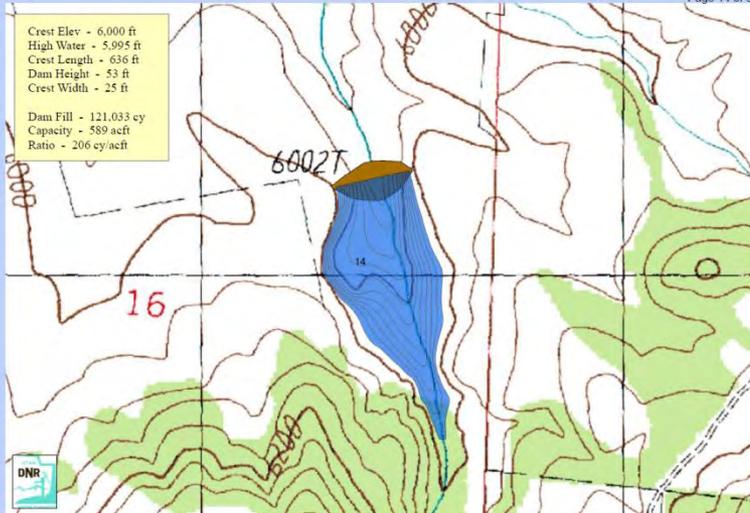


1516 Johnson Creek T14N R15W 16

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Crest Elev - 6,000 ft
 High Water - 5,995 ft
 Crest Length - 636 ft
 Dam Height - 53 ft
 Crest Width - 25 ft

Dam Fill - 121,033 cy
 Capacity - 589 acft
 Ratio - 206 cy/acft

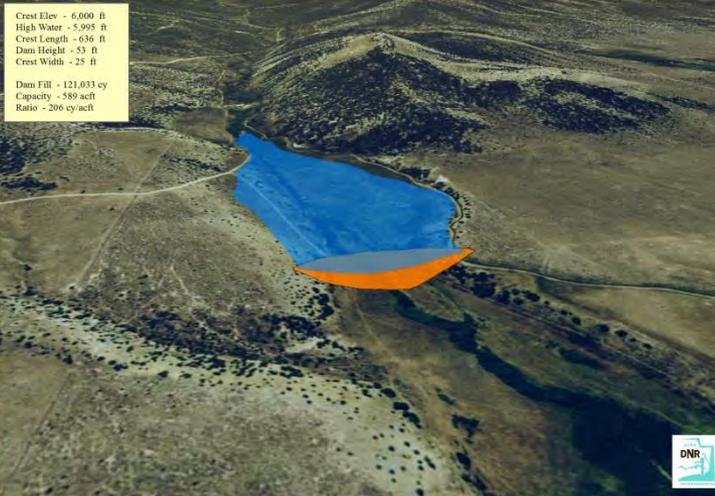


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Scale 1:7,000



1516 Johnson Creek (5995 ft)



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Crest Elev - 6,000 ft
 High Water - 5,995 ft
 Crest Length - 636 ft
 Dam Height - 53 ft
 Crest Width - 25 ft

Dam Fill - 121,033 cy
 Capacity - 589 acft
 Ratio - 206 cy/acft

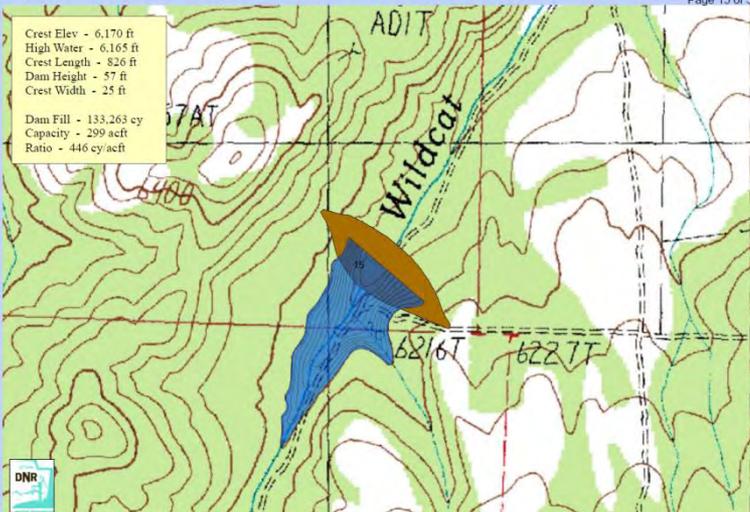


1517 Wildcat Creek T14N R15W 19

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Crest Elev - 6,170 ft
 High Water - 6,165 ft
 Crest Length - 826 ft
 Dam Height - 57 ft
 Crest Width - 25 ft

Dam Fill - 133,263 cy
 Capacity - 299 acft
 Ratio - 446 cy/acft



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Scale 1:7,000



1517 Wildcat Creek (6240 ft)

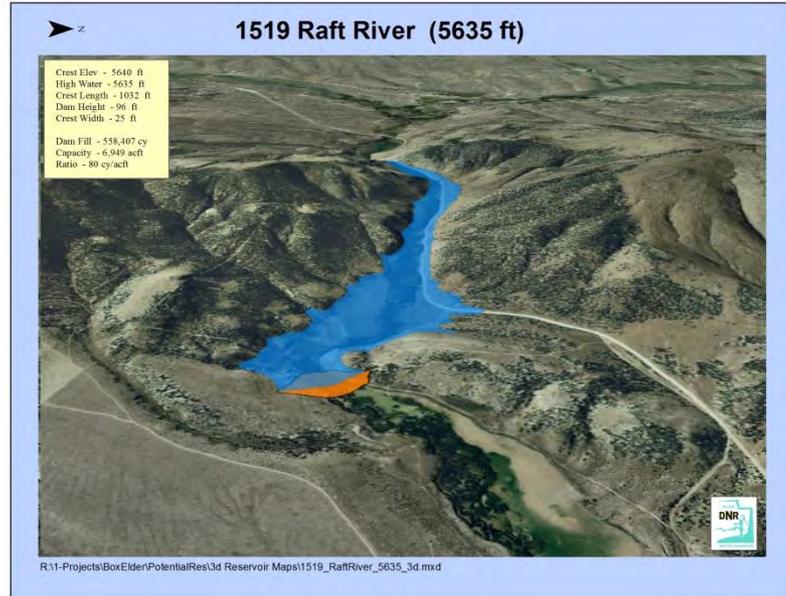
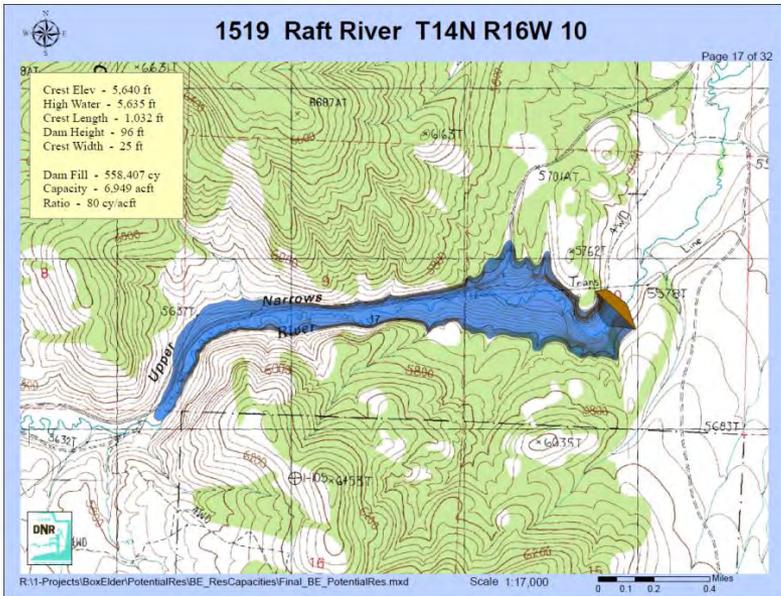
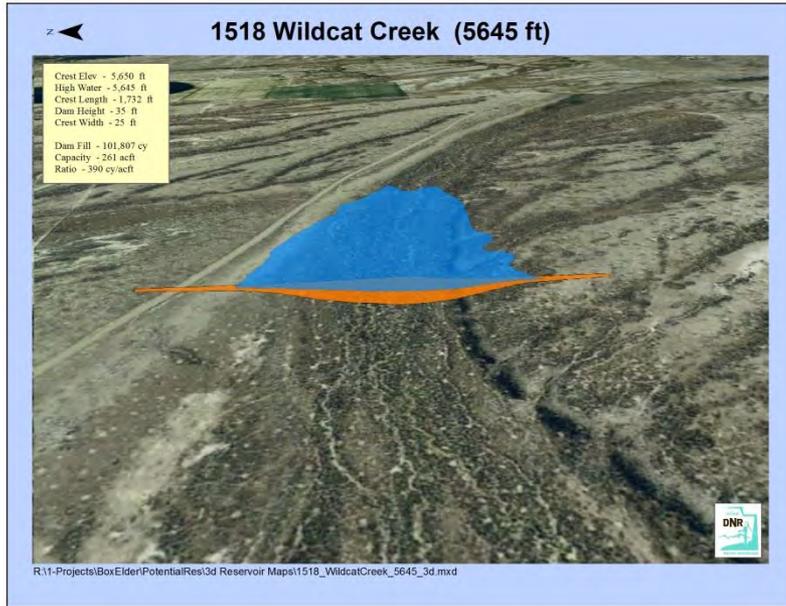
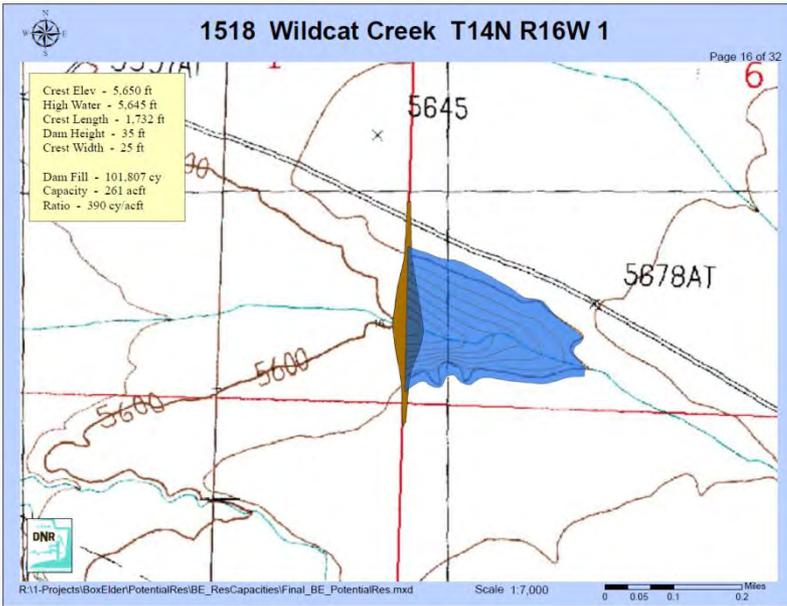


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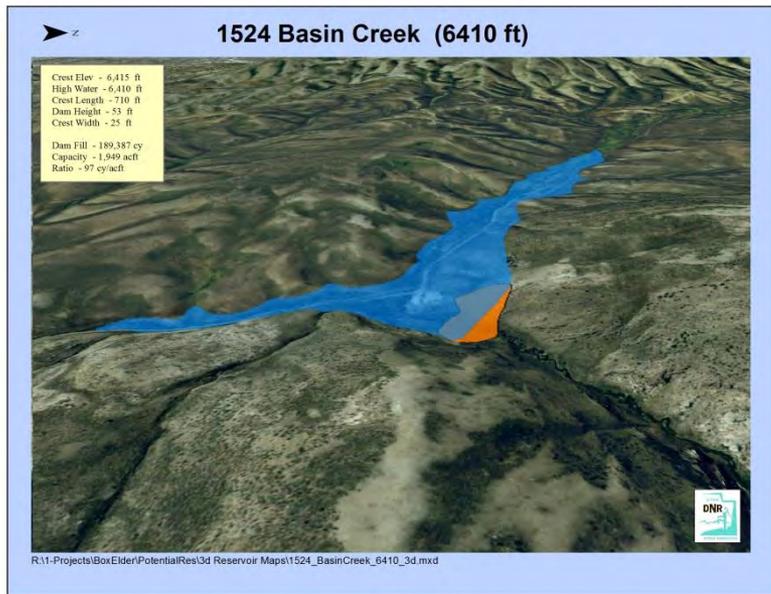
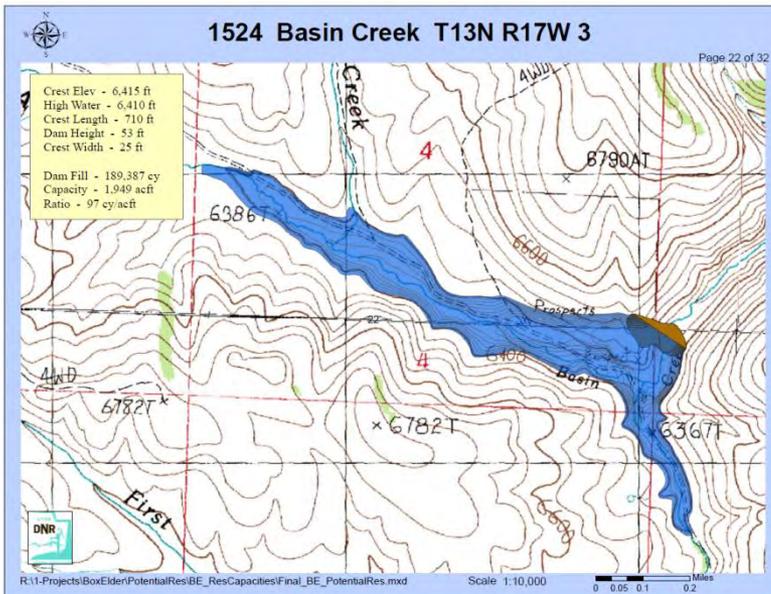
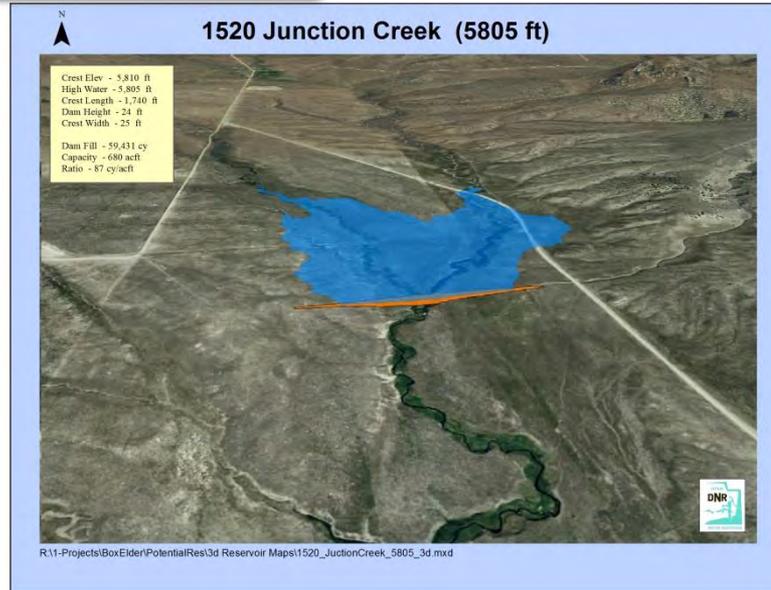
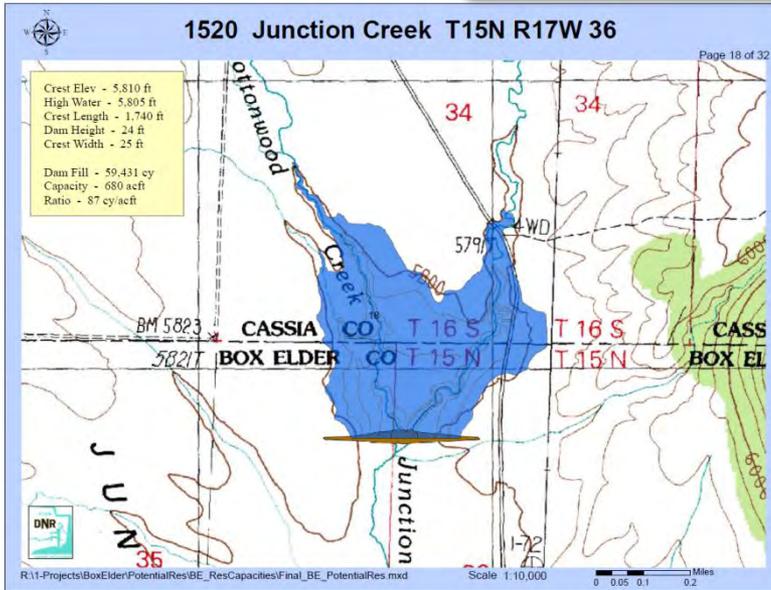
Crest Elev - 6,170 ft
 High Water - 6,165 ft
 Crest Length - 826 ft
 Dam Height - 57 ft
 Crest Width - 25 ft

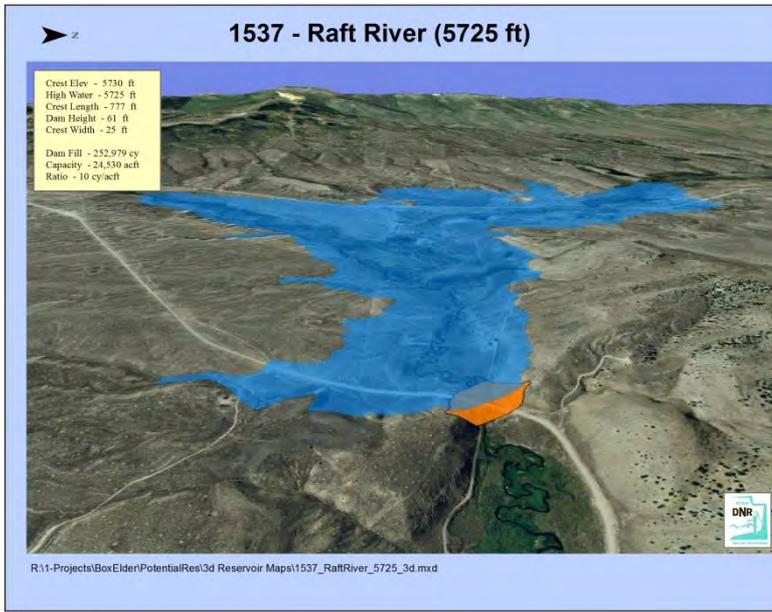
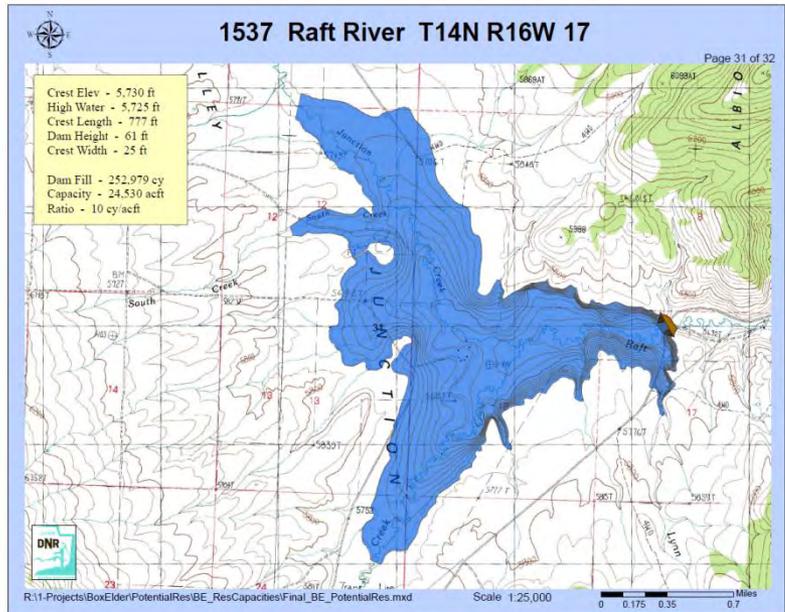
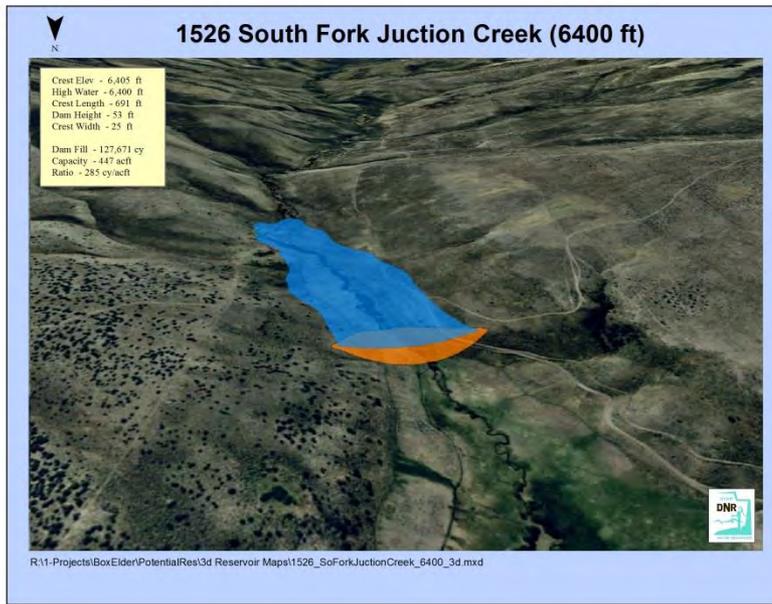
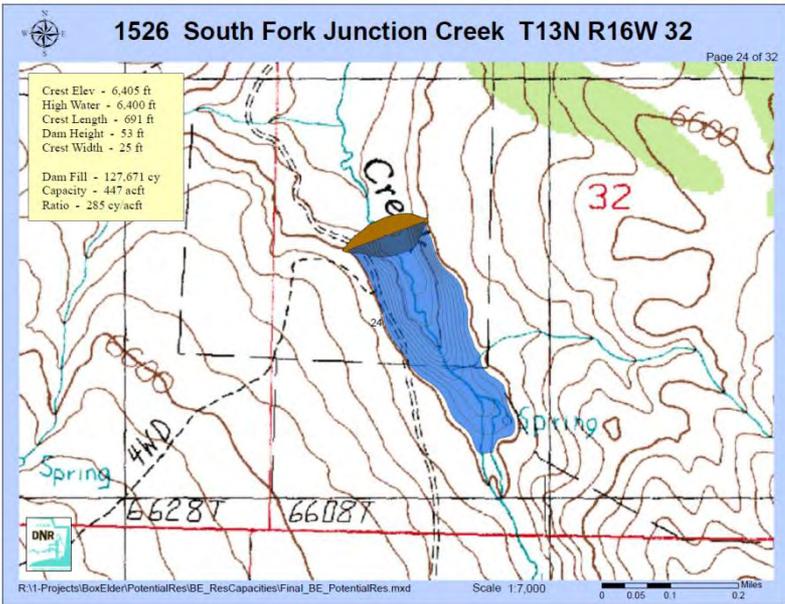
Dam Fill - 133,263 cy
 Capacity - 299 acft
 Ratio - 446 cy/acft



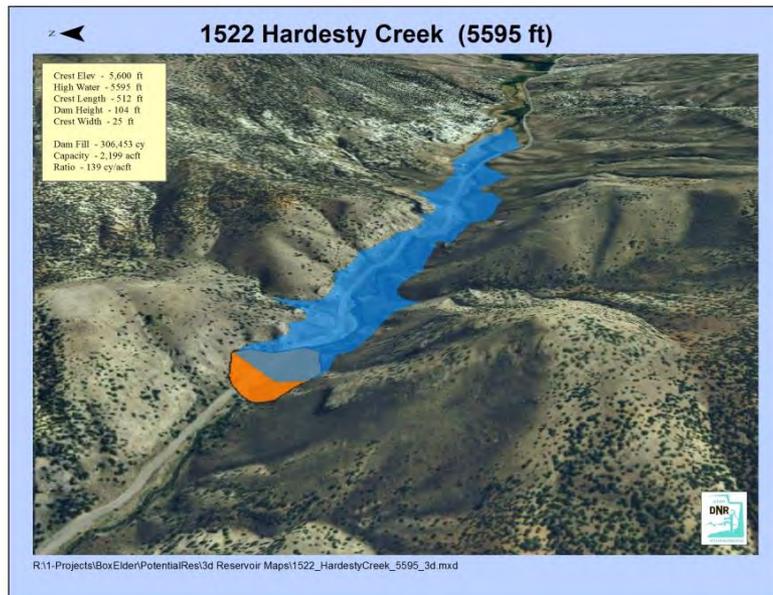
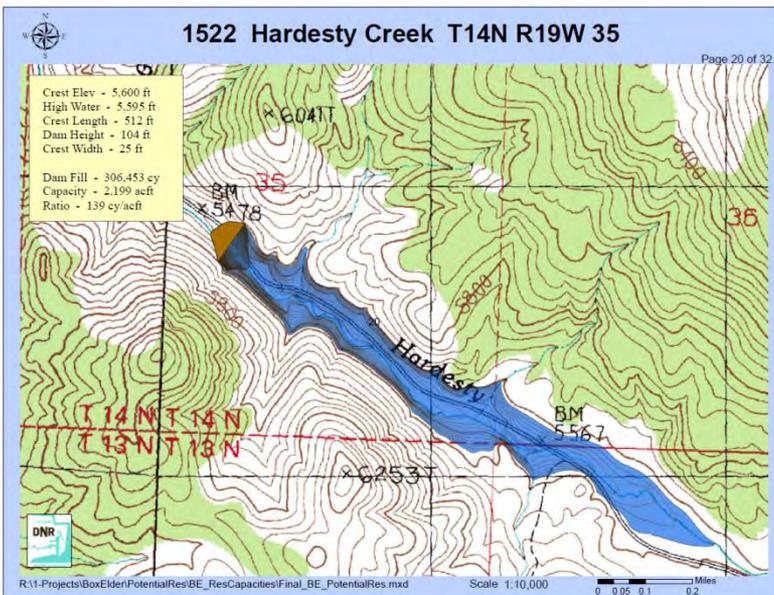
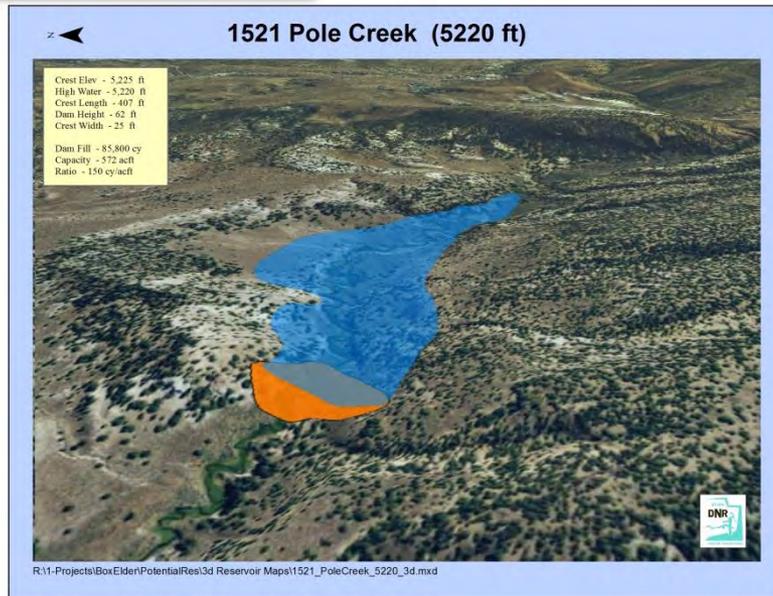
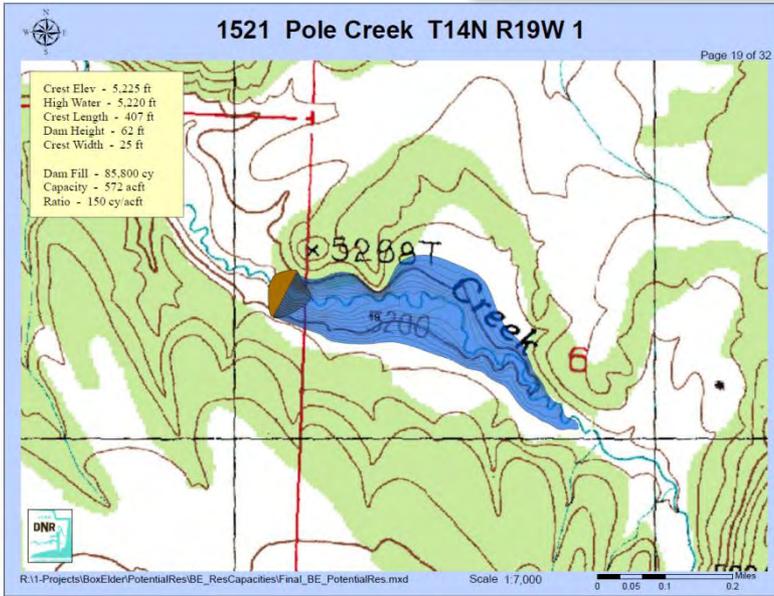


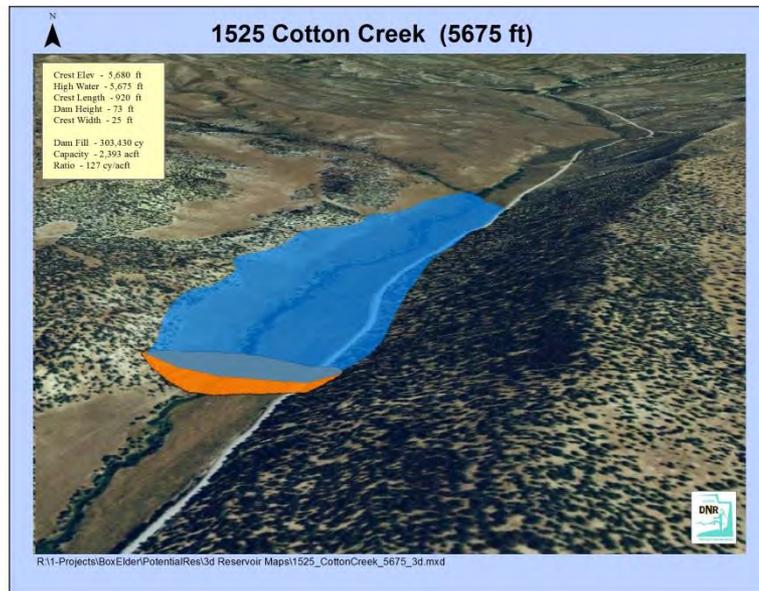
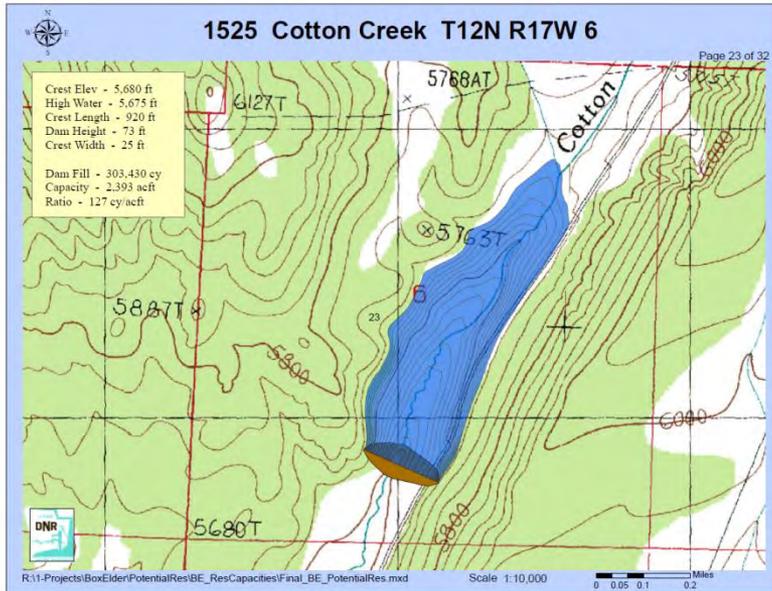
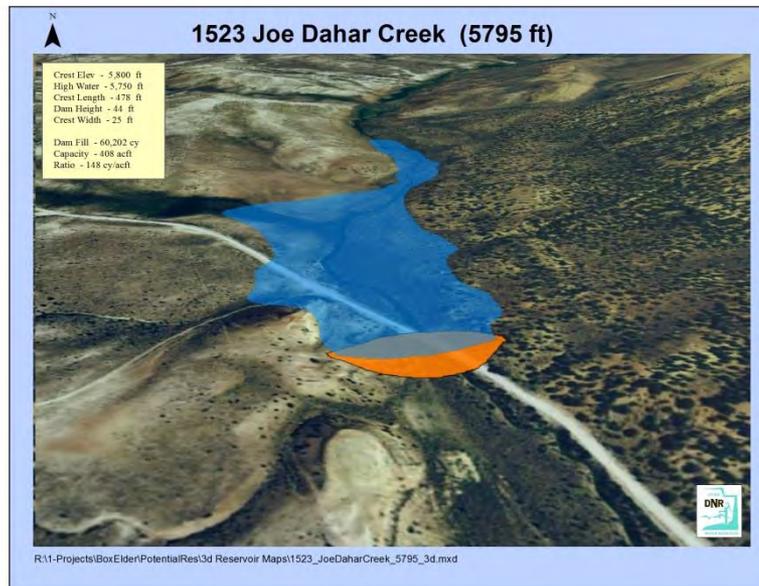
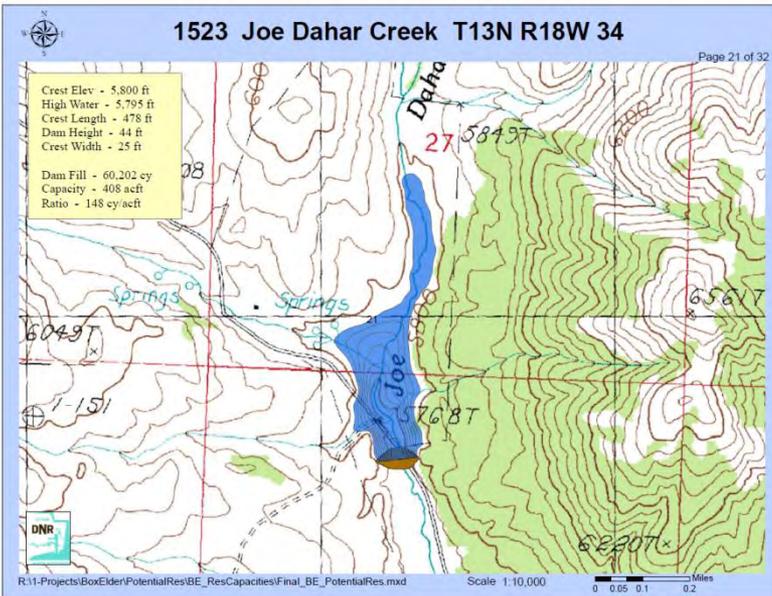
Dam sites near Lynn, Utah





Dam sites near Grouse Creek, Utah

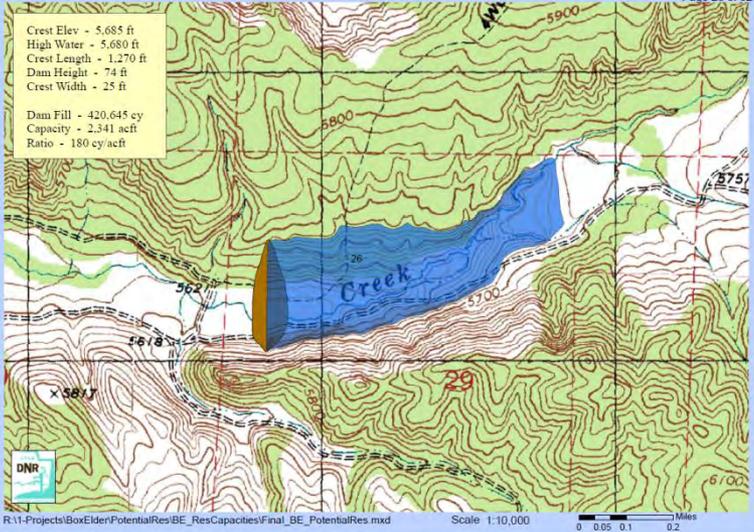




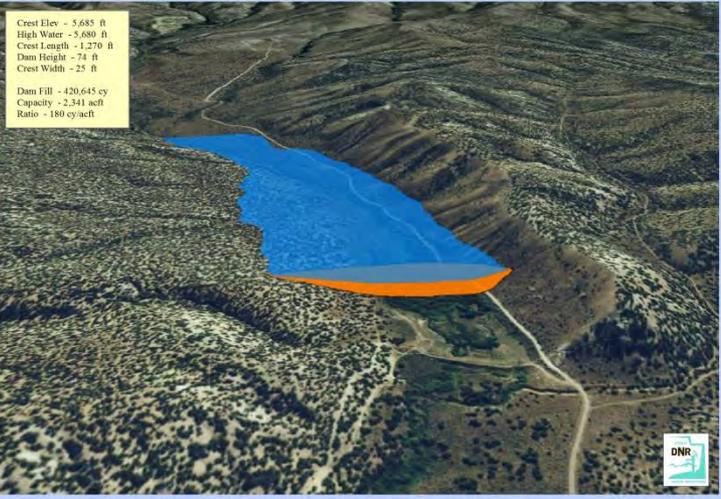


1529 Pine Creek T12N R17W 29

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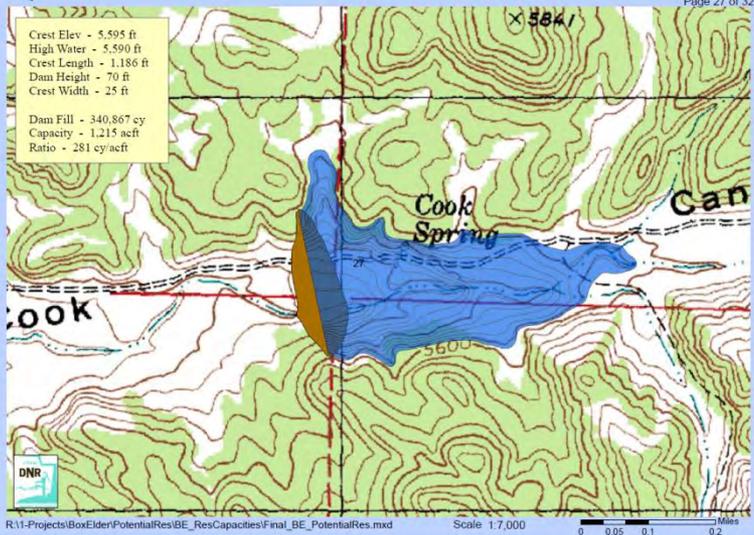


1529 Pine Creek (5680 ft)

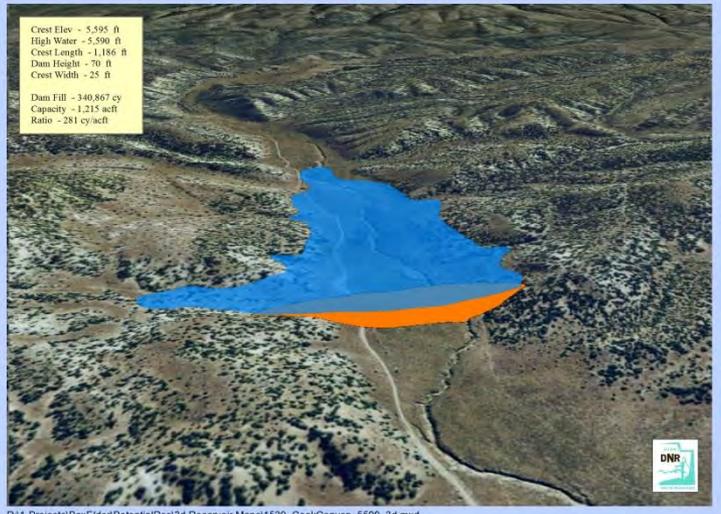


1530 Cook Canyon T11N R18W 1

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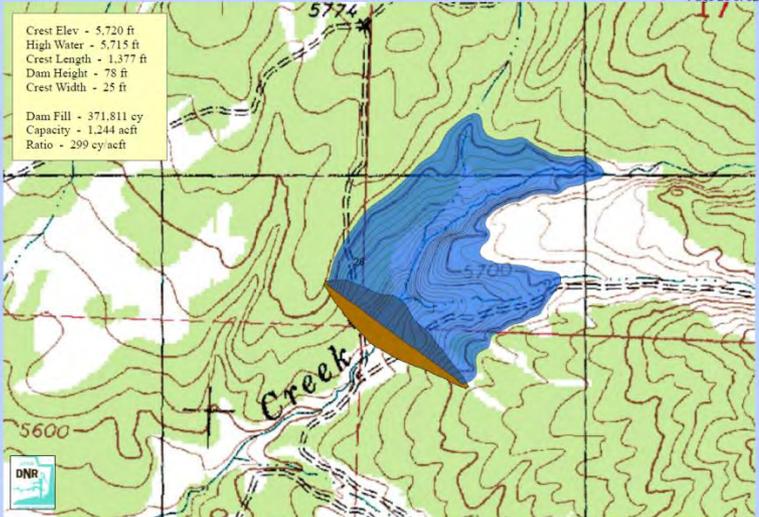
1530 Cook Canyon (5590 ft)



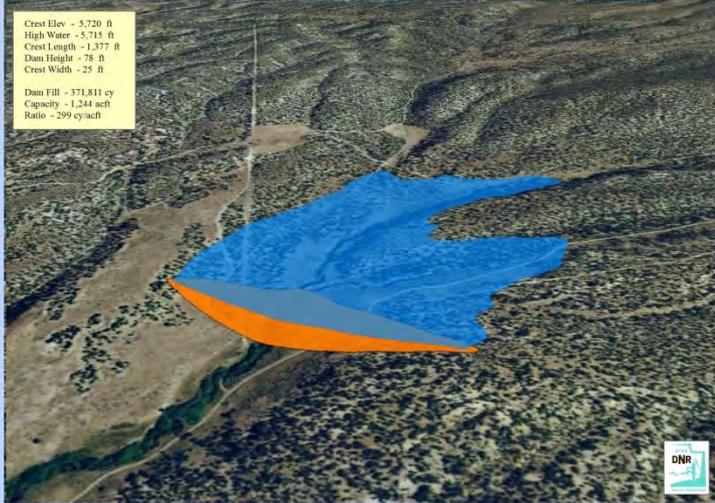


1531 Red Butte Creek T11N R17W 17

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1531 Red Butte Creek (5715 ft)



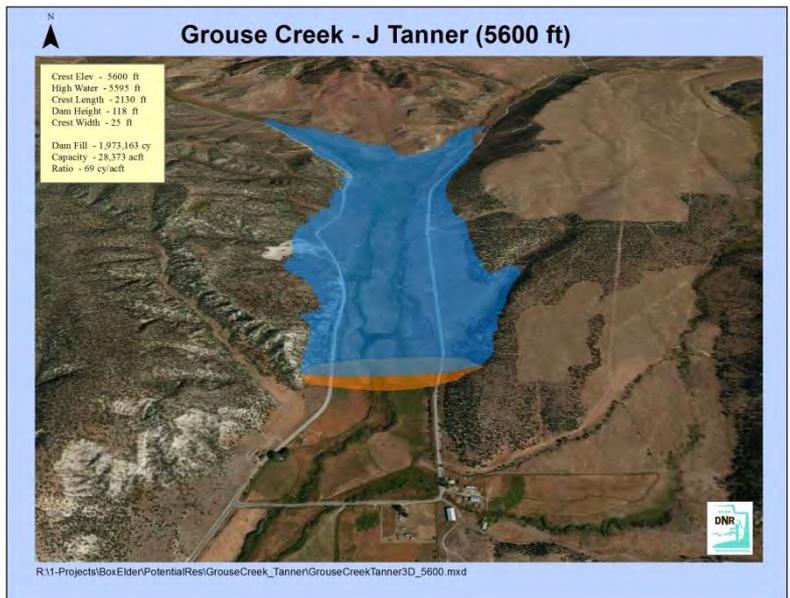
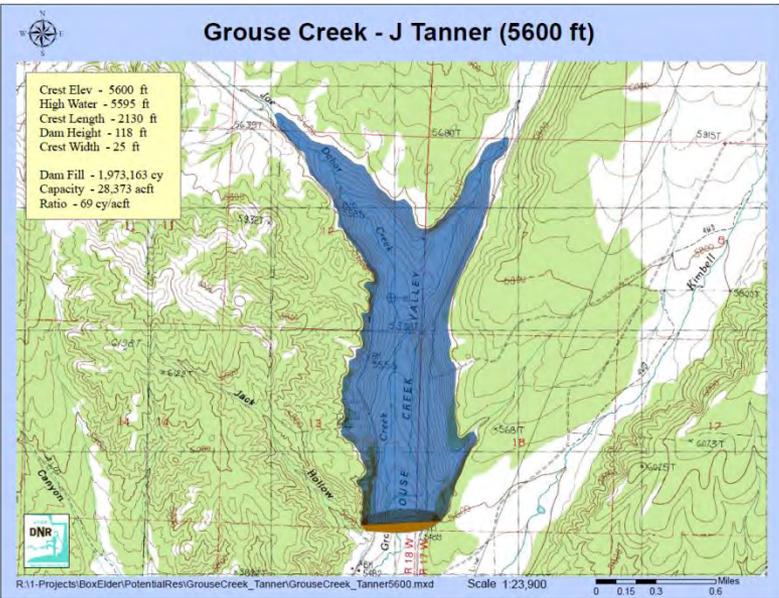
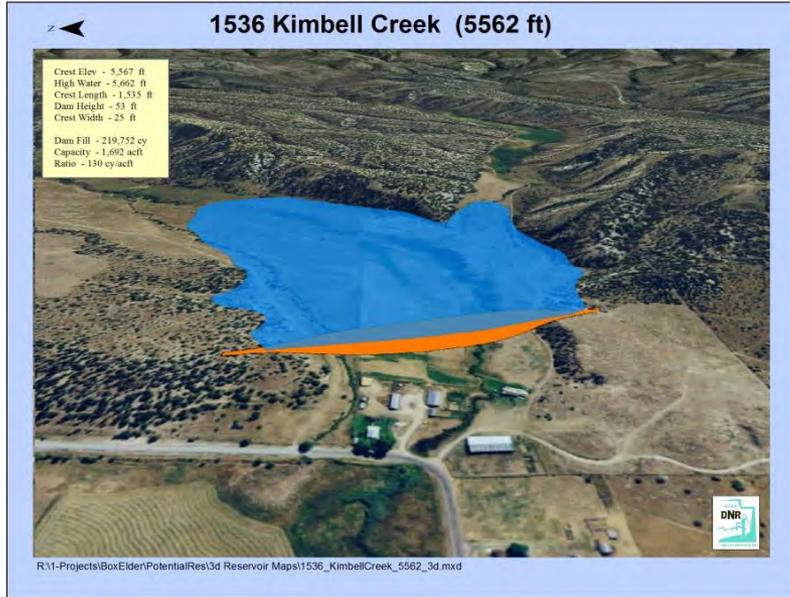
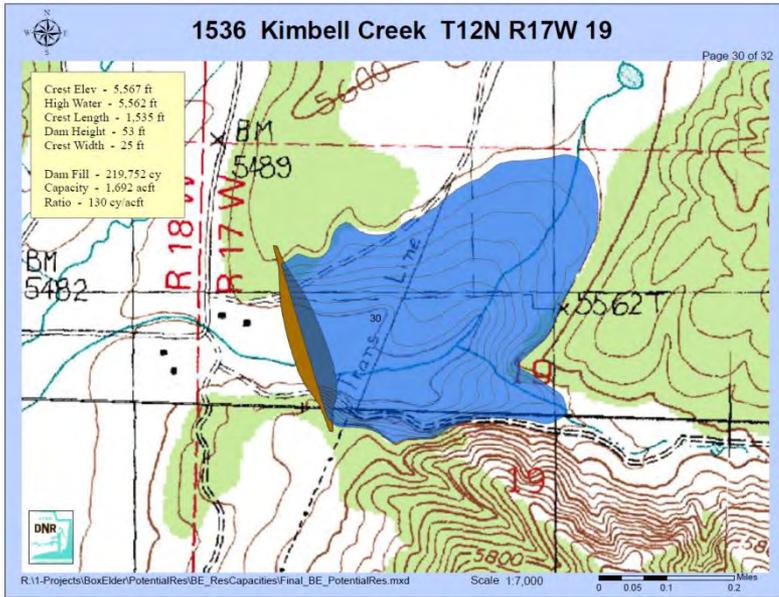
1534 Upper Grouse Creek T12N R18W 25

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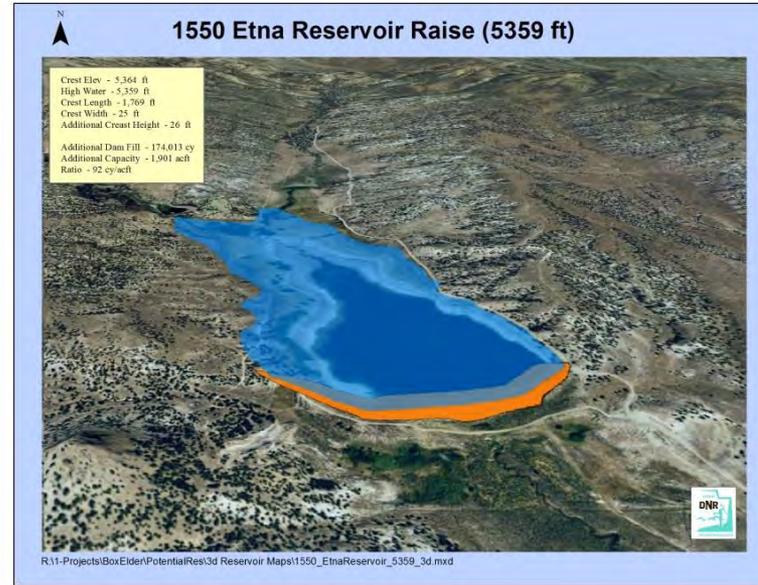
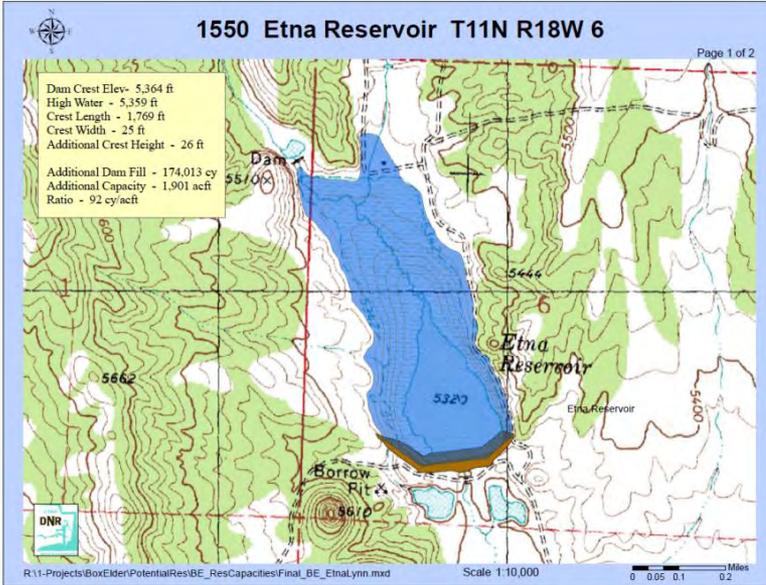


1534 Upper Grouse Creek (5455 ft)





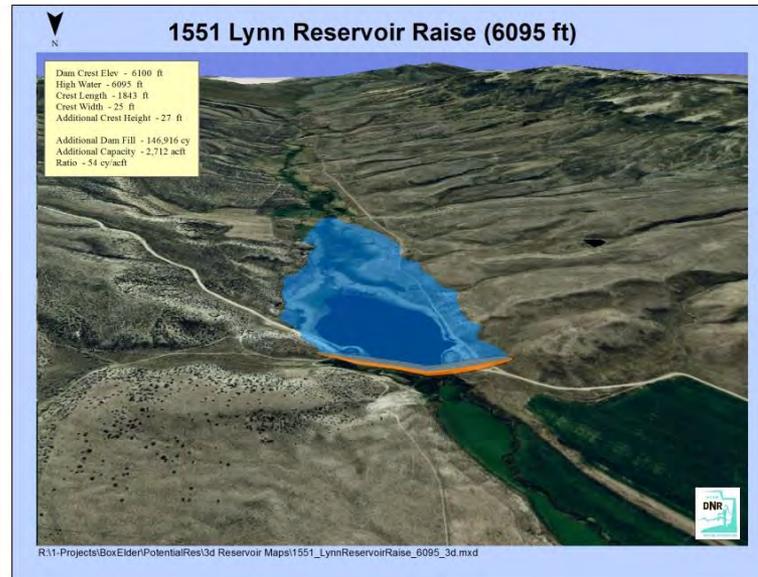
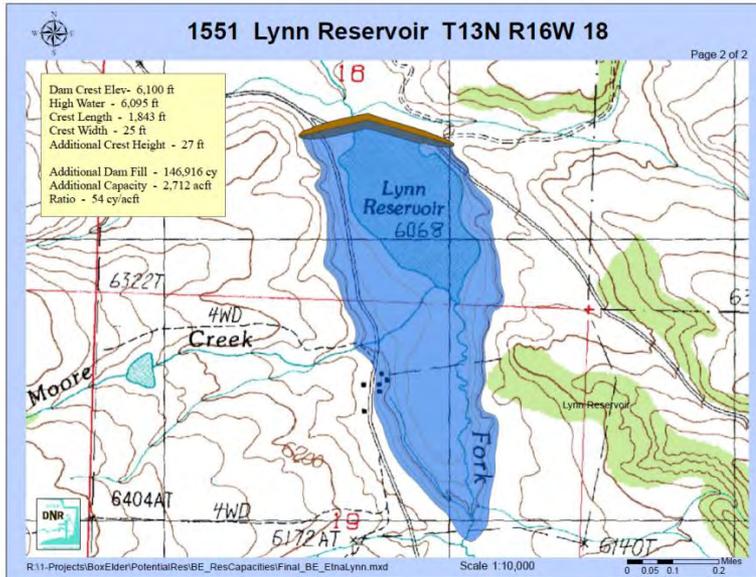
Current Reservoirs and associated raises



Existing Capacity:
 1,510 acft

Add Capacity:
 1,901 acft

New Capacity:
 3,411 acft



Existing Capacity:
 865 acft

Add Capacity:
 2,712 acft

New Capacity:
 3,037 acft



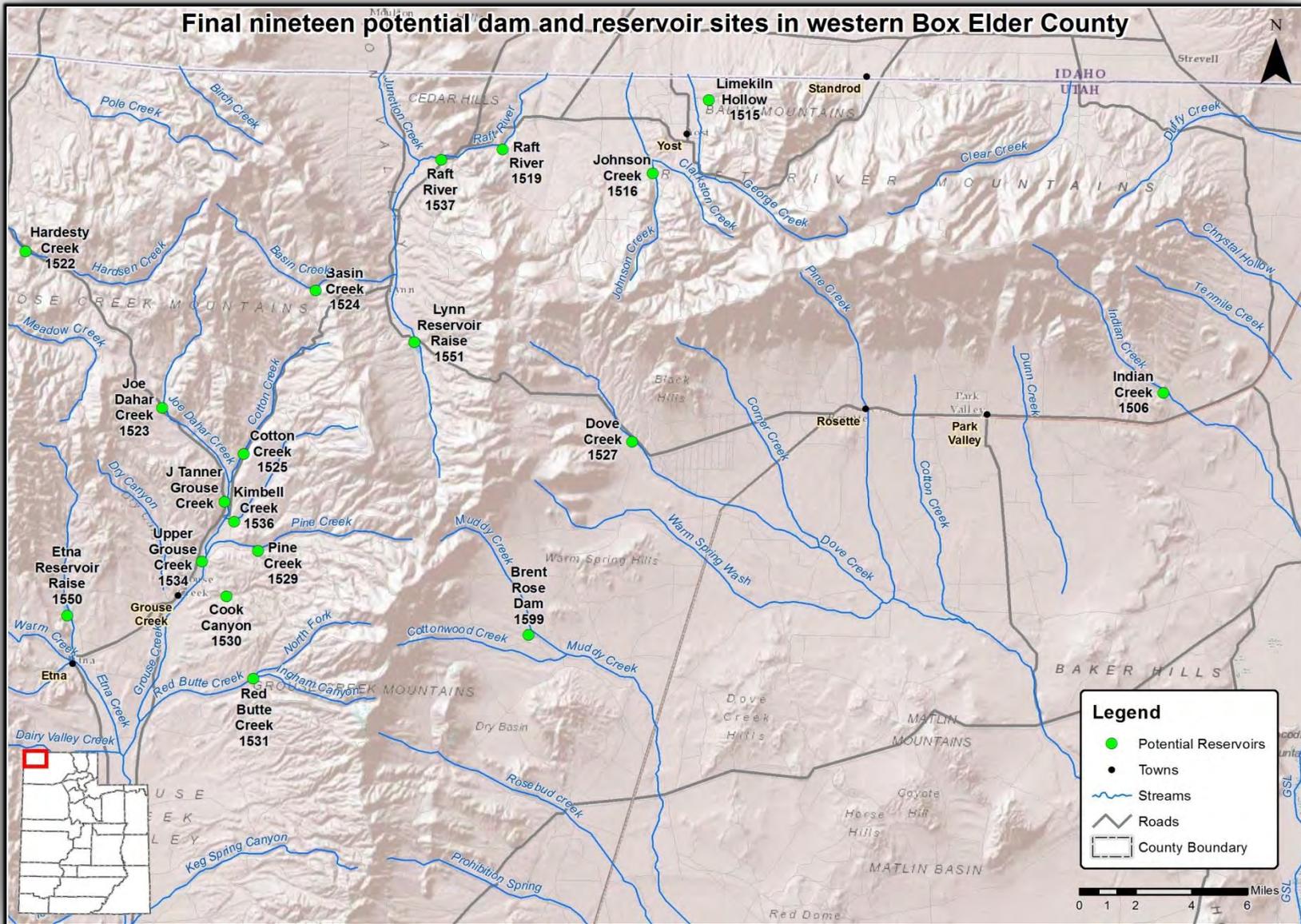
Phase 3 - Screening Process

SIXTEEN SITES WERE ELIMINATED...

Eliminated Dam Site	Reason for Elimination
#1501 Pine Creek	The ratio of embankment volume compared to reservoir storage that is excessively high for a dam at this site and leads to an unreasonable cost per acre-foot.
#1502 Fisher Creek	The ratio of embankment volume compared to reservoir storage is extremely high and portends to an excessive cost per acre-foot
#1503 Dunn Creek	The ratio of embankment volume compared to reservoir storage that is excessively high for a dam at this site and points to an exorbitant cost per acre-foot.
#1507 Indian Creek	The ratio of embankment volume compared to reservoir storage that is excessively high and portends an unreasonable cost per acre-foot.
#1508 Jim Canyon	The ratio of embankment volume compared to reservoir storage that is extremely high and portends to an excessive cost per acre-foot.
#1509 Rice Canyon	The ratio of embankment volume compared to reservoir storage that is extremely high and portends to an excessive cost per acre-foot.
#1510 Clear Creek	The site consists of an active landslide where the right abutment of the dam would be located and the ratio of embankment volume compared to reservoir storage that is extremely high and portends to an excessive cost per acre-foot.
#1511 Water Canyon	The ratio of embankment volume compared to reservoir storage that is extremely high and portends an unreasonable cost per acre-foot.
#1512 Onemile Creek	The ratio of embankment volume compared to reservoir storage that is excessively high and points to an unreasonable cost per acre-foot.
#1513 George Creek	Located on land administered by the U.S. Forest Service and has a ratio of embankment volume compared to reservoir storage that is excessively high and portends an unreasonable cost per acre-foot.
#1514 Lower George Creek	The ratio of embankment volume compared to reservoir storage that is excessively high and portends an unreasonable cost per acre-foot.
#1517 Wildcat Creek	The ratio of embankment volume compared to reservoir storage that is extremely high and portends an unreasonable cost per acre-foot.
#1518 Wildcat Creek	Located on a drainage that has very little water supply and was dry at our time of visit. Also, the ratio of embankment volume compared to reservoir storage is high and portends an unreasonable cost per acre-foot.
#1520 Junction Creek	Located along the Utah-Idaho border. The reservoir basin would extend into Idaho and would not benefit ranchers living in Utah.
#1521 Pole Creek	Located in a remote location that would not benefit ranchers living in Utah. Also, the ratio of embankment volume compared to reservoir storage is high and points to an excessive cost per acre-foot.
#1526 - South Fork Junction Creek	The site consists of an active landslide where the left abutment of the dam would be located.



Final nineteen potential dam and reservoir sites in western Box Elder County



Raft River & Grouse Creek Potential Reservoir Site Study

19 Final Preferred Sites

Site Number & Name	Embankment Volume (cy)	Reservoir Storage (acft)	Emb. Volume (cy) / Res. Storage (acft)	Land Ownership At Damsite	Land Ownership Of Reservoir Basin
1537 Raft River	252,979	24,530	10	Private	Private
1551 Lynn Reservoir Raise	146,916	2,712	54	Private	Private
J Tanner Grouse Creek	1,973,163	28,373	69	Private	Private
1519 Raft River	558,407	6,949	80	Private and BLM	BLM
1550 Etna Reservoir Raise	174,013	1,901	92	Private	Private
1524 Basin Creek	189,387	1,949	97	Private	Private
1534 Upper Grouse Creek	524,977	5,081	103	Private	Private
1525 Cotton Creek	303,430	2,393	127	Private	Private
1536 Kimbell Creek	219,752	1,692	130	Private	Private
1522 Hardesty Creek	306,453	2,199	139	Private	Private
1523 Joe Dahar Creek	60,202	408	148	Private	Private
1529 Pine Creek	420,645	2,341	180	Private	Private
1506 Indian Creek	271,227	1,278	212	Private	Private
1516 Johnson Creek	127,033	589	206	Private	Private
1527 Dove Creek	176,400	763	231	Private	Private
1599 Brent Rose Dam	149,921	602	249	Private	Private
1515 Limekiln Hollow	158,657	571	278	Private	Private
1530 Cook Canyon	340,867	1,215	281	Private	Private
1531 Red Butte Creek	371,811	1,244	299	Private	Private

Dam sites in black – these sites were not downsized

Dam sites in red – these sites were downsized due to economics.

Dam site in blue – this site was downsized to accommodate existing water supply and due to economics

Dam site in green – this site was downsized to accommodate existing water supply.



Phase 4 – EVALUATING AVAILABLE WATER SUPPLY, DOWNSIZING, AND CURSORY COST ESTIMATION

(1) WATER SUPPLY

- On-stream sites – amount of water in stream is evaluated from stream flow data or modeling.
- Off-stream sites – average yield of water in tributary is determined and feasibility of diverting water is evaluated.

(2) DOWNSIZING

- Only two sites were downsized (Cook Canyon 1530 and Upper Grouse Creek 1534) due to water availability.
- Many of the other sites were downsized entirely due to an economics standpoint (when initially evaluated projected cost were extremely high).

(3) CURSORY COST ESTIMATION

- **Over 14 different Items are evaluated:** Mobilization, access, clearing and grubbing, care and diversion, spillway, outlet, road alignment, power line relocation, diversion canal, and diversion structure.
- Based on as assumed simplified dam configuration and design which is uniformly applied to the nineteen sites.



Raft River Narrows



Phase 5 – Cost Per Acre Foot and Final Site Ranking

The Numbers.....

Table 5 - Dams Ranked based on Cost per Acft

Ranking No.	SiteName	Dam		Storage	Embankment Volume	Emb(cy)/	Off Stream	Cost	Cost/Acft
		Height (ft)	Length (ft)	(acft)	Dam (cy)	Storage(acft)	Diversion	(\$M)	(\$K/acft)
1	1537 Raft River	60'	780'	24,530	253,000	10	No	14.3	0.6
2	J Tanner Grouse Creek	118'	2130'	28,400	1,973,160	69	No	52.2	1.8
3	1534 Upper Grouse Creek	65'	2160'	5,100	525,000	103	No	18.6	3.7
4	1519 Raft River	96'	1032'	6,949	558,407	80	No	29.0	4.2
5	1551 Lynn Reservoir 27' raise	74'	1840'	2,712	146,916	54	No	11.4	4.2
6	1522 Hardesty Creek	104'	512'	2,199	306,453	139	No	9.4	4.3
7	1525 Cotton Creek	73'	920'	2,400	303,400	127	No	11.2	4.7
8	1524 Basin Creek	53'	710'	1,940	189,400	97	No	9.8	5.0
9	1550 Etna Reservoir 26' raise	81'	1770'	1,901	174,000	92	No	11.3	5.9
10	1536 Kimbell Creek	53'	1535'	1,692	220,000	130	No	10.1	6.0
11	1529 Pine Creek	74'	1270'	2,341	420,700	180	No	14.9	6.4
12	1506 Indian Creek	89'	559'	1,278	271,227	212	No	9.5	7.3
13	1527 Dove Creek	47'	1340'	763	176,400	231	No	8.9	8.2
14	1516 Johnson Creek	53'	640'	590	121,000	206	No	5.7	9.6
15	1530 Cook Canyon	70'	1200'	1,215	340,900	281	No	12.6	10.4
16	1515 Limekiln Hollow	39'	860'	570	158,700	278	No	6.5	11.3
17	1531 Red Butte Creek	80'	1400'	1,244	371,800	299	No	14.2	11.4
18	1523 Joe Dahar Creek	44'	480'	410	60,200	148	No	4.8	11.8
19	1599 Brent Rose Dam	50'	1240'	600	150,000	249	No	8.1	13.5
	Comparison - M & S Dam	85'	1450'	2,600	1,244,550	478.7	Yes	11	4.2
	Comparison - Jackson Flat	45'	4450'	4,228	831,290	197.9	Yes	6.7	1.6

Yellow Current dams have been raised to increase reservoir capacity. Numbers are very rough due to low level of accuracy of the elevation used. For greater level of accuracy in estimating volumes, high accuracy elevation data must be acquired.

Orange Location that may require construction of a reservoir blanket due to site being founded on alluvial fan sediments.



SURFACE WATER STORAGE OPTIONS

In Conclusion...

- **Very few favorable dam sites exist in this region of Utah due to a variety of factors such as **geology, location, water availability, etc.****
- **Of the favorable dam site locations, none of the sites appear to be financially feasible without the aid of state or federal funding**
- **Even the potential raises at Etna and Lynn are estimated to cost over eleven million dollars each.**
- **Small ponds or small reservoirs appear to be the most economic means of storing water in this portion of northwestern Utah.**



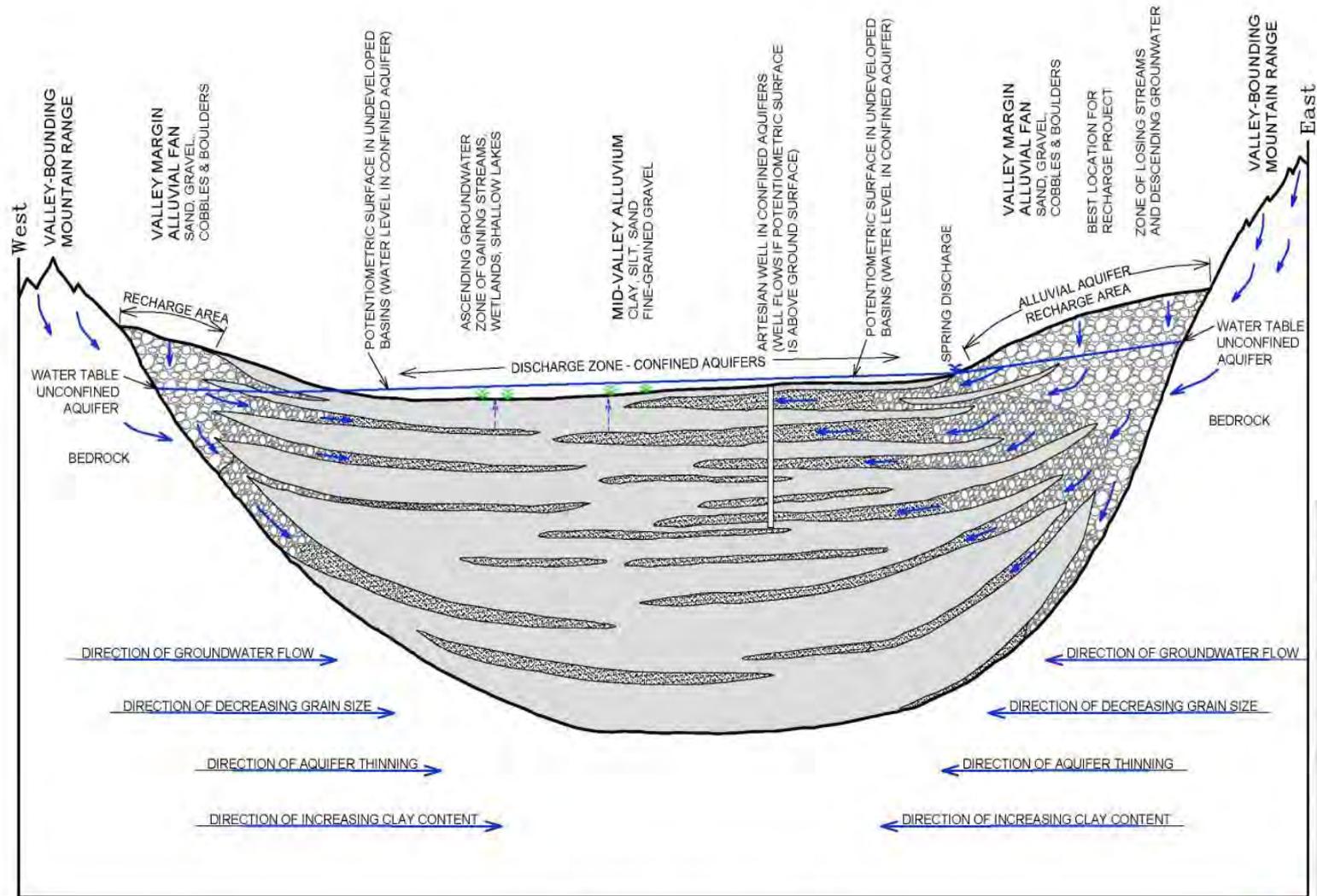
Lynn Reservoir

**Preliminary Assessment of the Potential
For Enhancing Aquifer Recharge
In Select Areas
Western Box Elder County, Utah**



**State of Utah
Division of Water Resources
2013**

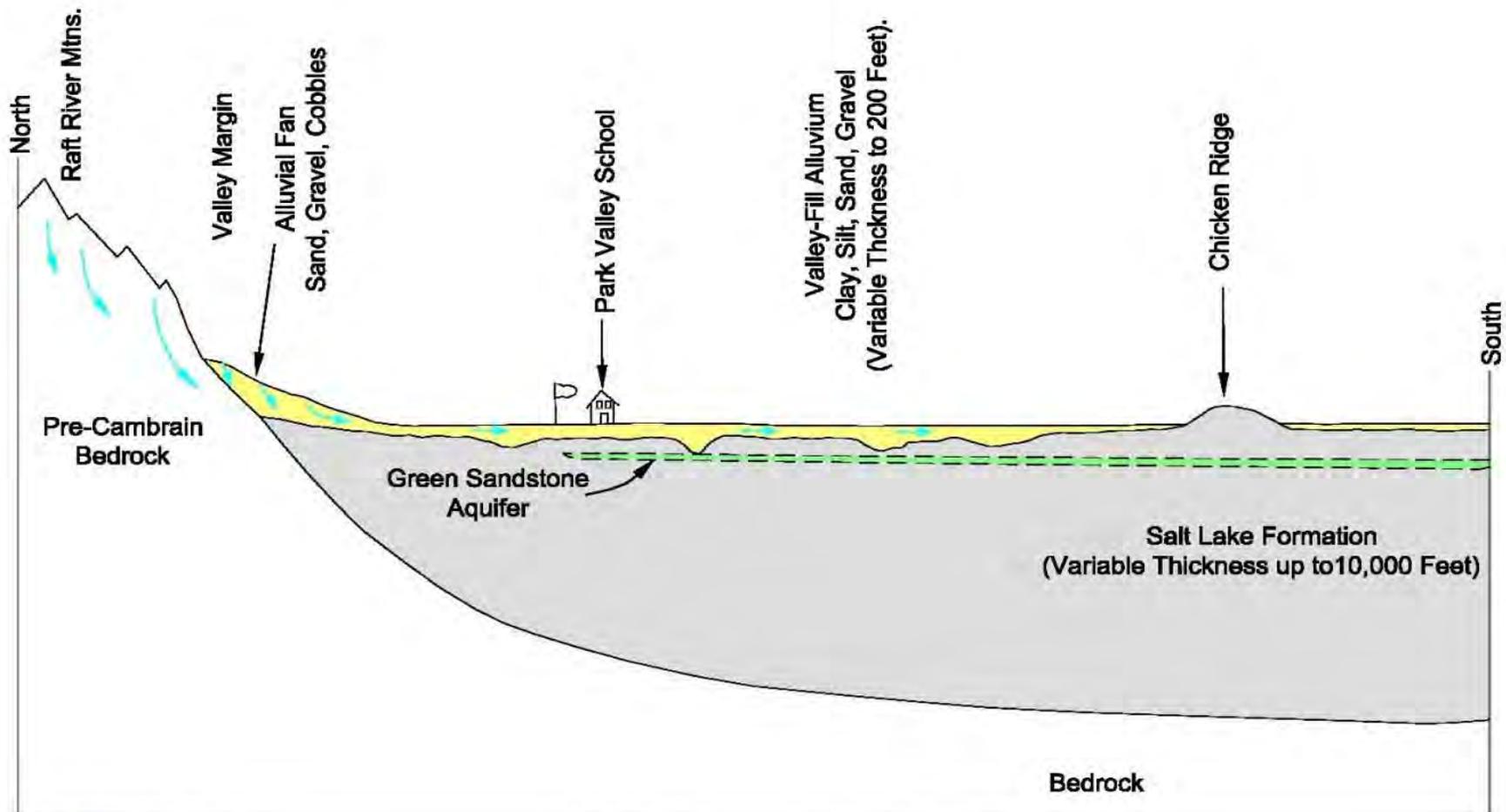




-  GRAVEL AND COBBLES
-  SAND AND GRAVEL
-  CLAY AND SILT
-  GROUNDWATER MOVEMENT

GENERALIZED GEOLOGIC CROSS-SECTION
 HYDROGEOLOGIC SETTING
 NOT TO SCALE





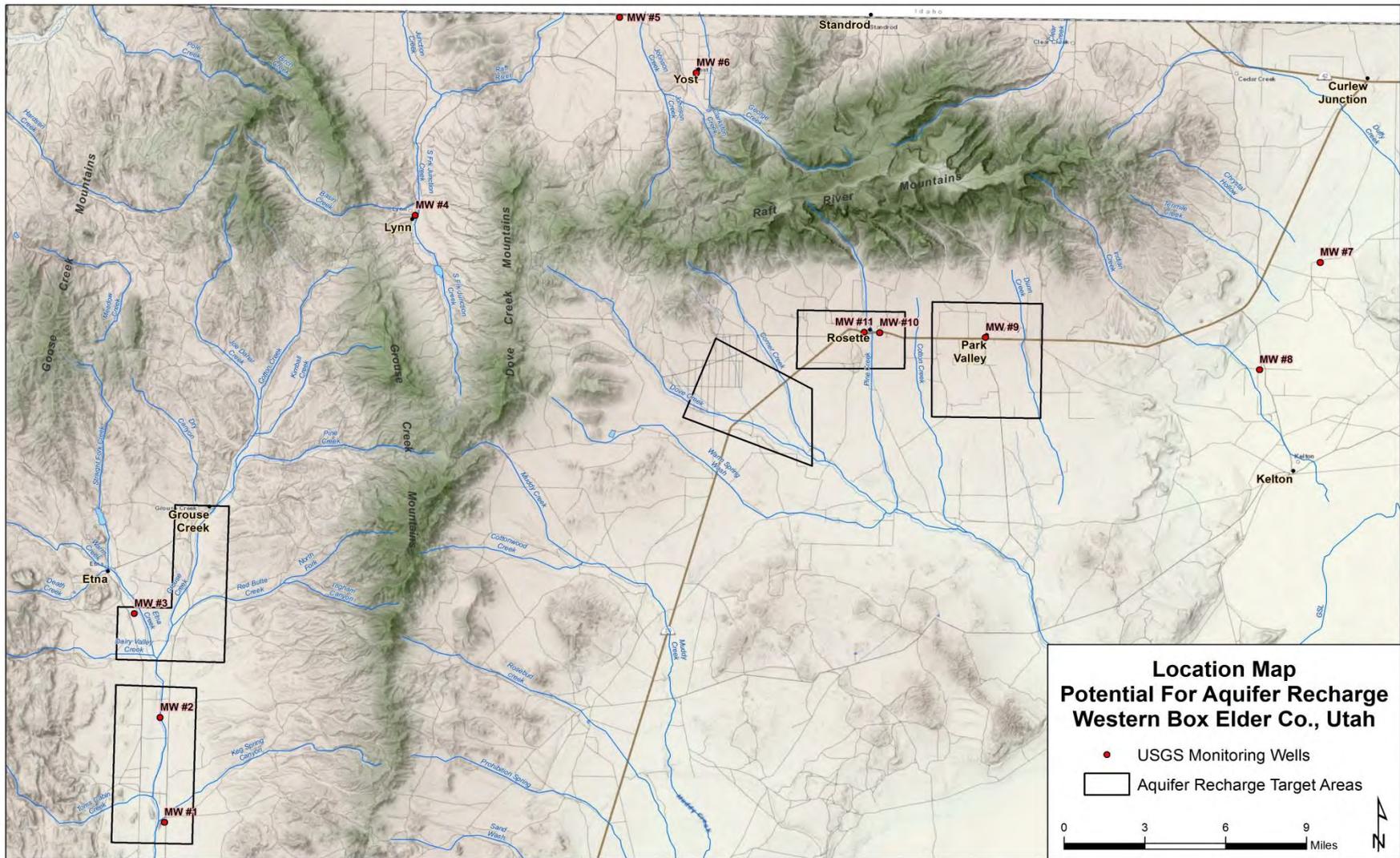
-  **Alluvium**
Unconsolidated
Valley - Fill
-  **Salt Lake Formation**
Green Sandstone
-  **Groundwater Movement**

**GENERALIZED GEOLOGIC CROSS-SECTION
HYDROGEOLOGIC SETTING
WESTERN BOX ELDER CO,
NOT TO SCALE**

LOOKING EASTERLY



Assessment of the Potential for Enhancing Aquifer Recharge



Aquifer Recharge Applicability

Conditions Conducive to Artificial Recharge	Conditions in Western Box Elder County
1. Large or rapidly growing population	Stable to declining population
2. Expanding agriculture and industry	Is stable to fluctuating
3. Limited surface water resource	Fulley utilizes supply, must pump to supplement
4. Strong reliance/dependence on groundwater	Yes-without groundwater agriculture is impacted
5. Aquifer thickness of 100's to 1000's of feet	Aquifers are thin 10's to ~100 feet
6. Aquifers have large aerial extent	Aquifers are moderately extensive
7. Aquifers have good to excellent porosity	Aquifers have moderate to good porosity
8. Aquifers are experiencing overdraft conditions	Not a current condition in most areas
9. Aquifers show steady declines in water levels	Only in very limited areas
10. Water levels/pressures do not recover annually	Most do recover annually
11. Aquifers have plenty of unsaturated capacity	No-unsaturated capacity is limited
12. Aquifers are capable of large sustained yields	Aquifer properties limit large sustained yields
13. Aquifers produce good quality groundwater	Generally groundwater is good to excellent in quality

- From the information in this table, it appears unlikely that current groundwater conditions in most of western Box Elder County would benefit from the implementation of aquifer recharge technology



Water Funding Boards

- **Division of Drinking Water**
http://www.drinkingwater.utah.gov/loan_program_intro.htm
- **Division of Water Quality**
<http://www.waterquality.utah.gov/FinAst/index.htm>
- **Permanent Community Impact (CIB)**
<http://jobs.utah.gov/housing/cib/cib.html>
- **Division of Water Resources**
<http://www.water.utah.gov/Construction/Applicatn.asp>



Etna Reservoir



UTAH
DNR

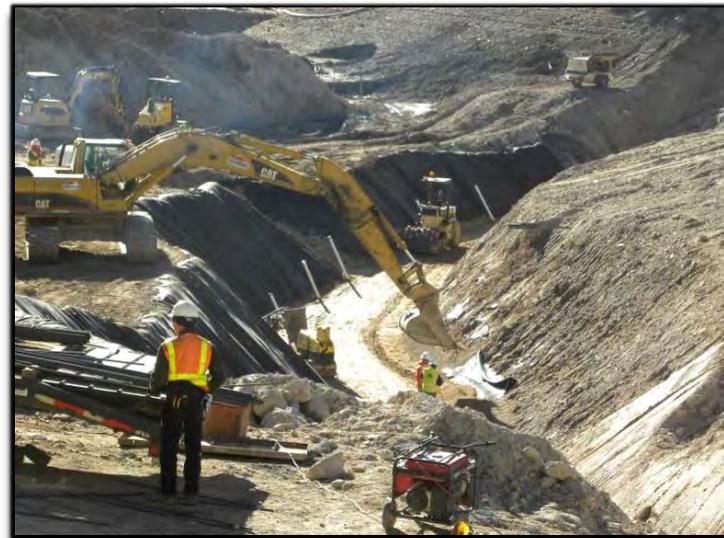
WATER RESOURCES

The Board and Division of Water Resources

- Provides technical and financial assistance to public and private entities to develop, upgrade, or repair municipal, agricultural and industrial water systems.
- During the past 55 years, the division and the board have been involved in the planning, design, and construction of nearly 1,200 water projects.
- There are three funding programs: The Revolving Construction Fund, Conservation and Development Fund, and Cities Water Loan.



Fairview Lakes, Wasatch Plateau, Emery Co., Utah



Manderfield Reservoir, Tushar Mountains, Beaver Co., Utah

Summary of Board Water Resources Funding Programs

Revolving Construction Fund

- Types of Sponsors:** Irrigation companies, water companies, or private corporations owning clear title to a water right.
- Types of Projects:** Irrigation projects less than \$500,000; rural culinary projects less than \$500,000 involving mutual irrigation companies and water companies.
- Interest Rate:** 0%
- Minimum Sponsor Cost Sharing:** 15-25%
- Repayment Period:** 10-25 years

Conservation & Development Fund

- Types of Sponsors:** Private corporations, political subdivisions of the state (metropolitan water districts, special improvement districts, special service districts, water conservancy districts, water improvement districts, Incorporated cities and towns), another state, Federal Government, or Indian tribes.
- Types of Projects:** Irrigation projects, municipal culinary projects, municipal irrigation (secondary water systems, flood control projects, multipurpose dams).
- Interest Rates:** 1 to 7% depending on applicant's ability to pay, benefits derived from project, income level of area, etc. For planning purposes assume:
- 1% for irrigation projects
 - 3% for municipal culinary & irrigation
 - 7% for industrial water projects

For more information: www.water.utah.gov or Val Anderson, 801-538-7292



Division of Water Resources

The following is needed to get started:

- *Project plans designed by a Professional Engineer (PE)*
- *Cost estimate of project (construction and engineering)*
- *Approval from Board member on application: Charles Holmgren*

Contact Information:

Charles Holmgren

P.O. Box 187

Bear River City, Utah 84301

Phone: (435)-279-3303

cwhom@frontiernet.net

