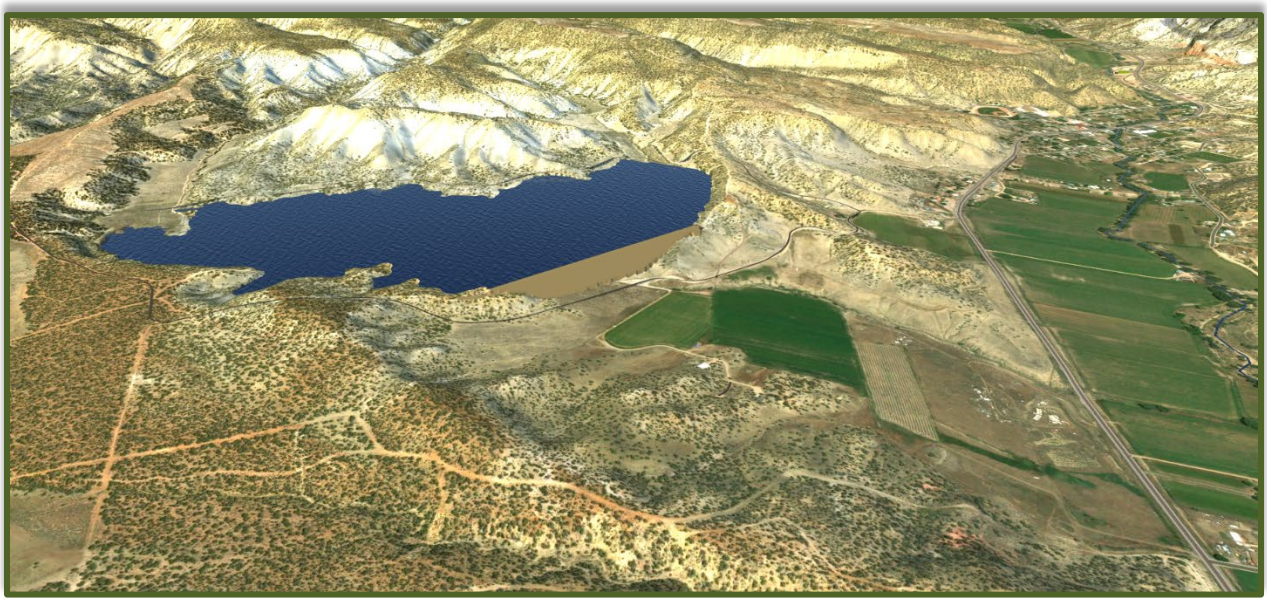
Kane County
Water Conservancy District



Submitted to
Natural Resources
Conservation Service
125 South State Street, Room 4010
Salt Lake City, Utah 84138

Submitted by
Kane County Water
Conservancy District
725 E Kaneplex Drive
Kanab, Utah 84741

Updated July 2024

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Part I. Introduction

A. Background

The Kane County Water Conservancy District (KCWCD) is proposing to construct a reservoir with associated facilities on property owned by the KCWCD as well as additional private land located near Orderville, Utah. Material borrow areas for construction of the dam are located on Bureau of Land Management (BLM) lands and private land. The dam is situated 0.6 miles from Highway 89 southwest of downtown Orderville (see **Figure 1**). As proposed, the reservoir would be constructed by the KCWCD. The Washington County Water Conservancy District (WCWCD) may participate in funding a portion of the water storage created by the project. The WCWCD participation would provide for: 1) storage of their water rights at higher elevation to reduce evaporation rates; 2) water releases during periods of low stream flows to augment peak summer uses and provide in stream flows for native and threatened and endangered fish species; and 3) more efficient use of the Quail Lake and Sand Hollow pipeline delivery system by releasing water when there is excess capacity in the pipeline system. This site was identified in the mid- to late-1980s during a reconnaissance level inventory of potential dam sites associated with tributaries of the Virgin River. Starting in 1996, the KCWCD and WCWCD have further explored constructing a dam at this location.

A feasibility study of the dam was performed in 2004 by RB&G Engineering. There were five borings along the dam alignment and 13 test pits completed during the investigation. The report concluded that the site is suitable for a dam and reservoir, there are available materials within a five- to 20-mile radius and the reservoir would be cost effective to construct.

The project will serve current water right holders and store water from the East Fork of the Virgin River during months with high river flow and then provide water during months with high demand. The components of the project include (see **Figure 2a** and **Figure 2b**):

- Reservoir
- Dam
- Low Level Outlet
- Principal Spillway
- Auxiliary Spillway
- Pipeline
- Pump Station
- Access Road
- Borrow Areas
- Recreation Area

The dam will be designed to maximize storage capacity with principal/auxiliary spillways to sustain the improvements during storm events. At full capacity, the reservoir would have a surface elevation of approximately 5545.5 feet above mean sea level (amsl) and a capacity of approximately 6,055 acre-feet. Rock, gravel, and clay borrow sources from nearby pits will be utilized to construct the facility. Approximately 3.2 miles of new and existing roads will be constructed and/or improved to provide access around the reservoir and replace access to properties surrounding the reservoir. Approximately 1.2 miles of existing roadway will be graded and improved from its current width of approximately 12 to 16 feet and improved with road base to a width of 28 feet. Approximately 2.0 miles of new roadway will be constructed to a width of 28 feet of road base.

Approximately 700 feet of large diameter pipe is required to extend from the existing irrigation transmission line, near the reservoir, to the outlet works of the reservoir. This extension will allow the use of the existing diversion dam and transmission line to fill the reservoir and allow use of the stored water during the irrigation season. This extension will also serve as the emergency drain for the reservoir. It is also proposed to replace approximately 1.7 miles of existing 4-inch to 8-inch lines in the Glendale irrigation system with a larger transmission line from the current hydro plant location to a new location next to the Orderville Diversion Dam. Excess water from the Glendale Irrigation System will then be combined with water diverted from the Orderville Diversion Dam to provide use of the existing irrigation pipeline system to fill the Cove Reservoir.

The existing Glendale and Orderville irrigation systems have limited capacity to deliver flows from the river and no capacity for storage during non-use and high flow periods. The Orderville Hydro Plant currently uses excess head available from the piping system and will continue to be used after the construction of the Cove Reservoir. Currently the hydro plant generates power during the winter months. With the construction of the Cove Reservoir, water will be stored during the winter and released during the irrigation season as water is needed for irrigation and to generate power during the summer. The construction of the proposed Cove Reservoir with its associated facilities provide a drought buffer, improve water quality, increase and maintain a more consistent reliable flow for the pressurized irrigation system, provide a water-energy nexus, and provide for more efficient irrigation methods. This will allow the KCWCD to take advantage of existing water rights and provide a more stable and sustainable supply of water for the area. Water storage at higher elevations also reduces evaporation losses that occur in lower reservoirs operated by the WCWCD. In addition, water can be released from the reservoir to provide for in-stream flows during periods of low flow in the Virgin River for endangered fish species.

Since the original concept of the Cove Reservoir and piping of a portion of the Glendale Irrigation Company piping the Mt. Carmel Irrigation Company has approached the KCWCD to pressurize the remainder of their irrigation system. There is approximately 24,000 feet of pipeline varying

in size from 8 to 16 inches in diameter and a booster pump station required to provide pressurized irrigation for the irrigation company.

This Plan of Development (POD) includes descriptions of and guidelines for the design, construction, operation, maintenance, and reclamation of the Project. The KCWCD and WCWCD would construct and operate the project in conformity with the approved POD.

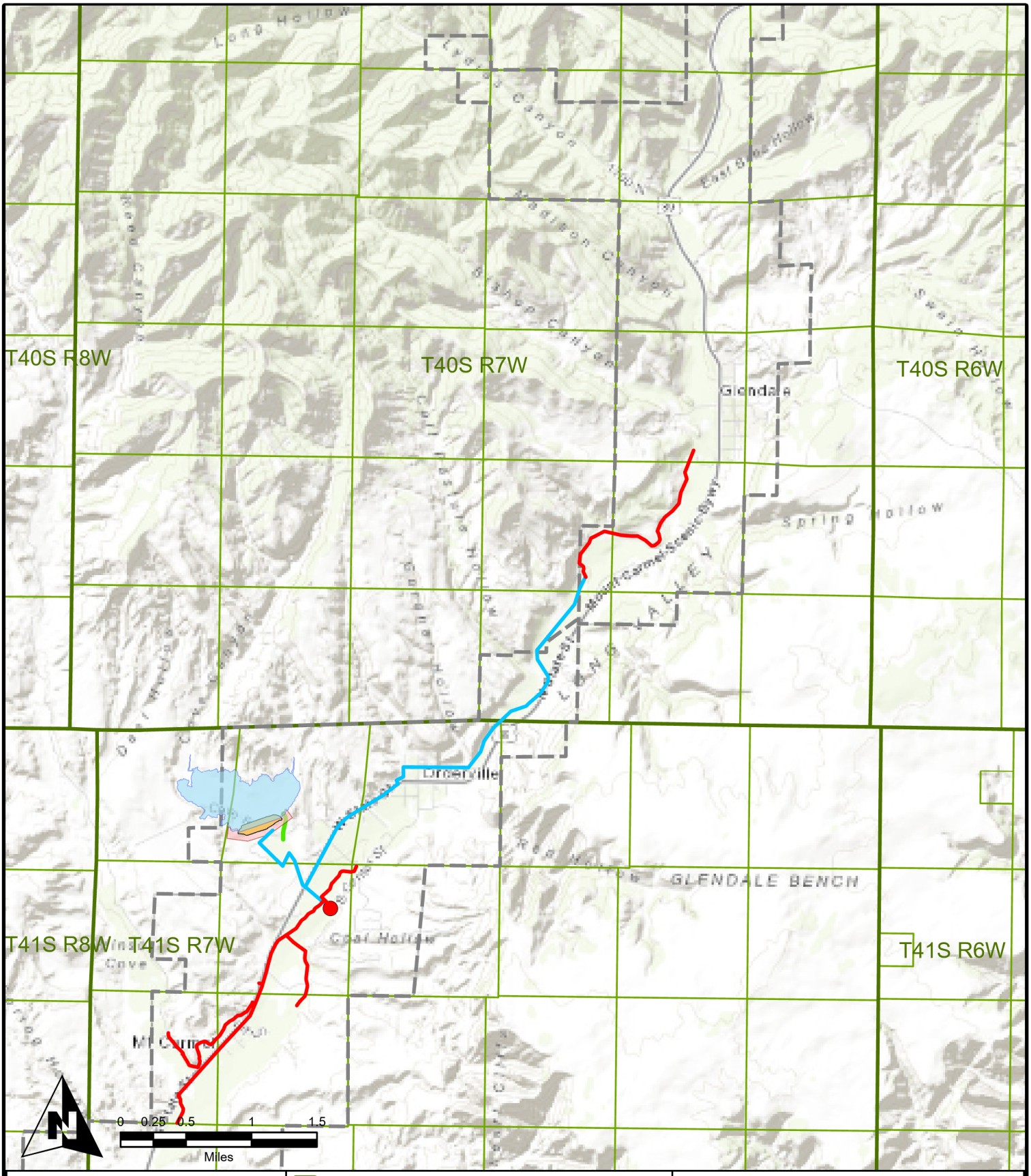
B. Diversion & Water Rights

The proposed system will store water from the Glendale Irrigation Company, the Orderville Irrigation Company and the Mt. Carmel Irrigation Company. Water rights held by the respective irrigation companies include points of diversion from the East Fork Virgin River.

A portion of the water rights owned by the three irrigation companies that could be stored in the proposed reservoir are summarized in **Table 1.** Additional water rights will be provided by the WCWCD.

User	Flow	Volume	Acreage
Glendale Irrigation Company	7.23 cfs	2,170 ac-ft	434
Orderville Irrigation Company	4.684 cfs	1,430 ac-ft	286
Mt. Carmel Irrigation Company	6.58 cfs	2,020 ac-ft	404
Total	**18.494 cfs**	**5,620 ac-ft**	**1,124**

Table 1 Water Rights Summary



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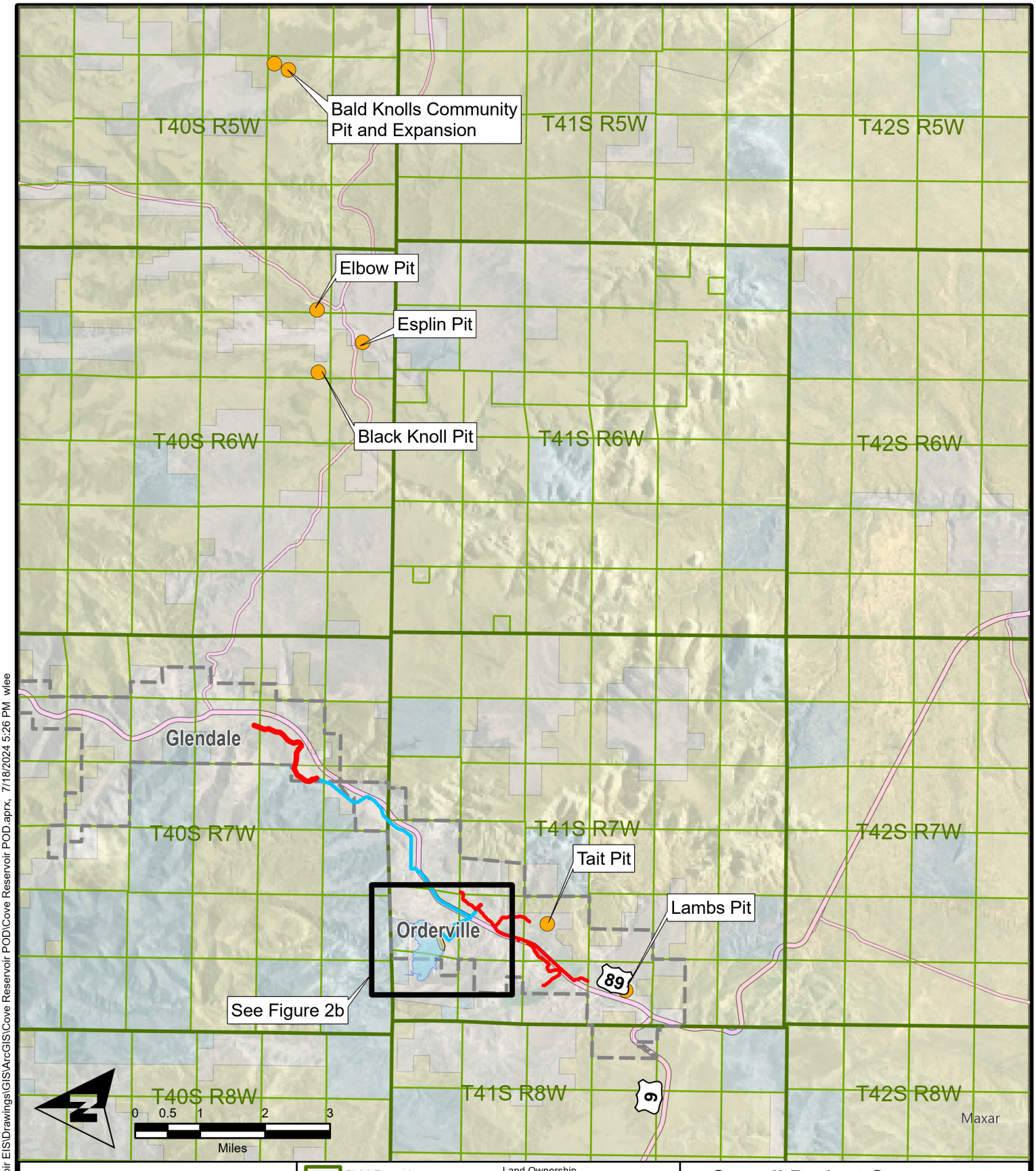
RB&G ENGINEERING, INC.

- PLSS Townships
- PLSS Sections
- Municipalities
- Cove Reservoir
- Existing Transmission Pipeline
- New 8" to 16" Diameter Pipes
- Existing Hydroplant & Proposed Pump Station

Project Location

Figure 1 - Cove Reservoir POD

Spatial Reference:	UT83-SF
Drawn By:	JTM
Scale:	1:63,360
Date:	July 18, 2024



ALPHA ENGINEERING

RB&G ENGINEERING, INC.

PLSS Townships
PLSS Sections
Municipalities
Roads
Cove Reservoir
Existing Transmission Pipeline
New Transmission Line
Borrow Areas

Land Ownership
Federal
Private
State
Tribal

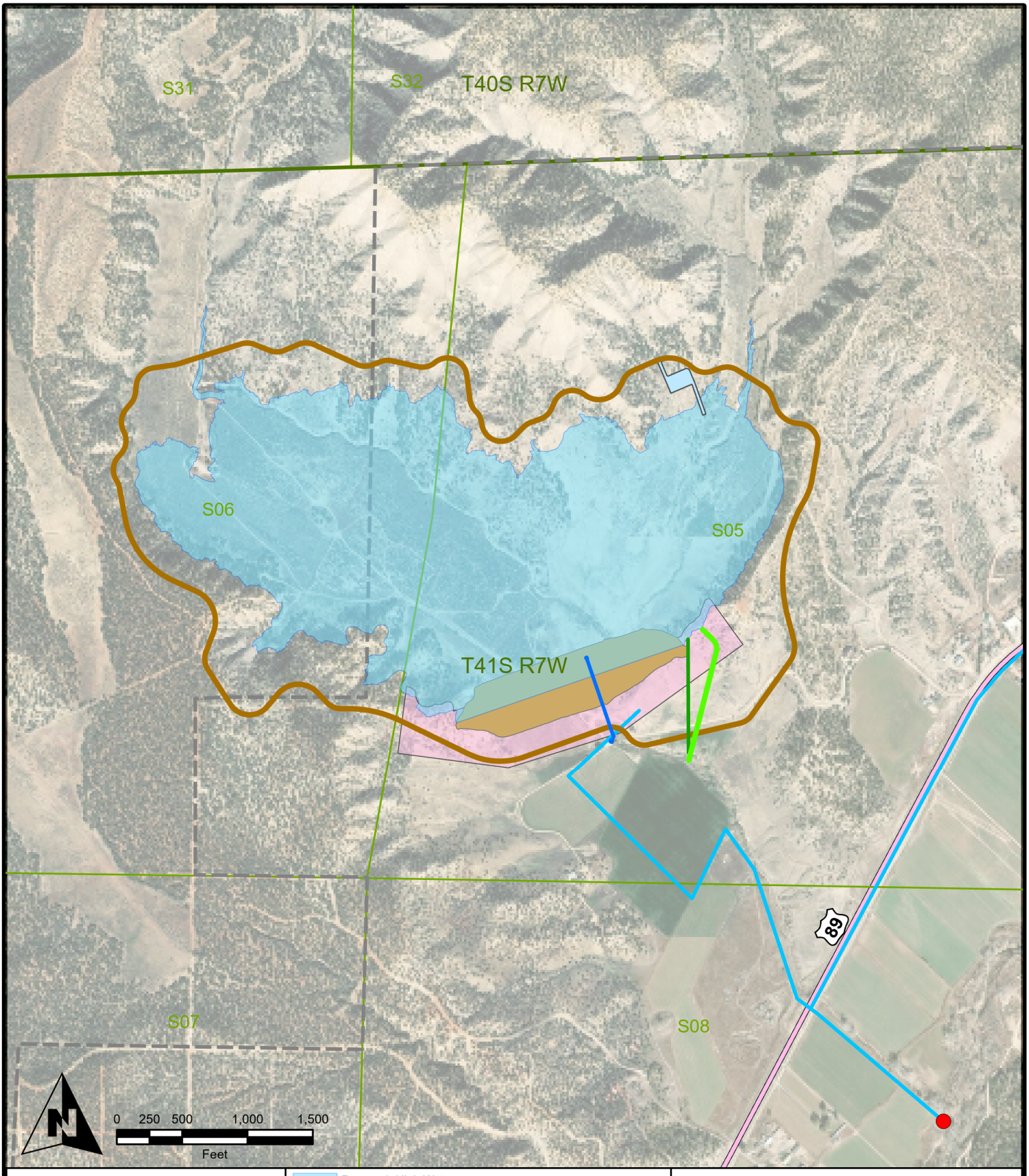
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Overall Project Components

Figure 2a - Cove Reservoir POD

Spatial Reference:	UT83-SF
Drawn By:	JTM
Scale:	1:126,720
Date:	July 18, 2024

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ALPHA ENGINEERING

RB&G ENGINEERING, INC.

- Reservoir High Water
- Dam Structure
- Principal Spillway
- Auxiliary Spillway
- Outlet Works
- Access Road
- Highway 89
- Existing Hydroplant & Proposed Pump Station
- Existing Pipeline
- Contingency Disturbance Area

Reservoir Project Components

Figure 2b - Cove Reservoir POD

Spatial Reference:	UT83-SF
Drawn By:	JTM
Scale:	1:12,000
Date:	July 18, 2024

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Part II. Purpose and Need for Facility

The primary purpose of the project is to serve the current water users by providing for enhanced conservation and beneficial use of water. This purpose would be achieved by increasing water availability through collecting and storing water during non-use periods and providing flows during the irrigation season. As mentioned, the existing irrigation facilities have limited capabilities to divert water from the East Fork Virgin River and store water during high flows. This project creates a drought buffer for sustained time periods of low flows in the East Fork Virgin River. The water storage can also provide recreation opportunities for the area including fishing, camping, and small watercraft. In addition, flows from the reservoir may be released during drought conditions to provide additional instream flows in the Virgin River to help decrease high water temperatures that affect certain threatened and endangered species.

Secondary to water conservation, there are other purposes for the reservoir. The existing Orderville Hydro Plant will also maintain a more consistent output with the creation of the reservoir to allow generation with releases from the reservoir which otherwise may not be available during drought conditions. The reservoir allows for storage of water at higher elevations, which reduces evaporation rates. The reservoir improves water conditions for water users as water quality is a concern in the area due to periodic high sediment loads from the upstream basin. Finally, the water surface elevation will provide pressure head that will increase and maintain pressures throughout the irrigation system. With improved water quality and pressure, more efficient irrigation methods are enabled for the system users.

Part III. Project Description and Land Ownership

A. Project Description and Land Ownership

The proposed reservoir and pipelines would be located on private lands. Permanent facilities would consist of a 190-acre reservoir, principal and auxiliary spillways, an access road, recreation facilities and pipelines. **Table 3** depicts the length, width and acreage for each of the facility components with permanent and temporary disturbance, including a final right-of-way required for each facility. The project layout with land ownership is shown on **Figure 2a**.

B. Right of Way

A 560-acre area would is potentially required for construction of the reservoir and dam, shown as the Contingency Disturbed Area in **Figure 1**. The temporary disturbance, permanent disturbance and right-of-ways for each component of the project are listed below.

- The reservoir area is comprised of the maximum water surface area, the dam and the low level outlet. A buffer area has been approximated to allow for instrumentation, which is also included in the reservoir area. Finally, portions of the spillways and recreation area are included in the reservoir area. The reservoir area requires 235 acres of temporary disturbance, permanent disturbance and right-of-way.
- The principal spillway is 870 lineal feet in length. 385 lineal feet of the spillway is accounted for within the reservoir disturbance and right-of-way. The principal spillway requires 100 feet of temporary disturbance and 14 feet of permanent disturbance (road) with a 50-foot right-of-way.
- The auxiliary spillway is 1,070 lineal feet in length. 355 lineal feet of the spillway is accounted for within the reservoir disturbance and right-of-way. The auxiliary spillway requires 100 feet of temporary disturbance and 30 feet of permanent disturbance (channel) with a 30-foot right-of-way.
- The Glendale Irrigation Company pipeline is 8,980 lineal feet in length and requires 50 feet of temporary disturbance but would not create permanent disturbance or require additional right-of-way as it will be located within an existing roadway. The Mt. Carmel Irrigation Company Pipeline is approximately 24,000 feet in length and requires 50 feet of temporary disturbance but would not create permanent disturbance or require additional right-of-way as it will be located within existing roadways, open canals, or through existing fields.

- The access road around the reservoir is 16,900 lineal feet in length. It will be located within existing roads where possible. Approximately 6,200 lineal feet of road will be located within existing dirt roads without a dedicated right-of-way and 10,700 lineal feet of road will be new roadway. The access road requires 100 feet for construction disturbance and 36 feet of permanent disturbance (road) with a 50-foot right-of-way.
- There are a total of six borrow areas being considered for the project. Two borrow areas (Lamb Pit and Tait Pit) are located on private property within existing pits and will require additional permanent disturbance and right-of-way of approximately 0.5 acres for Lamb Pit and 0.7 acres for Tait Pit. One of these pits will be selected for the project so there will be a maximum disturbance of 0.7 acres. Black Knoll Pit is located on BLM-administered property in an undisturbed area and will potentially require up to 5.0 acres of permanent disturbance and right-of-way. Elbow Pit is located on BLM-administered property within an existing pit and will not require additional permanent disturbance and right-of-way. The fifth site (Bald Knolls Pit) is located on BLM-administered property within an existing pit that will be required to be expanded with this project to include an additional 5.0 acres of permanent disturbance and right-of-way. Either the Bald Knoll or the Black Knoll Pit will be used so the maximum disturbance will be 5.0 acres. The sixth pit has been recently added to the project and is on private property and will require additional permanent disturbance of and right-of-way of approximately 5 acres but would eliminate the need from borrowing from the Bald Knoll or Black Knoll Pit.
- The recreation area will require approximately 4.3 acres of area. 0.2 acres of the recreation area is accounted for within the reservoir disturbance and right-of-way. It requires 4.1 acres of temporary disturbance, permanent disturbance and right-of-way.

Table 3 provides disturbance and right-of-way acreages for the project components. The temporary disturbance acreages shown in the table are calculated as the additional area after the permanent disturbance acreages have been calculated. The right-of-way acreages do not take into account any disturbance acreages. In total, the project requires 259.1 acres of permanent disturbance, 64 acres of temporary additional disturbance and 264.5 acres of right-of-way.

Component	Linear ROW (feet)	Permanent Disturbance (acres)			Add'l Temporary Disturbance (acres)			ROW (acres)		
		Private	BLM	Total	Private	BLM	Total	Private	BLM	Total
Reservoir	-	235.0	0.0	**235.0**	0.0	0.0	**0.0**	235.0	0.0	**235.0**
Principal Spillway	385	0.1	0.0	**0.1**	0.8	0.0	**0.8**	0.1	0.0	**0.1**
Auxiliary Spillway	355	0.2	0.0	**0.2**	0.6	0.0	**0.6**	0.2	0.0	**0.2**
Pipeline	32,980	0.0	0.0	**0.0**	37.9	0.0	**37.9**	0.0	0.0	**0.0**
Access Road	16,900	14.0	0.0	**14.0**	24.8	0.0	**24.8**	19.4	0.0	**19.4**
Borrow Areas	-	0.7	5.0	**5.7**	0.0	0.0	**0.0**	0.7	5.0	**5.7**
Recreation Area	-	4.1	0.0	**4.1**	0.0	0.0	**0.0**	4.1	0.0	**4.1**
Total	**50,620**	254.1	5.0	**259.1**	64.0	0.0	**64.0**	259.5	5.0	**264.5**

Table 2 Summary of Surface Disturbance.

C. Government Agencies Involved

The government agencies potentially involved include:

- Kane County Water Conservancy District
- Washington County Water Conservancy District
- Bureau of Land Management
- Utah Division of Wildlife Resources
- Kane County
- Town of Orderville
- Town of Glendale
- US Army Corps of Engineers
- Utah State Division of Water Rights, Dam Safety

Part IV. Facility Construction & Design

A. Schedule

Construction would commence after necessary permits are obtained and all plans are finalized. Construction of the pipelines and reservoir is estimated to take up to 15 months to complete. Construction of the pipelines and reservoir would occur simultaneously. **Table 4** provides an estimated sequence of construction activities:

Reservoir	Other Facilities
Clear & Grub Vegetation	Access Road
Develop Staging Areas	Install Pipelines
Construct Dam Trench	Principal & Auxiliary Spillway
Install Outlet Works	Recreation Area
Construct Dam (Haul Clay, Rock and Filter)	

Table 3 Estimated Sequence of Construction Activities

B. Construction of Facilities

i. Reservoir and Dam

The reservoir would be created by the construction of an earthen and rock fill dam having a central clay core. The length of the dam would be approximately 1,900 feet with a maximum dam height of 90 feet and a crest elevation of 5552 feet amsl.

Staging areas for the construction of the dam would be located within the footprint of the reservoir and will eventually be covered with water. An additional 200- to 300-foot buffer downstream of the dam will be used for instrumentation and additional staging. Construction of the dam would require large earth moving machinery, a portable gravel pit operation, water and multiple personnel.

The initial phase of construction would be to prepare the foundation, which will include excavation of overburden soils to varying degrees to mitigate settlement, excavation of a cutoff trench extending into bedrock, and installation of a grout curtain where conditions warrant, expected as a minimum, to be up both abutments. Borrow sources for the materials to construct the dam are discussed in **Section vi**, and large machinery will make continual trips between the reservoir and borrow sites as the dam is constructed. Operations to separate and produce engineer-specified material to be

used for the dam will occur on-site within the project staging areas. Watering activities will continue throughout the construction of the dam as necessary to allow optimum compaction of the excavated material and maintain air quality.

A concrete encased pipeline will be used as the low level outlet works with a screened intake structure at the upstream end and an energy dissipater structure at the downstream end. The outlet works excavation will extend to bedrock through the embankment footprint, near the left abutment, and will be constructed in conjunction with the dam.

The estimated personnel and equipment required for the construction of the reservoir and dam are shown in **Table 5**.

Task	# of People	Equipment
Construction Engineering	4 - People	3 - Pickup Trucks, 1 - Four-wheeler
Foundation Preparation	9 - People	1 - Bulldozer, 1 - Track hoe, 2 - Scrapers, 2 - Pickup Trucks 1 - Drill, 1- Grout Plant
Dam Embankment	6 - People	1 - Bulldozer, 1 - Compactor, 1 - Grader, 1 - Water Truck
Embankment Borrow	6 - People	1 - Bulldozer, 1 - Track Hoe, 4 - Scrapers
Filter and Drain	3 - People	2 - Dump Trucks, 1 - Compactor
Outlet Works	4 - People	1 - Concrete Truck

Table 4 Estimated Personnel and Equipment for Reservoir and Dam Construction

ii. Principal Spillway

A pipeline will be used as the principal spillway, including an intake screen and structure at the intake and an energy dissipater structure at the outfall. The alignment for the pipeline will be located near the left abutment and will convey flows away from the dam structure. This pipeline has an approximate length of 870 lineal feet.

Pipeline installation activities would include staking, clearing and grubbing, trenching, hauling equipment and materials, pipeline assembly, backfill and access road construction, in this order. Prior to construction, the exact centerline of the pipeline ROW would be staked. The ROW boundaries would also be flagged in some areas (e.g., thick vegetation). Following staking, vegetation within the ROW would be cleared and grubbed to the extent necessary to provide for equipment clearance, construction, and maintenance operations.

The pipeline would be bedded and buried to a minimum depth of four feet to the top of pipe. The trench width and depth would vary depending upon the final design of the pipeline but will be sloped to gravity drain. The trench would generally be two feet wider than the pipe.

In areas where the pipelines would parallel or be within existing roads, the surface would be brought back to an as-good-as or better condition or replaced according to the governing agency's recommended specifications and requirements. The estimated personnel and equipment required for the construction of the principal spillway are shown in **Table 6**.

Task	# of People	Equipment
Survey and Staking	2 - People	1 - Pickup Truck
Trenching	1 - People	1 - Track Hoe
Pipe and Materials Hauling	2 - People	1 - Semi-truck and Flatbed Trailer
Pipeline Assembly & Burying	4 - People	1 - Bulldozer, 3 - Track Hoe, 1 - Dump Truck, 1 - Loader, 2 - Pickup Trucks
New Road Construction	1 - People	1 - Bulldozer

Table 5 Estimated Personnel and Equipment for Principal Spillway Construction

iii. Auxiliary Spillway

The auxiliary spillway will comprise a trapezoidal earthen channel, including a concrete weir structure a few hundred feet west of the left abutment of the dam. The auxiliary spillway will extend into an existing drainage channel west of the dam. Where the grade of the spillway becomes too steep for natural stabilization, additional armoring or riprap will be installed to prevent erosion of the spillway or adjacent grades.

The spillway will be constructed simultaneously with the dam as needed for additional access to the left abutment. This will allow easier access for the construction of the dam. The spillway ROW will be staked and cleared of all vegetation. The estimated personnel and equipment required for the construction of the spillway are shown in **Table 7**.

Task	# of People	Equipment
Survey and Staking	2 - People	1 - Pickup Truck
Concrete Weir Construction	2 - People	1 - Concrete Mixer
Channel Grading	3 - People	1 - Bulldozer, 1 - Track Hoe

Task	# of People	Equipment
Channel Armoring	2 - People	1 - Track Hoe

Table 6 Estimated Personnel and Equipment for Auxiliary Spillway Construction

iv. Pipeline

Additional pipeline is required to meet the project objectives. The additional pipeline will complete the transmission system to and from the reservoir. The pipeline will be located at the south end of the Town of Glendale near the East Fork Virgin River. The pipeline would replace the existing 4 to 8-inch pipelines and be installed adjacent to the existing lines. Additional piping will also be installed to provide pressurized irrigation to areas within the Mt. Carmel area that will vary in size from 8 to 16 inches in diameter.

Appropriate air valves would be installed along the pipeline at approximately 1/2-mile intervals and at major grade changes. In-line valves would be required at all pipeline intersections. Drain-lines or blow-off valves would also be located periodically along the pipeline at low points in the pipeline and would drain to existing channels. The pipeline would also be provided with tracer wire for locating the underground piping. Above-ground fiberglass markers would also be placed at strategic locations to provide public notice of the underground piping to avoid conflicts with future construction.

Pipeline installation activities would include staking, clearing and grubbing, trenching, hauling equipment and materials, pipeline assembly, and backfill, in this order. Prior to construction, the exact centerline of the pipeline ROW would be staked. The ROW boundaries would also be flagged in some areas (e.g., thick vegetation). Following staking, vegetation within the ROW would be cleared and grubbed to the extent necessary to provide for equipment clearance, construction, and maintenance operations.

Where the pipeline parallels existing utilities, care would be taken to protect existing infrastructure and coordination would take place among affected entities. Where the pipeline would be installed under existing asphalt or where it would cross paved roads, asphalt would be replaced according to the governing agency's recommended specifications and requirements.

In areas where the pipelines would parallel or be within existing non-paved roads, the surface would be brought back to an as-good-as or better condition, or replaced according to the governing agency's recommended specifications and requirements. Where there would be air valves or other pipeline appurtenances, construction would follow standard safety guidelines, including distance from roads or installation of barriers.

The pipelines would be bedded and buried to a minimum depth of three feet to the top of pipe and deeper under streambed crossings. The trench width and depth would vary depending upon the size of the pipe being installed. The trench would generally be two feet wider than the pipe. The estimated personnel and equipment required for the construction of the pipeline are shown in **Table 8**.

Task	# of People	Equipment
Survey and Staking	2 - People	1 - Pickup Truck
Trenching	1 - Person	1 - Track Hoe
Pipe and Materials Hauling	2 - People	1 - Semi-truck and Flatbed Trailer
Pipeline Assembly & Burying	4 - People	1 - Bulldozer, 3 - Track Hoe, 1 - Dump Truck, 1 - Loader, 2 - Pickup Trucks
New Road Construction	1 - Person	1 - Bulldozer

Table 7 Estimated Personnel and Equipment for Pipeline Construction

v. Access Road

The access road will be located around the perimeter of the reservoir using existing roads where possible. Approximately 3.2 miles of new and existing roads will be constructed and/or improved to provide access around the reservoir and replace access to properties surrounding the reservoir. Approximately 1.2 miles of existing roadway will be graded and improved from its current width of approximately 12 to 16 feet and improved with road base to a width of 28 feet. Approximately 2.0 miles of new roadway will be constructed to a width of 28 feet of road base. The cross-section of the roadway would be constructed to permit two-way traffic for the construction and access of the dam. Due to the hilly terrain, a minimal section will be used in order to reduce cuts and fills. A borrow ditch and culverts will be installed as needed to allow drainage without damage to the access road. The access road will be covered with a graded and compacted road base material.

The access road will be constructed early in the construction process to allow access for upstream property owners. This will also facilitate construction of the dam. The road ROW and grade slopes will be staked and cleared of all vegetation. Watering equipment will be kept on-site for compaction and to control air quality. The estimated personnel and equipment required for the construction of the access road are shown in **Table 9**.

Task	# of People	Equipment
Survey and Staking	2 - People	1 - Pickup Truck
Rough Grading	2 - People	1 - Track Hoe, 1 – Bulldozer, 1 - Water Truck
Final Road Grading	2 - People	1 – Bulldozer, 1 - Dump Truck

Table 9 Estimated Personnel and Equipment for Access Road Construction

vi. Borrow Areas

Borrow sources would include (1) the Lambs Pit located 0.5 miles north of Mt Carmel Junction off of Highway 89; (2) the Tait Pit located 2.0 miles north of Mt Carmel Junction off of Highway 89; (3) the Black Knoll Pit located 6.0 miles east of the Town of Glendale off of Glendale Bench Road (partial dirt road); (4) the Elbow Pit located 7.1 miles east of the Town of Glendale off of Glendale Bench Road (partial dirt road); and (5) the Bald Knolls Community Pit located 11 miles east of the Town of Glendale off of Glendale Bench Road (partial dirt road) and the Esplin Pit located 5.9 miles east of the Town of Glendale off Glendale Bench Road (partial dirt road). The transportation path to and from the borrow areas will run along existing roadways, including smaller county dirt roads. Additional right-of-ways to access the borrow areas will not be required. The approximate quantities for the dam are provided in **Table 10**.

Type	Quantity
Excavation	644,000 cubic-yards
Earthfill	1,575,000 cubic-yards
Filter/Drain	82,000 cubic-yards
Riprap Bedding	19,000 cubic-yards
Riprap	28,000 cubic-yards
Total	**2,348,000 cubic-yards**

Table 80 Estimated Earthwork Quantities

vii. Recreation Area and Boat Ramp

Initial discussions have identified the area as an overnight and day-use facility equipped with picnic tables, restrooms, campgrounds, a pavilion and a boat ramp for small-engine (trolling motors) boat access. No utilities will be extended to the recreation facilities. A detailed recreation plan would be prepared by a committee that involves all stakeholders. The KCWCD would anticipate contracting with a separate state or local governmental entity to manage the recreation area. A parking area and boat ramp have been identified on Figure 2b. A camp host for overnight camping, who would maintain the facility, is being considered.

C. Resource Value and Environmental Concerns

KCWCD will contract the services of an environmental consultant to complete required resource surveys and to prepare National Environmental Policy Act (NEPA) related documents.

Cultural resources that would be directly or indirectly impacted would be subject to evaluation and determination through Section 106 consultation (under the National Historic Properties Act). Project engineers would work with archaeologists to avoid or minimize impacts to any identified cultural resources. As necessary, specific mitigation measures for biological resources would also be developed as part of the EA, and if necessary, additional surveys and Section 7 consultation (under the Endangered Species Act) would be conducted.

Implementation of the project would comply with all applicable federal and state laws and any local zoning and building ordinances during all phases of the project. Potential impacts to the environment are expected to be minimal as standard Best Management Practices (BMPs) would be followed (**Appendix A**) and the Environmental Protection Measures (EPMs) listed below would be implemented. EPMs would also apply to operation and maintenance of the completed facility. The NRCS is expected to inspect the project both during and after project completion to ensure compliance with EPMs and other requirements.

Air Resources: The generation of fugitive dust from surface activities, including earth moving and hauling and handling of materials, would be controlled by implementing BMPs. When needed, water would be applied during construction to control fugitive dust levels on access roads and construction sites.

Water Resources: BMPs would be used as needed to control storm water discharges. These practices would include material handling and temporary storage procedures that minimize the exposure of potential pollutants to storm water, spill prevention and response, sediment and erosion controls, and physical storm water controls. Site runoff would be controlled and managed in accordance with regulation. A Storm Water Pollution Prevention Plan would be prepared prior to construction and followed during construction.

Hazardous Materials and Wastes: Construction sites, staging areas, and access roads would be kept in an orderly condition throughout construction. Refuse and trash, including stakes and flags, would be removed and disposed. Covered dumpsters located in the Project Area would contain all refuse. Refuse would be removed on a regular basis to an approved disposal facility. No open burning of construction trash would occur. Portable toilets would be used on site, and would be maintained on a regular schedule.

No construction equipment oil or fuel would be drained on the ground. Oils or chemicals would be hauled to an approved site for disposal. The only significant sources of potential petroleum or

other hazardous material spills are from mobile equipment. If a fuel/oil or other hazardous material spill were to occur, the required regulatory agencies would be contacted as soon as possible, and actions would be taken to minimize the amount and spread of the spill material. Such measures may include straw bale plugs, earthen berms, or use of other absorbent materials. If necessary, soil remediation would be conducted and would include the removal of contaminated soils to an approved facility and a soil sample(s) would be taken to verify the success of the site remediation. In addition, the KCWCD would follow any other local, state, or Federal regulations related to the use, handling, storing, transporting, and disposing of hazardous materials.

Fire Prevention and Protection: All construction personnel would have fire tools and extinguishers available at all times for use if the occasion arises. Construction staff would adhere to any local fire prevention and suppression requirements.

Cultural Resources: If during any project activities, cultural, historical, or prehistoric resources, including any of Native American religious interest, are inadvertently discovered, the appropriate authorized officer would be notified, and all work in the area would cease. A professionally trained archeologist would work with the SHPO and affiliated or interested Tribes to determine eligibility for the National Register of Historic Places. If needed, a mitigation plan would be developed in consultation with the SHPO, KCWCD, construction crews, and interested Tribes. Construction personnel would be instructed to watch for cultural artifacts while working on the project. In the event significant vertebrate paleontological resources are discovered, including human remains, the authorized officer would be notified.

Human Health and Safety: Blasting will not be allowed at the dam site, however it may be an option for the Hydro Plant. The contractor performing blasting would comply with applicable regulations and standards established by the regulatory agencies, codes, and professional societies, including the rules and regulations for storage, transportation, delivery, and use of explosives. Whenever blasting operations are in progress, explosives would be stored, handled, and used as provided by law, including safety and health regulations for construction. No explosives would be stored on the Project Area.

Construction sites would be managed to prevent harm to any person and property. During construction, all employees, project managers, supervisors, inspectors, contractors, and subcontractors would be required to conform to contractor safety procedures. All personnel would be adequately trained to perform their tasks. Heavy equipment would be outfitted with Occupational Safety and Health Administration (OSHA) required safety devices such as backup warnings and seat belts. Hard hats, safety boots, ear and eye protection, and other personal

safety equipment would be available to any personnel requesting it. All accidents and injuries would be reported to the appropriate contractor safety officer.

Noxious Weeds/Invasive Species: All equipment, including pickup trucks and passenger vehicles, would be cleaned of soils, seeds, vegetative matter, or other debris or matter that could contain or hold noxious seeds prior to entering the Project Area. The cleaning of equipment would also be done any time thereafter if the equipment leaves the Project Area, is used on another project, and reenters the Project Area. The KCWCD would follow any regulations pertaining to control of noxious weeds on state- or federal-administered land. Vegetation in the Project Area would be monitored periodically for the establishment of noxious weeds or undesirable plant species. The KCWCD would be responsible for any future weed control work, if needed, as a result of the implementation of this Project. Any use of herbicides would comply with local requirements.

Stabilization and Rehabilitation: All areas subject to temporary ground disturbance would be restored to original contours to the extent determined by the governing agency. Temporarily disturbed areas would be seeded using a certified weed-free seed mix approved by the governing agency. Seed would be hand broadcasted and lightly covered with soil by hand using a rake or by pulling a chain-link fence with an all-terrain vehicle. All soil removed during construction would be reused. Vegetation removal would be kept to that necessary to construct the project. Any brush removed during construction would be used as mulch after reclamation activities. Any trees felled would either be left on site as down woody debris or removed if preferred by the governing agency. The reservoir area would be smoothed and cleaned up prior to filling the reservoir with water. The borrow areas would be cleaned up of all debris and smoothed out.

Raptors and Migratory Birds: In order to avoid or reduce impacts on nesting success of raptors, activities would not occur within recommended spatial and seasonal buffers, and would follow Utah BLM BMPs for Raptors and Their Associated Habitats in Utah [BLM 2006]. If existing topography limits actual line-of-sight of between an active nest (i.e., the nest has eggs or young) and construction activities, the spatial and seasonal buffer may be reduced.

To avoid or minimize potential short-term and long-term impacts to migratory birds, construction activities would be either limited during the migratory bird nesting period (generally defined as 15 May – July 15 [BLM 2008], but could start as early as March/April depending on elevation and latitude), or a migratory bird nesting survey would be completed in areas proposed for disturbance during this time period. If an active nest were discovered, the appropriate agency biologist would be notified and an appropriate buffer area around the nest would be established to prevent nest abandonment until after the migratory bird nesting period is over and/or young have fledged.

Wildlife: No firearms, air guns, or archery equipment would be allowed on the project sites. No pets would be permitted on project sites. To prevent entrapment of wildlife during construction, any open pits or trenches would be monitored throughout the construction day. Excavated pits and trenches more than 2 feet deep would be covered at the close of each day. Alternatively, fencing may be erected around open pits or trenches. At the beginning of the construction day and before pits or trenches are filled, they would be inspected for trapped animals. If any animals are found, they would be moved out of harm's way. No rodenticides would be used on project sites. Encounters with a protected species (e.g., raptors, migratory birds, listed or sensitive species) would be reported to the appropriate oversight agency (e.g., USFWS). Any contractor or employee who inadvertently kills or injures a protected species would immediately report the incident to the appropriate oversight agencies.

D. Operation and Maintenance

It is anticipated that routine maintenance would include the following, and as summarized in **Table 11**:

- The reservoir requires water management practices of maintaining water levels.
- The reservoir dam would require regular inspection and maintenance.
- A grader would be used to grade the spillway as necessary to maintain functionality.
- The pipeline air valves would need to be inspected at least annually to ensure that they are functioning properly.
- The pipeline would likely need to be cleaned with a poly pig on an annual basis.
- The pipeline system is estimated to have a 100-year life before major pipeline repair would be required.
- The existing hydro plant would require regular inspection and maintenance to maintain turbines, valves, and other mechanical equipment.
- The recreation area would require regular inspection and maintenance to maintain hard surfaces and erosional protection and to keep site free of debris and excessive vegetation.

Task	Number of People	Equipment
Reservoir Inspection & Maintenance	1 - Person	1 - Pickup Truck
Dam Inspection & Maintenance	1 - Person	1 - Pickup Truck
Flushing Pipeline	2 - People	1 - Pickup Truck
Road Maintenance	1 - Person	1 - Grader 1 - Pickup Truck
Pipeline Maintenance	2 - People	1 - Pickup Truck

Task	Number of People	Equipment
Hydro Plant Inspection & Maintenance	1 - Person	1 - Pickup Truck
Recreation Area	1 - Person	1 - Pickup Truck

Table 9 Estimated Personnel and Equipment to Perform Operation and Maintenance

E. Termination and Restoration

If the project is to be terminated or abandoned, a joint inspection would be held with the authorized officer(s) of the NRCS prior to termination. This would be held to agree upon an acceptable rehabilitation plan for the area.

Part V. References

Bureau of Land Management (BLM). 2006. Best management practices for raptors and their associated habitats in Utah. Recommendations for implementing the U.S. Fish and Wildlife Service, Utah Field Office's Guidelines for Raptor Protection from Human and Land Use Disturbances [Romin and Muck 2002]. BLM Utah State Office, Salt Lake City. August 2006.

Bureau of Land Management. 2008. Instruction Memorandum No. 2008-050: Migratory Bird Treaty Act – Interim Management Guidance.

Appendix A. Best Management Practices

Best Management Practices

As part of standard operating procedures, standard BMPs would be implemented throughout the project in order to reduce potential adverse environmental impacts. Most of the impacts are short term and generally occur during the construction period. Project design and implementation of site-specific or selectively recommended BMPs would minimize the effect of the project where the potential for long-term, adverse impacts may occur.

STANDARD BMPs
1. All construction vehicle movement outside of the right-of-way would be restricted to pre-designated access, contractor acquired access, or public roads.
2. The limits of construction activities would be predetermined, with activity restricted to and confined within those limits. No paint or permanent discoloring agents would be applied to rocks or vegetation to indicate survey or construction activity limits. The right-of-way boundary would be flagged in environmentally sensitive areas described in the plan of development to alert construction personnel that those areas would be avoided.
3. In construction areas where re-contouring is not required, vegetation would be left in place wherever possible to avoid excessive root damage and allow for re-sprouting.
4. In construction areas where ground disturbance is significant or where re-contouring is required, surface restoration would occur as required by the landowner or land management agency. The method of restoration typically would consist of returning disturbed areas to their natural contour (to the extent practical) and reseeding or re-vegetating with native plants. Seed viability would be tested and seed mixes would be certified to contain no noxious weeds.
5. Prior to construction, all construction personnel would be instructed on the protection of cultural, paleontological, and ecological resources. To assist in this effort, the construction contract would address (a) federal and state laws regarding antiquities, fossils, and plants and wildlife, including collection and removal; and (b) the importance of these resources and the purpose and necessity of protecting them.
6. An initial intensive cultural resource inventory survey would be conducted prior to construction. Impact avoidance and mitigation measures developed in consultation with appropriate land management and regulatory agencies and other interested parties would be implemented subsequent to the completion of the NEPA compliance document.
7. Any cultural and/or paleontological resource discovered during construction by the KCWCD or any person working on their behalf on public or federal land would be reported immediately to the authorized officer. The KCWCD would suspend operations in the area until an evaluation is completed to prevent the loss of cultural or scientific values.
8. All construction and maintenance activities would be conducted in a manner that would minimize disturbance to vegetation, drainage channels, and intermittent and perennial stream banks. In addition, dust-control measures would be utilized as necessary during construction in sensitive areas. Any used existing roads would be left in a condition equal to or better than their condition prior to construction.

STANDARD BMPs
9. All requirements of those entities having jurisdiction over air quality matters would be adhered to and any necessary permits for construction activities would be obtained. Open burning of construction trash (cleared trees, etc.) would not be allowed on BLM- or USFS-administered lands.
10. Fences and gates, if damaged or destroyed by construction activities, would be repaired or replaced to their original pre-disturbed condition as required by the landowner or the land management agency. Temporary gates would be installed only with the permission of the landowner or the land management agency.
11. Totally enclosed containment would be provided for all hazardous materials (if needed) and trash. All construction waste including trash, litter, garbage, other solid waste, petroleum products, and other potentially hazardous materials would be removed to a disposal facility authorized to accept such materials.
12. Third-party environmental contractors would be used throughout the construction effort, from clearing through rehabilitation.
13. The KCWCD would trim trees in preference to cutting trees, and would cut trees in preference to bulldozing them.
14. Construction holes left open overnight would be covered to prevent livestock or wildlife from harm.
15. The contractor would clean off-road equipment (power or high-pressure cleaning) of all mud, dirt, and plant parts prior to moving equipment onto public land.

ADDITIONAL STIPULATIONS

The following additional stipulations would be implemented throughout the construction and operation of the project and would be included as part of the standard operating procedures.

STIPULATIONS – STANDARD OPERATING PROCEDURES
1. KCWCD would construct, operate, and maintain the facilities, improvements, and structures within this ROW in strict conformity with the plan of development as it is approved. Any relocation, additional construction, or use that is not in accord with the approved plan of development would not be initiated without the prior written approval of the authorized officer. A copy of the complete ROW grant or acknowledgment, including all stipulations and approved plan of development, would be made available on the ROW area during construction, operation, and maintenance to the authorized officer. Noncompliance with the above shall be grounds for an immediate temporary suspension of activities if it constitutes a threat to public health and safety or a material threat to the environment.
2. This plan of development describes in detail the construction, operation, maintenance of the ROW and its associated improvements and/or facilities. An approved plan of development may be referred to for interpretation of the right-of-way grant.
3. KCWCD would contact the authorized officer at least 10 days prior to the anticipated start of construction and/or any surface-disturbing activities. The authorized officer may require and

STIPULATIONS – STANDARD OPERATING PROCEDURES
schedule a preconstruction conference with the KCWCD prior to commencement of construction and/or surface-disturbing activities on the ROW. The KCWCD, its contractor(s), or agents involved with the construction and/or surface-disturbing activities on the ROW should attend this conference to review the stipulations of the grant and the plan(s) of development.
4. KCWCD would designate a representative(s) who would have the authority to act upon and implement instructions from the authorized officer within a reasonable time when construction or other surface-disturbing activities are underway.
5. KCWCD would protect all survey monuments found within the right-of-way. Survey monuments include but are not limited to General Land Office and BLM Cadastral Survey Corners, reference corners, witness points, U.S. Coastal and Geodetic benchmarks and triangulation stations, military control monuments, and recognizable civil (both public and private) survey monuments. In the event of obliteration or disturbance of any of the above, the KCWCD would immediately report the incident, in writing, to the authorized officer and the respective installing authority, if known. Where General Land Office or BLM ROW monuments or references are obliterated during operations, KCWCD shall secure the services of a registered land surveyor or a BLM cadastral surveyor to restore the disturbed monuments and references using surveying procedures found in the *Manual of Surveying Instructions for the Survey of the Public Lands of the United States*, latest edition. KCWCD shall record such survey in the appropriate county and send a copy to the authorized officer. If the BLM cadastral surveyors or other federal surveyors are used to restore the disturbed survey monument, KCWCD would be responsible for the survey cost.
6. The KCWCD or the successor in interest shall comply with Title VI of the Civil Rights Act of 1964 (42 U.S.C. 2000d et. seq.) and the regulations of the Secretary of Interior issued pursuant hereto.
7. KCWCD would mark the exterior boundaries of the ROW with a stake and/or lath. The intervals may be varied at the time of staking at the discretion of the authorized officer. The tops of the stakes and/or laths would be painted and the laths flagged in a distinctive color as determined by the holder. The survey station numbers would be marked on the boundary stakes and/or laths at the entrance to and exit from public land. Holder would maintain all boundary stakes and/or laths in place until final cleanup and restoration are completed and approved by the authorized officer. The stakes and/or laths would then be removed at the direction of the authorized officer.
8. KCWCD would conduct all activities associated with the construction, operation, and maintenance of the right-of-way within the authorized limits of the ROW and approved plan of development.
9. KCWCD would survey and clearly mark the centerline and/or exterior limits of the ROW, as determined by the authorized officer.
10. All design, material, and construction, operation, maintenance, and termination practices would be in accordance with safe and proven engineering practices.
11. KCWCD would inform the authorized officer within 48 hours of any accidents on federal lands that require reporting to the Department of Transportation as required by 49 CFR Part 195.
12. During conditions of extreme fire danger, operations may be suspended or limited in certain areas.
13. KCWCD would be liable for damage or injury to the United States to the extent provided by 43 CFR Sec. 2803.1-4. KCWCD would be held to a standard of strict liability for damage or injury to the

STIPULATIONS – STANDARD OPERATING PROCEDURES
United States resulting from fire or soil movement (including landslides and slumps as well as wind and water-caused movement of particles) caused or substantially aggravated by any of the following within the ROW or permit area: • Activities of the holder including but not limited to construction, operation and maintenance of the facility. • Activities of other parties acting under color of authority from the KCWCD, including but not limited to: - land clearing - earth-disturbing and earth-moving work - blasting
14. Within 30 days of completion, KCWCD would submit to the authorized officer, as-built drawings and a certification of construction verifying that the facility has been constructed (and tested) in accordance with the design, plans, specifications, and applicable laws and regulations.
15. Construction sites would be maintained in a sanitary condition at all times; waste materials at those sites would be disposed of promptly at an appropriate waste disposal site. “Waste” means all discarded matter including but not limited to human waste, debris, garbage, refuse, oil drums, petroleum products, ashes, and equipment.
16. Prior to preconstruction activities on the subject parcel, KCWCD would identify all noxious weeds present. A list of the weeds would be provided to the authorized officer. A determination would be made by the authorized officer of any noxious weeds that may require flagging for treatment. KCWCD shall treat the noxious weeds as required by the authorized officer.
17. KCWCD would clean off-road equipment (power or high-pressure cleaning) of all mud, dirt, and plant parts prior to moving equipment onto public land authorized under this lease.
18. Gravel and/or fill material to be placed in relatively weed-free areas must come from weed-free sources. Prior to obtaining gravel and/or fill material, the authorized officer would inspect the source for weeds and determine adequacy of site.
19. KCWCD would identify a road maintenance program, which would include monitoring for noxious weeds. If KCWCD identifies any noxious weeds, KCWCD would notify the authorized officer immediately. A treatment program would be identified and KCWCD would be responsible for weed abatement.

EAST FORK VIRGIN RIVER
COVE RESERVOIR
WATERSHED PLAN - EIS

Kane County, Utah

RB&G ENGINEERING, INC.

MEMORANDUM

To: Brent Gardner, P.E., Alpha Engineering

From: Brandon Horrocks, P.E. and Brad Price, P.E.

Date: September 8, 2021

RE: ALTERNATIVE SITE EVALUATION

Site visits and a review of available information have been performed to assist the project team with evaluation of potential reservoir sites for the East Fork Virgin River – Cove Reservoir Watershed Plan – EIS. A summary of the observations and available information relating to the geotechnical and geological conditions for each of the sites evaluated is provided below. The locations of the sites are shown on Figures 1, 2A, 2B, and 2C. Descriptions of the geologic units shown on Figures 2A-2C are provided on Figure 3. The site visits were performed on July 22, 2021 with representatives of Kane County Water Conservancy District, Washington County Water Conservancy District, NRCS, Alpha Engineering, Transcon Environmental, and RB&G Engineering.

MUDDY CREEK – LOWER (FIGURE 2A)

The right abutment of the dam site evaluated is near the mapped contact of the Winsor member (Jcw) and Paria River member (Jcp) of the Carmel formation, with the Winsor member overlying Paria River member. Geologic descriptions indicate that gypsum deposits are present within the upper portion of the Winsor member and lower portion of the Paria River member.

A gypsum deposit with an exposed thickness of about 5 feet was observed near the base of the right abutment of the dam alignment (lower portion of Winsor member/upper portion of Paria River member). Additional gypsum deposits several feet thick were observed along the right side of the possible reservoir site and within the erosion channel near the center of the basin, particularly near the location of the historic flume. Defining the lateral and vertical limits of the gypsum deposits will require detailed foundation investigations. Foundation treatment required to mitigate potential dissolution and erosion of gypsum deposits will likely be extensive, Depending on the extents of the gypsum deposits, it may not be feasible to construct a safe dam at the location evaluated.

1435 WEST 820 NORTH, PROVO, UTAH 84601-1343
PROVO 801-374-5771 SALT LAKE CITY 801-521-5771 FAX 801-374-5773

An erosion channel visually estimated to be 20 to 30 feet deep was observed within the center of the basin at this location. It is likely that a cutoff will need to be excavated to a depth of at least 30 feet to expose the bedrock formation prior to treating the foundation bedrock. .

Considering the availability of other potential reservoir sites, this site is not the preferred alternative for the project. A photo below shows the gypsum deposit observed near the right abutment of the dam alignment.



MUDDY CREEK – UPPER (FIGURE 2A)

The right and left abutments of the dam site are near the mapped contact of the Paria River member of the Carmel formation and Dakota and Cedar Mountain (undivided) formations (Kdcm), with the Dakota and Cedar Mountain formations overlying the Carmel formation. Gypsum deposits were not observed at this site; however, based on the Paria River member geologic description referenced above, gypsum deposits may be present at relatively shallow depths within the dam foundation.

Using the USGS online StreamStats tool, we estimate that the drainage basin for this reservoir site would have an area of about 35 mi^2. Based on previous sediment studies for the nearby Cove Dam reservoir site, we estimate that average sedimentation into the Upper Muddy Creek reservoir would be between 0.5 and 1.0 ac-ft per year per square mile of drainage basin. Using an average value of

0.75 ac-ft/yr/mi^2, we recommend that a 50-yr sediment volume of 1,300 ac-ft be used for conceptual evaluations of this reservoir site.

We understand that several factors, including purpose and need, estimated costs, and impacts to human and natural environments are being considered by the project team to determine viable alternatives for the project. If conceptual evaluations indicate that construction of a reservoir at this site is a viable project alternative, we recommend that geological and geotechnical field investigations be performed to evaluate foundation conditions.

Based on the observed depth of the Muddy Creek erosion channel at this site, we recommend that conceptual evaluations assume a cutoff trench will be excavated to a depth of 25 feet for construction of a dam at this site.

A review of topography at this site indicates that a dam with a maximum height of about 92 feet (crest el. 5,518 ft) will need to be constructed to store 3,000 ac-ft, and a dam with a maximum height of about 115 feet (crest el. 5,541 ft) will need to be constructed to store 6,000 ac-ft. These estimates assume the dam would have 10 feet of freeboard above the normal high-water elevation.

COVE (FIGURE 2A)

Preliminary design evaluations were performed for the Cove Dam site during the 2019-2020 Environmental Assessment. Geotechnical and geological feasibility studies for a dam at this site were performed in 2004. Previous studies have indicated that constructing a dam at the Cove site is a viable project alternative. The foundation for the dam previously evaluated would be founded on Tropic Shale formation bedrock. A dam at the Cove site will have a maximum height of about 67 feet (crest el. 5,526 ft) to store 3,000 ac-ft, and a maximum height of about 86 feet (crest el. 5,552 ft) to store 6,000 ac-ft of water.

DRY WASH (FIGURE 2B)

From the geologic map shown on Figure 1B and assuming overburden deposits were excavated, it is apparent that a dam within Dry Wash would be founded on Cretaceous age Straight Cliffs formation or Tropic Shale bedrock. As shown on Figure 2B, there are multiple fault traces mapped within the Dry Wash area. Based on the available information, we believe that the mapped faults would be considered inactive, and their presence does not necessarily preclude this site as a feasible location for a dam and water storage reservoir. It is likely that the bedrock formations in the area are fractured due to past faulting, and the faulting increases the risk that seepage from the reservoir would be greater at this site compared to other sites.

We believe that the Utah Division of Water Resources investigated geologic conditions at a possible dam alignment within Dry Wash in the 1990's. To date, we have not been able to locate the results of the investigations that have been performed.

Using the USGS online StreamStats tool, we estimate that the drainage basin for this reservoir site would have an area of about 6.8 mi^2. For conceptual evaluations, we recommend that an average sedimentation rate of 1 ac-ft/yr/mi^2 be used. This sedimentation rate is likely conservative.

As stated above, we understand that multiple factors are being considered to evaluate project alternatives. If conceptual evaluations indicate that construction of a reservoir at this site is a viable project alternative, we recommend that geological and geotechnical field investigations be

performed to evaluate foundation conditions. Past studies performed by Water Resources would be a valuable resource for evaluation of this alternative if the reports or test hole logs could be obtained. It is likely that studies to evaluate potential activity of the mapped faults would be required if this site is determined to be a possible preferred alternative for the project.

A review of topography at this site indicates that a dam with a maximum height of about 112 feet (crest el. 5,944 ft) will need to be constructed to store 3,000 ac-ft, and a dam with a maximum height of about 139 feet (crest el. 5,971 ft) will need to be constructed to store 6,000 ac-ft. These estimates assume the dam would have 7 feet of freeboard above the normal high-water elevation.

LYDIA'S CANYON – LOWER (FIGURE 2B)

The lower portion of Lydia's Canyon has been developed with several residential structures on both sides of the canyon. Several small ponds have been constructed within the center portion of the canyon. Impacts to current residents will likely preclude this site as a viable location for a water storage reservoir.

The Upper unit of the Straight Cliffs Formation mapped in the area of this site is described as interbedded sandstone, mudstone, and siltstone. The information available to us is not sufficient to determine the geological and geotechnical suitability of this site for a storage reservoir.

From visual observation of the erosion channel on the south side of Lydia's Canyon, we recommend that conceptual evaluations assume a cutoff trench will be excavated to a depth of 25 feet within the foundation of a dam at this site. Geological and geotechnical field investigations should be performed to evaluate foundation conditions if initial evaluations indicate a reservoir in the lower portion of Lydia's Canyon is a viable project alternative.

Using the USGS online StreamStats tool, we estimate that the drainage basin for this reservoir site will have an area of about 15 mi^2. For conceptual evaluations, we recommend that an average sedimentation rate of 1 ac-ft/yr/mi^2 be used. This sedimentation rate is likely conservative.

A review of topography at this site indicates that a dam with a maximum height of about 126 feet (crest el. 6,076 ft) would need to be constructed to store 3,000 ac-ft, and a dam with a maximum height of about 162 feet (crest el. 6,112 ft) would need to be constructed to store 6,000 ac-ft. These estimates assume the dam will have 10 feet of freeboard above the normal high-water elevation.

LYDIA'S CANYON – UPPER (FIGURE 2B)

We are aware of one residential dwelling within the area that would be inundated by a reservoir at the location shown on Figure 2B. The geological, assumed cutoff depth, and sedimentation rate for conceptual evaluation provided above for the lower Lydia's Canyon site are applicable to the upper site. The drainage basin for this upper site is about 12 mi^2. Aerial imagery indicates that soil materials have been borrowed from the vicinity of this site within the last few years.

A review of topography at this site indicates that a dam with a maximum height of about 142 feet (crest el. 6,402 ft) will need to be constructed to store 3,000 ac-ft, and a dam with a maximum height of about 185 feet (crest el. 6,445 ft) will need to be constructed to store 6,000 ac-ft. These estimates assume the dam will have 10 feet of freeboard above the normal high-water elevation.

STOUT CREEK – LOWER (FIGURE 2C)

The Wahweap formation bedrock mapped within the Stout Creek Canyon area consists of interbedded mudstone, claystone, sandstone, siltstone and conglomerate rock. The information available to us is not sufficient to determine the geological and geotechnical suitability of this site for a storage reservoir.

The current erosion channel in the bottom of Stout Creek Canyon is shallower than the erosion channels observed at the other sites described above. We recommend that conceptual evaluations assume a cutoff trench will be excavated to a depth of 20 feet within the foundation of a dam at this site. Geological and geotechnical field investigations should be performed to evaluate foundation conditions if initial evaluations indicate a reservoir in the lower portion of Stout Creek Canyon is a viable project alternative.

Using the USGS online StreamStats tool, we estimate that the drainage basin for this reservoir site will have an area of about 23 mi^2. For conceptual evaluations, we recommend that an average sedimentation rate of 1 ac-ft/yr/mi^2 be used. This sedimentation rate is likely conservative.

A review of topography at this site indicates that a dam with a maximum height of about 118 feet (crest el. 6,418 ft) will need to be constructed to store 3,000 ac-ft, and a dam with a maximum height of about 158 feet (crest el. 6,458 ft) will need to be constructed to store 6,000 ac-ft. These estimates assume the dam will have 10 feet of freeboard above the normal high-water elevation.

STOUT CREEK – UPPER (FIGURE 2C)

The geological, assumed cutoff depth, and sedimentation rate for conceptual evaluation provided above for the lower Stout Creek Canyon site are applicable to the upper site. The drainage basin for this upper site is about 19 mi^2.

A review of topography at this site indicates that a dam with a maximum height of about 116 feet (crest el. 6,546 ft) will need to be constructed to store 3,000 ac-ft, and a dam with a maximum height of about 152 feet (crest el. 6,582 ft) will need to be constructed to store 6,000 ac-ft. These estimates assume the dam will have 10 feet of freeboard above the normal high-water elevation.

LOWER SWAPP (FIGURE 2C)

Tertiary age Pink member of the Claron formation bedrock is mapped at the Lower Swapp site. This formation contains limestone, limey mudstone, dolomite, mudstone, and conglomerate materials. The information available to us is not sufficient to determine the geological and geotechnical suitability of this site for a storage reservoir. A small reservoir named McDonald lake is currently present at this site.

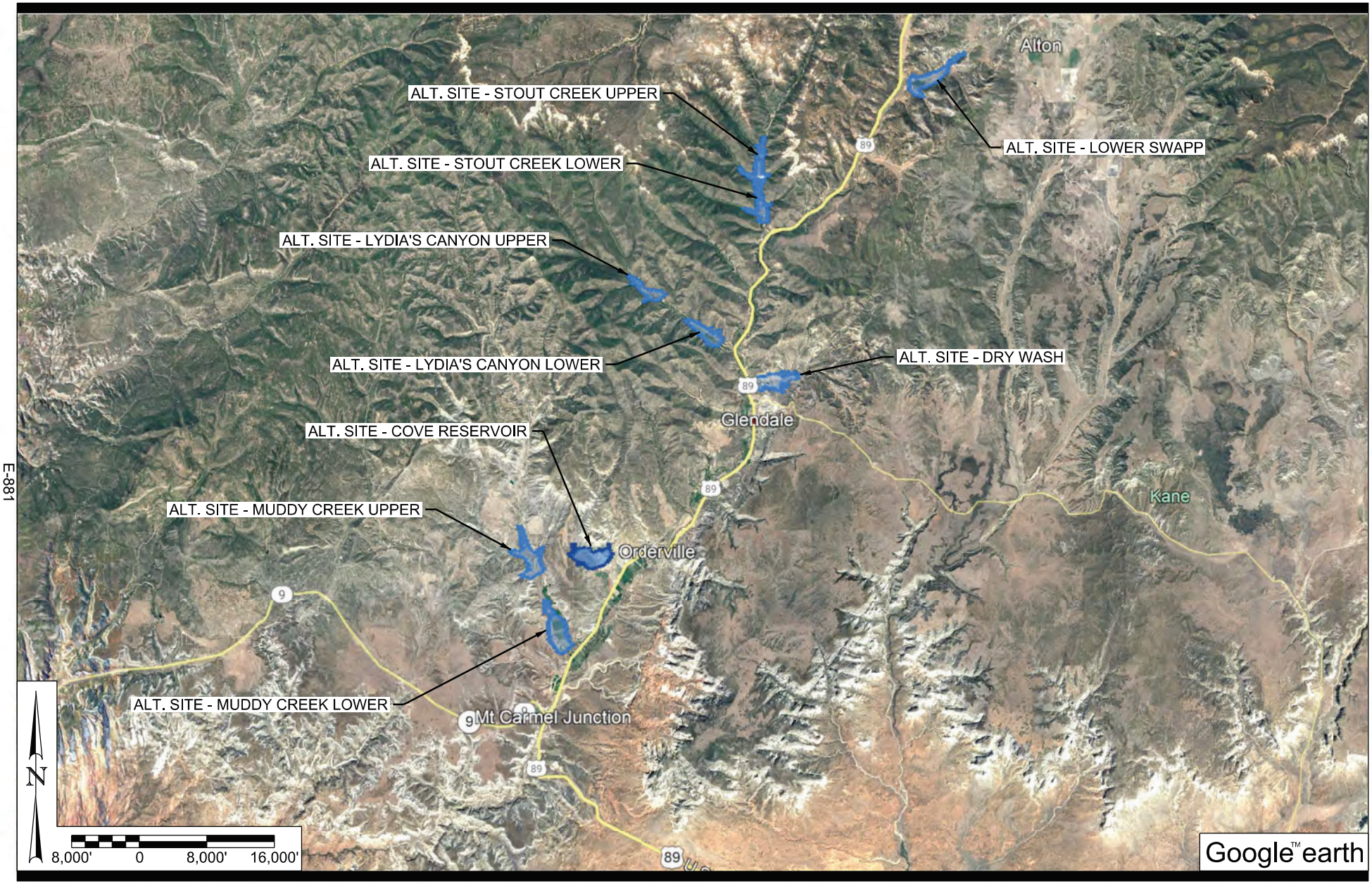
There is not a deep erosion channel at this site which could provide an indication of the depth of bedrock below the overburden deposits. We recommend that conceptual evaluations assume a cutoff trench will be excavated to a depth of 30 feet within the foundation of a dam at this site. Geological and geotechnical field investigations should be performed to evaluate foundation conditions if initial evaluations indicate at this site is a viable project alternative.

Using the USGS online StreamStats tool, we estimate that the drainage basin for this reservoir site will have an area of about 2.3 mi^2. For conceptual evaluations, we recommend that an average sedimentation rate of 1 ac-ft/yr/mi^2 be used. This sedimentation rate is likely conservative.

A review of topography at this site indicates that a dam with a maximum height of about 70 feet (crest el. 7,012 ft) will need to be constructed to store 3,000 ac-ft, and a dam with a maximum height of about 97 feet (crest el. 7,039 ft) will need to be constructed to store 6,000 ac-ft. These estimates assume the dam will have 7 feet of freeboard above the normal high-water elevation.

CONCEPTUAL DAM CROSS SECTION

A multi-zoned earthfill dam will likely be the most efficient structure for the dam sites discussed above. It is recommended that conceptual design for dams less than 100 feet high consider an upstream slope of 3H:1V (three horizontal to one vertical) and a downstream slope of 2H:1V. For dams between 100 and 150 feet, we recommend using an upstream slope of 3.5H:1V and a downstream slope of 2.5H:1V for conceptual design. We recommend that conceptual evaluations assume a dam crest width of 26 feet. We also recommend that a unit price of $\$25/yd^3$ be used to estimate costs of earthfill dam embankments for conceptual level cost comparisons. This cost is intended to provide an approximate average of earthfill, drainfill, riprap, and other materials which would be used for construction of a dam embankment.



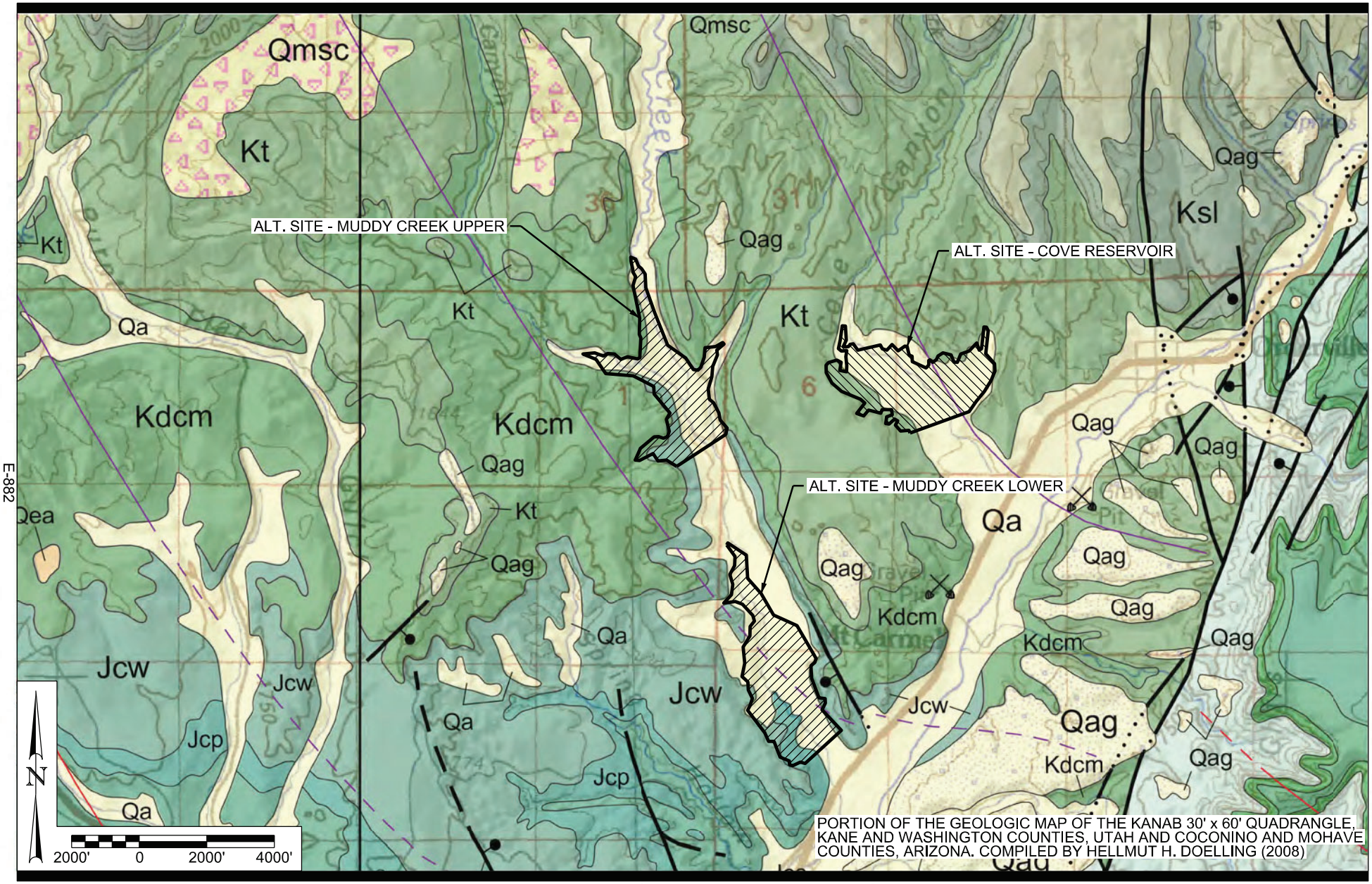
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Figure 1 VICINITY MAP

East Fork Virgin River - Cove Reservoir Watershed Plan - EIS

near Orderville, Kane County, Utah



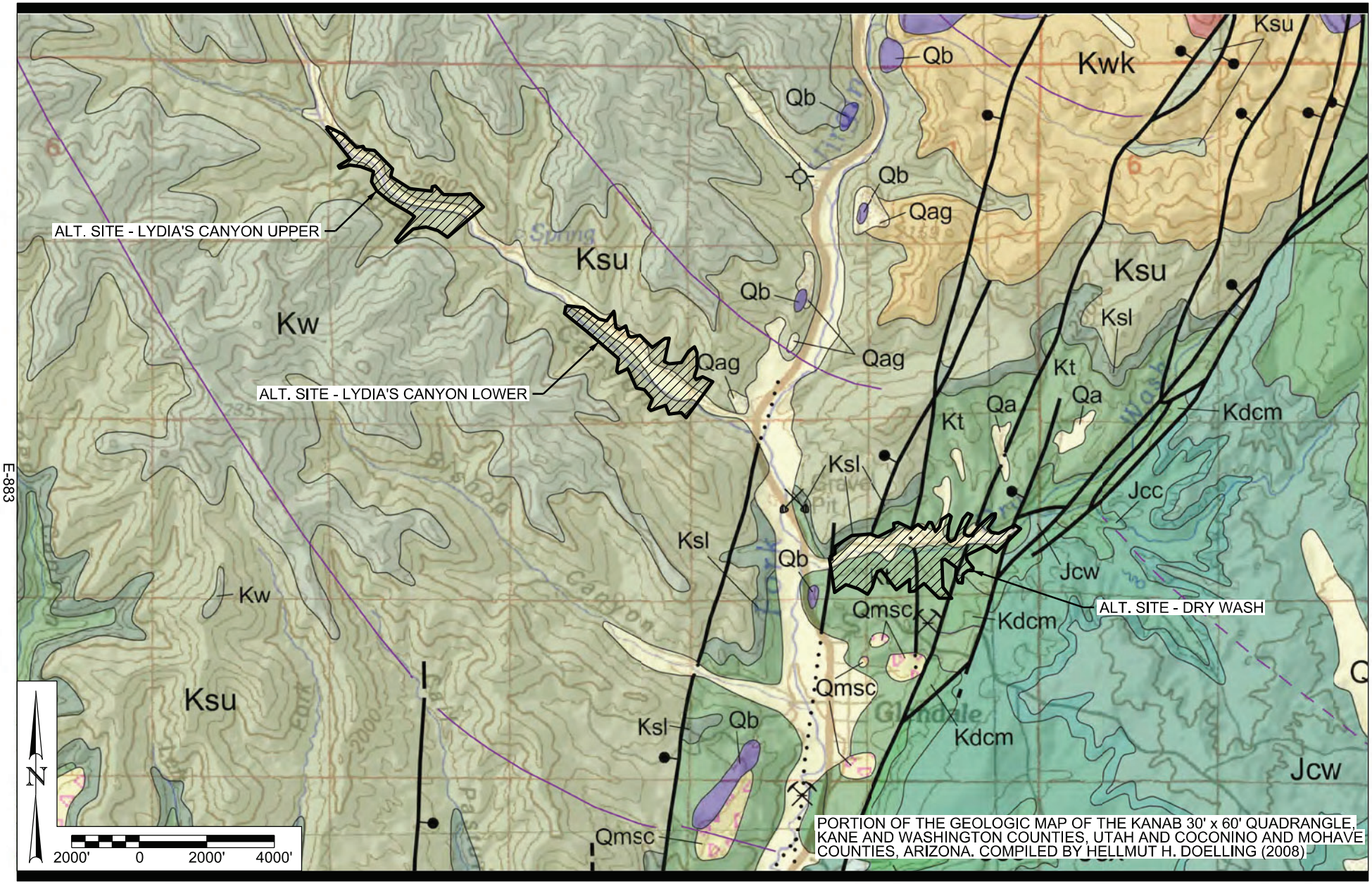
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Figure 2A GEOLOGIC MAP

East Fork Virgin River - Cove Reservoir Watershed Plan - EIS

near Orderville, Kane County, Utah



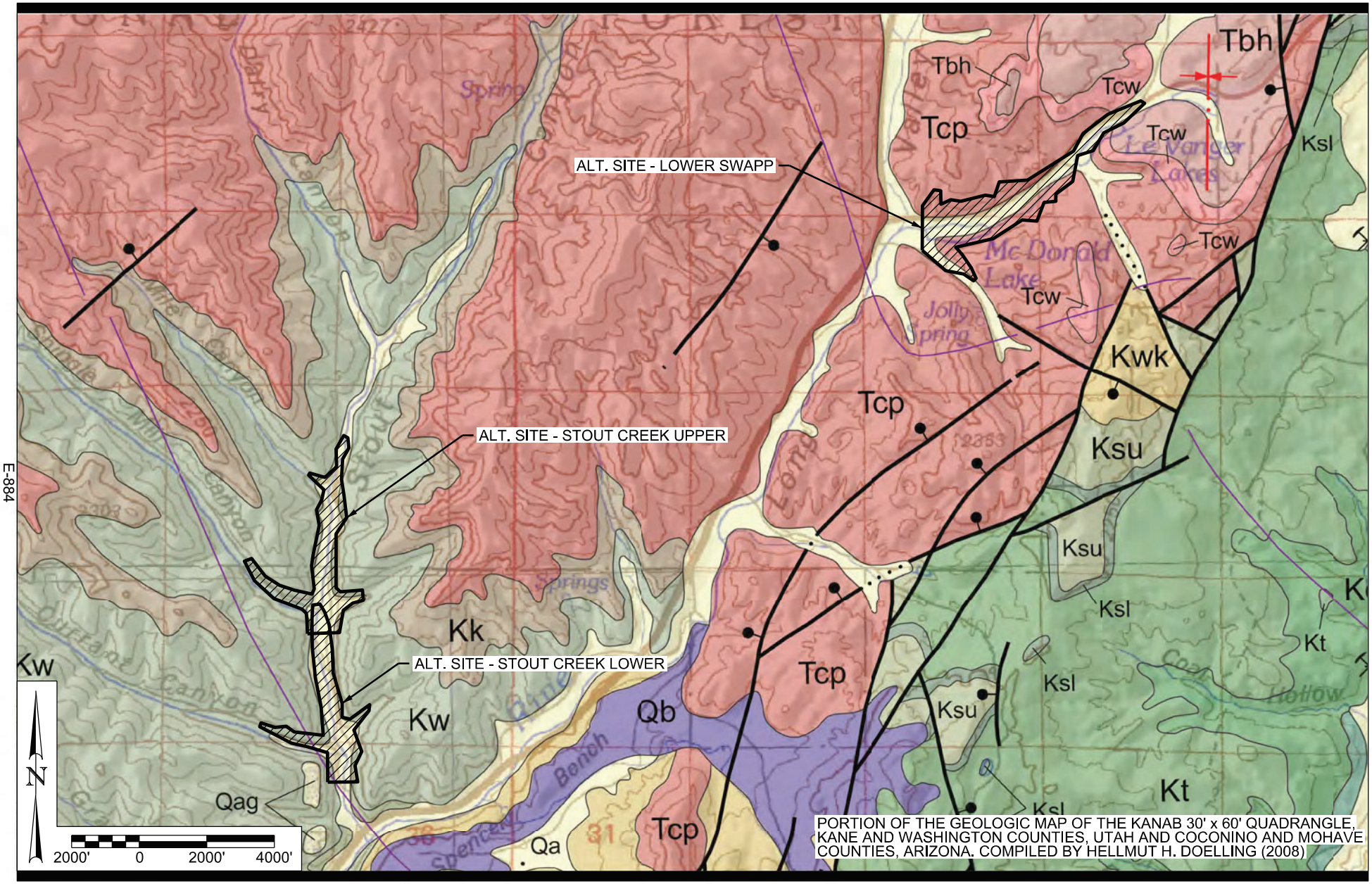
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Figure 2B GEOLOGIC MAP

East Fork Virgin River - Cove Reservoir Watershed Plan - EIS

near Orderville, Kane County, Utah



E-884

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Figure 2C GEOLOGIC MAP

East Fork Virgin River - Cove Reservoir Watershed Plan - EIS

near Orderville, Kane County, Utah

Utah Geological Survey
a division of
Utah Department of Natural Resources

DESCRIPTION OF GEOLOGIC UNITS

QUATERNARY DEPOSITS

Qa **Alluvium** – Mostly sand with lenses of silty clay, sandy silt, and gravel deposited in stream beds, washes, adjacent floodplains, and on low alluvial slopes; includes lower terrace and alluvial fan deposits; 0 to 36 m (0-120 ft) thick.

Qes **Windblown sand** – Sand in active to partially stabilized dunes and sheets; mostly fine to medium grained; generally derived from and deposited on and downwind of large exposures of eolian sandstone formations (primarily Navajo and Entrada Sandstones); locally includes alluvial deposits; 0 to 30 m (0-100 ft) thick.

Qea **Mixed eolian and alluvial sand** – Mostly sand with minor amounts of clay, silt, and gravel; stabilized sand sheets locally reworked by alluvial processes and with well-developed calcic soil; 0 to 30 m (0-100 ft) thick.

Qag **Alluvial gravel** – Poorly to well-sorted gravel, sand, and boulders with interlayers of silt and mud; present on pediments and higher river terraces, and as older erosional remnants; 0 to 20 m (0-60 ft) thick.

Qls **Lacustrine sand** – Well stratified sand, clay, silt, and minor gravel deposited where drainage was blocked by a landslide in Zion Canyon; also mapped in a human-made reservoir on South Creek near southwest corner of the quadrangle; 0 to 40 m (0-135 ft) thick.

Qmsc **Mass-movement deposits, undifferentiated** – Includes landslides, slumps, colluvium, talus, and other mass-movement deposits; very poorly sorted; nonstratified; common on moderate to steep slopes; only larger deposits mapped; 0 to 75 m (0-250 ft) thick.

Qb **Basalt lava flows and cinder cones** – Blocky vesicular basalt and basaltic andesite lava flows and cinder cones, commonly partially covered by a thin veneer of eolian silt and sand; phenocrysts include olivine, labradorite, titaniferous augite, plagioclase, and iron-titanium oxides (Sable and Hereford, 2004; Biek and Hylland, 2007); remnants of four flows are preserved near the Sevier fault and southwest to southeast of the Paunsaugunt Plateau (Sable and Hereford, 2004; Tilton, 1991a,b) – Best and others (1980) obtained K-Ar ages of 0.56±0.05 Ma on the Spencer Bench (Black Mountain) flow and 1.1±0.1 Ma on the Tenny Creek flow (26 km [16 mi] east-northeast of Glendale); Schiefelbein (2002) obtained $^{40}Ar/^{39}Ar$ ages of 0.58+0.05 Ma and 0.564+0.02 Ma on the Spencer Bench (Black Mountain) flow; remnants of six or more flows are preserved in the Markagunt Plateau area in the northwest part of the quadrangle – Best and others (1980) obtained K-Ar ages of 1.2±0.6 Ma on the Hornet Point flow (age is probably unreliable – note large standard error), 0.81±0.05 Ma on the Horse Knoll flow, and 0.36±0.08 Ma on the Volcano Knoll flow; Biek and Hylland (2007) obtained $^{40}Ar/^{39}Ar$ ages of 0.74±0.05 Ma on the Hornet Point flow, 0.37±0.02 Ma on the Virgin Flats flow, and 0.34±0.03 on the Volcano Knoll flow, and estimated the Three Creeks flow (near China Point) at less than 0.3 Ma; other flows have not been dated but are probably similar in age to the dated flows; some flows are cut by post-flow movement on Quaternary faults.

TERTIARY ROCKS

Ta **Older Boulder Gravel Deposits** (Miocene?) – Unconsolidated, very poorly sorted, clay- to large boulder-size sediment characterized by very large quartz monzonite boulders as much as 30 feet (10 m) long; also includes large boulders of limestone, sandstone, and quartzite; probably deposited by debris flows originating in the Pine Valley Mountains west of the quadrangle (Biek and Hylland, 2007); 0 to 90 feet (0-27 m) thick.

Tbh **Brian Head Formation** (Oligocene - late Eocene) – Yellow-gray to pale-orange tuffaceous sandstone, conglomerate, mudstone, and minor limestone, shale, and claystone; weathers to drab gray and brown slopes; sandstone is mostly poorly sorted and cross-bedded; lower part is largely yellow-orange weathering siltstone and claystone; lower contact may be an unconformity; as much as 120 m (400 ft) thick.

unconformity

Claron Formation (Eocene - Paleocene)

Tcw **White member** – White to light-gray limestone and chalky claystone; calcite-filled vugs and fractures are common; forms massive rough-weathering cliffs; contains some limy shale partings; 20 to 40 m (60-120 ft) thick.

Tcp **Pink member** – Pink, orange, and pale gray, commonly stained limestone, limey mudstone, dolomite, mudstone, and conglomerate; irregularly bedded; nodular and mottled paleosols common; weathers into picturesque cliffs, columns, spires, and pinnacles; commonly overlying limestone breccia and a basal conglomerate; basal beds of map unit locally equivalent to Pine Hollow and Canaan Peak Formations (Bowers, 1972); unit forms the Pink Cliffs of the Grand Staircase; 150 to 250 m (490-820 ft) thick.

unconformity

CRETACEOUS ROCKS

(see Eaton, 1991, for additional discussion of Cretaceous units and contacts in this quadrangle and surrounding area)

Kk **Kaiparowits Formation** (Upper Cretaceous) – Drab-gray, olive-gray, brown-gray, and green-gray sandstone, mudstone, and siltstone; sandstone is very fine to fine grained; bedding is poorly defined and lenticular; forms ledgy steep slopes and badlands; lesser amounts of thin light-gray mudstone and light yellow-gray calcareous siltstone are interbedded; locally contains molluscan fragments, plant debris, and dinosaur bones; 0 to 75 m (0-250 ft) thick; absent or thin and mapped with the Wahweap Formation (Kwk) in Paunsaugunt Plateau area.

Kwk **Wahweap and Kaiparowits Formations, undivided**

Kw **Wahweap Formation** (Upper Cretaceous) – Mostly gray to yellow-gray, interbedded mudstone, claystone, sandstone, siltstone, and conglomerate with some brown fine- to medium-grained sandstone beds; forms slopes and ledges; 100 to 200 m (330-660 ft) thick below and south of the Paunsaugunt Plateau and 245 to 300 m (800-1000 ft) thick south of the Markagunt Plateau.

Straight Cliffs Formation (Upper Cretaceous)

Ksu **Upper unit** – Interbedded yellow-gray to light-brown sandstone and gray mudstone and siltstone; forms ledges, cliffs, and slopes; sandstone is fine to coarse grained and locally conglomeratic; upper part commonly forms a sandy conglomeratic cliff that may correlate with the Drip Tank Member of the Straight Cliffs Formation in the Kaiparowits Plateau; mudstones are locally carbonaceous and contain thin coal beds, especially toward the east; 300 to 380 m (900-1250 ft) thick.

Ksl **Lower unit** – Yellow-gray, orange-gray, and light-brown sandstone interbedded with lesser quantities of mudstone, siltstone, and claystone; generally forms a cliff or a series of ledges; locally contains carbonaceous mudstone and very thin beds of coal and coaly shale in upper part, especially toward the east; locally intertongues with the Tropic Shale below; 26 to as much as 100 m (85-330 ft) thick.

Kt **Kt** **Tropic Shale** (Upper Cretaceous) – Mapped as single line where thin in western part of map area. Drab-gray, marine shale with subordinate gray sandstone; generally forms a steep slope; sandstone becomes more abundant in the upper part and to the west; thins to the west where unit interfingers with non-marine sandstone beds and contains carbonaceous mudstone and very thin coaly beds; lower contact placed stratigraphically higher to west (see Dakota discussion); 90 to 300 m (300-1000 ft) thick; thickness varies irregularly, but generally is thicker to the east.

Kdcm **Dakota and Cedar Mountain Formations, undivided** (Upper-Lower Cretaceous; Cenomanian to Albian?) (Cedar Mountain beds locally present at base of unit) – Yellowish-brown, gray, and white, thin- to thick-bedded, interbedded sandstone, sandy shale, carbonaceous shale, shaly sandstone, conglomerate, smectitic mudstone, coal, and marl; forms a moderate to steep slope with ledgy cliffs; sandstone is fine to medium grained; smectitic strata become more common westward; oysters, clams, and gastropods are common; map unit is conducive to landsliding and complete, undeformed exposures are uncommon; lower contact is a regional unconformity; forms the Gray Cliffs of the Grand Staircase with the cliff-forming units of the Straight Cliffs Formation; 60 to 270 m (200-900 ft) thick; thickens westward across quadrangle; in western part of quadrangle (west of 112°45' W.) upper contact is placed at top of "sugarledge sandstone" (Hylland, 2000; Biek and Hylland, 2007; also see Gustason, 1989; Elder and others, 1994), making contact stratigraphically higher than in central part of map area where sugarledge sandstone is included in Tropic Shale (Cashion, 1961; Doelling and Davis, 1989; Sable and Hereford, 2004). Lower part of unit is 0 to 30 m (0-100 ft) of yellowish-brown, brown, pale-olive-gray, and gray, commonly variegated, thin- to medium-bedded sandstone, smectitic mudstone, and pebble conglomerate with a local thick basal conglomerate ledge; overall, this lower interval is thin, locally not present, and commonly difficult to distinguish from remaining Dakota strata; Hylland (2000) and Biek and Hylland (2007) mapped this interval as Cedar Mountain Formation because lithologic similarity and age data suggest it is correlative with the Cedar Mountain Formation of central Utah, while some workers consider it the basal part of the Dakota Formation (Titus and others, 2005).

unconformity

JURASSIC ROCKS

Je **Entrada Sandstone** (Middle Jurassic) – Pale-yellow to pale-green-gray sandstone and siltstone, very fine to fine-grained sandstone, and coarse siltstone in exposures between Indian Hollow and Adams Wash; forms earthy weathering steep slopes or mud-plastered cliffs; in the extreme northeast corner of the quadrangle, the lower part of the unit is present and is red-brown, fine-grained sandstone that forms smooth rounded, "slickrim" cliffs; 0 to 170 m (0-560 ft) thick; thins westward and is entirely "cut out" beneath a pre-Cedar Mountain unconformity west of Adams Wash; in the northeast corner of the quadrangle only the lower 88 m (290 ft) of the formation is exposed.

Jc **Carmel Formation** (Middle Jurassic) (cross section only)

Carmel Formation – upper part (Middle Jurassic)

Jcw **Winsor Member –** Red and yellow silty sandstone; contains a few thin gypsum beds near the top in the extreme northeast part of the quadrangle; red colors dominate to the east and yellow colors dominate to the west; forms earthy-weathering steep slopes; 60 to 85 m (200-280 ft) thick; thins to the west.

Jcp **Paria River Member** – White alabaster gypsum at base with overlying red siltstone, white sandstone, and chippy weathering white to pink microgranular limestone at the top; locally the basal gypsum is missing; limestone at top locally contains casts and molds of pelecypods; overlies the Thousand Pockets Tongue of the Page Sandstone to the east and the Crystal Creek Member of the Carmel Formation to the west; 18 to 50 m (60-165 ft) thick; unit thins and thickens irregularly in relation to the thickness of gypsum, but generally thins westward; thickest gypsum bed is about 12 m (40 ft) thick.

Page Sandstone (Middle Jurassic)

Jpt **Thousand Pockets Tongue** – Yellow, white, or brown sandstone; generally massive and cross-bedded with thin red siltstone intercalations; overlies the Crystal Creek Member of the Carmel Formation to the west and the Judd Hollow Tongue of the Carmel Formation east of the Paunsaugunt fault; 0 to 30 m (0-100 ft) thick; thins westward and pinches out near Skutumpah Creek.

Carmel Formation – lower part (Middle Jurassic)

Jcx **Crystal Creek Member –** Brown-banded sandstone, siltstone, and mudstone; generally earthy weathering; forms slopes and mounds; common gypsum as cement or veinlets; 15 to 55 m (50-180 ft) thick where not mapped as part of the Judd Hollow Tongue; thickens westward.

Jcc **Co-op Creek Limestone Member** – Light-gray limestone and tan limey shale; forms thick limestone ledges at base and top with steep limestone shale in the middle; 3 to 4 m (9-12 ft) of red to brown siltstone interbedded with thin limestone beds common at base; locally fossiliferous with pelecypods, gastropods, and star-shaped crinoid columnals; unconformably overlies Navajo Sandstone to the east and Temple Cap Sandstone to the west; 15 to 80 m (50-260 ft) thick where not mapped as part of the Judd Hollow Tongue; thickens westward.

Jci **Judd Hollow Tongue** – Combined Crystal Creek and Co-op Creek Members where thin in the east part of the quadrangle underlying the Thousand Pockets Tongue of the Page Sandstone (Jpt); mostly forms a lower red slope and an upper white bench between Jpt and the Navajo Sandstone; unconformably overlies the Navajo Sandstone; 30 to 60 m (100-200 ft) thick; thins eastward.

unconformity

Jt **Temple Cap Sandstone** (Middle Jurassic) – Light-pink-gray, cross-bedded, cliff-forming sandstone with a few intercalations of dark-red siltstone (White Throne Member) overlying dark-red siltstone and silty sandstone (Sinawava Member) at the base; present only in the west part of the quadrangle where unconformably overlies Navajo Sandstone; 0 to 60 m (0-200 ft) thick; thickens westward.

unconformity

Jn **Navajo Sandstone** (Lower Jurassic) – White, pink, and brown sandstone; forms cliffs, domes, and bare-rock outcrops; famous for high-angle cross-beds in sets to 10 m (30 ft) thick or more; generally divisible into an upper white, cliff-forming, calcareous part recognized as the White Cliffs in the Grand Staircase, a less resistant pink part commonly covered with sand and cemented with iron oxides, and a lower cliff-forming brown part that contains many planar beds (not mapped separately); the Navajo is an excellent aquifer; 395 to 670 m (1300-2200 ft) thick; thickens westward.

Jkt **Jnl** **Tenney Canyon Tongue of the Kayenta Formation** (Lower Jurassic) – (Mapped as single line between Jn and Jnl where thin or locally missing on the Wygaret Terrace west of the Paunsaugunt fault in eastern part of map area.) Red-brown siltstone, mudstone, and fine-grained sandstone; generally forms a steep slope, but locally contains thick to massive, planar, ledge-forming sandstone beds at the top of the unit; 0 to 98 m (0 to 320 ft) thick; pinches out eastward. The type locality (never officially defined) and name source of this unit is a small canyon about 6 km (4 mi) north of Kanab called Tenney Canyon on plate 2 of Gregory (1950) that is now called Tiny Canyon on modern U.S. Geological Survey topographic maps. (This "Tenney" differs from spelling of Tenny Creek in basalt lava flows unit description).

Jnl **Jnl** **Lamb Point Tongue of the Navajo Sandstone** (Lower Jurassic) – (Mapped as single line between Jk and Jkt where thin in western part of map area.) White to light-gray, mostly fine-grained sandstone; massive with high-angle cross-beds; red-brown and locally planar bedded in far west exposures; pinches out in southwest part of quadrangle; merges into main part of Navajo Sandstone in eastern part of quadrangle; excellent aquifer in the Kanab area; 0 to 125 m (0-410 ft) thick; thickens eastward.

Jk **Main body of the Kayenta Formation** (Lower Jurassic) – Red to red-brown sandstone, siltstone, and claystone with lesser amounts of limestone and intraformational conglomerate; locally, especially to the east, lavender, white, and brown sandstone is common; sandstone is dominant in eastern exposures, siltstone and claystone in western exposures; forms ledges and slopes to the east and steep slopes to the west; constitutes the entire formation where the Lamb Point Tongue is not present. All of the Kayenta Formation, including the Tenney Canyon Tongue, thickens westward; the entire formation along the Cockscomb is 60 to 90 m (200-300 ft) thick, near Kanab the Tenney Canyon Tongue is about 28 m (90 ft) thick and the main body is about 95 m (315 ft) thick, in the Zion Canyon area the Tenney Canyon Tongue is about 96 m (315 ft) thick and the main body is nearly 106 m (350 ft) thick, and in the southwest corner of the quadrangle the Kayenta Formation (where there is no Lamb Point Tongue) is about 183 m (600 ft) thick.

JURASSIC-TRIASSIC ROCKS

JRmo **Moenave Formation and Springdale Sandstone Member of Kayenta Formation** (Lower Jurassic - Upper Triassic) – Generally red-orange to brown sandstone, siltstone, and shale; sandstone is mostly fine grained and commonly forms ledges and cliffs; generally divisible into two or three members (not mapped separately): in descending order – Springdale Sandstone Member, Whitmore Point Member, and Dinosaur Canyon Member. At the time source mapping was done, the Springdale was a member of the Moenave Formation; it was recently reassigned to the Kayenta Formation (see discussion and references in Biek and Hylland, 2007); the Springdale Sandstone generally forms cliffs and with the main body of the Kayenta Formation forms the Vermilion Cliffs of the Grand Staircase. In the west part of the quadrangle, the Whitmore Point Member forms a slope or a recess beneath the Springdale Sandstone and commonly contains fish fossil fragments; it pinches out east of Kanab near Johnson Canyon (Hayden, 2006). The Dinosaur Canyon Member forms ledges and steep slopes and rests unconformably on the Triassic Chinle Formation. As far west as Kitchen Corral Wash a thin layer of the Wingate Sandstone may be recognized at the base of the Dinosaur Canyon Member. The Springdale Sandstone is 27 to 60 m (90-200 ft) thick and unconformably overlies lower units, the Whitmore Point is 0 to 24 m (0-80 ft) thick, and the Dinosaur Canyon is 43 to 76 m (140-250 ft) thick.

unconformity

TRIASSIC ROCKS

Tc **Chinle Formation** (Upper Triassic) (cross section only)

Tcu **Upper members (Church Rock, Owl Rock, Petrified Forest, and Monitor Butte Members)** – Picturesque, varicolored and banded mudstone, claystone, sandstone, siltstone, limestone, and conglomerate; generally forms a steep slope; prone to landsliding that commonly involves the overlying Dinosaur Canyon Member of the Moenave Formation; locally contains petrified wood and siliceous nodules; 130 to 240 m (425-800 ft) thick.

Trcl **Lower member (Shinarump Conglomerate Member and locally part of Monitor Butte Member)** – Gray, yellow-gray, and gray-orange conglomeratic sandstone, sandstone, and minor gray mudstone; massive and generally forms cliff; remobilized iron oxides commonly form Liesegang bands; upper part (locally part of Monitor Butte Member) commonly forms ledges or steep slopes rather than cliffs; locally contains large amounts of petrified logs and branches; unconformable with Moenkopi Formation below; 0 to 47 m (0-155 ft) thick; discontinuous and thins and thickens in paleochannels to the east.

unconformity

Trm **Moenkopi Formation** (Lower Triassic) – Entire formation on cross section. Does not include Timpoweap Member along Kaibab monocline in southeast part of map area.

Trmu **Upper red member** – Dark-brown to dark-red sandstone in thin to thick beds; micaceous; forms cliffs and steep slopes; 38 to 50 m (99-165 ft) thick.

Trms **Shnabkaib Member** – Light-brown and white, interbedded sandstone, shale, and impure gypsum; earthy weathering; forms ledges and slopes; individual gypsum beds as much as 2 m (6 ft) thick; member is about 50 to 67 m (165-220 ft) thick.

Trmm **Middle red member** – Light red-brown to orange-brown, lightly banded sandstone, and red siltstone and mudstone; sandstone is fine grained; thin to thick bedded; crisscrossed with gypsum veinlets and upper part cemented with gypsum; earthy weathering, forming gentle to steep slopes; 85 to 113 m (280-370 ft) thick.

Trml **Lower red member** – Red sandstone and siltstone capped by about 10 m (30 ft) of calcareous sandstone (Virgin Limestone Member equivalent); sandstone is fine grained and the unit forms gentle to steep slopes; upper calcareous sandstone is platy to thin bedded and forms ledges; 43 to 67 m (140-220 ft) thick.

Trmt **Timpoweap Member** – Light gray-brown limestone, dolomite, sandstone, cherty breccia, and siltstone; thin to thick bedded; some sandstone beds are pebbly; upper half is more resistant and forms a cliff over a ledgy lower part; locally a thin section of tan and brown siltstone (Black Dragon Member?) underlies the unit; contact with Kaibab Formation below is an unconformity; 6 to 15 m (20-50 ft) thick at exposures on Buckskin Mountain in the southeast part of the quadrangle; well data indicate the Timpoweap may be as much as 45 m (150 ft) thick in western part of the quadrangle.

unconformity

PERMIAN ROCKS

Pk **Kaibab Formation** (lower Permian) – Cherty gray limestone and dolomitic limestone and calcareous, commonly cherty sandstone; divisible into two members (not mapped separately), upper Harrisburg Member and lower Fossil Mountain Member; Harrisburg rocks are ledge-and slope-forming and unfossiliferous; Fossil Mountain rocks are massive, cliff forming, and fossiliferous containing mostly brachiopods, crinoid columnals, and bryozoa; thickness of the Kaibab ranges from 45 to 90 m (150-295 ft) in outcrops in the southeast corner of the quadrangle, of which 5 to 25 m (15-80 ft) is Harrisburg Member; it may be 45 to 155 m (150-500 ft) thick in the quadrangle subsurface and thickens to the west.

Pt **Toroweap Formation** (includes possible thin **Coconino Sandstone)** (lower Permian) – Limestone, dolomite, anhydrite, gypsum, and sandstone. Upper part (Woods Ranch Member) is mostly slope-forming, yellow-gray and red-brown, very fine- to fine-grained calcareous sandstone, with discontinuous gypsum, travertine, and intraformational conglomerate, and is about 46 m (150 ft) thick; middle part (Brady Canyon Member) is yellow-gray, cherty, fossiliferous, cliff-forming limestone and subordinate sandstone, and is about 30 m (100 ft) thick; lower part (Coconino Sandstone) is pale-yellow, fine-grained, cliff-forming, quartz sandstone about 20 m (65 ft) thick. Map unit is 96 to 102 m (315-335 ft) thick in Buckskin Gulch in southeast corner of quadrangle.

Ph **Hermit Formation** – Red-brown, silty sandstone, mudstone, and shale; forms slope; only upper 17 m (55 ft) exposed in the southeast corner of the quadrangle in Buckskin Gulch; wells indicate the formation is 32 to 190 m (105-625 ft) thick in the subsurface.

MAP SYMBOLS

- Contact – Dashed where approximately located
- Fault – Dashed where approximately located; dotted where concealed; bar and ball on down-thrown side

[This map shows many solid and dashed faults bounding surficial deposits in places where the fault and the surficial deposit contact are in approximately the same location; these faults are shown this way on the original source maps; this does not imply that fault movement cut or displaced the surficial deposit]

- Anticline – Showing axial trace; arrow on trace shows direction of plunge; dotted where concealed
- Syncline – Showing axial trace; arrow on trace shows direction of plunge; dotted where concealed
- Monocline – Line placed on axial trace of upper hinge; dotted where concealed
- 2400 / 1800 Structural contour – Contours in meters; *red* - drawn on top of Navajo Sandstone (western, southern, and eastern part of map in areas of Jurassic and older outcrops); *purple* - drawn on top of Jurassic Entrada or Carmel Formation (north-central part of map in area of Cretaceous and younger outcrops); dashed where projected above ground
- Cinder cone
- Oil or gas exploration drill hole – Plugged and abandoned
- Sand, gravel, or road-fill quarry
- Abandoned mine
- A — A' Line of cross section

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Figure 3 GEOLOGIC MAP - DESCRIPTION OF UNITS

East Fork Virgin River - Cove Reservoir Watershed Plan - EIS

near Orderville, Kane County, Utah

East Fork Virgin River - Alternatives Screening Matrix

10/14/2021

None | Low | Medium | High | Further Study Needed

			Constructability Concerns								Special Environmental Concerns					
Alternative	**Meets Purpose and Need**	**On-Channel Reservoir**	**Removal of Homes/Buldings for Construction**	**Irrigated Land Loss**	**Geotechnical Challenges**	**Sedimentation Load**	**Required Dam Height**	**Earthwork Quantity**	**Diversion Changes / Energy Requirements**	**Road Realignment Impacts**	**Perennial Stream Impacts**	**Intermittent Stream Impacts**	**Wetland Impacts**	**Cultural Resource Impacts**	**Riparian Area Impacts**	**Sensitive Fish Species Impacts**
Lower Swapp Reservoir	Yes	No	0	0 ac		115 ac-ft @ 50yrs	97 ft	1159198	Pump & pipeline needed							
Stout Creek Upper Reservoir	Yes	Yes	0	0 ac		950 ac-ft @ 50yrs	152 ft	1553511	Pump & pipeline needed							
Stout Creek Lower Reservoir	Yes	Yes	Possibly 1 Outbuilding	0 ac		1150 ac-ft @ 50yrs	158 ft	1548485	Pump & pipeline needed							
Lydia's Canyon Upper Reservoir	Yes	Yes	0	15 ac		600 ac-ft @ 50yrs	185 ft	2430834	Pump & pipeline needed				0 ac			
Lydia's Canyon Lower Reservoir	Yes	Yes	9	88 ac		750 ac-ft @ 50yrs	162 ft	1979492	Pump & pipeline needed							
Dry Wash Reservoir	Yes	No	1	20 ac	Faults	340 ac-ft @ 50yrs	139 ft	1085076	Pump & pipeline needed				0 ac			
Cove Reservoir (Full)	Yes	No	0	0 ac		235 ac-ft @ 50yrs	86 ft	1192320	Existing pipeline plus gravity feed				0 ac			
Muddy Creek Upper Reservoir	Yes	Yes	0	0 ac		1300 ac-ft @ 50yrs	115 ft	1293213	Pump back to users							
Muddy Creek Lower Reservoir	Yes	Yes	Possibly 2 Outbuildings	180 ac	Gypsum	1,300+ ac-ft @ 50yrs	85 ft	924873	Pump back to users				0 ac			
Conservation (No-Build)	No	N/A														
Cove Reservoir (Small)	Yes	No	0	0 ac		235 ac-ft @ 50yrs	67	897,590	Existing pipeline plus gravity feed							

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MEMO DRAFT

Date: July 22, 2024

To: KCWCD East Fork Virgin River Watershed Plan – Project Team

From: Brent Gardner

Re: 3,000 vs. 6,000-Acre Foot Reservoir Analysis

Items:

As requested, I am providing the information that has been provided in the past in the form of a memo to the project team. We have developed the following information in relation to the construction of a 3,000 acre foot (AF) reservoir verses a 6,000 AF reservoir:

1) Earthwork quantities for the construction of the dam are reduced by approximately 40% with the lower dam height but foundation preparation requirements were not reduced substantially. In addition, the excavation required for the smaller reservoir spillway was over 100% higher. There was an overall reduction in cost of approximately $6,732,796.

2) The 6,000 AF reservoir had a cost of $31,511,514 or $5,252 per AF in 2023 dollars. The 3,000 AF reservoir cost was $24,778,718 or $8,260 per AF.

3) Having a larger reservoir increases the surface area available for recreation from approximately 122 acres to 187 acres or an increase of about 50%.

4) A larger reservoir also provides for additional storage at a higher elevation to reduce evaporation losses and provide for drought relief when needed. According to Utah State University Research Report 145 approximately 43 inches of lake evaporation occurs in the St. George area annually and 27 inches in the Orderville area near the Cove Reservoir site or a reduction of approximately 60%.

5) With maximum demands placed on the reservoir a yield of 2,148 AF could be met during each of the 54 years of record with a 6,000 AF capacity reservoir. A 3,000 AF reservoir only yielded 1,453 AF of water during the same period of record. The larger reservoir yielded 48% more water with an increase of 27% in cost.

6) The smaller reservoir did not provide an adequate water supply during 17 of the 54 years of record to the Kane County irrigators. The larger reservoir did not meet the irrigation demands during one year of the 54 years of record. The following average annual yields would be provided to the KCWCD and the WCWCD with the differing sizes of reservoirs:

Cove Reservoir Size	KCWCD	WCWCD
3,000 AF	784 AF	1,092 AF
6,000 AF	867 AF	1,340 AF

It should be noted that the WCWCD anticipates an overall yield to their system of 700 AF from the Cove Reservoir as the Division of Water Resources (DOWR) water model shows that a portion of the high water available at the Cove Reservoir diversion is also available at the Quail Creek Diversion dam during the same period to fill the Quail Lake and Sand Hollow Reservoirs. However, there is reduced evaporation losses storing the water at a higher elevation.

End of Memo

Standard Best Management Practices and Standard Operating Procedures

As part of standard operating procedures, standard best management practices (BMPs) would be implemented throughout the project in order to reduce potential adverse environmental impacts. Most of the impacts are short-term and generally occur during the construction period. Project design and implementation of site-specific or selectively recommended BMPs would minimize the effect of the project where the potential for long-term, adverse impacts may occur. These BMPs were taken from the Draft Cove Reservoir Plan of Development (POD) (Appendix E, Plan of Development for Cove Reservoir).

Standard BMPs
1. All construction vehicle movement outside of the ROW would be restricted to pre-designated access roads, contractor-acquired access roads, or public roads.
2. The limits of construction activities would be predetermined, with activity restricted to and confined within those limits. No paint or permanent discoloring agents would be applied to rocks or vegetation to indicate survey or construction activity limits. The ROW boundary would be flagged in environmentally sensitive areas, described in the POD, to alert construction personnel that those areas would be avoided.
3. In construction areas where re-contouring is not required, vegetation would be left in place wherever possible to avoid excessive root damage and allow for resprouting.
4. In construction areas where ground disturbance is significant or where recontouring is required, surface restoration would occur as required by the landowner or land management agency. The method of restoration typically would consist of returning disturbed areas to their natural contour (to the extent practical) and reseeding or revegetating with native plants. Seed viability would be tested and seed mixes would be certified to contain no noxious weeds.
5. Prior to construction, all construction personnel would be instructed on the protection of cultural, paleontological, and ecological resources. To assist in this effort, the construction contract would address (a) federal and state laws regarding antiquities, fossils, and plants and wildlife, including collection and removal; and (b) the importance of these resources and the purpose and necessity of protecting them.
6. An initial intensive cultural resource inventory survey would be conducted prior to construction. Impact avoidance and mitigation measures developed in consultation with appropriate land management and regulatory agencies and other interested parties would be implemented subsequent to the completion of the National Environmental Policy Act (NEPA) compliance document.
7. Any cultural and/or paleontological resource discovered during construction by the Kane County Water Conservancy District (KCWCD) or any person working on their behalf on public or federal land would be reported immediately to the authorized officer. The KCWCD would suspend operations in the area until an evaluation is completed to prevent the loss of cultural or scientific values.
8. All construction and maintenance activities would be conducted in a manner that would minimize disturbance to vegetation, drainage channels, and intermittent and perennial stream banks. In addition, dust-control measures would be utilized as necessary during construction in sensitive areas. Any used existing roads would be left in a condition equal to or better than their condition prior to construction.
9. All requirements of those entities having jurisdiction over air quality matters would be adhered to and any necessary permits for construction activities would be obtained. Open burning of construction trash (cleared trees, etc.) would not be allowed on Bureau of Land Management- (BLM) or U.S. Forest Service- (USFS) administered lands.
10. Fences and gates, if damaged or destroyed by construction activities, would be repaired or replaced to their original pre-disturbed condition as required by the landowner or the land management agency. Temporary gates would be installed only with the permission of the landowner or the land management agency.
11. Totally enclosed containment would be provided for all hazardous materials (if needed) and trash. All construction waste including trash, litter, garbage, other solid waste, petroleum products, and other potentially hazardous materials would be removed to a disposal facility authorized to accept such materials.
12. Third-party environmental contractors would be used throughout the construction effort, from clearing through rehabilitation.
13. The KCWCD would trim trees, in preference to cutting trees, and would cut trees, in preference to bulldozing them.
14. Construction holes left open overnight would be covered to prevent livestock or wildlife from harm.

Standard BMPs
15. The contractor would clean off-road equipment (power or high-pressure cleaning) of all mud, dirt, and plant parts prior to moving equipment onto public land.

Additional Stipulations

The following additional stipulations would be implemented throughout the construction and operation of the project and would be included as part of the standard operating procedures.

Stipulations – Standard Operating Procedures
1. KCWCD would construct, operate, and maintain the facilities, improvements, and structures within this ROW in strict conformity with the POD, as it is approved. Any relocation, additional construction, or use that is not in accord with the approved POD would not be initiated without the prior written approval of the authorized officer. A copy of the complete ROW grant or acknowledgment, including all stipulations and approved POD, would be made available on the ROW area during construction, operation, and maintenance to the authorized officer. Noncompliance with the above shall be grounds for an immediate temporary suspension of activities if it constitutes a threat to public health and safety or a material threat to the environment.
2. This POD describes in detail the construction, operation, maintenance of the ROW and its associated improvements and/or facilities. An approved POD may be referred to for interpretation of the ROW grant.
3. KCWCD would contact the authorized officer at least 10 days prior to the anticipated start of construction and/or any surface-disturbing activities. The authorized officer may require and schedule a preconstruction conference with the KCWCD prior to commencement of construction and/or surface disturbing activities on the ROW. The KCWCD, its contractor(s), or agents involved with the construction and/or surface disturbing activities on the ROW should attend this conference to review the stipulations of the grant and the POD.
4. KCWCD would designate a representative(s) who would have the authority to act upon and implement instructions from the authorized officer within a reasonable time when construction or other surface disturbing activities are underway.
5. KCWCD would protect all survey monuments found within the ROW. Survey monuments include but are not limited to General Land Office and BLM Cadastral Survey Corners, reference corners, witness points, U.S. Coastal and Geological Survey benchmarks and triangulation stations, military control monuments, and recognizable civil (both public and private) survey monuments. In the event of obliteration or disturbance of any of the above, the KCWCD would immediately report the incident, in writing, to the authorized officer and the respective installing authority, if known. Where General Land Office or BLM ROW monuments or references are obliterated during operations, KCWCD shall secure the services of a registered land surveyor or a BLM cadastral surveyor to restore the disturbed monuments and references using surveying procedures found in the *Manual of Surveying Instructions for the Survey of the Public Lands of the United States*, latest edition. KCWCD shall record such survey in the appropriate county and send a copy to the authorized officer. If the BLM cadastral surveyors or other federal surveyors are used to restore the disturbed survey monument, KCWCD would be responsible for the survey cost.
6. The KCWCD or the successor in interest shall comply with Title VI of the Civil Rights Act of 1964 (42 U.S.C. 2000d et. seq.) and the regulations of the Secretary of Interior issued pursuant hereto.
7. KCWCD would mark the exterior boundaries of the ROW with a stake and/or lath. The intervals may be varied at the time of staking at the discretion of the authorized officer. The tops of the stakes and/or laths would be painted and the laths flagged in a distinctive color as determined by the holder. The survey station numbers would be marked on the boundary stakes and/or laths at the entrance to and exit from public land. Holder would maintain all boundary stakes and/or laths in place until final cleanup and restoration are completed and approved by the authorized officer. The stakes and/or laths would then be removed at the direction of the authorized officer.
8. KCWCD would conduct all activities associated with the construction, operation, and maintenance of the ROW within the authorized limits of the ROW and approved POD.
9. KCWCD would survey and clearly mark the centerline and/or exterior limits of the ROW, as determined by the authorized officer.

Stipulations – Standard Operating Procedures
10. All design, material, and construction, operation, maintenance, and termination practices would be in accordance with safe and proven engineering practices.
11. KCWCD would inform the authorized officer within 48 hours of any accidents on federal lands that require reporting to the Department of Transportation as required by 49 CFR Part 195.
12. During conditions of extreme fire danger, operations may be suspended or limited in certain areas.
13. KCWCD would be liable for damage or injury to the United States to the extent provided by 43 CFR Sec. 2803.1-4. KCWCD would be held to a standard of strict liability for damage or injury to the United States resulting from fire or soil movement (including landslides and slumps as well as wind- and water-caused movement of particles) caused or substantially aggravated by any of the following within the ROW or permit area: • Activities of the holder including but not limited to construction, operation and maintenance of the facility. • Activities of other parties acting under color of authority from the KCWCD, including but not limited to: o land clearing; o earth-disturbing and earth-moving work; and o blasting.
14. Within 30 days of completion, KCWCD would submit to the authorized officer, as-built drawings and a certification of construction verifying that the facility has been constructed (and tested) in accordance with the design, plans, specifications, and applicable laws and regulations.
15. Construction sites would be maintained in a sanitary condition at all times. Waste materials at those sites would be disposed of promptly at an appropriate waste disposal site. "Waste" means all discarded matter including but not limited to human waste, debris, garbage, refuse, oil drums, petroleum products, ashes, and equipment.
16. Prior to preconstruction activities on the subject parcel, KCWCD would identify all noxious weeds present. A list of the weeds would be provided to the authorized officer. A determination would be made by the authorized officer of any noxious weeds that may require flagging for treatment. KCWCD shall treat the noxious weeds as required by the authorized officer.
17. KCWCD would clean off-road equipment (power or high-pressure cleaning) of all mud, dirt, and plant parts prior to moving equipment onto public land authorized under this lease.
18. Gravel and/or fill material to be placed in relatively weed-free areas must come from weed-free sources. Prior to obtaining gravel and/or fill material, the authorized officer would inspect the source for weeds and determine adequacy of site.
19. KCWCD would identify a road maintenance program, which would include monitoring for noxious weeds. If KCWCD identifies any noxious weeds, KCWCD would notify the authorized officer immediately. A treatment program would be identified and KCWCD would be responsible for weed abatement.

Best Management Practices

As part of standard operating procedures, standard BMPs would be implemented throughout the project in order to reduce potential adverse environmental impacts. Most of the impacts are short term and generally occur during the construction period. Project design and implementation of site-specific or selectively recommended BMPs would minimize the effect of the project where the potential for long-term, adverse impacts may occur.

STANDARD BMPs
1. All construction vehicle movement outside of the right-of-way would be restricted to pre-designated access, contractor acquired access, or public roads.
2. The limits of construction activities would be predetermined, with activity restricted to and confined within those limits. No paint or permanent discoloring agents would be applied to rocks or vegetation to indicate survey or construction activity limits. The right-of-way boundary would be flagged in environmentally sensitive areas described in the plan of development to alert construction personnel that those areas would be avoided.
3. In construction areas where re-contouring is not required, vegetation would be left in place wherever possible to avoid excessive root damage and allow for re-sprouting.
4. In construction areas where ground disturbance is significant or where re-contouring is required, surface restoration would occur as required by the landowner or land management agency. The method of restoration typically would consist of returning disturbed areas to their natural contour (to the extent practical) and reseeding or re-vegetating with native plants. Seed viability would be tested and seed mixes would be certified to contain no noxious weeds.
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6. An initial intensive cultural resource inventory survey would be conducted prior to construction. Impact avoidance and mitigation measures developed in consultation with appropriate land management and regulatory agencies and other interested parties would be implemented subsequent to the completion of the NEPA compliance document.
7. Any cultural and/or paleontological resource discovered during construction by the KCWCD or any person working on their behalf on public or federal land would be reported immediately to the authorized officer. The KCWCD would suspend operations in the area until an evaluation is completed to prevent the loss of cultural or scientific values.
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STANDARD BMPs
9. All requirements of those entities having jurisdiction over air quality matters would be adhered to and any necessary permits for construction activities would be obtained. Open burning of construction trash (cleared trees, etc.) would not be allowed on BLM- or USFS-administered lands.
10. Fences and gates, if damaged or destroyed by construction activities, would be repaired or replaced to their original pre-disturbed condition as required by the landowner or the land management agency. Temporary gates would be installed only with the permission of the landowner or the land management agency.
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14. Construction holes left open overnight would be covered to prevent livestock or wildlife from harm.
15. The contractor would clean off-road equipment (power or high-pressure cleaning) of all mud, dirt, and plant parts prior to moving equipment onto public land.

ADDITIONAL STIPULATIONS

The following additional stipulations would be implemented throughout the construction and operation of the project and would be included as part of the standard operating procedures.

STIPULATIONS – STANDARD OPERATING PROCEDURES
1. KCWCD would construct, operate, and maintain the facilities, improvements, and structures within this ROW in strict conformity with the plan of development as it is approved. Any relocation, additional construction, or use that is not in accord with the approved plan of development would not be initiated without the prior written approval of the authorized officer. A copy of the complete ROW grant or acknowledgment, including all stipulations and approved plan of development, would be made available on the ROW area during construction, operation, and maintenance to the authorized officer. Noncompliance with the above shall be grounds for an immediate temporary suspension of activities if it constitutes a threat to public health and safety or a material threat to the environment.
2. This plan of development describes in detail the construction, operation, maintenance of the ROW and its associated improvements and/or facilities. An approved plan of development may be referred to for interpretation of the right-of-way grant.
3. KCWCD would contact the authorized officer at least 10 days prior to the anticipated start of construction and/or any surface-disturbing activities. The authorized officer may require and

STIPULATIONS – STANDARD OPERATING PROCEDURES
schedule a preconstruction conference with the KCWCD prior to commencement of construction and/or surface-disturbing activities on the ROW. The KCWCD, its contractor(s), or agents involved with the construction and/or surface-disturbing activities on the ROW should attend this conference to review the stipulations of the grant and the plan(s) of development.
4. KCWCD would designate a representative(s) who would have the authority to act upon and implement instructions from the authorized officer within a reasonable time when construction or other surface-disturbing activities are underway.
5. KCWCD would protect all survey monuments found within the right-of-way. Survey monuments include but are not limited to General Land Office and BLM Cadastral Survey Corners, reference corners, witness points, U.S. Coastal and Geodetic benchmarks and triangulation stations, military control monuments, and recognizable civil (both public and private) survey monuments. In the event of obliteration or disturbance of any of the above, the KCWCD would immediately report the incident, in writing, to the authorized officer and the respective installing authority, if known. Where General Land Office or BLM ROW monuments or references are obliterated during operations, KCWCD shall secure the services of a registered land surveyor or a BLM cadastral surveyor to restore the disturbed monuments and references using surveying procedures found in the *Manual of Surveying Instructions for the Survey of the Public Lands of the United States*, latest edition. KCWCD shall record such survey in the appropriate county and send a copy to the authorized officer. If the BLM cadastral surveyors or other federal surveyors are used to restore the disturbed survey monument, KCWCD would be responsible for the survey cost.
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8. KCWCD would conduct all activities associated with the construction, operation, and maintenance of the right-of-way within the authorized limits of the ROW and approved plan of development.
9. KCWCD would survey and clearly mark the centerline and/or exterior limits of the ROW, as determined by the authorized officer.
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13. KCWCD would be liable for damage or injury to the United States to the extent provided by 43 CFR Sec. 2803.1-4. KCWCD would be held to a standard of strict liability for damage or injury to the

STIPULATIONS – STANDARD OPERATING PROCEDURES
United States resulting from fire or soil movement (including landslides and slumps as well as wind and water-caused movement of particles) caused or substantially aggravated by any of the following within the ROW or permit area: • Activities of the holder including but not limited to construction, operation and maintenance of the facility. • Activities of other parties acting under color of authority from the KCWCD, including but not limited to: - land clearing - earth-disturbing and earth-moving work - blasting
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Cove Reservoir
SITES Analysis

Kane County, Utah

RB&G ENGINEERING, INC.
1435 West 820 North
Provo, Utah 84601
801-374-5771 Provo
801-521-5771 Salt Lake City
801-374-5773 Fax

MEMORANDUM

To: Brent Gardner, P.E.

From: Brandon Horrocks, P.E.

Date: November 13, 2019

This memorandum describes auxiliary spillway stability and integrity analyses performed for the proposed Cove Dam, located in Kane County, Utah. The purpose of these analyses was to evaluate if the planned auxiliary spillway to be excavated into the native materials near the left abutment of the dam will meet NRCS stability and integrity design requirements. It is anticipated that this memorandum will be included in Appendix D of the project Environmental Assessment, and that the studies and documents referenced herein, such as the hydrological analyses, 2004 Cove Dam Feasibility Study, and preliminary design drawings will also be included in Appendix D, and the reader will have access to these documents for reference.

Flood routing and spillway evaluation analyses were performed for the calculated Stability Design Hydrograph (SDH) and Freeboard Hydrograph (FBH). The reservoir inflow hydrographs were provided to us by Alpha Engineering. The calculated SDH and FBH provided to us have peak reservoir inflows of 1,516 and 3,524 cfs, respectively. Routing analyses performed indicated that the SDH can be routed through the proposed Cove Reservoir and principal spillway without use of the auxiliary spillway; therefore, no erosion within the auxiliary spillway would occur as a result of the stability design storm, and the NRCS stability design requirements would be satisfied. An integrity design erosion analysis for the auxiliary spillway while passing the FBH was performed using the NRCS SITES computer program (version 2015.1.8). The calculated peak flow through the auxiliary spillway while routing the FBH through the reservoir is 378 cfs. NRCS requires that the spillway be designed to not breach during passage of the FBH.

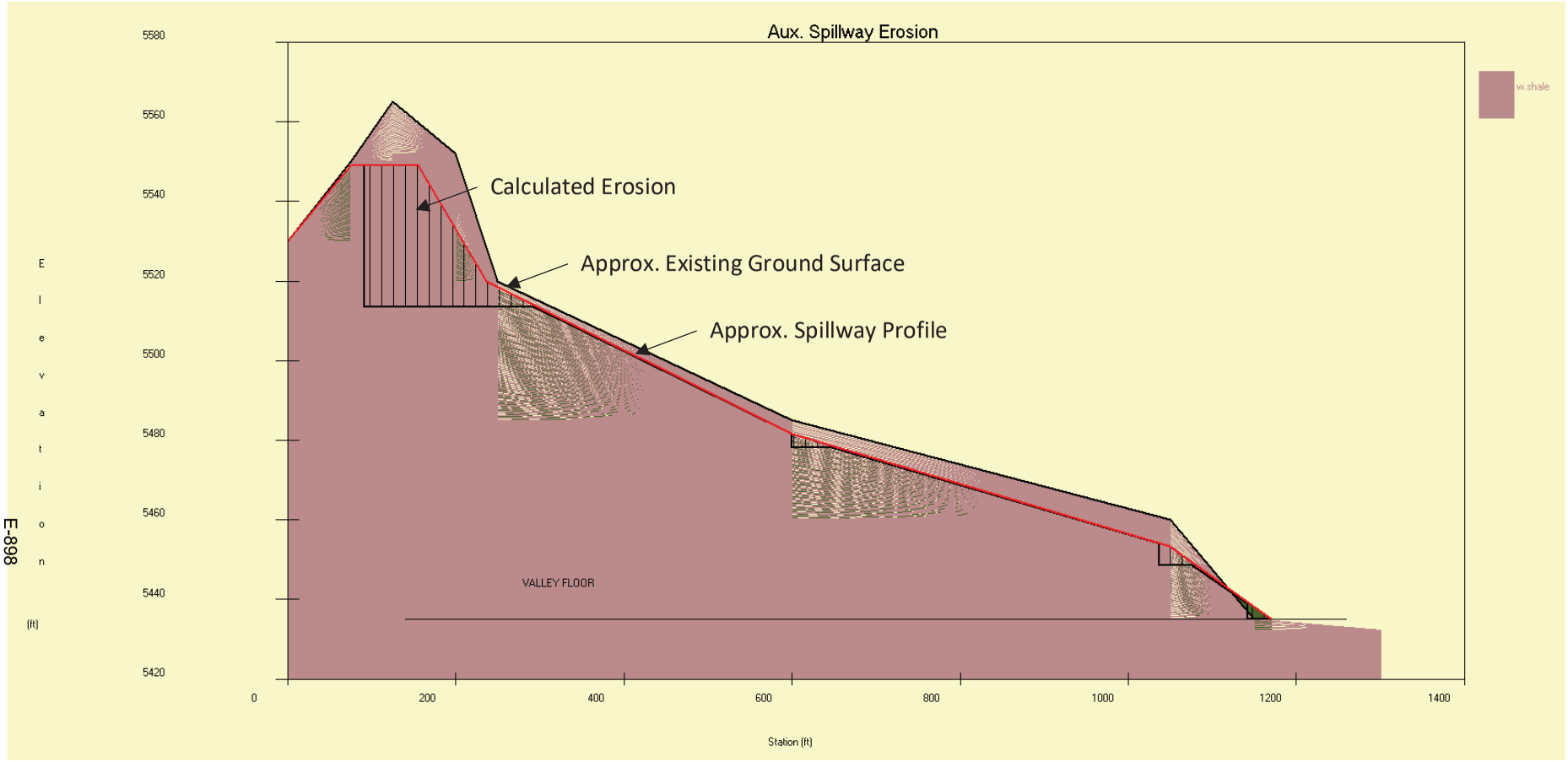
The boring completed on the left abutment nearest the proposed auxiliary spillway during the 2004 feasibility study (DH04-5) encountered weathered shale at the ground surface. Based upon

a review of erosion parameters for weathered shale included in the SITES program Help menu, a head cut index of 0.2 and representative diameter of 1 inch was used to model the weathered shale materials.

The existing ground surface and proposed spillway profile along the planned auxiliary spillway alignment were inputted into the SITES model. The existing topography along the planned spillway is as steep as about 1.5H:1V (Horizontal:Vertical). The planned spillway profile will require excavation into the native subsurface materials, resulting in spillway flowline grades as steep as about 3H:1V.

The results of the SITES analysis are illustrated on the attached output graphic, and it will be noted that the estimated erosion as a result of the FBH does not result in a spillway breach. The results of the analysis indicate that NRCS auxiliary spillway integrity requirements are satisfied.

We appreciate the opportunity to provide this service to you. Please feel free to contact us if you have any questions.

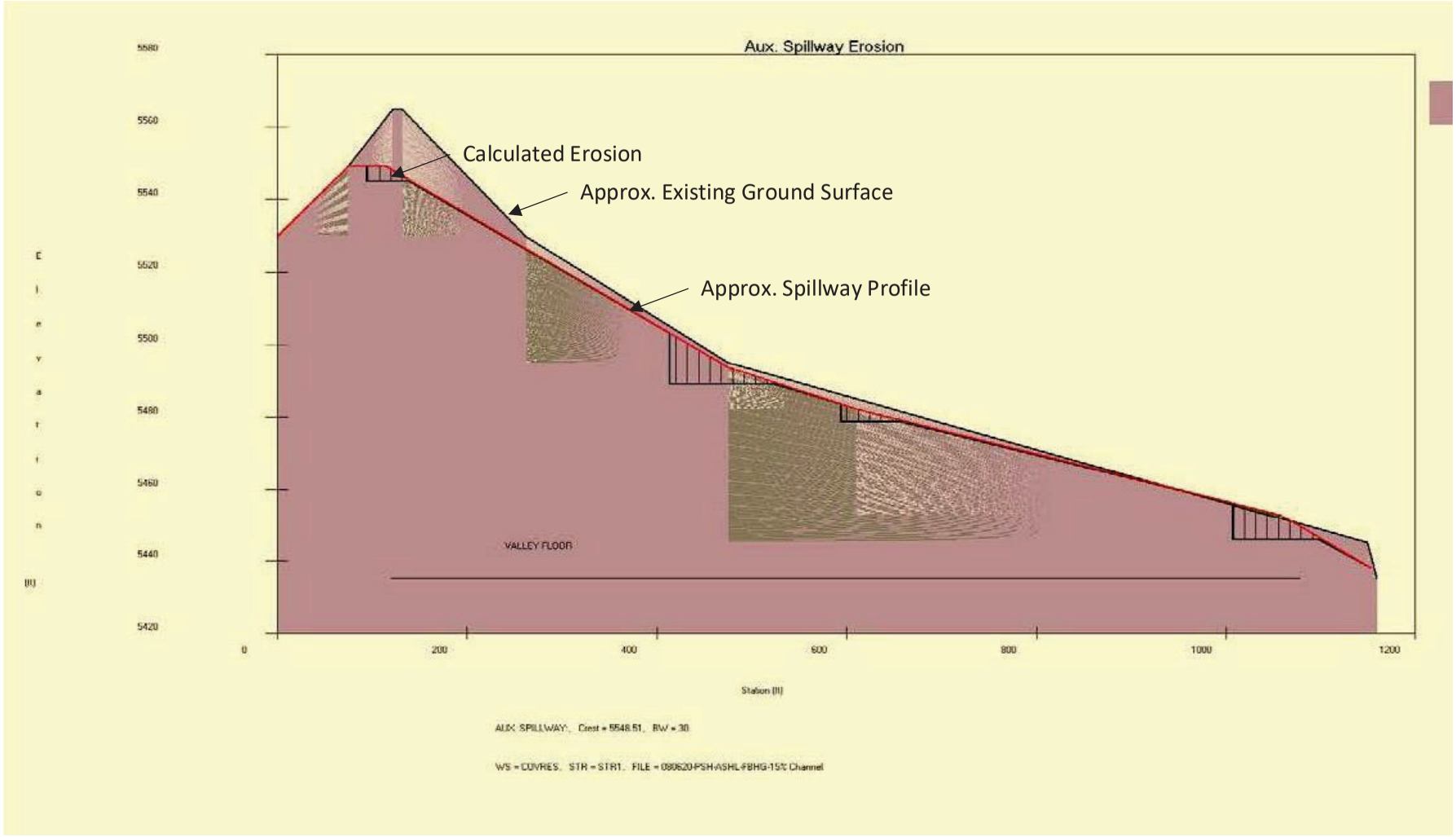


E-898

RB&G ENGINEERING, INC.

SITES OUTPUT

Cove Reservoir
Kane County, Utah



RB&G ENGINEERING, INC.

SITES OUTPUT

Cove Reservoir
Kane County, Utah

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SITES XEQ 08/28/2020   WATER RESOURCE SITE ANALYSIS COMPUTER PROGRAM
     VER 2005.1.8              (USER MANUAL - DATED DECEMBER 2005)
     TIME 16:21:21

************************* 80-80 LIST OF INPUT Data ***************************

SITES     01/01/2005COVRES    COV RES                        4.74      C3
SAVMOV    0    101
SAVMOV    101  1                                                      1
STRUCTURE STR1      Cove Res
                    5470                                     0.18
                    5480                                     62.26
                    5490                                     303.40
                    5500                                     738.03
                    5510                                     1400.09
                    5520                                     2323.02
                    5530                                     3541.97
                    5540                                     5073.81
                    5545.5                                   6055.03
                    5550                                     6934.92
                    5552                                     7347.18
                    5552.5                                   7450.25
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                    0         11        14        15        15
                    15        15        15        15        15
                    15        16        16        16        16
                    16        16        16        16        16
                    16        17        17        17        17
                    17        17        17        17        17
                    17        18        18        18        18
                    18        18        18        18        19
                    19        19        19        19        19
                    20        20        20        20        20
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                    21        21        22        22        22
                    22        23        23        23        23
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                    27        27        27        28        28
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                    34        35        35        36        37
                    38        39        40        41        42
                    43        45        46        48        49
                    51        53        56        58        61
                    65        69        74        80        87
                    96        109       127       157       219
                    850       479       259       172       132
                    111       98        88        81        75
                    70        65        62        59        56
                    54        51        50        48        46
                    45        43        42        41        40
                    39        38        37        36        35
                    35        34        33        33        32
                    32        31        30        30        29
                    29        29        28        28        27
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                    27        27        26        26        26
                    25        25        25        24        24
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                    21        20        20        20        20
                    20        20        19        19        19
                    19        19        19        19        18
                    18        18        18        18        18
                    18        17        17        17        17
                    17        17        17        17        17
                    17        16        16        16        16
                    16        16        16        16        16
                    16        15        15        15        15
                    15        15        15        15        15
                    15        4         1
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HYD       3                 Auxiliary Spillway (Local)
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                    6         39        194       687       1365
                    2027      2180      1955      1683      1441
                    1248      1107      1001      924       874
                    833       748       589       423       283
                    180       112       73        47        28
                    16        9         5         3         1
                    1         0
ENDTABLE
HYD       5                 Freeboard (General)
                    1.2
                    0         0         4         35        84
                    195       425       1352      3365      3296
                    2008      1331      1060      912       792
                    742       664       624       613       611
                    547       262       90        24        5
                    1         0
ENDTABLE
WSDATA    2C CR             4.74
PDIRECT                               9.40      16.00
POOLDATA  ELEV              5545.5              5552      5435      SC
PSINLET             1       3.75
PSDATA    1         1000      30                0.012     5450
ASSPRFL   41
          0         5530      75        5549.2  115       5549.2
          475       5493.8    610       5482.3  1057      5453
          1153      5438
ENDTABLE
ASSURFACE 41        1170      1
          0         1170      .025      0         1
ENDTABLE
ASDATA    41                            2                             1
BTMWIDTH  FEET      30
ASMATERIAL
          1         50        1         75        115       .25
ENDTABLE
ASCOORD    1        W.Shale   N
          0         5530      75        5549.3    122       5565
          132       5565      262       5530      475       5495
          1150      5445      1155      5440      1160      5435
```

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 ENDTABLE
 GRAPHICS  I
 GO,DESIGN LCPIO     TYPE2     24
 SAVMOV    2    101  1                   STR1
 ENDJOB

 ********************************************************************************

 ***** MESSAGE - DEFAULT TOPSOIL FILL MATERIAL PARAMETERS USED.

 ***** MESSAGE - AUXILIARY SPILLWAY CREST ELEVATION IS SET TO  5549.20
                 FROM THE ASSPRFL RECORDS.

 ***** MESSAGE - VALUES FROM ASSURFACE, REACH  1 IMPLY NO VEGETAL COVER WITH
                 "n" OF 0.025.


1SITES ----------------------------------------------------------------------
 XEQ 08/28/2020                    COV RES                        WSID= COVRES
 VER 2005.1.8                        Cove Res                       SUBW= CR
 TIME 16:21:21           SITE = STR1             PASS=    1     PART=   1


 **********************    MATERIAL PROPERTIES    ****************************
                            DRY                    PERCENT       DETACH.      REP.
      MATERIAL       PI    DENSITY        Kh        CLAY         RATE      DIAMETER
                           lbs/CuFt                            (Ft/H)/(lb/SqFt)  inches
     W.Shale        50.      115.      0.25        75.0          --        1.00000
     TS_FILL         0.      100.      0.05         0.0          --        0.05000
     GEN_FILL       50.      115.      0.25        75.0          --        1.00000

 ****************************    BASIC Data    ********************************
 HUMID- SUBHUMID CLIMATE AREA                    DESIGN CLASS  C

 INFLOW HYDROGRAPH(S) ENTERED

 PRECIP. - Q-PS,1-DAY    Q-PS,10-DAY       P-SD          P-FB
               0.00          0.00          9.40         16.00

 WSDATA -       CN          DA-SM          TC/L           -/H          QRF
               0.00          4.74          0.00          0.00         0.00

 SITEDATA- PERM POOL     CREST PS        FP SED       VALLEY FL        378?
               0.00       5545.50          0.00        5435.00          NO

           BASEFLOW      INITIAL EL     EXTRA VOL      SITE TYPE
               0.00          0.00          0.00         DESIGN

 PSDATA -  NO. COND        COND L         DIA/W           -/H
               1.00       1000.00         30.00          0.00

              PS N            KE         WEIR L         TW EL
             0.012          1.00          3.75        5450.00

            2ND STG         ORF H          ORF L      START AUX.
               0.00          0.00          0.00          0.00

 ASCRESTS -   AUX.1         AUX.2         AUX.3         AUX.4         AUX.5
```

5549.20	0.00	0.00	0.00	0.00

AUX.Data - REF.NO.	RETARD. Ci	TIE STATION	INLET LENGTH
41	0.00	115.00	0

AUX.Data - INLET N	SIDE SLOPE	EXIT N	EXIT SLOPE	ACTUAL AUX?
0.025	2.00	0.025	0.154	NO

BTM WIDTH -	BW1	BW2	BW3	BW4	BW5
ft	30.00	0.00	0.00	0.00	0.00

AUXILIARY SPILLWAY RATING DEVELOPED USING WSPVRT.

1********** DETAILED LIST OF BASIC Data **********

WEIR COEF. FOR ORIFICES.....	3.10	RATIO OF Ia TO S (CH.10,NEH4).	0.20
WEIR COEF. FOR DROP INLET.....	3.10	TIME INCS TO PEAK OF UNIT HYD.	10.
DISCHARGE COEF. FOR ORIFICES.....	0.60	NO. POINTS FOR DESIGN HYD. ...	5000
HOOD, WEIR INLET COEF.	0.60	DRAWDOWN TIME LIMIT - DAYS....	10.0
HOOD, PIPE ENTRANCE COEF.	0.60	DRAWDOWN RATIO STORAGE LIMIT..	0.15
HOOD, SLUG FLOW COEF.	0.00	OTHER DRAWDOWN RATIOS APPLY ?.	NO
PS ACCURACY OF FULL FLOW CALC.,FT	0.01	WSP ALLOWABLE FSS VEL. CHANGE.	0.05
FILLET SIZE FOR BOX CONDUITS.....	6.00	WSP FSS CALC. PRECISION, FT..	0.005
GRAVITATIONAL CONSTANT.....	32.16	AUX. SPILLWAY MIN. CAP. COEF.	237.0
MIN. NHCP378 PS PIPE AREA SQFT..	0.545	AUX. SPILLWAY MIN. CAP. EXP.	0.493
MIN. TR60 DEPTH AUX. TO TOP DAM..	3.00	MIN. AUX. BW IN BW SOLUTION,FT	20.0
MIN. NHCP378 DEPTH AUX.TO TOP DAM	2.00	PRECISION OF BW SOLUTION.....	1.0
MIN. NHCP378 DEPTH PS - AUX.CREST	1.00	OLD TR60 CRITERIA USED	NO
MIN. NHCP378 DEPTH DESIGN Q - TOD	1.00	OLD NHCP378 CRITERIA USED	NO

EMBANKMENT TEMPLATE: TOP WIDTH = (calc.), MAX. CROWN = 0.667 ft,

SIDE SLOPE RATIOS		WAVE BERM WIDTH	MULTIPLE STABILITY BERMS U&D/S WIDTHS	DELTA H	SEPARATE STABILITY BERMS WIDTHS, ft		HEIGHTS, ft	
U/S	D/S	ft	ft	ft	U/S	D/S	U/S	D/S
2.50	2.50	10.0	0.0	0.00	0.00	0.00	0.00	0.00

DIMENSIONLESS UNIT HYDROGRAPH
STANDARD DIMENSIONLESS UNIT HYDROGRAPH
PEAK FACTOR = 484.0 | TIME INC. =0.020 | NO. INC. TO PEAK = 10.
VOLUME FACTOR = 48.3429

0.0000	0.0300	0.1000	0.1900	0.3100
0.4700	0.6600	0.8200	0.9300	0.9900
1.0000	0.9900	0.9300	0.8600	0.7800
0.6800	0.5600	0.4600	0.3900	0.3300
0.2800	0.2410	0.2070	0.1740	0.1470
0.1260	0.1070	0.0910	0.0770	0.0660
0.0550	0.0470	0.0400	0.0340	0.0290
0.0250	0.0210	0.0180	0.0150	0.0130
0.0110	0.0090	0.0080	0.0070	0.0060
0.0050	0.0040	0.0030	0.0020	0.0010
0.0000				

EXISTING NATURAL SURFACE AT AUXILIARY SPILLWAY SITE - X,Y COORDINATES:

0.	5530.00
75.	5549.30
122.	5565.00
132.	5565.00
262.	5530.00
475.	5495.00
1150.	5445.00
1155.	5440.00
1160.	5435.00

1NRCS DESIGN STORM RAINFALL DISTRIBUTION (CHAPTER 21, NEH4 & TR-60).

0.000	0.008	0.016	0.025	0.033
0.043	0.052	0.063	0.074	0.086
0.099	0.112	0.126	0.142	0.160
0.180	0.205	0.255	0.345	0.437
0.530	0.603	0.633	0.660	0.684
0.705	0.724	0.742	0.759	0.775
0.790	0.804	0.818	0.831	0.844
0.856	0.868	0.879	0.890	0.900
0.910	0.920	0.930	0.939	0.948
0.957	0.966	0.975	0.983	0.992
1.000				

24 HOUR TYPE II RAINFALL DISTRIBUTION
IDENTIFICATION NAME IS TYPE2 GIVEN DURATION = 24.0 HRS

0.000	0.001	0.002	0.003	0.004
0.005	0.006	0.007	0.008	0.009
0.010	0.012	0.013	0.014	0.015
0.016	0.017	0.018	0.020	0.021
0.022	0.023	0.024	0.026	0.027
0.028	0.029	0.031	0.032	0.033
0.034	0.036	0.037	0.038	0.040
0.041	0.042	0.044	0.045	0.047
0.048	0.049	0.051	0.052	0.054
0.055	0.057	0.058	0.060	0.061
0.063	0.065	0.066	0.068	0.070
0.071	0.073	0.075	0.076	0.078
0.080	0.082	0.084	0.085	0.087
0.089	0.091	0.093	0.095	0.097
0.099	0.101	0.103	0.105	0.107
0.109	0.111	0.113	0.116	0.118
0.120	0.122	0.125	0.127	0.130
0.132	0.135	0.138	0.141	0.144
0.147	0.150	0.153	0.157	0.160
0.163	0.166	0.170	0.173	0.177
0.181	0.185	0.189	0.194	0.199
0.204	0.209	0.215	0.221	0.228
0.235	0.243	0.251	0.261	0.271
0.283	0.307	0.354	0.431	0.568
0.663	0.682	0.699	0.713	0.725
0.735	0.743	0.751	0.759	0.766
0.772	0.778	0.784	0.789	0.794
0.799	0.804	0.808	0.812	0.816
0.820	0.824	0.827	0.831	0.834
0.838	0.841	0.844	0.847	0.850

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      0.854      0.856      0.859      0.862      0.865
      0.868      0.870      0.873      0.875      0.878
      0.880      0.882      0.885      0.887      0.889
      0.891      0.893      0.895      0.898      0.900
      0.902      0.904      0.906      0.908      0.910
      0.912      0.914      0.915      0.917      0.919
      0.921      0.923      0.925      0.926      0.928
      0.930      0.931      0.933      0.935      0.936
      0.938      0.939      0.941      0.942      0.944
      0.945      0.947      0.948      0.949      0.951
      0.952      0.953      0.955      0.956      0.957
      0.958      0.960      0.961      0.962      0.964
      0.965      0.966      0.967      0.968      0.970
      0.971      0.972      0.973      0.975      0.976
      0.977      0.978      0.979      0.981      0.982
      0.983      0.984      0.985      0.986      0.988
      0.989      0.990      0.991      0.992      0.993
      0.994      0.996      0.997      0.998      0.999
      1.000

1SITES ------------------------------------------------------------------------
 XEQ 08/28/2020                    COV RES                          WSID= COVRES
 VER 2005.1.8                       Cove Res                          SUBW= CR
 TIME 16:21:21           SITE = STR1              PASS=    1     PART=   2

MESSAGE ---- Climatic Index changed from 0.0 to 1.0 for this run.

 CREST PS       5545.50 FT    6055.0 ACFT      0.00 AC     126.3 CFS

 SED ACCUM      5545.50 FT    6055.0 ACFT      0.00 AC     126.3 CFS

 START ELEV     5545.50 FT    6055.0 ACFT      0.00 AC       0.0 CFS

 INFLOW HYDROGRAPH PROVIDED IN LOCATION  1,  PEAK=    850.00 CFS, AT 120.00 HRS.
 TITLE = Principal Spillway

 HYD       PO              4.74Cove Res                                COVRES  1
           0             1.0000                                      STR1    2
                           0.03       0.03       0.10       0.18       0.26   PO D  3
                           0.34       0.41       0.49       0.57       0.65   PO D  4
                           0.73       0.81       0.89       0.97       1.05   PO D  5
                           1.13       1.22       1.30       1.38       1.45   PO D  6
                           1.53       1.61       1.70       1.78       1.86   PO D  7
                           1.95       2.03       2.11       2.19       2.27   PO D  8
                           2.35       2.43       2.51       2.60       2.68   PO D  9
                           2.77       2.85       2.93       3.01       3.10   PO D 10
                           3.18       3.27       3.35       3.44       3.52   PO D 11
                           3.61       3.70       3.79       3.87       3.96   PO D 12
                           4.05       4.14       4.23       4.32       4.41   PO D 13
                           4.50       4.59       4.68       4.77       4.87   PO D 14
                           4.96       5.05       5.15       5.25       5.34   PO D 15
                           5.44       5.54       5.64       5.74       5.84   PO D 16
                           5.95       6.05       6.16       6.26       6.37   PO D 17
                           6.48       6.59       6.70       6.82       6.93   PO D 18
                           7.05       7.17       7.28       7.40       7.53   PO D 19
                           7.65       7.78       7.91       8.04       8.17   PO D 20
                           8.31       8.45       8.60       8.74       8.89   PO D 21
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9.05	9.21	9.37	9.54	9.71	PO D 22
9.89	10.08	10.27	10.47	10.67	PO D 23
10.89	11.11	11.34	11.59	11.85	PO D 24
12.13	12.43	12.75	13.09	13.47	PO D 25
13.90	14.38	14.94	15.63	17.26	PO D 26
22.38	28.72	32.09	33.90	35.07	PO D 27
35.92	36.60	37.15	37.62	38.02	PO D 28
38.36	38.65	38.90	39.11	39.29	PO D 29
39.45	39.58	39.68	39.78	39.85	PO D 30
39.90	39.94	39.97	39.98	39.99	PO D 31
39.98	39.97	39.94	39.91	39.87	PO D 32
39.82	39.77	39.70	39.64	39.57	PO D 33
39.49	39.41	39.33	39.23	39.14	PO D 34
39.04	38.94	38.84	38.73	38.62	PO D 35
38.50	38.39	38.27	38.15	38.03	PO D 36
37.91	37.78	37.65	37.52	37.39	PO D 37
37.26	37.13	36.99	36.85	36.72	PO D 38
36.58	36.44	36.30	36.16	36.02	PO D 39
35.88	35.74	35.59	35.45	35.30	PO D 40
35.16	35.02	34.87	34.72	34.58	PO D 41
34.43	34.29	34.14	33.99	33.85	PO D 42
33.70	33.55	33.41	33.27	33.12	PO D 43
32.97	32.82	32.68	32.53	32.39	PO D 44
32.25	32.10	31.95	31.80	31.66	PO D 45
31.51	31.37	31.23	31.09	30.95	PO D 46
30.81	30.67	30.52	30.38	30.24	PO D 47
30.10	29.96	29.82	29.68	29.55	PO D 48
29.41	29.28	29.14	29.00	28.86	PO D 49
28.72	28.58	28.45	28.32	28.19	PO D 50
28.06	27.87	27.62	27.36	27.10	PO D 51
26.84	26.58	26.33	26.08	25.83	PO D 52
25.59	25.35	25.10	24.87	24.63	PO D 53
24.40	24.17	23.94	23.71	23.49	PO D 54
23.26	23.04	22.83	22.61	22.40	PO D 55
22.18	21.98	21.77	21.56	21.36	PO D 56
21.16	20.96	20.76	20.57	20.37	PO D 57
20.18	19.99	19.80	19.62	19.43	PO D 58
19.25	19.07	18.89	18.72	18.54	PO D 59
18.37	18.20	18.03	17.86	17.69	PO D 60
17.53	17.36	17.20	17.04	16.88	PO D 61
16.73	16.57	16.42	16.26	16.11	PO D 62
15.96	15.82	15.69	15.61	15.53	PO D 63
15.45	15.37	15.29	15.22	15.14	PO D 64
15.06	14.99	14.91	14.83	14.76	PO D 65
14.69	14.61	14.54	14.46	14.39	PO D 66
14.32	14.25	14.17	14.10	14.03	PO D 67
13.96	13.89	13.82	13.75	13.68	PO D 68
13.61	13.55	13.48	13.41	13.34	PO D 69
13.28	13.21	13.14	13.08	13.01	PO D 70
12.95	12.88	12.82	12.75	12.69	PO D 71
12.63	12.56	12.50	12.44	12.38	PO D 72
12.32	12.25	12.19	12.13	12.07	PO D 73
12.01	11.95	11.89	11.83	11.78	PO D 74
11.72	11.66	11.60	11.54	11.49	PO D 75
11.43	11.37	11.32	11.26	11.21	PO D 76
11.15	11.10	11.04	10.99	10.93	PO D 77
10.88	10.83	10.77	10.72	10.67	PO D 78
10.61	10.56	10.51	10.46	10.41	PO D 79
10.36	10.31	10.26	10.21	10.16	PO D 80

10.11	10.06	10.01	9.96	9.91	PO D 81
9.86	9.81	9.77	9.72	9.67	PO D 82
9.62	9.58	9.53	9.48	9.44	PO D 83
9.39	9.35	9.30	9.26	9.21	PO D 84
9.17	9.12	9.08	9.04	8.99	PO D 85
8.95	8.91	8.86	8.82	8.78	PO D 86
8.74	8.69	8.65	8.61	8.57	PO D 87
8.53	8.49	8.45	8.41	8.37	PO D 88
8.33	8.29	8.25	8.21	8.17	PO D 89
8.13	8.09	8.05	8.02	7.98	PO D 90
7.94	7.90	7.87	7.83	7.79	PO D 91
7.75	7.72	7.68	7.64	7.61	PO D 92
7.57	7.54	7.50	7.47	7.43	PO D 93
7.40	7.36	7.33	7.29	7.26	PO D 94
7.23	7.19	7.16	7.12	7.09	PO D 95
7.06	7.03	6.99	6.96	6.93	PO D 96
6.90	6.86	6.83	6.80	6.77	PO D 97
6.74	6.71	6.68	6.65	6.61	PO D 98
6.58	6.55	6.52	6.49	6.46	PO D 99
6.43	6.41	6.38	6.35	6.32	PO D100
6.29	6.26	6.23	6.20	6.18	PO D101
6.15	6.12	6.09	6.06	6.04	PO D102
6.01	5.98	5.96	5.93	5.90	PO D103
5.88	5.85	5.82	5.80	5.77	PO D104
5.74	5.72	5.69	5.67	5.64	PO D105
5.62	5.59	5.57	5.54	5.52	PO D106
5.49	5.47	5.45	5.42	5.40	PO D107
5.37	5.35	5.33	5.30	5.28	PO D108
5.26	5.23	5.21	5.19	5.16	PO D109
5.14	5.12	5.10	5.08	5.05	PO D110
5.03	5.01	4.99	4.97	4.94	PO D111
4.92	4.90	4.88	4.86	4.84	PO D112
4.82	4.80	4.78	4.76	4.74	PO D113
4.72	4.70	4.68	4.66	4.64	PO D114
4.62	4.60	4.58	4.56	4.54	PO D115
4.52	4.50	4.48	4.46	4.44	PO D116
4.43	4.41	4.39	4.37	4.35	PO D117
4.33	4.32	4.30	4.28	4.26	PO D118
4.24	4.23	4.21	4.19	4.17	PO D119
4.16	4.14	4.12	4.11	4.09	PO D120
4.07	4.06	4.04	4.02	4.01	PO D121
3.99	3.97	3.96	3.94	3.93	PO D122
3.91	3.89	3.88	3.86	3.85	PO D123
3.83	3.82	3.80	3.79	3.77	PO D124
3.76	3.74	3.73	3.71	3.70	PO D125
3.68	3.67	3.65	3.64	3.62	PO D126
3.61	3.60	3.58	3.57	3.55	PO D127
3.54	3.53	3.51	3.50	3.49	PO D128
3.47	3.46	3.45	3.43	3.42	PO D129
3.41	3.39	3.38	3.37	3.35	PO D130
3.34	3.33	3.32	3.30	3.29	PO D131
3.28	3.27	3.25	3.24	3.23	PO D132
3.22	3.21	3.19	3.18	3.17	PO D133
3.16	3.15	3.14	3.12	3.11	PO D134
3.10	3.09	3.08	3.07	3.06	PO D135
3.04	3.03	3.02	3.01	3.00	PO D136
2.99	2.98	2.97	2.96	2.95	PO D137
2.94	2.93	2.92	2.90	2.89	PO D138
2.88	2.87	2.86	2.85	2.84	PO D139

2.83	2.82	2.81	2.80	2.79	PO D140
2.78	2.78	2.77	2.76	2.75	PO D141
2.74	2.73	2.72	2.71	2.70	PO D142
2.69	2.68	2.67	2.66	2.65	PO D143
2.65	2.64	2.63	2.62	2.61	PO D144
2.60	2.59	2.58	2.58	2.57	PO D145
2.56	2.55	2.54	2.53	2.52	PO D146
2.52	2.51	2.50	2.49	2.48	PO D147
2.48	2.47	2.46	2.45	2.44	PO D148
2.44	2.43	2.42	2.41	2.41	PO D149
2.40	2.39	2.38	2.38	2.37	PO D150
2.36	2.35	2.35	2.34	2.33	PO D151
2.32	2.32	2.31	2.30	2.30	PO D152
2.29	2.28	2.27	2.27	2.26	PO D153
2.25	2.25	2.24	2.23	2.23	PO D154
2.22	2.21	2.21	2.20	2.19	PO D155
2.19	2.18	2.17	2.17	2.16	PO D156
2.16	2.15	2.14	2.14	2.13	PO D157
2.12	2.12	2.11	2.11	2.10	PO D158
2.09	2.09	2.08	2.08	2.07	PO D159
2.07	2.06	2.05	2.05	2.04	PO D160
2.04	2.03	2.03	2.02	2.01	PO D161
2.01	2.00	2.00	1.99	1.99	PO D162
1.98	1.98	1.97	1.97	1.96	PO D163
1.96	1.95	1.95	1.94	1.94	PO D164
1.93	1.92	1.92	1.91	1.91	PO D165
1.91	1.90	1.90	1.89	1.89	PO D166
1.88	1.88	1.87	1.87	1.86	PO D167
1.86	1.85	1.85	1.84	1.84	PO D168
1.83	1.83	1.83	1.82	1.82	PO D169
1.81	1.81	1.80	1.80	1.79	PO D170
1.79	1.79	1.78	1.78	1.77	PO D171
1.77	1.76	1.76	1.76	1.75	PO D172
1.75	1.74	1.74	1.74	1.73	PO D173
1.73	1.72	1.72	1.72	1.71	PO D174
1.71	1.70	1.70	1.70	1.69	PO D175
1.69	1.69	1.68	1.68	1.67	PO D176
1.67	1.67	1.66	1.66	1.66	PO D177
1.65	1.65	1.65	1.64	1.64	PO D178
1.64	1.63	1.63	1.63	1.62	PO D179
1.62	1.62	1.61	1.61	1.61	PO D180
1.60	1.60	1.60	1.59	1.59	PO D181
1.59	1.58	1.58	1.58	1.57	PO D182
1.57	1.57	1.56	1.56	1.56	PO D183
1.56	1.55	1.55	1.55	1.54	PO D184
1.54	1.54	1.53	1.53	1.53	PO D185
1.53	1.52	1.52	1.52	1.51	PO D186
1.51	1.51	1.51	1.50	1.50	PO D187
1.50	1.50	1.49	1.49	1.49	PO D188
1.48	1.48	1.48	1.48	1.47	PO D189
1.47	1.47	1.47	1.46	1.46	PO D190
1.46	1.46	1.45	1.45	1.45	PO D191
1.45	1.44	1.44	1.44	1.44	PO D192
1.43	1.43	1.43	1.43	1.43	PO D193
1.42	1.42	1.42	1.42	1.41	PO D194
1.41	1.41	1.41	1.41	1.40	PO D195
1.40	1.40	1.40	1.39	1.39	PO D196
1.39	1.39	1.39	1.38	1.38	PO D197
1.38	1.38	1.38	1.37	1.37	PO D198

1.37	1.37	1.37	1.36	1.36	PO D199
1.36	1.36	1.36	1.35	1.35	PO D200
1.35	1.35	1.35	1.34	1.34	PO D201
1.34	1.34	1.34	1.33	1.33	PO D202
1.33	1.33	1.33	1.33	1.32	PO D203
1.32	1.32	1.32	1.32	1.32	PO D204
1.31	1.31	1.31	1.31	1.31	PO D205
1.31	1.30	1.30	1.30	1.30	PO D206
1.30	1.30	1.29	1.29	1.29	PO D207
1.29	1.29	1.29	1.28	1.28	PO D208
1.28	1.28	1.28	1.28	1.28	PO D209
1.27	1.27	1.27	1.27	1.27	PO D210
1.27	1.27	1.26	1.26	1.26	PO D211
1.26	1.26	1.26	1.26	1.25	PO D212
1.25	1.25	1.25	1.25	1.25	PO D213
1.25	1.24	1.24	1.24	1.24	PO D214
1.24	1.24	1.24	1.24	1.23	PO D215
1.23	1.23	1.23	1.23	1.23	PO D216
1.23	1.23	1.22	1.22	1.22	PO D217
1.22	1.22	1.22	1.22	1.22	PO D218
1.21	1.21	1.21	1.21	1.21	PO D219
1.21	1.21	1.21	1.21	1.20	PO D220
1.20	1.20	1.20	1.20	1.20	PO D221
1.20	1.20	1.20	1.19	1.19	PO D222
1.19	1.19	1.19	1.19	1.19	PO D223
1.19	1.19	1.19	1.18	1.18	PO D224
1.18	1.18	1.18	1.18	1.18	PO D225
1.18	1.18	1.18	1.17	1.17	PO D226
1.17	1.17	1.17	1.17	1.17	PO D227
1.17	1.17	1.17	1.17	1.16	PO D228
1.16	1.16	1.16	1.16	1.16	PO D229
1.16	1.16	1.16	1.16	1.16	PO D230
1.15	1.15	1.15	1.15	1.15	PO D231
1.15	1.15	1.15	1.15	1.15	PO D232
1.15	1.15	1.15	1.14	1.14	PO D233
1.14	1.14	1.14	1.14	1.14	PO D234
1.14	1.14	1.14	1.14	1.14	PO D235
1.14	1.13	1.13	1.13	1.13	PO D236
1.13	1.13	1.13	1.13	1.13	PO D237
1.13	1.13	1.13	1.13	1.13	PO D238
1.12	1.12	1.12	1.12	1.12	PO D239
1.12	1.12	1.12	1.12	1.12	PO D240
1.12	1.12	1.12	1.12	1.12	PO D241
1.11	1.11	1.11	1.11	1.11	PO D242
1.11	1.11	1.11	1.11	1.11	PO D243
1.11	1.11	1.11	1.11	1.11	PO D244
1.11	1.11	1.10	1.10	1.10	PO D245
1.10	1.10	1.10	1.10	1.10	PO D246
1.10	1.10	1.10	1.10	1.10	PO D247
1.10	1.10	1.10	1.10	1.10	PO D248
1.10	1.09	1.09	1.09	1.09	PO D249
1.09	1.09	1.09	1.09	1.09	PO D250
1.09	1.09	1.09	1.09	1.09	PO D251
1.09	1.09	1.09	1.09	1.09	PO D252
1.09	1.08	1.08	1.08	1.08	PO D253
1.08	1.08	1.08	1.08	1.08	PO D254
1.08	1.08	1.08	1.08	1.08	PO D255
1.08	1.08	1.08	1.08	1.08	PO D256
1.08	1.08	1.08	1.08	1.07	PO D257

1.07	1.07	1.07	1.07	1.07	PO D258
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1.07	1.07	1.07	1.07	1.07	PO D261
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1.07	1.06	1.06	1.06	1.06	PO D263
1.06	1.06	1.06	1.06	1.06	PO D264
1.06	1.06	1.06	1.06	1.06	PO D265
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1.06	1.06	1.06	1.06	1.06	PO D267
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1.05	1.05	1.05	1.05	1.05	PO D274
1.05	1.05	1.05	1.05	1.05	PO D275
1.05	1.05	1.05	1.04	1.04	PO D276
1.04	1.04	1.04	1.04	1.04	PO D277
1.04	1.04	1.04	1.04	1.04	PO D278
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1.04	1.04	1.04	1.04	1.04	PO D280
1.04	1.04	1.04	1.04	1.04	PO D281
1.04	1.04	1.04	1.04	1.04	PO D282
1.04	1.04	1.04	1.04	1.04	PO D283
1.04	1.04	1.04	1.04	1.04	PO D284
1.04	1.04	1.04	1.04	1.04	PO D285
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1.00	1.00	1.00	1.00	1.00	PO D417
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1.00	1.00	1.00	1.00	1.00	PO D420
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1.00	1.00	1.00	1.00	1.00	PO D422
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1.00	1.00	1.00	1.00	1.00	PO D425
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1.00	1.00	1.00	1.00	1.00	PO D427
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1.00	1.00	1.00	1.00	1.00	PO D433
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1.00	1.00	1.00	1.00	1.00	PO D462
1.00	1.00	1.00	1.00	1.00	PO D463
1.00	1.00	1.00	1.00	1.00	PO D464
1.00	1.00	1.00	1.00	1.00	PO D465
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1.00	1.00	1.00	1.00	1.00	PO D467
1.00	1.00	1.00	1.00	1.00	PO D468
1.00	1.00	1.00	1.00	1.00	PO D469
1.00	1.00	1.00	1.00	1.00	PO D470
1.00	1.00	1.00	1.00	1.00	PO D471
1.00	1.00	1.00	1.00	1.00	PO D472
1.00	1.00	1.00	1.00	1.00	PO D473
1.00	1.00	1.00	1.00	1.00	PO D474
1.00	1.00	1.00	1.00	1.00	PO D475
1.00	1.00	1.00	1.00	1.00	PO D476
1.00	1.00	1.00	1.00	1.00	PO D477
1.00	1.00	1.00	1.00	1.00	PO D478
1.00	1.00	1.00	1.00	1.00	PO D479
1.00	1.00	1.00	1.00	1.00	PO D480
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1.00	1.00	1.00	1.00	1.00	PO D482
1.00	1.00	1.00	1.00	1.00	PO D483
1.00	1.00	1.00	1.00	1.00	PO D484
1.00	1.00	1.00	1.00	1.00	PO D485
1.00	1.00	1.00	1.00	1.00	PO D486
1.00	1.00	1.00	1.00	1.00	PO D487
1.00	1.00	1.00	1.00	1.00	PO D488

ENDTABLE P 1,T 1489

1SITES ----------

XEQ 08/28/2020 COV RES WSID= COVRES

CREST PS 5545.50 FT 6055.0 ACFT 0.00 AC 126.3 CFS

SED ACCUM 5545.50 FT 6055.0 ACFT 0.00 AC 126.3 CFS

START ELEV 5545.50 FT 6055.0 ACFT 0.00 AC 0.0 CFS

NRCS-PSH RAINFALL 1-DAY = 0.00 IN 10-DAY = 0.00 IN DA = 4.74 SM
RUNOFF 1-DAY = 0.00 IN 10-DAY = 0.00 IN

CLIMATIC INDEX = 1.00 CN 10-DAY = 0. CN 1-DAY = 0.

PEAK = 850.0 CFS, AT 120.0 HRS.

ROUTED RESULT - HYD TYPE EMAX VOL-MAX AMAX QMAX
NRCS-PSH 5547.76 FT 6496.1 ACFT 0.00 AC 40.0 CFS

PS STORAGE 441.0 ACFT, BETWEEN AUX. CREST AND SED. ACCUM ELEVATIONS.

DRAWDOWN (DDT) TEST 5545.84 FT 6121.2 ACFT 4.35 CFS
CONTROL IS 0.150 DETENTION STORAGE

TIME LIMIT REACHED = 10.00 DAYS. FLOW WAS 9.73 CFS, ELEV = 5546.26
(ELEVATION TO START ROUTING SDH AND/OR FBH HAS BEEN RAISED.)

TIME TO DDT TEST DISCHARGE IS 15.79 DAYS - DRAWDOWN STOPPED.

***** NOTE - CREST OF AUX. RAISED TO HOLD 148.03 ACFT NOT EVACUATED IN
DRAWDOWN TIME LIMIT. TOTAL STORAGE REQUIRED = 6644.08 ACFT,
NEW ELEVATION OF AUXILIARY SPILLWAY CREST = 5548.51 FT.

PLOT OF PRINCIPAL SPILLWAY HYDROGRAPH, 1 INCH= 200. CFS

Time	Qin	Qout	Elev	Vol	Area	ExtVel	0. I 200. I 400. I 600. I 800 I
0.00	0.0	0.0	5545.5	6055.5	0.0		.
1.00	11.0	0.0	5545.5	6055.5	0.0		.I
2.00	14.0	0.1	5545.5	6056.5	0.0		.I
3.00	15.0	0.2	5545.5	6057.7	0.0		.I
4.00	15.0	0.3	5545.5	6058.9	0.0		.I
5.00	15.0	0.3	5545.5	6060.1	0.0		.I
6.00	15.0	0.4	5545.5	6061.3	0.0		.I
7.00	15.0	0.5	5545.5	6062.5	0.0		.I
8.00	15.0	0.6	5545.5	6063.7	0.0		.I
9.00	15.0	0.7	5545.6	6064.9	0.0		.I
10.00	15.0	0.7	5545.6	6066.1	0.0		.I
11.00	16.0	0.8	5545.6	6067.3	0.0		.I
12.00	16.0	0.9	5545.6	6068.6	0.0		.I
13.00	16.0	1.0	5545.6	6069.8	0.0		.I
14.00	16.0	1.1	5545.6	6071.1	0.0		.I
15.00	16.0	1.1	5545.6	6072.3	0.0		.I
16.00	16.0	1.2	5545.6	6073.5	0.0		.I
17.00	16.0	1.3	5545.6	6074.7	0.0		.I
18.00	16.0	1.4	5545.6	6076.0	0.0		.I
19.00	16.0	1.5	5545.6	6077.2	0.0		.I

20.00	16.0	1.5	5545.6	6078.4	0.0	.I
21.00	17.0	1.6	5545.6	6079.6	0.0	.I
22.00	17.0	1.7	5545.6	6080.9	0.0	.I
23.00	17.0	1.8	5545.6	6082.1	0.0	.I
24.00	17.0	1.9	5545.6	6083.4	0.0	.I
25.00	17.0	1.9	5545.7	6084.6	0.0	.I
26.00	17.0	2.0	5545.7	6085.9	0.0	.I
27.00	17.0	2.1	5545.7	6087.1	0.0	.I
28.00	17.0	2.2	5545.7	6088.3	0.0	.I
29.00	17.0	2.3	5545.7	6089.5	0.0	.I
30.00	17.0	2.3	5545.7	6090.8	0.0	.I
31.00	18.0	2.4	5545.7	6092.0	0.0	.I
32.00	18.0	2.5	5545.7	6093.3	0.0	.I
33.00	18.0	2.6	5545.7	6094.6	0.0	.I
34.00	18.0	2.7	5545.7	6095.8	0.0	.I
35.00	18.0	2.8	5545.7	6097.1	0.0	.I
36.00	18.0	2.8	5545.7	6098.4	0.0	.I
37.00	18.0	2.9	5545.7	6099.6	0.0	.I
38.00	18.0	3.0	5545.7	6100.8	0.0	.I
39.00	19.0	3.1	5545.7	6102.1	0.0	.I
40.00	19.0	3.2	5545.7	6103.4	0.0	.I
41.00	19.0	3.3	5545.8	6104.7	0.0	.I
42.00	19.0	3.4	5545.8	6106.0	0.0	.I
43.00	19.0	3.4	5545.8	6107.3	0.0	.I
44.00	19.0	3.5	5545.8	6108.6	0.0	.I
45.00	20.0	3.6	5545.8	6109.9	0.0	.I
46.00	20.0	3.7	5545.8	6111.3	0.0	.I
47.00	20.0	3.8	5545.8	6112.6	0.0	.I
48.00	20.0	3.9	5545.8	6114.0	0.0	.I
49.00	20.0	4.0	5545.8	6115.3	0.0	.I
50.00	20.0	4.0	5545.8	6116.6	0.0	.I
51.00	21.0	4.1	5545.8	6118.0	0.0	.I
52.00	21.0	4.2	5545.8	6119.4	0.0	.I
53.00	21.0	4.3	5545.8	6120.7	0.0	.I
54.00	21.0	4.4	5545.8	6122.1	0.0	.I
55.00	21.0	4.5	5545.9	6123.5	0.0	.I
56.00	21.0	4.6	5545.9	6124.8	0.0	.I
57.00	22.0	4.7	5545.9	6126.2	0.0	.I
58.00	22.0	4.8	5545.9	6127.7	0.0	.I
59.00	22.0	4.9	5545.9	6129.1	0.0	.I
60.00	22.0	5.0	5545.9	6130.5	0.0	.I
61.00	23.0	5.1	5545.9	6131.9	0.0	.I
62.00	23.0	5.2	5545.9	6133.4	0.0	.I
63.00	23.0	5.2	5545.9	6134.9	0.0	.I
64.00	23.0	5.3	5545.9	6136.4	0.0	.I
65.00	24.0	5.4	5545.9	6137.8	0.0	.I
66.00	24.0	5.5	5545.9	6139.4	0.0	.I
67.00	24.0	5.6	5545.9	6140.9	0.0	.I
68.00	24.0	5.7	5545.9	6142.4	0.0	.I
69.00	25.0	5.8	5546.0	6144.0	0.0	.I
70.00	25.0	5.9	5546.0	6145.5	0.0	.I
71.00	25.0	6.1	5546.0	6147.1	0.0	.I
72.00	26.0	6.2	5546.0	6148.7	0.0	.I
73.00	26.0	6.3	5546.0	6150.3	0.0	.I
74.00	26.0	6.4	5546.0	6152.0	0.0	.I
75.00	27.0	6.5	5546.0	6153.6	0.0	.I
76.00	27.0	6.6	5546.0	6155.3	0.0	.I
77.00	27.0	6.7	5546.0	6157.0	0.0	.I
78.00	28.0	6.8	5546.0	6158.7	0.0	.I

79.00	28.0	6.9	5546.0	6160.5	0.0	.I
80.00	29.0	7.0	5546.0	6162.2	0.0	.I
81.00	29.0	7.2	5546.1	6164.1	0.0	.I
82.00	29.0	7.3	5546.1	6165.9	0.0	.I
83.00	30.0	7.4	5546.1	6167.7	0.0	. I
84.00	30.0	7.5	5546.1	6169.5	0.0	. I
85.00	31.0	7.7	5546.1	6171.4	0.0	. I
86.00	31.0	7.8	5546.1	6173.4	0.0	. I
87.00	32.0	7.9	5546.1	6175.3	0.0	. I
88.00	33.0	8.0	5546.1	6177.3	0.0	. I
89.00	33.0	8.2	5546.1	6179.4	0.0	. I
90.00	34.0	8.3	5546.1	6181.5	0.0	. I
91.00	35.0	8.5	5546.2	6183.6	0.0	. I
92.00	35.0	8.6	5546.2	6185.8	0.0	. I
93.00	36.0	8.7	5546.2	6188.1	0.0	. I
94.00	37.0	8.9	5546.2	6190.3	0.0	. I
95.00	38.0	9.0	5546.2	6192.7	0.0	. I
96.00	39.0	9.2	5546.2	6195.1	0.0	. I
97.00	40.0	9.4	5546.2	6197.6	0.0	. I
98.00	41.0	9.5	5546.2	6200.2	0.0	. I
99.00	42.0	9.7	5546.3	6202.8	0.0	. I
100.00	43.0	9.9	5546.3	6205.5	0.0	. I
101.00	45.0	10.1	5546.3	6208.3	0.0	.PI
102.00	46.0	10.3	5546.3	6211.3	0.0	.PI
103.00	48.0	10.5	5546.3	6214.3	0.0	.PI
104.00	49.0	10.7	5546.3	6217.4	0.0	.PI
105.00	51.0	10.9	5546.3	6220.7	0.0	.P I
106.00	53.0	11.1	5546.4	6224.0	0.0	.P I
107.00	56.0	11.3	5546.4	6227.6	0.0	.P I
108.00	58.0	11.6	5546.4	6231.4	0.0	.P I
109.00	61.0	11.9	5546.4	6235.3	0.0	.P I
110.00	65.0	12.1	5546.4	6239.5	0.0	.P I
111.00	69.0	12.4	5546.5	6244.1	0.0	.P I
112.00	74.0	12.7	5546.5	6248.9	0.0	.P I
113.00	80.0	13.1	5546.5	6254.2	0.0	.P I
114.00	87.0	13.5	5546.5	6260.0	0.0	.P I
115.00	96.0	13.9	5546.6	6266.5	0.0	.P I
116.00	109.0	14.4	5546.6	6273.8	0.0	.P I
117.00	127.0	14.9	5546.7	6282.3	0.0	.P I
118.00	157.0	15.6	5546.7	6292.8	0.0	.P I
119.00	219.0	17.3	5546.8	6307.0	0.0	.P I
120.00	850.0	22.4	5547.0	6349.5	0.0	.P
121.00	479.0	28.7	5547.3	6402.3	0.0	.P I
122.00	259.0	32.1	5547.4	6430.3	0.0	. P I
123.00	172.0	33.9	5547.5	6445.4	0.0	. P I
124.00	132.0	35.1	5547.5	6455.1	0.0	. P I
125.00	111.0	35.9	5547.6	6462.2	0.0	. P I
126.00	98.0	36.6	5547.6	6467.8	0.0	. P I
127.00	88.0	37.2	5547.6	6472.5	0.0	. P I
128.00	81.0	37.6	5547.7	6476.4	0.0	. P I
129.00	75.0	38.0	5547.7	6479.7	0.0	. P I
130.00	70.0	38.4	5547.7	6482.5	0.0	. P I
131.00	65.0	38.7	5547.7	6484.9	0.0	. PI
132.00	62.0	38.9	5547.7	6487.0	0.0	. PI
133.00	59.0	39.1	5547.7	6488.7	0.0	. PI
134.00	56.0	39.3	5547.7	6490.2	0.0	. PI
135.00	54.0	39.4	5547.7	6491.5	0.0	. PI
136.00	51.0	39.6	5547.7	6492.6	0.0	. PI
137.00	50.0	39.7	5547.7	6493.5	0.0	. PI

138.00	48.0	39.8	5547.7	6494.3	0.0	. P
139.00	46.0	39.8	5547.7	6494.9	0.0	. P
140.00	45.0	39.9	5547.8	6495.3	0.0	. P
141.00	43.0	39.9	5547.8	6495.7	0.0	. P
142.00	42.0	40.0	5547.8	6495.9	0.0	. P
143.00	41.0	40.0	5547.8	6496.0	0.0	. P
144.00	40.0	40.0	5547.8	6496.1	0.0	. X
145.00	39.0	40.0	5547.8	6496.0	0.0	. P
146.00	38.0	40.0	5547.8	6495.9	0.0	. P
147.00	37.0	39.9	5547.8	6495.7	0.0	. P
148.00	36.0	39.9	5547.8	6495.4	0.0	. P
149.00	35.0	39.9	5547.8	6495.0	0.0	. P
150.00	35.0	39.8	5547.7	6494.6	0.0	. P
151.00	34.0	39.8	5547.7	6494.2	0.0	. P
152.00	33.0	39.7	5547.7	6493.7	0.0	. P
153.00	33.0	39.6	5547.7	6493.1	0.0	. P
154.00	32.0	39.6	5547.7	6492.6	0.0	. P
155.00	32.0	39.5	5547.7	6491.9	0.0	. P
156.00	31.0	39.4	5547.7	6491.3	0.0	. P
157.00	30.0	39.3	5547.7	6490.5	0.0	. P
158.00	30.0	39.2	5547.7	6489.8	0.0	. P
159.00	29.0	39.1	5547.7	6489.0	0.0	.IP
160.00	29.0	39.0	5547.7	6488.1	0.0	.IP
161.00	29.0	38.9	5547.7	6487.3	0.0	.IP
162.00	28.0	38.8	5547.7	6486.5	0.0	.IP
163.00	28.0	38.7	5547.7	6485.6	0.0	.IP
164.00	27.0	38.6	5547.7	6484.6	0.0	.IP
165.00	27.0	38.5	5547.7	6483.7	0.0	.IP
166.00	27.0	38.4	5547.7	6482.7	0.0	.IP
167.00	26.0	38.3	5547.7	6481.8	0.0	.IP
168.00	26.0	38.1	5547.7	6480.8	0.0	.IP
169.00	26.0	38.0	5547.7	6479.8	0.0	.IP
170.00	25.0	37.9	5547.7	6478.7	0.0	.IP
171.00	25.0	37.8	5547.7	6477.7	0.0	.IP
172.00	25.0	37.7	5547.7	6476.6	0.0	.IP
173.00	24.0	37.5	5547.7	6475.5	0.0	.IP
174.00	24.0	37.4	5547.6	6474.4	0.0	.IP
175.00	24.0	37.3	5547.6	6473.3	0.0	.IP
176.00	24.0	37.1	5547.6	6472.2	0.0	.IP
177.00	23.0	37.0	5547.6	6471.1	0.0	.IP
178.00	23.0	36.9	5547.6	6470.0	0.0	.IP
179.00	23.0	36.7	5547.6	6468.8	0.0	.IP
180.00	23.0	36.6	5547.6	6467.7	0.0	.IP
181.00	22.0	36.4	5547.6	6466.5	0.0	.IP
182.00	22.0	36.3	5547.6	6465.3	0.0	.IP
183.00	22.0	36.2	5547.6	6464.2	0.0	.IP
184.00	22.0	36.0	5547.6	6463.0	0.0	.IP
185.00	22.0	35.9	5547.6	6461.8	0.0	.IP
186.00	21.0	35.7	5547.6	6460.7	0.0	.IP
187.00	21.0	35.6	5547.6	6459.5	0.0	.IP
188.00	21.0	35.4	5547.6	6458.3	0.0	.IP
189.00	21.0	35.3	5547.6	6457.1	0.0	.IP
190.00	21.0	35.2	5547.6	6455.9	0.0	.IP
191.00	20.0	35.0	5547.5	6454.7	0.0	.IP
192.00	20.0	34.9	5547.5	6453.4	0.0	.IP
193.00	20.0	34.7	5547.5	6452.2	0.0	.IP
194.00	20.0	34.6	5547.5	6451.0	0.0	.IP
195.00	20.0	34.4	5547.5	6449.8	0.0	.IP
196.00	20.0	34.3	5547.5	6448.6	0.0	.IP

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197.00  19.0  34.1 5547.5  6447.4   0.0          .IP
198.00  19.0  34.0 5547.5  6446.2   0.0          .IP
199.00  19.0  33.8 5547.5  6444.9   0.0          .IP
200.00  19.0  33.7 5547.5  6443.7   0.0          .IP
201.00  19.0  33.6 5547.5  6442.5   0.0          .IP
202.00  19.0  33.4 5547.5  6441.3   0.0          .IP
203.00  19.0  33.3 5547.5  6440.1   0.0          .IP
204.00  18.0  33.1 5547.5  6438.9   0.0          .IP
205.00  18.0  33.0 5547.5  6437.7   0.0          .IP
206.00  18.0  32.8 5547.5  6436.4   0.0          .IP
207.00  18.0  32.7 5547.4  6435.2   0.0          .IP
208.00  18.0  32.5 5547.4  6434.0   0.0          .IP
209.00  18.0  32.4 5547.4  6432.8   0.0          .IP
210.00  18.0  32.2 5547.4  6431.6   0.0          .IP
211.00  17.0  32.1 5547.4  6430.4   0.0          .IP
212.00  17.0  32.0 5547.4  6429.2   0.0          .IP
213.00  17.0  31.8 5547.4  6427.9   0.0          .IP
214.00  17.0  31.7 5547.4  6426.7   0.0          .IP
215.00  17.0  31.5 5547.4  6425.5   0.0          .IP
216.00  17.0  31.4 5547.4  6424.3   0.0          .IP
217.00  17.0  31.2 5547.4  6423.1   0.0          .IP
218.00  17.0  31.1 5547.4  6422.0   0.0          .IP
219.00  17.0  30.9 5547.4  6420.8   0.0          .IP
220.00  17.0  30.8 5547.4  6419.7   0.0          .IP
221.00  16.0  30.7 5547.4  6418.5   0.0          .IP
222.00  16.0  30.5 5547.4  6417.3   0.0          .IP
223.00  16.0  30.4 5547.3  6416.1   0.0          .IP
224.00  16.0  30.2 5547.3  6414.9   0.0          .IP
225.00  16.0  30.1 5547.3  6413.7   0.0          .IP
226.00  16.0  30.0 5547.3  6412.6   0.0          .P
227.00  16.0  29.8 5547.3  6411.4   0.0          .P
228.00  16.0  29.7 5547.3  6410.3   0.0          .P
229.00  16.0  29.5 5547.3  6409.2   0.0          .P
230.00  16.0  29.4 5547.3  6408.1   0.0          .P
231.00  15.0  29.3 5547.3  6406.9   0.0          .P
232.00  15.0  29.1 5547.3  6405.7   0.0          .P
233.00  15.0  29.0 5547.3  6404.6   0.0          .P
234.00  15.0  28.9 5547.3  6403.4   0.0          .P
235.00  15.0  28.7 5547.3  6402.3   0.0          .P
236.00  15.0  28.6 5547.3  6401.2   0.0          .P
237.00  15.0  28.5 5547.3  6400.0   0.0          .P
238.00  15.0  28.3 5547.3  6398.9   0.0          .P
239.00  15.0  28.2 5547.3  6397.8   0.0          .P
 Time    Qin  Qout   Elev    Vol   Area  ExtVel  I          I          I          I          I
                                                 0.       200.       400.       600.       800
        END NRCS-PSH   PLOT


**********************************************************************************
RATING TABLE DEVELOPED, SITE = STR1 :
 BY PROGRAM FOR PS AND AUX. SPILLWAYS
 AUX. RATING USED WSPVRT METHOD.


RATING TABLE NUMBER  1
       ELEV.    Q-TOTAL    Q-PS     Q-AUX.    VOLUME     AREA
       FEET       CFS       CFS       CFS      AC-FT     ACRE
  1  5545.50      0.00      0.00      0.00   6055.03      0.00
  2  5546.72     15.71     15.71      0.00   6294.00      0.00
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   3  5547.94     44.43     44.43      0.00   6532.97      0.00
   4  5549.17     81.62     81.62      0.00   6771.95      0.00
                                                FULL CONDUIT FLOW, ELEV = 5550.39 FT
   5  5550.39    125.65    125.65      0.00   7015.04      0.00
   6  5550.65    125.84    125.84      0.00   7069.39      0.00
   7  5550.92    126.01    126.01      0.00   7123.74      0.00
   8  5551.18    126.17    126.17      0.00   7178.09      0.00
   9  5551.44    126.34    126.34      0.00   7232.44      0.00
  10  5551.71    126.50    126.50      0.00   7286.79      0.00
  11  5551.97    126.67    126.67      0.00   7341.14      0.00
  12  5552.23    126.83    126.83      0.00   7395.49      0.00
  13  5552.50    126.99    126.99      0.00   7449.85      0.00

 INFLOW HYDROGRAPH PROVIDED IN LOCATION  3,  PEAK=   2180.00 CFS, AT   3.30 HRS.
 TITLE = Auxiliary Spillway (Local)


 INFLOW HYDROGRAPH PROVIDED IN LOCATION  5,  PEAK=   3365.00 CFS, AT   9.60 HRS.
 TITLE = Freeboard (General)



1SITES ------------------------------------------------------------------------
 XEQ 08/28/2020                    COV RES                          WSID= COVRES
 VER 2005.1.8                       Cove Res                          SUBW= CR
 TIME 16:21:21           SITE = STR1              PASS=    1     PART=   4


 AUX. CREST     5548.51 FT    6644.1 ACFT      0.00 AC      61.7 CFS

      PS STORAGE    589.1 ACFT,  BETWEEN AUX. CREST AND SED. ACCUM ELEVATIONS.

 START ELEV     5546.26 FT    6203.0 ACFT      0.00 AC       9.7 CFS

 ***** WARNING - AUXILIARY CREST LOWER THAN LOW POINT IN SITE.

 NRCS-SDH   INFLOW HYDROGRAPH INPUT, DA =    4.74 SQUARE MILES

      PEAK =      2180.0 CFS, AT    3.3 HRS.

 NRCS-FBH   INFLOW HYDROGRAPH INPUT, DA =    4.74 SQUARE MILES

      PEAK =      3365.0 CFS, AT    9.6 HRS.

 ***** WARNING - MAXIMUM AUX. SURFACE PROFILE ELEVATION ( 5549.20) AND AUXILIARY
                 CREST ( 5548.51) ELEVATION Do NOT MATCH.  MAXIMUM AUX. SURFACE
                 PROFILE ELEVATION USED IN WSPVRT PROCEDURE.


 ***** MESSAGE - INPUT(5549.14) TO INTERPOLATION ROUTINE IS BELOW
                 ARRAY LIMIT(5549.20).


 ********************************************************************************
 RATING TABLE DEVELOPED, SITE = STR1 :
  BY PROGRAM FOR PS AND AUX. SPILLWAYS
  AUX. RATING USED WSPVRT METHOD.
```

RATING TABLE NUMBER 2

	ELEV. FEET	Q-TOTAL CFS	Q-PS CFS	Q-AUX. CFS	VOLUME AC-FT	AREA ACRE	
1	5545.50	0.00	0.00	0.00	6055.03	0.00	
2	5545.83	2.25	2.25	0.00	6120.52	0.00	
3	5546.17	6.37	6.37	0.00	6186.02	0.00	
4	5546.50	11.71	11.71	0.00	6251.52	0.00	
5	5546.84	18.03	18.03	0.00	6317.01	0.00	
6	5547.17	25.20	25.20	0.00	6382.51	0.00	
7	5547.51	33.12	33.12	0.00	6448.00	0.00	
8	5547.84	41.74	41.74	0.00	6513.50	0.00	
9	5548.18	50.99	50.99	0.00	6578.99	0.00	
10	5548.51	60.85	60.85	0.00	6644.49	0.00	
11	5549.14	80.67	80.67	0.00	6766.41	0.00	
12	5549.76	128.97	102.35	26.63	6888.71	0.00	
					FULL CONDUIT FLOW, ELEV = 5550.39 FT		
13	5550.39	227.03	125.67	101.36	7015.14	0.00	
14	5550.49	242.46	125.75	116.71	7036.88	0.00	
15	5550.60	260.89	125.81	135.07	7058.62	0.00	
16	5550.79	295.79	125.93	169.86	7097.77	0.00	
17	5551.02	338.51	126.08	212.44	7145.68	0.00	
18	5551.44	429.26	126.34	302.92	7232.64	0.00	
19	5551.97	558.86	126.67	432.19	7341.44	0.00	
20	5552.50	706.93	126.99	579.94	7450.25	0.00	

****

SUMMARY OF AUXILIARY SPILLWAY SURFACE CONDITIONS USED IN COMPUTATIONS BY REACH

REACH	FROM STA (ft)	TO STA (ft)	SLOPE (%)	RETARDANCE CURVE INDEX@	VEGETAL COVER FACTOR	MAINT. CODE +	ROOTING DEPTH (ft)	REACH LOCATION *
1	0.	75.	-25.6	0.025	**	**	**	INLET
2	75.	115.	0.0	0.025	**	**	**	CREST
3	115.	475.	15.4	0.025	0.00	1		EXIT !
4	475.	610.	8.5	0.025	0.00	1		EXIT
5	610.	1057.	6.6	0.025	0.00	1		EXIT
6	1057.	1153.	15.6	0.025	0.00	1		EXIT

@ The program interprets retardance curve index entries of less than 1 as Manning's n values.
+ The minimum maintenance code value of 2 is used in INTEGRITY computations (the program changes values of 1 to 2 during computation).
* Upper case indicates a reach of constructed spillway channel.
** The program does not use vegetal cover factor, maintenance code, and rooting depth for inlet and crest reaches in computations.
! Reach 3 used in computing exit channel velocities.

****

```
HYD       AO              4.74Cove Res                                    COVRES  1
          0             0.3000                                            STR1    2
                          7.76      7.76      7.79      8.01      8.88   AO D  3
                         10.93     14.81     20.04     25.63     31.00   AO D  4
                         35.80     40.07     43.92     47.45     50.65   AO D  5
                         53.79     56.77     59.50     61.84     63.63   AO D  6
                         64.79     65.46     65.79     65.90     65.87   AO D  7
                         65.76     65.58     65.37     65.13     64.89   AO D  8
                         64.63     64.38     64.12     63.87     63.62   AO D  9
                         63.36     63.11     62.86     62.62     62.37   AO D 10
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62.12     61.87     61.63     61.39     61.14   AO D 11
60.90     60.67     60.45     60.23     60.01   AO D 12
59.79     59.57     59.35     59.14     58.92   AO D 13
58.70     58.49     58.27     58.06     57.85   AO D 14
57.64     57.43     57.22     57.01     56.80   AO D 15
56.59     56.38     56.18     55.97     55.77   AO D 16
55.56     55.36     55.16     54.96     54.76   AO D 17
54.56     54.36     54.16     53.96     53.76   AO D 18
53.57     53.37     53.17     52.98     52.79   AO D 19
52.59     52.40     52.21     52.02     51.83   AO D 20
51.64     51.45     51.26     51.08     50.90   AO D 21
50.72     50.55     50.38     50.20     50.03   AO D 22
49.86     49.69     49.52     49.35     49.18   AO D 23
49.01     48.84     48.68     48.51     48.34   AO D 24
48.18     48.01     47.85     47.68     47.52   AO D 25
47.36     47.20     47.03     46.87     46.71   AO D 26
46.55     46.39     46.23     46.08     45.92   AO D 27
45.76     45.60     45.45     45.29     45.14   AO D 28
44.98     44.83     44.68     44.52     44.37   AO D 29
44.22     44.07     43.92     43.77     43.62   AO D 30
43.47     43.32     43.17     43.03     42.88   AO D 31
42.73     42.59     42.44     42.30     42.15   AO D 32
42.01     41.86     41.72     41.59     41.46   AO D 33
41.33     41.19     41.06     40.93     40.80   AO D 34
40.67     40.54     40.41     40.29     40.16   AO D 35
40.03     39.90     39.78     39.65     39.53   AO D 36
39.40     39.27     39.15     39.03     38.90   AO D 37
38.78     38.66     38.53     38.41     38.29   AO D 38
38.17     38.05     37.93     37.81     37.69   AO D 39
37.57     37.45     37.33     37.21     37.09   AO D 40
36.97     36.86     36.74     36.62     36.51   AO D 41
36.39     36.28     36.16     36.05     35.93   AO D 42
35.82     35.71     35.59     35.48     35.37   AO D 43
35.26     35.15     35.03     34.92     34.81   AO D 44
34.70     34.59     34.48     34.37     34.27   AO D 45
34.16     34.05     33.94     33.83     33.73   AO D 46
33.62     33.51     33.41     33.30     33.20   AO D 47
33.10     33.00     32.90     32.81     32.71   AO D 48
32.62     32.52     32.43     32.33     32.24   AO D 49
32.15     32.05     31.96     31.87     31.78   AO D 50
31.68     31.59     31.50     31.41     31.32   AO D 51
31.23     31.14     31.05     30.96     30.87   AO D 52
30.78     30.69     30.60     30.51     30.42   AO D 53
30.33     30.25     30.16     30.07     29.98   AO D 54
29.90     29.81     29.72     29.64     29.55   AO D 55
29.47     29.38     29.30     29.21     29.13   AO D 56
29.04     28.96     28.87     28.79     28.71   AO D 57
28.62     28.54     28.46     28.38     28.30   AO D 58
28.21     28.13     28.05     27.97     27.89   AO D 59
27.81     27.73     27.65     27.57     27.49   AO D 60
27.41     27.33     27.25     27.17     27.09   AO D 61
27.02     26.94     26.86     26.78     26.71   AO D 62
26.63     26.55     26.48     26.40     26.32   AO D 63
26.25     26.17     26.10     26.02     25.95   AO D 64
25.87     25.80     25.72     25.65     25.57   AO D 65
25.50     25.43     25.35     25.28     25.21   AO D 66
ENDTABLE                                        P 1,T 2 67
```

ROUTED RESULTS	BTM WIDTH FT	MAX ELEV FT	VOL-MAX ACFT	AREA-MAX AC	AUX.-HP FT	VOL-AUX. ACFT
NRCS-SDH	30.0	5548.67	6675.5	0.0	0.16	31.0

PEAK - CFS	Q-PS	Q-AUX.	Q-TOT.
DISCHARGE =	65.7	0.2	65.9

AUXILIARY	CRITICAL DEPTH FT	CRITICAL VELOCITY FT/SEC	CRITICAL SLOPE-Sc FT/FT	25% OF Q Sc FT/FT
SPILLWAY ---	0.01	0.57	0.039	0.054

AUXILIARY SPILLWAY DURATION FLOW = 8.7 HOURS

***** MESSAGE - MAX. DISCHARGE OF 0. CFS IS BELOW CREST AUXILIARY SPILLWAY. NO STABILITY STRESS COMPUTED.

PLOT NRCS-SDH 1 IN = 500. CFS

Time	Qin	Qout	Elev	Vol	Area	ExtVel	0. 500. 1000. 1500. 2000
1.50	0	8	5546.3	6203.0	0.0	0.00	.
1.80	6	8	5546.3	6203.0	0.0	0.00	.
2.10	39	8	5546.3	6203.4	0.0	0.00	.I
2.40	194	8	5546.3	6206.1	0.0	0.00	. I
2.70	687	9	5546.3	6216.8	0.0	0.00	. I
3.00	1365	11	5546.5	6242.0	0.0	0.00	. I
3.30	2027	15	5546.7	6283.7	0.0	0.00	.
3.60	2180	20	5546.9	6335.4	0.0	0.00	.
3.90	1955	26	5547.2	6386.1	0.0	0.00	.P I
4.20	1683	31	5547.4	6430.5	0.0	0.00	.P I
4.50	1441	36	5547.6	6468.4	0.0	0.00	.P I
4.80	1248	40	5547.8	6500.8	0.0	0.00	.P I
5.10	1107	44	5547.9	6528.9	0.0	0.00	.P I
5.40	1001	47	5548.1	6553.9	0.0	0.00	.P I
5.70	924	51	5548.2	6576.6	0.0	0.00	.P I
6.00	874	54	5548.3	6597.6	0.0	0.00	.P I
6.30	833	57	5548.4	6617.4	0.0	0.00	.P I
6.60	748	60	5548.5	6635.5	0.0	0.00	.P I
6.90	589	62	5548.5	6650.6	0.0	0.00	.A I
7.20	423	64	5548.6	6661.6	0.0	0.00	.A I
7.50	283	65	5548.6	6668.8	0.0	0.00	.A I
7.80	180	65	5548.7	6672.9	0.0	0.00	.A I
8.10	112	66	5548.7	6674.9	0.0	0.00	.AI
8.40	73	66	5548.7	6675.5	0.0	0.00	.X
8.70	47	66	5548.7	6675.4	0.0	0.00	.A
9.00	28	66	5548.7	6674.7	0.0	0.00	.A
9.30	16	66	5548.7	6673.6	0.0	0.00	.A
9.60	9	65	5548.7	6672.3	0.0	0.00	.A
9.90	5	65	5548.6	6670.8	0.0	0.00	.A
10.20	3	65	5548.6	6669.3	0.0	0.00	.A
10.50	1	65	5548.6	6667.8	0.0	0.00	.A
10.80	1	64	5548.6	6666.2	0.0	0.00	.A
11.10	0	64	5548.6	6664.6	0.0	0.00	.A

11.40	0	64	5548.6	6663.1	0.0	0.00	.A
11.70	0	64	5548.6	6661.5	0.0	0.00	.A
12.00	0	63	5548.6	6660.0	0.0	0.00	.A
12.30	0	63	5548.6	6658.4	0.0	0.00	.A
12.60	0	63	5548.6	6656.9	0.0	0.00	.A
12.90	0	63	5548.6	6655.4	0.0	0.00	.A
13.20	0	62	5548.6	6653.8	0.0	0.00	.A
13.50	0	62	5548.6	6652.3	0.0	0.00	.A
13.80	0	62	5548.5	6650.8	0.0	0.00	.A
14.10	0	62	5548.5	6649.3	0.0	0.00	.A
14.40	0	61	5548.5	6647.8	0.0	0.00	.A
14.70	0	61	5548.5	6646.3	0.0	0.00	.A
15.00	0	61	5548.5	6644.8	0.0	0.00	.A
15.30	0	61	5548.5	6643.3	0.0	0.00	.P
15.60	0	60	5548.5	6641.9	0.0	0.00	.P
15.90	0	60	5548.5	6640.4	0.0	0.00	.P
16.20	0	60	5548.5	6638.9	0.0	0.00	.P
16.50	0	60	5548.5	6637.5	0.0	0.00	.P
16.80	0	60	5548.5	6636.0	0.0	0.00	.P
17.10	0	59	5548.5	6634.5	0.0	0.00	.P
17.40	0	59	5548.5	6633.1	0.0	0.00	.P
17.70	0	59	5548.4	6631.7	0.0	0.00	.P
18.00	0	59	5548.4	6630.2	0.0	0.00	.P
18.30	0	58	5548.4	6628.8	0.0	0.00	.P
18.60	0	58	5548.4	6627.4	0.0	0.00	.P
18.90	0	58	5548.4	6626.0	0.0	0.00	.P
19.20	0	58	5548.4	6624.6	0.0	0.00	.P
19.50	0	58	5548.4	6623.1	0.0	0.00	.P
19.80	0	57	5548.4	6621.7	0.0	0.00	.P
20.10	0	57	5548.4	6620.3	0.0	0.00	.P
20.40	0	57	5548.4	6619.0	0.0	0.00	.P
20.70	0	57	5548.4	6617.6	0.0	0.00	.P
21.00	0	57	5548.4	6616.2	0.0	0.00	.P
21.30	0	56	5548.4	6614.8	0.0	0.00	.P
21.60	0	56	5548.4	6613.4	0.0	0.00	.P
21.90	0	56	5548.3	6612.1	0.0	0.00	.P
22.20	0	56	5548.3	6610.7	0.0	0.00	.P
22.50	0	56	5548.3	6609.4	0.0	0.00	.P
22.80	0	55	5548.3	6608.0	0.0	0.00	.P
23.10	0	55	5548.3	6606.7	0.0	0.00	.P
23.40	0	55	5548.3	6605.3	0.0	0.00	.P
23.70	0	55	5548.3	6604.0	0.0	0.00	.P
24.00	0	55	5548.3	6602.7	0.0	0.00	.P
24.30	0	54	5548.3	6601.3	0.0	0.00	.P
24.60	0	54	5548.3	6600.0	0.0	0.00	.P
24.90	0	54	5548.3	6598.7	0.0	0.00	.P
25.20	0	54	5548.3	6597.4	0.0	0.00	.P
25.50	0	54	5548.3	6596.1	0.0	0.00	.P
25.80	0	53	5548.3	6594.8	0.0	0.00	.P
26.10	0	53	5548.3	6593.5	0.0	0.00	.P
26.40	0	53	5548.2	6592.2	0.0	0.00	.P
26.70	0	53	5548.2	6590.9	0.0	0.00	.P
27.00	0	53	5548.2	6589.6	0.0	0.00	.P
27.30	0	52	5548.2	6588.4	0.0	0.00	.P
27.60	0	52	5548.2	6587.1	0.0	0.00	.P
27.90	0	52	5548.2	6585.8	0.0	0.00	.P
28.20	0	52	5548.2	6584.5	0.0	0.00	.P
28.50	0	52	5548.2	6583.3	0.0	0.00	.P
28.80	0	51	5548.2	6582.0	0.0	0.00	.P

29.10	0	51	5548.2	6580.8	0.0	0.00	.P
29.40	0	51	5548.2	6579.5	0.0	0.00	.P
29.70	0	51	5548.2	6578.3	0.0	0.00	.P
30.00	0	51	5548.2	6577.1	0.0	0.00	.P
30.30	0	51	5548.2	6575.8	0.0	0.00	.P
30.60	0	50	5548.2	6574.6	0.0	0.00	.P
30.90	0	50	5548.2	6573.4	0.0	0.00	.P
31.20	0	50	5548.1	6572.2	0.0	0.00	.P
31.50	0	50	5548.1	6571.0	0.0	0.00	.P
31.80	0	50	5548.1	6569.8	0.0	0.00	.P
32.10	0	50	5548.1	6568.5	0.0	0.00	.P
32.40	0	49	5548.1	6567.3	0.0	0.00	.P
32.70	0	49	5548.1	6566.1	0.0	0.00	.P
33.00	0	49	5548.1	6565.0	0.0	0.00	.P
33.30	0	49	5548.1	6563.8	0.0	0.00	.P
33.60	0	49	5548.1	6562.6	0.0	0.00	.P
33.90	0	49	5548.1	6561.4	0.0	0.00	.P
34.20	0	48	5548.1	6560.2	0.0	0.00	.P
34.50	0	48	5548.1	6559.1	0.0	0.00	.P
34.80	0	48	5548.1	6557.9	0.0	0.00	.P
35.10	0	48	5548.1	6556.7	0.0	0.00	.P
35.40	0	48	5548.1	6555.6	0.0	0.00	.P
35.70	0	48	5548.1	6554.4	0.0	0.00	.P
36.00	0	47	5548.0	6553.3	0.0	0.00	.P
36.30	0	47	5548.0	6552.1	0.0	0.00	.P
36.60	0	47	5548.0	6551.0	0.0	0.00	.P
36.90	0	47	5548.0	6549.8	0.0	0.00	.P
37.20	0	47	5548.0	6548.7	0.0	0.00	.P
37.50	0	47	5548.0	6547.6	0.0	0.00	.P
37.80	0	46	5548.0	6546.4	0.0	0.00	.P
38.10	0	46	5548.0	6545.3	0.0	0.00	.P
38.40	0	46	5548.0	6544.2	0.0	0.00	.P
38.70	0	46	5548.0	6543.1	0.0	0.00	.P
39.00	0	46	5548.0	6542.0	0.0	0.00	.P
39.30	0	46	5548.0	6540.9	0.0	0.00	.P
39.60	0	45	5548.0	6539.8	0.0	0.00	.P
39.90	0	45	5548.0	6538.7	0.0	0.00	.P
40.20	0	45	5548.0	6537.6	0.0	0.00	.P
40.50	0	45	5548.0	6536.5	0.0	0.00	.P
40.80	0	45	5548.0	6535.4	0.0	0.00	.P
41.10	0	45	5548.0	6534.3	0.0	0.00	.P
41.40	0	45	5547.9	6533.2	0.0	0.00	.P
41.70	0	44	5547.9	6532.1	0.0	0.00	.P
42.00	0	44	5547.9	6531.1	0.0	0.00	.P
42.30	0	44	5547.9	6530.0	0.0	0.00	.P
42.60	0	44	5547.9	6528.9	0.0	0.00	.P
42.90	0	44	5547.9	6527.9	0.0	0.00	.P
43.20	0	44	5547.9	6526.8	0.0	0.00	.P
43.50	0	43	5547.9	6525.7	0.0	0.00	.P
43.80	0	43	5547.9	6524.7	0.0	0.00	.P
44.10	0	43	5547.9	6523.6	0.0	0.00	.P
44.40	0	43	5547.9	6522.6	0.0	0.00	.P
44.70	0	43	5547.9	6521.6	0.0	0.00	.P
45.00	0	43	5547.9	6520.5	0.0	0.00	.P
45.30	0	43	5547.9	6519.5	0.0	0.00	.P
45.60	0	42	5547.9	6518.5	0.0	0.00	.P
45.90	0	42	5547.9	6517.4	0.0	0.00	.P
46.20	0	42	5547.9	6516.4	0.0	0.00	.P
46.50	0	42	5547.9	6515.4	0.0	0.00	.P

46.80	0	42	5547.8	6514.4	0.0	0.00	.P
47.10	0	42	5547.8	6513.4	0.0	0.00	.P
47.40	0	42	5547.8	6512.4	0.0	0.00	.P
47.70	0	41	5547.8	6511.4	0.0	0.00	.P
48.00	0	41	5547.8	6510.4	0.0	0.00	.P
48.30	0	41	5547.8	6509.4	0.0	0.00	.P
48.60	0	41	5547.8	6508.4	0.0	0.00	.P
48.90	0	41	5547.8	6507.4	0.0	0.00	.P
49.20	0	41	5547.8	6506.4	0.0	0.00	.P
49.50	0	41	5547.8	6505.4	0.0	0.00	.P
49.80	0	41	5547.8	6504.4	0.0	0.00	.P
50.10	0	40	5547.8	6503.4	0.0	0.00	.P
50.40	0	40	5547.8	6502.5	0.0	0.00	.P
50.70	0	40	5547.8	6501.5	0.0	0.00	.P
51.00	0	40	5547.8	6500.5	0.0	0.00	.P
51.30	0	40	5547.8	6499.6	0.0	0.00	.P
51.60	0	40	5547.8	6498.6	0.0	0.00	.P
51.90	0	40	5547.8	6497.6	0.0	0.00	.P
52.20	0	40	5547.8	6496.7	0.0	0.00	.P
52.50	0	39	5547.8	6495.7	0.0	0.00	.P
52.80	0	39	5547.7	6494.8	0.0	0.00	.P
53.10	0	39	5547.7	6493.8	0.0	0.00	.P
53.40	0	39	5547.7	6492.9	0.0	0.00	.P
53.70	0	39	5547.7	6491.9	0.0	0.00	.P
54.00	0	39	5547.7	6491.0	0.0	0.00	.P
54.30	0	39	5547.7	6490.1	0.0	0.00	.P
54.60	0	39	5547.7	6489.1	0.0	0.00	.P
54.90	0	38	5547.7	6488.2	0.0	0.00	.P
55.20	0	38	5547.7	6487.3	0.0	0.00	.P
55.50	0	38	5547.7	6486.4	0.0	0.00	.P
55.80	0	38	5547.7	6485.4	0.0	0.00	.P
56.10	0	38	5547.7	6484.5	0.0	0.00	.P
56.40	0	38	5547.7	6483.6	0.0	0.00	.P
56.70	0	38	5547.7	6482.7	0.0	0.00	.P
57.00	0	38	5547.7	6481.8	0.0	0.00	.P
57.30	0	37	5547.7	6480.9	0.0	0.00	.P
57.60	0	37	5547.7	6480.0	0.0	0.00	.P
57.90	0	37	5547.7	6479.1	0.0	0.00	.P
58.20	0	37	5547.7	6478.2	0.0	0.00	.P
58.50	0	37	5547.7	6477.3	0.0	0.00	.P
58.80	0	37	5547.7	6476.4	0.0	0.00	.P
59.10	0	37	5547.7	6475.5	0.0	0.00	.P
59.40	0	37	5547.6	6474.6	0.0	0.00	.P
59.70	0	37	5547.6	6473.7	0.0	0.00	.P
60.00	0	36	5547.6	6472.9	0.0	0.00	.P
60.30	0	36	5547.6	6472.0	0.0	0.00	.P
60.60	0	36	5547.6	6471.1	0.0	0.00	.P
60.90	0	36	5547.6	6470.2	0.0	0.00	.P
61.20	0	36	5547.6	6469.4	0.0	0.00	.P
61.50	0	36	5547.6	6468.5	0.0	0.00	.P
61.80	0	36	5547.6	6467.7	0.0	0.00	.P
62.10	0	36	5547.6	6466.8	0.0	0.00	.P
62.40	0	35	5547.6	6465.9	0.0	0.00	.P
62.70	0	35	5547.6	6465.1	0.0	0.00	.P
63.00	0	35	5547.6	6464.2	0.0	0.00	.P
63.30	0	35	5547.6	6463.4	0.0	0.00	.P
63.60	0	35	5547.6	6462.5	0.0	0.00	.P
63.90	0	35	5547.6	6461.7	0.0	0.00	.P
64.20	0	35	5547.6	6460.9	0.0	0.00	.P

64.50	0	35	5547.6	6460.0	0.0	0.00	.P
64.80	0	35	5547.6	6459.2	0.0	0.00	.P
65.10	0	34	5547.6	6458.4	0.0	0.00	.P
65.40	0	34	5547.6	6457.5	0.0	0.00	.P
65.70	0	34	5547.6	6456.7	0.0	0.00	.P
66.00	0	34	5547.5	6455.9	0.0	0.00	.P
66.30	0	34	5547.5	6455.1	0.0	0.00	.P
66.60	0	34	5547.5	6454.2	0.0	0.00	.P
66.90	0	34	5547.5	6453.4	0.0	0.00	.P
67.20	0	34	5547.5	6452.6	0.0	0.00	.P
67.50	0	34	5547.5	6451.8	0.0	0.00	.P
67.80	0	34	5547.5	6451.0	0.0	0.00	.P
68.10	0	33	5547.5	6450.2	0.0	0.00	.P
68.40	0	33	5547.5	6449.4	0.0	0.00	.P
68.70	0	33	5547.5	6448.6	0.0	0.00	.P
69.00	0	33	5547.5	6447.8	0.0	0.00	.P
69.30	0	33	5547.5	6447.0	0.0	0.00	.P
69.60	0	33	5547.5	6446.2	0.0	0.00	.P
69.90	0	33	5547.5	6445.4	0.0	0.00	.P
70.20	0	33	5547.5	6444.6	0.0	0.00	.P
70.50	0	33	5547.5	6443.8	0.0	0.00	.P
70.80	0	33	5547.5	6443.1	0.0	0.00	.P
71.10	0	32	5547.5	6442.3	0.0	0.00	.P
71.40	0	32	5547.5	6441.5	0.0	0.00	.P
71.70	0	32	5547.5	6440.7	0.0	0.00	.P
72.00	0	32	5547.5	6439.9	0.0	0.00	.P
72.30	0	32	5547.5	6439.2	0.0	0.00	.P
72.60	0	32	5547.5	6438.4	0.0	0.00	.P
72.90	0	32	5547.5	6437.6	0.0	0.00	.P
73.20	0	32	5547.5	6436.9	0.0	0.00	.P
73.50	0	32	5547.4	6436.1	0.0	0.00	.P
73.80	0	32	5547.4	6435.4	0.0	0.00	.P
74.10	0	31	5547.4	6434.6	0.0	0.00	.P
74.40	0	31	5547.4	6433.8	0.0	0.00	.P
74.70	0	31	5547.4	6433.1	0.0	0.00	.P
75.00	0	31	5547.4	6432.3	0.0	0.00	.P
75.30	0	31	5547.4	6431.6	0.0	0.00	.P
75.60	0	31	5547.4	6430.8	0.0	0.00	.P
75.90	0	31	5547.4	6430.1	0.0	0.00	.P
76.20	0	31	5547.4	6429.4	0.0	0.00	.P
76.50	0	31	5547.4	6428.6	0.0	0.00	.P
76.80	0	31	5547.4	6427.9	0.0	0.00	.P
77.10	0	31	5547.4	6427.1	0.0	0.00	.P
77.40	0	31	5547.4	6426.4	0.0	0.00	.P
77.70	0	30	5547.4	6425.7	0.0	0.00	.P
78.00	0	30	5547.4	6425.0	0.0	0.00	.P
78.30	0	30	5547.4	6424.2	0.0	0.00	.P
78.60	0	30	5547.4	6423.5	0.0	0.00	.P
78.90	0	30	5547.4	6422.8	0.0	0.00	.P
79.20	0	30	5547.4	6422.1	0.0	0.00	.P
79.50	0	30	5547.4	6421.3	0.0	0.00	.P
79.80	0	30	5547.4	6420.6	0.0	0.00	.P
80.10	0	30	5547.4	6419.9	0.0	0.00	.P
80.40	0	30	5547.4	6419.2	0.0	0.00	.P
80.70	0	30	5547.4	6418.5	0.0	0.00	.P
81.00	0	29	5547.4	6417.8	0.0	0.00	.P
81.30	0	29	5547.4	6417.1	0.0	0.00	.P
81.60	0	29	5547.3	6416.4	0.0	0.00	.P
81.90	0	29	5547.3	6415.7	0.0	0.00	.P

82.20	0	29	5547.3	6415.0	0.0	0.00	.P
82.50	0	29	5547.3	6414.3	0.0	0.00	.P
82.80	0	29	5547.3	6413.6	0.0	0.00	.P
83.10	0	29	5547.3	6412.9	0.0	0.00	.P
83.40	0	29	5547.3	6412.2	0.0	0.00	.P
83.70	0	29	5547.3	6411.5	0.0	0.00	.P
84.00	0	29	5547.3	6410.8	0.0	0.00	.P
84.30	0	29	5547.3	6410.2	0.0	0.00	.P
84.60	0	28	5547.3	6409.5	0.0	0.00	.P
84.90	0	28	5547.3	6408.8	0.0	0.00	.P
85.20	0	28	5547.3	6408.1	0.0	0.00	.P
85.50	0	28	5547.3	6407.4	0.0	0.00	.P
85.80	0	28	5547.3	6406.8	0.0	0.00	.P
86.10	0	28	5547.3	6406.1	0.0	0.00	.P
86.40	0	28	5547.3	6405.4	0.0	0.00	.P
86.70	0	28	5547.3	6404.8	0.0	0.00	.P
87.00	0	28	5547.3	6404.1	0.0	0.00	.P
87.30	0	28	5547.3	6403.4	0.0	0.00	.P
87.60	0	28	5547.3	6402.8	0.0	0.00	.P
87.90	0	28	5547.3	6402.1	0.0	0.00	.P
88.20	0	27	5547.3	6401.4	0.0	0.00	.P
88.50	0	27	5547.3	6400.8	0.0	0.00	.P
88.80	0	27	5547.3	6400.1	0.0	0.00	.P
89.10	0	27	5547.3	6399.5	0.0	0.00	.P
89.40	0	27	5547.3	6398.8	0.0	0.00	.P
89.70	0	27	5547.3	6398.2	0.0	0.00	.P
90.00	0	27	5547.3	6397.5	0.0	0.00	.P
90.30	0	27	5547.2	6396.9	0.0	0.00	.P
90.60	0	27	5547.2	6396.3	0.0	0.00	.P
90.90	0	27	5547.2	6395.6	0.0	0.00	.P
91.20	0	27	5547.2	6395.0	0.0	0.00	.P
91.50	0	27	5547.2	6394.3	0.0	0.00	.P
91.80	0	27	5547.2	6393.7	0.0	0.00	.P
92.10	0	26	5547.2	6393.1	0.0	0.00	.P
92.40	0	26	5547.2	6392.4	0.0	0.00	.P
92.70	0	26	5547.2	6391.8	0.0	0.00	.P
93.00	0	26	5547.2	6391.2	0.0	0.00	.P
93.30	0	26	5547.2	6390.6	0.0	0.00	.P
93.60	0	26	5547.2	6389.9	0.0	0.00	.P
93.90	0	26	5547.2	6389.3	0.0	0.00	.P
94.20	0	26	5547.2	6388.7	0.0	0.00	.P
94.50	0	26	5547.2	6388.1	0.0	0.00	.P
94.80	0	26	5547.2	6387.5	0.0	0.00	.P
95.10	0	26	5547.2	6386.9	0.0	0.00	.P
95.40	0	26	5547.2	6386.2	0.0	0.00	.P
95.70	0	26	5547.2	6385.6	0.0	0.00	.P
96.00	0	26	5547.2	6385.0	0.0	0.00	.P
96.30	0	25	5547.2	6384.4	0.0	0.00	.P
96.60	0	25	5547.2	6383.8	0.0	0.00	.P
96.90	0	25	5547.2	6383.2	0.0	0.00	.P
97.20	0	25	5547.2	6382.6	0.0	0.00	.P

Time	Qin	Qout	Elev	Vol	Area	ExtVel	I	I	I	I	I
							0.	500.	1000.	1500.	2000

END NRCS-SDH PLOT

HYD	FO	4.74	Cove Res							COVRES	1
	0	1.2000								STR1	2
		7.74	7.74	7.84	8.25	9.31	FO	D			3
		11.73	20.36	49.54	130.06	325.02	FO	D			4

```
                    458.59    540.79    594.66    627.20    644.87   FO D  5
                    652.22    651.18    647.05    642.62    634.58   FO D  6
                    605.49    552.09    496.87    443.06    398.14   FO D  7
                    359.06    325.87    298.36    273.18    250.64   FO D  8
                    232.38    215.72    199.82    185.09    171.45   FO D  9
                    158.83    147.14    136.31    127.58    122.72   FO D 10
                    118.04    113.55    109.22    105.07    101.07   FO D 11
                     97.22     93.53     89.97     86.56     83.27   FO D 12
                     80.44     79.17     77.92     76.69     75.48   FO D 13
                     74.28     73.11     71.96     70.82     69.71   FO D 14
                     68.61     67.53     66.46     65.41     64.38   FO D 15
                     63.37     62.37     61.39     60.46     59.58   FO D 16
                     58.71     57.85     57.01     56.18     55.36   FO D 17
                     54.56     53.77     52.98     52.21     51.46   FO D 18
                     50.73     50.03     49.35     48.68     48.01   FO D 19
                     47.36     46.72     46.08     45.45     44.83   FO D 20
                     44.22     43.62     43.03     42.44     41.87   FO D 21
                     41.33     40.81     40.29     39.78     39.28   FO D 22
                     38.78     38.29     37.81     37.33     36.86   FO D 23
                     36.40     35.94     35.48     35.04     34.60   FO D 24
                     34.16     33.73     33.31     32.91     32.53   FO D 25
                     32.15     31.78     31.41     31.05     30.69   FO D 26
                     30.33     29.98     29.64     29.30     28.96   FO D 27
                     28.63     28.30     27.97     27.65     27.33   FO D 28
                     27.02     26.71     26.40     26.10     25.80   FO D 29
                     25.50     25.21     24.95     24.69     24.43   FO D 30
                     24.18     23.93     23.68     23.44     23.20   FO D 31
                     22.96     22.72     22.48     22.25     22.02   FO D 32
                     21.80     21.57     21.35     21.13     20.91   FO D 33
                     20.70     20.49     20.27     20.07     19.86   FO D 34
                     19.66     19.46     19.26     19.06     18.86   FO D 35
                     18.67     18.48     18.29     18.11     17.93   FO D 36
                     17.77     17.61     17.45     17.30     17.14   FO D 37
                     16.99     16.84     16.69     16.54     16.39   FO D 38
                     16.24     16.10     15.95     15.81     15.67   FO D 39
                     15.53     15.39     15.25     15.12     14.98   FO D 40
                     14.85     14.72     14.59     14.46     14.33   FO D 41
                     14.20     14.08     13.95     13.83     13.71   FO D 42
                     13.59     13.47     13.35     13.23     13.11   FO D 43
                     13.00     12.89     12.77     12.66     12.55   FO D 44
                     12.44     12.33     12.22     12.12     12.01   FO D 45
                     11.90     11.80     11.70     11.61     11.53   FO D 46
                     11.44     11.36     11.28     11.19     11.11   FO D 47
                     11.03     10.95     10.87     10.79     10.71   FO D 48
                     10.63     10.56     10.48     10.40     10.33   FO D 49
                     10.25     10.18     10.10     10.03      9.96   FO D 50
                      9.89      9.81      9.74      9.67      9.60   FO D 51
                      9.53      9.46      9.40      9.33      9.26   FO D 52
 ENDTABLE                                                          P 1,T 2 53


1SITES ------------------------------------------------------------------------
 XEQ 08/28/2020                    COV RES                        WSID= COVRES
 VER 2005.1.8                        Cove Res                       SUBW= CR
 TIME 16:21:21          SITE = STR1              PASS=    1     PART=   6


 ROUTED       BTM WIDTH  MAX ELEV   VOL-MAX  AREA-MAX   AUX.-HP   VOL-AUX.
 RESULTS          FT        FT        ACFT      AC         FT       ACFT
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NRCS-FBH 30.0 5552.31 7410.0 0.0 3.79 765.6

PEAK - CFS Q-PS Q-AUX. Q-TOT.
DISCHARGE = 126.9 525.3 652.2

AUXILIARY SPILLWAY ---	CRITICAL DEPTH FT	CRITICAL VELOCITY FT/SEC	CRITICAL SLOPE-Sc FT/FT	25% OF Q Sc FT/FT
	2.02	7.63	0.008	0.010

INTEGRITY ANALYSIS - REACH SURFACE PERFORMANCE SUMMARY
(The auxiliary spillway began flow at time = 9.6 hours
and peaked at time = 20.4 hours.)

REACH 3: FROM STATION 115. TO 475. ON 15.4% SLOPE.
Non-vegetated conditions implied: flow concentration
assumed with minimal flow: Time = 12.0 hours.

REACH 4: FROM STATION 475. TO 610. ON 8.5% SLOPE.
Non-vegetated conditions implied: flow concentration
assumed with minimal flow: Time = 12.0 hours.

REACH 5: FROM STATION 610. TO 1057. ON 6.6% SLOPE.
Non-vegetated conditions implied: flow concentration
assumed with minimal flow: Time = 12.0 hours.

REACH 6: FROM STATION 1057. TO 1153. ON 15.6% SLOPE.
Non-vegetated conditions implied: flow concentration
assumed with minimal flow: Time = 12.0 hours.

INTEGRITY ANALYSIS - HEADCUT EROSION DAMAGE SUMMARY

The most upstream headcut began at station 115.
and progressed upstream to station 94.
The final height of the headcut was 4.3 ft.

The headcut having the maximum final overfall height began
at station 475. and progressed upstream to station 414.
The final height of the headcut was 14.1 ft.

THE HYDROGRAPH WAS NOT ADJUSTED FOR THE EFFECTS OF EROSION.

AUXILIARY SPILLWAY ---	DURATION FLOW HRS	ATTACK OE/B ACFT/FT	DIST. FROM MOST U/S HEADCUT TO U/S EDGE AUX. CREST, FT
	73.2	28.0	19.

EXIT CHANNEL FLOW SUPERCRITICAL: MAX VELOCITY= 19.8 FT/SEC
EXIT SLOPE = 0.154 FT/FT
FLOW DEPTH = 0.8 FT

PLOT NRCS-FBH 1 IN = 500. CFS

Time	Qin	Qout	Elev	Vol	Area	ExtVel	0. I	500. I	1000. I	1500. I	2000 I

2.40	0	8	5546.3	6203.0	0.0	0.00	.
3.60	4	8	5546.3	6203.0	0.0	0.00	.
4.80	35	8	5546.3	6204.0	0.0	0.00	.I
6.00	84	8	5546.3	6209.1	0.0	0.00	. I
7.20	195	9	5546.4	6222.1	0.0	0.00	. I
8.40	425	12	5546.5	6251.8	0.0	0.00	. I
9.60	1352	20	5546.9	6338.3	0.0	0.00	. I
10.80	3365	50	5548.1	6568.7	0.0	0.00	.P
12.00	3296	130	5549.8	6890.1	0.0	6.33	. A
13.20	2008	325	5550.9	7130.6	0.0	13.72	. A I
14.40	1331	459	5551.6	7257.3	0.0	16.69	. A I
15.60	1060	541	5551.9	7326.3	0.0	18.14	. A I
16.80	912	595	5552.1	7367.8	0.0	19.00	. A I
18.00	792	627	5552.2	7391.7	0.0	19.48	. A I
19.20	742	645	5552.3	7404.6	0.0	19.73	. A I
20.40	664	652	5552.3	7410.0	0.0	19.84	. X
21.60	624	651	5552.3	7409.3	0.0	19.82	. IA
22.80	613	647	5552.3	7406.2	0.0	19.77	. IA
24.00	611	643	5552.3	7403.0	0.0	19.70	. IA
25.20	547	635	5552.2	7397.1	0.0	19.59	. I A
26.40	262	605	5552.1	7375.7	0.0	19.16	. I A
27.60	90	552	5551.9	7335.8	0.0	18.33	. I A
28.80	24	497	5551.7	7289.4	0.0	17.39	. A
30.00	5	443	5551.5	7244.2	0.0	16.39	. A
31.20	1	398	5551.3	7202.8	0.0	15.47	. A
32.40	0	359	5551.1	7165.4	0.0	14.58	. A
33.60	0	326	5551.0	7131.5	0.0	13.75	. A
34.80	0	298	5550.8	7100.6	0.0	12.99	. A
36.00	0	273	5550.7	7072.4	0.0	12.22	. A
37.20	0	251	5550.5	7046.5	0.0	11.46	. A
38.40	0	232	5550.4	7022.7	0.0	10.78	. A
39.60	0	216	5550.3	7000.6	0.0	10.21	. A
40.80	0	200	5550.2	6980.1	0.0	9.67	. A
42.00	0	185	5550.1	6961.1	0.0	9.12	. A
43.20	0	171	5550.0	6943.5	0.0	8.55	. A
44.40	0	159	5550.0	6927.2	0.0	7.97	. A
45.60	0	147	5549.9	6912.1	0.0	7.38	. A
46.80	0	136	5549.8	6898.2	0.0	6.74	. A
48.00	0	128	5549.7	6885.2	0.0	6.18	. A
49.20	0	123	5549.7	6872.9	0.0	5.93	. A
50.40	0	118	5549.6	6861.0	0.0	5.67	. A
51.60	0	114	5549.6	6849.7	0.0	5.39	. A
52.80	0	109	5549.5	6838.7	0.0	5.11	. A
54.00	0	105	5549.5	6828.2	0.0	4.80	. A
55.20	0	101	5549.4	6818.1	0.0	4.48	. A
56.40	0	97	5549.4	6808.3	0.0	4.12	. A
57.60	0	94	5549.3	6799.0	0.0	3.73	. A
58.80	0	90	5549.3	6790.0	0.0	3.28	. A
60.00	0	87	5549.2	6781.3	0.0	2.74	. A
61.20	0	83	5549.2	6773.0	0.0	1.98	. A
62.40	0	80	5549.1	6765.0	0.0	0.00	. A
63.60	0	79	5549.1	6757.2	0.0	0.00	. A
64.80	0	78	5549.1	6749.5	0.0	0.00	. A
66.00	0	77	5549.0	6741.9	0.0	0.00	. A
67.20	0	75	5549.0	6734.4	0.0	0.00	. A
68.40	0	74	5548.9	6727.1	0.0	0.00	.A
69.60	0	73	5548.9	6719.9	0.0	0.00	.A
70.80	0	72	5548.9	6712.8	0.0	0.00	.A
72.00	0	71	5548.8	6705.8	0.0	0.00	.A

```
 73.20     0    70 5548.8  6699.0   0.0   0.00   .A
 74.40     0    69 5548.8  6692.2   0.0   0.00   .A
 75.60     0    68 5548.7  6685.6   0.0   0.00   .A
 76.80     0    66 5548.7  6679.0   0.0   0.00   .A
 78.00     0    65 5548.7  6672.6   0.0   0.00   .A
 79.20     0    64 5548.6  6666.2   0.0   0.00   .A
 Time    Qin  Qout   Elev    Vol   Area  ExtVel  I         I         I         I         I
                                                 0.      500.     1000.     1500.     2000
        END NRCS-FBH   PLOT
 ------------------------------------------------------------------------------

 Inflow Hyd 1 PSH-Peak =         39.99 CFS  at  143.00 hrs.,  Location Point

 Inflow Hyd 1 SDH-Peak =         65.90 CFS  at    8.10 hrs.,  Location Point

 Inflow Hyd 1 FBH-Peak =        652.22 CFS  at   19.20 hrs.,  Location Point
HYDOUT   1     STR1

1SITES....JOB NO.  1 COMPLETE.
 ------------------------------------------------------------------------------

 COVRES        COV RES

       0 SUBWATERSHED(S) ANALYZED.

       1 STRUCTURE(S) ANALYZED.

       3 HYDROGRAPHS ROUTED AT LOWEST SITE.

       0 TRIALS TO OBTAIN BOTTOM WIDTH FOR SPECIFIED STRESS OR VELOCITY.

 ******************************************************************************



 SITES.....COMPUTATIONS COMPLETE

                                SUMMARY TABLE  1          SITES VERSION 2005.1.8
                               ----------------               DATED 01/01/2005


 WATERSHED ID                          RUN DATE                          RUN TIME
 ------------                          --------                          --------
 COVRES                              08/28/2020                          16:21:21

 >>>   SITE   SUBWS   SUBWS DA   CURVE    TC   TOTAL DA   TYPE    STRUC    <<<
         ID     ID     (SQ MI)    NO.    (HRS)  (SQ MI)  DESIGN   CLASS
         -----  ----   --------   -----  ----   -------  -----   -----
         STR1    CR        4.74      0.  0.00      4.74    TR60     C

 PASS  DIA./  AUX.CREST  BTM.  MAX.    MAX.    EMB.  INTEGR.*  EXIT*    TYPE
  NO.  WIDTH    ELEV    WIDTH   HP     ELEV    VOL.   DIST.     VEL.     HYD
      (IN/FT)   (FT)     (FT)  (FT)    (FT)    (CY)   (FT)   (FT/SEC)
 ---- -----  -------  ------  ----  -------  -------  -----  ------  ---------
    1  30.0   5548.5    30.0   3.8   5552.3       0.    19.    19.8  NRCS-FBH
```

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 *  INTEGRITY DIST. AND EXIT VEL. VALUES ARE BASED ON THE ROUTED
    HYDROGRAPH SHOWN UNDER TYPE HYD.



 SITES.......SUMMARY TABLE 1 COMPLETED.


                    NRCS  SITES    VERSION 2005.1.8  ,01/01/2005
                             COVRES   FILES

INPUT  = H:\DAMS\Cove.200401-025\TASK 1 - Cove Reservoir EA Project\SITES\Aug 2020\SITES\08
OUTPUT = H:\DAMS\Cove.200401-025\TASK 1 - Cove Reservoir EA Project\SITES\Aug 2020\SITES\08
         DATED 08/28/2020 16:21:21

        FILE GEN.   = H:\DAMS\Cove.200401-025\TASK 1 - Cove Reservoir EA Project\SITES\Aug

                          GRAPHICS FILES GENERATED

OPTION "L"  = H:\DAMS\Cove.200401-025\TASK 1 - Cove Reservoir EA Project\SITES\Aug 2020\SIT

OPTION "P"  = H:\DAMS\Cove.200401-025\TASK 1 - Cove Reservoir EA Project\SITES\Aug 2020\SIT

OPTION "E"  = H:\DAMS\Cove.200401-025\TASK 1 - Cove Reservoir EA Project\SITES\Aug 2020\SIT

AUX.GRAPHICS = H:\DAMS\Cove.200401-025\TASK 1 - Cove Reservoir EA Project\SITES\Aug 2020\SI
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Sediment

The site is located in the East Fork of the Virgin River Watershed at 37.273° N 112.660° W. The reservoir will serve as a multi-purpose structure including providing storage for irrigation, recreation, and drought.

The reservoir will have a storage capacity of 6,032 acre-feet and an average depth 40 feet. The drainage area covers 4.7 square miles (3034 acres). The reservoir site is in an alluvial valley that has been cut into Cretaceous and Tertiary sedimentary rocks consisting mostly of sandstone and shale. Residual soils are silt and sandy clay. The terrain adjacent to the basin valley has steep slopes. Ridges are capped with thin deposits of pebble gravel and cobbles of grey and red quartzite, grey to black chert, and grey limestone in a matrix of sand with silt. Vegetation in the drainage is sparse, consisting of brush and small trees. Using the National Engineering Handbook (NEH) land cover designation, the majority of the drainage basin is comprised of Woods, Fair; with portions of Desert Shrub, Poor. The drainage areas are capable of producing flash flood conditions and large sediment volumes during intense rainfalls. The reservoir is expected to contain all of the sediment and therefore, the trap efficiency is assumed to be 100 percent for the reservoir.

An initial estimate of sediment yield has been performed using two methods included in the Bureau of Reclamation Erosion and Sedimentation Manual (November 2006) and the Estimated Sediment Yield Rates for the State of Utah Map (U.S.D.A SCS, 1973). These methods are described below.

Sediment Yield as a Function of Drainage Area

Empirical sediment yield equations have been developed strictly as a function of drainage area based on reservoir sediment survey data. Strand and Pemberton (1982) developed the following equation for the semiarid climate of the Southwestern United States:

$$Q = 1.84A_d^{-0.24}$$

Where Q = sediment yield in ac-ft/mi^2/yr
A_d = drainage area in mi^2

For the reservoir drainage area of 4.7 mi^2, a sediment accumulation 6 acre-feet per year or 600 acre-feet over a 100- year period is computed.

Sediment Yield Classification Procedure

The Pacific Southwest Inter-Agency Committee developed a sediment yield classification procedure that estimates sediment yield as a function of nine individual drainage basin characteristics. Each characteristic is given a subjective numerical rating based on

observation and experience and the sum of these ratings determines the basin classification and the annual sediment yield per unit area. Tables showing this procedure are included on the following page. The sum of the basin characteristics ratings is 70, resulting in a classification number of 3, with annual sediment yield (ac-ft/mi^2) ranging from 0.5 to 1.0. For the drainage basin area of 4.7 mi^2, using the upper end of the range results in an annual yield of 4.7 ac-ft and a sediment yield of 470 acre-feet over a 100-year life span.

Estimated Sediment Yield Rate Map

An estimated sediment yield rate map for the State of Utah was prepared by the U.S.D.A. Soil Conservation Service in 1973. This map is a general area map with cautions that it is not to be used for specific sites since large variations may occur in the delineated areas. A copy of the map with the Cove Reservoir area enlarged is attached. This area in in a Yield Class 4 which indicates yield rates ranging from 0.2 to 0.5 ac-ft./sq mi^2/year. Using the upper end of the range, results in an estimate of 2.35 ac-ft per year for the 4.7 sq mi^2 drainage area and 235 acre-feet over a 100-year life span.

These initial estimate methods are considered to provide upper end values of the sediment volume which will accumulate over the 100-year life of the structure. Ranging from 235 to 600 acre-feet, these values represent 10% or less of the reservoir storage volume and more refined analyses are not deemed necessary for planning purposes.

Table 2.9. List of drainage basin characteristics and possible range of numerical ratings (modified from Pacific Southwest Interagency Committee, Water Management Subcommittee, 1968)

Drainage basin characteristics	Sediment yield levels		
	High rating	Moderate rating	Low rating
Surface geology	10: marine shales and related mudstones and siltstones	5: rocks of medium hardness moderately weathered and fractured	0: massive hard formations
Soils	10: fine textured and easily dispersed or single grain salts and fine sands	5: medium textured, occasional rock fragments, or caliche crusted layers	0: frequent rock fragments, aggregated clays, or high organic content
Climate	10: frequent intense convective storms	5: infrequent convective storms, moderate intensity	0: humid climate with low intensity rainfall, arid climate with low intensity rainfall, or arid climate with rare convective storms
Runoff	10: high flows or volume per unit area	5: moderate flows or runoff volume per unit area	0: low flows or volume per unit area or rare runoff events
Topography	20: steep slopes (in excess of 30%), high relief, little or no flood plain development	10: moderate slopes (about 20%), moderate flood plain development	0: gentle slopes (less than 5%), extensive flood plain development
Ground cover	10: ground cover less than 20%, no rock or organic litter in surface soil	0: ground cover less than 40%, noticeable organic litter in surface soil	-10: area completely covered by vegetation, rock fragments, organic litter with little opportunity for rainfall to erode soil
Land use	10: more than 50% cultivated, sparse vegetation, and no rock in surface soil	0: less than 25% cultivated, less than 50% intensively grazed	-10: no cultivation, no recent logging, and only low intensity grazing, if any
Upland erosion	25: rill, gully, or landslide erosion over more than 50% of the area	10: rill, gully, or landslide erosion over about 25% of area	0: no apparent signs of erosion
Channel erosion	25: continuous or frequent bank erosion, or active headcuts and degradation in tributary channels	10: occasional channel erosion of bed or banks	0: wide shallow channels with mild gradients, channels in massive rock, large boulders, or dense vegetation or artificially protected channels

TOTAL = 70

Table 2.10. Drainage basin sediment yield classification (Randle, 1996)

Drainage basin classification number	Total rating	Annual sediment yield (ac-ft/mi^2)
1	> 100	> 3
2	75 to 100	1.0 to 3.0
3	50 to 75	0.5 to 1.0
4	25 to 50	0.2 to 0.5
5	0 to 25	<0.2

- EXPLANATION -

Yield Class	Yield Rate 1/ (Ac.Ft/Sq.Mi/Yr.)	Total Area (Sq.Mi.)
1	> 3.0	____
2	1.0-3.0	____
3	0.5-1.0	____
4	0.2-0.5	____
5	0.1-0.2	____
6	< 0.1	____

▼ 0.45 AVERAGE ANNUAL SUSPENDED SEDIMENT YIELDS DETERMINED FROM SEDIMENT TRANSPORT RECORDS. RATES ARE IN Ac.Ft/Sq.Mi/Yr.

80 - 20 ECT. (PERCENT OF SHEET AND RILL EROSION - PERCENT OF CHANNEL AND GULLY EROSION.

Subregion Number	Subregions
4	SNAKE
1A	BEAR LAKE
1B	GREAT SALT LAKE
2A	SEVIER LAKE
2B	GREEN RIVER
2C	SAN JUAN - COLORADO
3	UPPER MAIN STEM
	LOWER MAIN STEM

1/ DO NOT USE THESE RATES TO DETERMINE SEDIMENT YIELDS AT SPECIFIC SITES. LARGE VARIATIONS IN SEDIMENT RATES MAY OCCUR WITHIN THE DELINEATED AREAS.

Cove Reservoir

SOURCES OF INFORMATION

1. GREAT BASIN, UPPER COLORADO AND LOWER COLORADO REGIONS, COMPREHENSIVE FRAMEWORK STUDY, APPENDICES VIII, WATERSHED MANAGEMENT, JUNE 1971, PACIFIC SOUTHWEST INTER-AGENCY COMMITTEE/WATER RESOURCES COUNCIL.
2. UTAH STATE SOILS MAP AND SOILS DESCRIPTIONS.
3. RESERVOIR SURVEYS BY SCS & USBR
4. SUSPENDED LOAD MEASUREMENTS BY USGS, USBR & SCS.
5. WATERSHED STUDIES BY SCS.
6. GENERAL KNOWLEDGE OF THE STATE FROM REGULAR SCS PROGRAM WORK.

ESTIMATED SEDIMENT YIELD RATES FOR THE STATE OF UTAH

EROSION & SEDIMENTATION -70
WESTERN U.S. WATER PLAN
AUGUST 1973
(SUBJECT TO REVISION)
prepared by
U.S.D.A., Soil Conservation Service
Geologist, Bob L. Bridges

10 5 0 5 10 15
scale in miles

Cove Dam Feasibility Study



Near Orderville, Kane County, Utah

June 2004

RB&G ENGINEERING, INC.

RB&G
ENGINEERING, INC.

June 16, 2004

Kane County Water Conservancy District
76 North Main Street
Kanab, UT 84741

Attn: Mike Noel

Subject: Cove Dam
Feasibility Study

Gentlemen:

A Feasibility Study has been completed for the proposed Cove Dam near Orderville, Kane County, Utah. The investigation has been conducted in accordance with a proposal submitted to your organization for the work, and the results of the study are summarized in the report transmitted herewith.

We appreciate the opportunity of providing this service for you. If there are any questions relating to the information contained herein, please call.

Sincerely,

RB&G ENGINEERING, INC.

Bradford E. Price, P.E.

bep/jag

1435 WEST 820 NORTH, PROVO, UTAH 84601-1343
PROVO 801-374-5771 SALT LAKE CITY 801-521-5771 FAX 801-374-5773

Feasibility Study

Cove Dam

near Orderville
Kane County, Utah

June 14, 2004

RB&G ENGINEERING, INC.

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COVE DAM

Kane County Water Conservancy District

Feasibility Study – Executive Summary

This report summarizes the results of a feasibility study performed for the proposed Cove Reservoir to be located about 1 mile southwest of Orderville, Utah. The purpose of the reservoir is to provide off-stream storage for the district to aid in water distribution for municipal and agricultural purposes. Water will be delivered to the off-stream reservoir via pipeline.

Surficial deposits in the study area consist of Quaternary alluvial deposits overlying the Tropic Shale Formation. This formation consists predominantly of dark gray shale with some gray sandstone. At the site, the formation also contains thin layers of grayish-white bentonite and minor to very minor gypsum lenses, stringers, and fracture infill. Bedrock in the upper 25 to 50 feet of the abutments is highly fractured and will require a grout curtain to reduce seepage through the abutments.

Based upon the results of field and laboratory testing, it is our opinion that a homogeneous clay earthfill embankment with an internal filter and drainage system will be the most efficient type of structure for this site. It is anticipated that clay fill can be obtained from required excavations and the reservoir basin. Filter, drain, riprap bedding, and riprap material must be imported from off-site sources. Sources have been identified within a 5 mile radius of the site.

A maximum dam height of between 100 and 110 feet is available at the site. Assuming 10 feet of freeboard, this results in an available capacity of between 6800 and 8800 acre feet. Our opinion of probable cost for a 100 foot high dam 10.7 million dollars, increasing to 14.5 million dollars for a 110 foot high structure. This results in a cost per acre foot of $1,578 for the 100 foot high structure and $1,644 for the 110 foot high structure. These values do not include the cost of land or piping to bring water to the reservoir.

COVE DAM

Kane County Water Conservancy District

Feasibility Study

I. INTRODUCTION

1. PROJECT DESCRIPTION

The proposed Cove Dam and Reservoir is located about 1 mile southwest of Orderville, Utah at the approximate location shown on the vicinity map in Figure 1. The reservoir site is situated in a natural off-stream drainage basin and will be enclosed by a single dam near the mouth of the basin. The drainage basin is located ½ mile west of the East Fork Virgin River. A new diversion structure and pipeline will route water into the reservoir. A site plan of the reservoir is shown in Figure 2. The purpose of the project is to provide water storage for Kane County Water Conservancy District to aid in water distribution for municipal and agricultural purposes.

2. PURPOSE AND SCOPE

The purpose and scope of this study was to (1) perform sufficient surface and subsurface investigations at the reservoir site to determine the feasibility of construction of the dam and reservoir, (2) perform sufficient field and laboratory investigations to identify borrow sources for the dam embankment, (3) evaluate dam type options, (4) provide recommendations relative to the best option for this site, and (5) provide preliminary cost estimates for the selected sections and appurtenant structures required to meet the safety, storage, and operation requirements of the owner.

Consideration has been given to potential borrow sources for earthfill, rockfill, and roller compacted concrete type structures. Borrow sources for impervious (clay/silt) type material, granular (sand/gravel) type material, and rock for use as riprap were identified within the basin or in the surrounding area. The work has been performed in accordance with the proposal and is discussed under the following headings:

- Geologic Investigations
- Field and Laboratory Testing Procedures
- Foundation Investigation
- Borrow Investigation
- Feasibility Analysis and Conclusions

3. PREVIOUS STUDIES

The following studies were reviewed for this report:

"Memorandum", State of Utah - Division of Water Resources; Engineering Geology Section; Oct. 6, 1997; Author: Ben Everitt, Engineering Geologist

"Proposed Cove Canyon Dam and Reservoir Near Orderville, Utah; Reconnaissance-Level Evaluation", June 1996; Franson-Noble & Associates, Inc.

II. GEOLOGIC INVESTIGATIONS

1. REGIONAL GEOLOGY

The Orderville area is located within the Grand Staircase section of the Colorado Plateau Physiographic Province. The Grand Staircase contains a series of terraces and cliffs, which rise northward from the Grand Canyon to the south to the High Plateaus to the north. The Hurricane Fault bounds the area to the west, the Kiabab Monocline bounds the area to the east (Stokes, 1987).

The Grand Staircase section is typified by a series of alternating step-like cliffs and flat areas. The upward steps in the staircase include the Vermillion Cliffs, White Cliffs, Gray Cliffs, and Pink Cliffs. The cliffs consist of more competent material while the lowlands between them consist of generally softer more erodible deposits (Stokes, 1987).

The age of the deposits exposed above the Grand Canyon range from the Triassic age, 245 million years ago near the Vermillion Cliffs, to the younger Tertiary deposits of the Pink Cliffs to the north, deposited 15 million years ago. A large portion of the sediments in this section were derived from continental deposits

The Orderville area is located within the less tectonically active Colorado Plateau Province. Bedrock in the Orderville area shows evidence of some ancient normal faulting as well as younger Quaternary faults. This general region has been less disrupted by compressional forces from the Sevier Orogeny, which was more prominent across the northwestern side of the state.

The area is located within the western edge of the Intermountain Seismic Belt (ISB). The ISB is a zone of seismic activity which trends from northern Arizona up through northern Montana in the U.S.A.

The study area is located east of the general transition zone between the Basin and Range Province and the Colorado Plateau Province. The area is located on the western edge of the potentially active Sevier Fault. The Sevier Fault is the eastern most major extensional fault in southern Utah.

2. SITE GEOLOGY

Figure 3 is a portion of a geologic map of Kane County showing the location of the study area. As shown on the map, surficial deposits in the study area consist of Quaternary alluvial deposits overlying bedrock. Bedrock throughout the reservoir basin and proposed dam abutments consists of the Cretaceous age Tropic Shale Formation (Doelling, etal, 1989, Doelling, 1999). No competent outcrops of Tropic Shale were observed at the site from which strike and dip could be measured. Based on information from drill holes, and topographic and structural geology maps, bedrock in the area appears to dip 2 to 3° down toward the northeast (Doelling, etal, 1989). The strike of the bedrock taken from a structural geologic map is about North 30° West. Interpretations taken from topographic and geologic maps show the strike to be about North 60° West.

The following descriptions of the surficial and rock units in the study area are taken from "The Geology of Kane County, Utah, Geology, Mineral Resources and Geologic Hazards, by Hellmut H. Doelling and Fritzhugh D. Davis"... published in 1987 and Interim geologic map of the Kanab 30'X60" Quadrangle..., Open-File Report 366,1999. Deposits are listed from youngest to oldest, with personal comments relative to the study area in italics.

Quaternary

Qa Alluvium - sand and silty clay with lenses of sandy silt and gravel sediments consist of unconsolidated clay, silt, sand and gravel, deposited in stream bed and flood-plains. *(During this investigation sand and gravel deposits appeared very limited and discontinuous. Deposits may be considered for embankment material).*

Qag Alluvial gravel - poor to well sorted gravel and sand with some silt and clay interbeds.(*Exposures are predominate terrace deposits along the east side of the East Fork of the Virgin River which trends southeast along the east side of the highway. Sand and gravel may be considered for granular borrow source*).

Cretaceous

Ks Straight Cliffs Formation - Yellow-gray very fine to fine grained , med to thick bedded, cliff forming, calcareous sandstone with interbedded less resistant sandstone, shale and mudstone. (*This unit is exposed north and northwest of the site. The unit is well exposed due to faulting on the north side of Orderville. The formation is exposed as a yellow cliff forming cap rock above the Tropic Shale. Competent material may be suitable for rip rap but appears to have many interbedded weak layers*).

Kt Tropic Shale Formation- Dark gray, drab marine shale with some gray sandstone. (*This unit forms the bedrock for the dam abutments and reservoir basin. At this site the formation also contains several grayish-white bentonite layers which are exposed along the south (right) side of the reservoir basin, septarian nodules/concretions are also common locally. Some minor gypsum lenses, stringers and fracture infilling were noted during this study*).

Kd Dakota Formation - Interbedded sandy shale, carbonaceous shale, sandstone, conglomerate and coal.

Jurassic

Jc Carmel formation - sandstone, siltstone, limestone, shaly limestone and gypsum. Divided into members.

Jcw Winsor and Wiggler Wash Members - Reddish or yellow slope forming silty sandstone.

Jcp Paria River Member - Gypsum, reddish siltstone and sandstone, with some limestone at top. *(south of site seen as a white gypsum cliff along highway*).

Jcc Crystal Creek Member - Brown banded sandstone. *(South of site this unit exposes a small fault zone in a road cut off of highway).*

Jck Co-op Creek Member - Thin to medium bedded light gray limestone and tan limestone shale. (*Unit forms ledges south of sewer lagoon, off of highway and was used as rip rap for lagoon. This unit is also exposed just east of the highway on the east side of the Sevier fault on the northeast end of Orderville. This may be a source of rip rap*).

3. SEISMIC CONSIDERATIONS

A detailed seismic evaluation for the site has not been completed as part of the Feasibility Study. However, the Utah Dam Safety Map for the *No Fault Specific* seismic event with a 5,000 year return interval indicates that the extreme event could generate a Peak Ground Acceleration (PGA) of about 0.29g. A preliminary seismic evaluation finds that the nearest seismic source is the southern section of the Sevier (Toroweap) Fault, located about 1.9 miles (3 km) east of the site. This fault is Quaternary in age (Late Pleistocene 10-130 k years ago) with no documented Holocene movement. No recurrence interval information is currently available for this fault, however an estimated slip rate of 0.2-1mm/yr has been given by others (Anderson and Christenson, 1989; Hecker, 1993; Black and others, 2003). This section of the fault is about 55 miles (88 km) long and may be capable of generating a Maximum Credible Earthquake (MCE) with a magnitude of about 7.2 to 7.4. Due to the close proximity of the fault, a 7.2 to7.4 earthquake could generate Peak Horizontal Ground Acceleration (PGA) values of between 0.62g to 0.65g.

4. GEOLOGIC HAZARDS

Geologic hazards which should be considered at this site include seismic, slope stability, and potential embankment and foundation hazards. These hazards are discussed below as follows:

Seismic

As mentioned previously, ground shaking during a moderate to large seismic event near the site is a potential hazard. While the activity rate of the Sevier Fault is not fully understood, evidence suggests that it has the potential to generate a large magnitude earthquake. Since the site is located a couple of miles west of the fault surface, fault rupture during a seismic event is unlikely. Hazards include tectonic subsidence and deformation. Tectonic deformation should be addressed during the design of the dam.

Liquefaction

Current and previous studies have identified some scattered alluvial sand and gravel deposits in the basin which may have a potential for liquefaction. Information to date indicates that the deposits are relatively localized and discontinuous. It is possible that loose sand deposits exist beneath the dam footprint, which will require mitigation. Sufficient investigation should be performed during final design to determine if mitigation measures are required.

Non-seismic Slope Failure

A review of the site did not find any evidence of rock fall, debris flow or landslide deposits. The stability of abutment slopes under saturated sudden draw down conditions should be addressed during design of the dam.

Foundation and Embankment Hazards

Several geologic hazard maps indicated that the Tropic Shale Formation and the alluvial material in the basin has a potential for swelling and shrinking with changes in moisture content (bentonite layers have very high potential) (Doelling etal, 1989; Mulvey, 1992). It

should be noted that during site visits between April and June (2004), relatively large polygonal desiccation cracks were observed within the alluvial material covering the basin and abutments. These cracks were observed to be up to 1 inch wide and 1 foot deep. In many places the cracks were difficult to see due to the popcorn texture of the soil at the surface.

Doelling's map also mentions that the Tropic Shale has a high sulfate content which may react with concrete (Doelling etal, 1989). For this project, site specific testing should be conducted to verify the sulfate content in the area. Gypsum is moderately soluble and may dissolve over time when exposed to water. Dissolution of the gypsum may gradually create voids within the foundation of the reservoir. During this preliminary investigation relatively little visible gypsum was observed in the test borings or test pits. Additional testing should be performed to determine the percent of soluble salts in the embankment and foundation materials. Test pits within the basin also encountered some collapsible soils. Testing results are discussed later in this report.

Based on observations at the site the bedrock contact beneath alluvium in the basin may be somewhat undulating. Three small knolls are located within the center of the basin in an east-west direction. Test Pit 04-5 was excavated in the eastern knoll and encountered bedrock at a depth of about 4.5 feet. It is assumed that the other knolls also have shallow bedrock. These exposures indicate that bedrock may also be located at varying depths beneath the foundation of the dam. Depending on the final design of the dam, variations in the depth of bedrock could have an effect on differential settlement of the structure. Additional investigations will be needed to better define the bedrock contact beneath the dam.

III. FIELD AND LABORATORY TESTING PROCEDURES

The borings were drilled using a CME 55 rotary drill rig with a tri-cone rock bit and NW casing to advance the boring and water as the drilling fluid through the over-burden. Continuous coring was performed in bedrock using an NQ size wireline system. In addition, test pits were excavated with a 310 SE John Deere backhoe. Sampling of over-burden in the borings was performed at about five-foot intervals, while sampling in the test pits was performed at approximately three-foot intervals or at each significant change of material type. Both disturbed and undisturbed samples were obtained during the field investigations. Disturbed samples from the borings were obtained by driving a 2-inch split spoon sampling tube through a distance of 18 inches using a 140-pound weight dropped from a distance of 30 inches. The number of blows to drive the sampling spoon through each 6 inches of penetration is shown on the boring logs. The sum of the last two blow counts, which represents the number of blows to drive the sampling spoon through 12 inches, is defined as the standard penetration value. The standard penetration value, corrected for overburden and hammer energy, provides a good indication of the in-place density of sandy material; however, it only provides an indication of the relative stiffness of the cohesive material, since the penetration resistance of materials of this type is a function of the moisture content.

Undisturbed samples in the borings were obtained by pushing a thin-walled sampling tube into the subsurface material using the hydraulic pressure on the drill rig. Undisturbed samples in the test pits were recovered by cutting block samples or by pushing consolidation rings into undisturbed benches

excavated into the side walls of the test pit. The location at which the undisturbed samples were obtained is shown on the boring and test pit logs.

Miniature vane shear tests, which provide an indication of the undrained shearing strength of cohesive materials, were performed on samples of the clay soil during the field investigations. The results of these tests are shown on the boring logs as the torvane value in tons per square foot (tsf).

Each sample obtained in the field was classified in the laboratory according to the Unified Soil Classification System. The symbol designating the soil type according to this system, is presented on the boring or test pit log. A description of the Unified Soil Classification System is presented in the appendix, and the meaning of the various symbols, shown on the log sheet, can be obtained from this figure.

Laboratory tests performed during this investigation to define the characteristics of the subsurface material throughout the proposed site and at the identified granular and rock borrow sources included in-place dry unit weight, natural moisture content, moisture-density (proctor) tests, Atterberg Limits, mechanical analyses, direct shear tests, laboratory permeability tests, dispersive clay tests, slaking tests, specific gravity tests, and consolidation tests. Testing was performed following procedures outlined in the American Society for Testing and Materials (ASTM) standards.

IV. FOUNDATION INVESTIGATION

Prior to beginning the subsurface investigation, a site reconnaissance was made to determine the optimal alignment for the dam. Topographically, the ridges at the southern end of the valley appear to provide the most efficient alignment for the dam enclosure. It was apparent that the ridges are relatively narrow and, to provide adequate abutment support, it was our opinion that the alignment shown on Figures 2 and 4 should be used for the embankment.

The characteristics of the subsurface material at the site were evaluated by drilling five borings to depths ranging from 39 to 101 feet and excavating two test pits to depths of about twelve feet. The drill hole and test pit locations are shown in Figure 4. The logs for the borings and test pits are presented in Test Hole Log section of this report. All five drill holes were completed within or very near the footprint of the proposed dam.

Both the drill holes and the test pits were used in evaluating the characteristics of the overburden material at this site. Bedrock core was recovered from four of the borings to assess the competency and condition of the foundation bedrock. Photographs of the core from the drill holes are included in the Test Hole Log section of this report.

Three holes were drilled within the footprint of the dam and one hole was drilled on each of the abutments at the locations shown in Figure 4. The test holes are also shown on the profile presented in Figure 5.

DH 04-1, 04-2 and 04-4 were drilled vertical and DH 04-3 and DH 04-5 were drilled at an angle of 60 degrees from horizontal. The percent recovery and Rock Quality Designation (RQD), along with the results of field permeability tests are shown on the logs and in profile view on Figure 5.

While the drill logs indicate the angles and direction the hole was drilled, the core is not classified as being "Oriented"; hence, the actual direction of bedding and fractures seen in the core can not always be determined. Terms on the drill logs such as vertical fractures and angles of bedding, refer to how they appear relative to the cored sample and not to actual vertical and horizontal at the surface.

Test Pit 04-1 was completed between the right abutment and the maximum section beneath the upstream shell portion of an earthfill type structure at approximately elevation 5463 feet. Test Pit 04-7 was completed on the centerline alignment at the maximum section of the proposed structure midway between DH 04-4 and DH 04-2 at elevation 5458 feet.

1. SOIL PROFILE

It will be observed from DH 04-1, 04-2 and 04-4 that the depth of soil overburden on the valley floor varies at these particular locations from 20 to 47 feet. Deeper channels may also be present which were not encountered by these borings. It should also be noted that TP 04-5 excavated on the small knoll at the upstream toe near the maximum section encountered heavily weathered shale bedrock at a depth of only four feet.

The soil overburden sampled from the drill holes and test pits consists predominantly of lean clay with interbedded layers and lenses of fat clay, sandy silt, and silty sand with pockets of gravel. The overburden is a combination of weathered material from the underlying Tropic Shale formation and alluvial material washed down from the surrounding slopes. The silt and clay deposits were heterogeneously layered with some sections of the test pits showing distinct layers several inches in thickness and other sections of the test pits showing thin closely spaced lenses less than an inch in thickness. When combined, these layers generally exhibit the characteristics of lean clay with medium plasticity and good workability. The silt and clay deposits were visually observed to have a low to moderate mineral content. A close examination of the sidewall of these test pits showed that the interbedded layers of silty sand were generally fine grained and from one to six inches in thickness. Gravel particles tended to be sandstone or shale in origin with sub-angular to sub-rounded edges. Generally the pockets of gravel were fine grained with a size range of ¼ to 1 inch. The gravel layers which made up these scattered deposits were observed to be from one to three feet in thickness. A few cobbles and boulders were encountered with maximum particle size of about 12 inches. A pin-hole type structure was readily evident in the silt and clay type deposits in the test pits. The moisture content of the samples varied from dry to very dry.

Standard Penetration Test (SPT) values ranged from 6 to 55 indicating the material is in a firm to hard condition. Thirteen disturbed samples were recovered and seven undisturbed samples were recovered from the bore holes. Some of the undisturbed samples recovered were not extracted intact due the very dry condition of the soil.

The overburden on the abutments was removed during construction of the access roads for DH 04-3 and DH 04-5. Drilling began directly in the weathered bedrock. It is estimated from the access road cut that the depth of overburden prior to its removal was between 1 and 3 feet.

2. BEDROCK PROFILE

The quality of the bedrock is characterized by the percent of core recovered, along with the rock quality designation (RQD). The RQD is the percent of material within a cored interval that is twice as long as the cored diameter (segment at least 4 inches long). The core generally consisted of gray mudstone (Tropic Shale Formation) with occasional bentonite layers. It will be noted from the boring logs and Figure 5 that the percent recovery and RQD ranged from 63 to 100% in DH 04-1 and DH 04-2 located on the valley floor.

In DH 04-3 on the right abutment, the bedrock in the upper 25 feet was highly weathered and fractured, with the percent recovery ranging from 78 to 100 and the RQD varying from 18 to 65. Below 25 feet, the percent recovery ranged from 69 to 100 and the RQD varied from 42 to 100 with the layer between 32 and 38 feet having 0 RQD. Minor gypsum coating was observed on some joints in the upper 70 feet. Bentonite layers, approximately 1.5 feet thick, were encountered at 25, 75 and 95 feet.

In DH 04-5 on the left abutment, the bedrock in the upper 40 feet was highly fractured, with the percent recovery ranging from 0 to 96 and an RQD of 0. Below 40 feet, the bedrock was relatively competent with the percent recovery ranging from 80 to 100 and the RQD varying from 60 to 100. A few random gypsum stringers were observed in the core between 28 and 46 feet. Bentonite layers ranging in thickness from 0.5 to 2 feet were encountered at 71, 77 and 89 feet.

3. GROUNDWATER

Ground water was not encountered in the test pits. Temporary monitoring wells consisting one inch PVC pipe were installed in each of the drill holes completed in April/May 2004. Each of the wells was bailed out upon completion of drilling. On June 3, 2004 the wells were bailed out again and ground water levels were recorded. The results are shown on the following table:

Water Table Readings - Recorded June 3, 2004

Drill Hole	Orientation	Depth		Elevation		Water Table	
		Angle	Vertical	Top	Bottom	Depth	Elevation
04-1	Vertical	-	90	5454	5364	46.8'	5407.2
04-2	Vertical	-	39	5458	5419	17.0'	5441.0
04-3	60° Dip	100.5	87	5546	5445.5	71.0'	5484.5
04-4	Vertical	-	41	5458	Caved at 29'	Dry @ 29'	-
04-5	60° Dip	101	87.5	5542.5	5441.5	36.0'	5511.3

The groundwater level at each bore hole is also shown on the Geologic Profile in Figure 5 and it will be observed that the gradient is toward the center of the basin.

4. PERMEABILITY

Permeability tests were conducted in both the soil overburden and the foundation bedrock. The test results are shown on the boring logs and the profile view in Figure 5. Permeability calculations are included in the appendix. It will be observed from Figure 5 that the permeability of the silt and clay overburden varied from 0 to 189 ft/yr. It will also be observed that the permeability of the Tropic Shale Formation is relatively low except within the upper 50 feet of the abutments in the more heavily fractured rock. Permeability tests in the upper 50 feet on the abutments in DH 04-3 and DH 04-5 show rates varying from 300 to 6,000 ft/yr. Below a depth of 50 feet in DH 04-3 on the right abutment, the permeability ranged from 0 to 394 ft/yr. Below a depth of 45 feet in DH 04-5 on the left abutment, the permeability ranged from 0 to 5 ft/yr.

5. LABORATORY TESTING

Laboratory tests performed to define the characteristics of the dam foundation included (1) Atterberg Limits, (2) in-place density, (3) consolidation (4) direct shear, and (5) slake durability. The results of the mechanical analyses, Atterberg Limits, dry unit weight and moisture content tests are summarized on the logs and in Table 1, Summary of Test Data contained in the Laboratory Testing Section of this report. The results of all tests are discussed below as follows:

A. Atterberg Limits

Fourteen Atterberg Limits tests were completed on soil samples recovered from the drill holes and test pits within the foundation area to determine the plasticity characteristics. It will be observed from Table 1 that the liquid limit varied from 20 to 58 while the plasticity index ranged from 5 to 34. Thirteen of the 14 samples classify as lean clay, with one sample classifying as fat clay.

Eight sections of bedrock core were pulverized from TP 5 at 6 and 9 feet, DH 04-1 at 53 and 73 feet, DH 04-2 at 26 feet, DH 04-3 at 14 feet and DH 04-5 at 41 and 48 feet to define the characteristics of the Tropic Shale mudstone. The liquid limit of these samples ranged from 43 to 82 while the plasticity index varied from 24 to 50. Six of the eight samples classify as fat clay, with two classifying as lean clay.

B. In-Place Density

The in-place dry density was determined for nine samples obtained at select locations, and the results of these tests are also included in Table 1, Summary of Test Data. It will be observed that the in-place density varied from 82.0 to 120.3 pcf.

C. Consolidation Tests

The compressibility, collapse and expansive characteristics of the clay were evaluated by performing eight consolidation tests on undisturbed samples recovered from DH 04-1, DH 04-2 and TP 7. The results of the consolidation tests are presented in the Laboratory Testing Section of this report. During the performance of the consolidation tests, each sample was loaded at the natural moisture content until a load intensity of 0.28 tsf had been reached. At this point in the loading cycle, each sample was permitted to absorb water without any increase in the load intensity. Soils having collapsible characteristics settle without any increase in the load when they become wet or saturated. It will be observed from these figures that the two samples from Test Pit 7 at 3 and 9 feet in depth exhibited some slight collapse characteristics.

Expansive soils always experience an increase in void ratio on absorbing water. It will be observed that five of the eight samples from the drill holes swelled when water was added. A summary of the Atterberg Limits and percent swell/collapse for each of the samples tested is shown on the following table.

Test Hole	Depth (ft)	Soil Type	Atterberg Limits		Dry Unit Weight (pcf)	Moisture Content (%)	Percent Swell (%)
			Liquid Limit	Plastic Index			
DH 1	5-6.5	CL-1	32	14	120.3	9.8	1.4
DH 1	15-16.5	CL-2	37	19	119.4	8.7	3.1
DH 1	25-26.5	CL-2	34	18	112.4	14.3	1.2
DH 1	35-36.5	CL-2	49	31	105.2	17.5	1.6
DH 1	45-46	CH	50	34	100.7	23.1	0
DH 2	15-16.5	CH	58	34	111.8	19.3	4.3
							Percent Collapse (%)
TP 7	3-4	CL-ML	26	6	86.9	6.5	1.2
TP 7	9-10	CL-1	33	15	89.6	9.1	< 0.5

D. Direct Shear

To obtain an indication of the drained shear strength of the cohesive material, two consolidated drained direct shear tests were performed on samples from TP 7 at 6 feet. One test was performed on an undisturbed block of the lean clay, and one test was performed on a re-molded sample compacted to a density of approximately 98% of the maximum density as determined by ASTM D 698. The results are presented in the Laboratory Testing Section of this report. A summary of the results from the direct shear tests are shown in the following table:

Test Hole	Depth (ft)	Soil Type	Condition	Friction Angle ϕ (degrees)	Cohesion (psf)
TP 7	6	CL-2	Undisturbed	29.9	144
TP 7	6	CL-2	Remolded	30.2	288

E. Slake Durability

Slaking tests were performed in accordance with ASTM D 4644 on the weathered shale / mudstone. The results of the test are shown in the following table:

Test Hole	Depth (ft)	Classification	Location	Slake Durability Index (%)
04-1	53	CH	MAX. SECTION	34.2
04-1	73	CH	MAX. SECTION	6.7
04-2	26	CH	TOE LEFT ABUTMENT	2.9
04-3	14	CH	RIGHT ABUTMENT	0.0
04-5	41	CL-2	LEFT ABUTMENT	3.4
04-5	48	CL-2	LEFT ABUTMENT	2.4

V. BORROW INVESTIGATION

1. IMPERVIOUS BORROW

Based upon the geologic studies, test holes located within the foundation footprint and observation of soils within gullies throughout the basin, sufficient impervious material appears to exist with the reservoir basin to construct an earthen embankment. In addition to the drill holes and test pits performed in the foundation area, 11 additional test pits were excavated throughout the basin at locations as shown in Figure 2. The test pit logs are included in the Test Hole Log Section and it will be observed that the soil profile in 10 of the 11 pits consists predominately of dry, hard lean clay with some interbedded silt and sand. Test Pit 13, located at the upper end of the basin, encountered silty sand with clay layers to a depth of 12 feet.

Information on material type and material distribution for test pits from the 1997 Engineering Memorandum (included in the appendix) was considered satisfactory and, as such, these areas within the basin were not covered with test pits during this investigation.

A. Laboratory Testing

Laboratory tests performed to define the characteristics of the impervious borrow included (1) Atterberg Limits, (2) mechanical analysis, (3) in-place density and natural moisture content, (4) soil moisture-density relation (proctor), (6) direct shear, (8) dispersive clay, and (9) laboratory permeability. The results of the mechanical analyses, Atterberg Limits, dry unit weight and moisture content tests are summarized on the logs and in Table 1, Summary of Test Data. The results of all tests are discussed below as follows:

(1) Atterberg Limits

Twenty six Atterberg Limits tests were completed on soil samples recovered from the drill holes and test pits within the foundation and reservoir basin area to determine the

plasticity characteristics. It will be observed from Table 1 that the liquid limit varied from 20 to 58 while the plasticity index ranged from 5 to 34. Twenty five of the 26 samples classify as lean clay, with one sample classifying as fat clay.

(2) Mechanical Analyses

Mechanical analyses were completed on twenty-six samples of the soil overburden recovered from the reservoir basin. The clay and silt samples contained 0% percent gravel and between 0 and 47% sand. The percent finer than a No. 200 sieve ranged from 53 to 100, with an average of 90%. A sand layer encountered in TP 3 from 0 to 1 feet had 25% gravel and 2% silt. A sand layer encountered in TP 4 at 5.5 feet had 0% gravel and 18% silt.

(3) Natural Moisture Content

The natural moisture content of twenty six samples was determined with values ranging from 3.4 to 23.1%. It will be noted that the natural moisture content of the samples from the test pits, which varied from 3 to 12 in depth, were all below 10%.

(4) Soil Moisture-Density Relation (Proctor) Tests

Three proctor tests were completed on samples of the lean clay / silty clay obtained from TP 04-1 at 3 feet, and TP 04-7 at 3 and 6 feet. The tests were completed in accordance with procedures outlined in ASTM D 698. The proctor curves are included in the Laboratory Testing Section. It will be noted that the maximum dry unit weight varies from 114 to 116 pcf and the optimum moisture content ranges from 14 to 16%.

(5) Dispersive Clay Tests

The dispersive characteristics of the impervious material were evaluated by performing pinhole tests on nine samples. The results of these tests are shown on Table 1 in the Laboratory Testing Section. Tests were conducted on samples from the test pits in the reservoir basin. The following table is a summary of the classification categories:

DISPERSIVE CLAY CHARACTERISTICS BY PIN HOLE TEST METHOD

CATEGORY	DESCRIPTION
D1, D2	DISPERSIVE
ND 3, ND 4	SLIGHTLY TO MODERATELY DISPERSIVE
ND 2, ND 1	NON-DISPERSIVE

It will be observed from the Summary of Test Data that 5 of the 9 samples classified as ND 2: non-dispersive, with the remaining 4 samples classifying as ND 3: slightly dispersive.

(6) Laboratory Permeability Tests

Constant head laboratory permeability tests were performed on three remolded samples of the lean clay obtained from the test pits in the reservoir basin. TP 1 at 3 feet, and TP 7 at 3 and 6 feet. The samples were placed in the permeability mold at 98% compaction and saturated using back-pressure techniques. The results of the tests are shown in the following table.

Test Hole	Depth (ft)	Soil Type	Coefficient of Permeability (ft/yr)
04-1	3	CL-1	0.09
04-7	3	CL-ML	0.23
04-7	6	CL-2	0.07

2. GRANULAR BORROW MATERIALS

Work performed during the investigation for granular borrow included identification of potential borrow areas, and limited laboratory testing of select soil samples to determine material properties. As stated above, no significant granular borrow sources were identified within the reservoir basin. Two commercially available granular borrow sources were identified within about 1 mile of the site as shown in Figure 3. The first site, referred to as Rose Pit, and is located across Highway 89 and just east of the Virgin River adjacent to Orderville. The second source is referred to as the Tate Pit and is located just east of the town of Mt. Carmel. Bucket samples of bank run material were collected from both the Rose and Tate gravel pits for laboratory testing. The sidewall of the cuts was also observed for variation in material layering. It was noted that in both of the cuts the sidewalls showed clay layers up to 6 feet thick interbedded among the sand and gravel deposits.

Gradation tests were completed on the bulk samples, and gradation curves are shown in the Laboratory Testing section of this report. The material in the Rose Pit classified as a well-graded gravel with silt and sand (GW-GM), while the material in Tate Pit classified as a poorly graded gravel with sand (GP).

Specific gravity and absorption tests were conducted these samples. The results of the tests show the gravelly sand at the Rose Pit to have an apparent specific gravity of 2.67 with absorption of 1.6%. The sandy gravel at the Tate Pit has an apparent specific gravity of 2.67 with absorption of 2.3%.

3. RIPRAP

No significant rock borrow sources were identified within the immediate vicinity of the reservoir basin. The most likely potential source of rock for use as riprap is a basalt formation near the town of Glendale or the limestone rock just south of the Orderville sewer lagoons. This same

limestone unit is also exposed at the northeast end of town. Potential riprap sources are identified in Figure 3.

Specific gravity and absorption tests were conducted both the limestone and basalt rock samples. The results of the tests show the basalt rock with an apparent specific gravity of 2.68 and an absorption of 0.9%. The limestone rock has an apparent specific gravity of 2.65 with an absorption of 0.8%.

Further testing of the rock material intended for use as riprap will be required during the final design stage of this project; however, it appears that either the limestone or basalt rock will serve satisfactorily as slope protection.

VI. FEASIBILITY ANALYSIS AND CONCLUSIONS

Based upon the information summarized in the previous sections, it is our opinion that a reservoir can be constructed at this site with a maximum storage capacity of about 8800 acre feet covering an area of 210 acres. We believe that an earthfill dam will be the most efficient structure for the reservoir. This opinion is based upon (1) the characteristics of the foundation material, (2) an adequate source of embankment material within the basin and (3) the lack of a good source of gravel and rock in close proximity to the site for construction of an RCC or rockfill type structure. Detailed analyses have, therefore, been limited to an earthfill type embankment.

1. EARTHFILL EMBANKMENT CROSS SECTION

The plan view and maximum section for the proposed embankment are presented in Figures 4 and 6. It will be observed from Figure 6 that a homogeneous embankment with an internal chimney filter/drain is proposed. Zone I will consist of relatively impervious material from foundation excavation and the reservoir basin. The material will be predominately lean clay. Material within the borrow is several percent below optimum moisture for placement and pre-wetting of the borrow areas will be required. Excavation methods will require mixing to blend silt and sand layers with the clay to achieve at least 50% minus No. 200 material. An 8 foot wide chimney filter/drain has been located downstream of centerline and will be designed as a crack stopper to protect the lean clay from piping and to intercept water, preventing saturation of the downstream embankment. Slope protection will be required, with rock riprap and bedding planned for the upstream slope and seeding planned for the downstream slope.

A 6 inch surface course of untreated road base is recommended to cap the crest of the dam to provide a finished surface. The crest should be sloped at 2% downward toward the reservoir to prevent ponding of rainwater.

A crest width of 25 feet has been assumed, with an upstream slope of 3 horizontal to 1 vertical and downstream slope of 2 horizontal to 1 vertical based upon the nature of the materials. It is

anticipated that a freeboard of between 7 and 10 feet will be required above the spillway level to provide protection from wave action and deformation associated with potential seismic activity. A conservative freeboard of 10 feet has been assumed for the feasibility study.

2. STABILITY ANALYSIS

Preliminary slope stability analyses were performed using strength parameters based upon limited field and laboratory testing. The analyses for the dam were performed for the upstream and downstream slopes for steady-state reservoir full conditions and the upstream slope for sudden draw-down conditions.

The stability analyses were performed using the slope stability program UTEXAS2, developed by Stephen Wright at the University of Texas for the U.S. Corps of Engineers. Spencer's Method satisfies both force and moment equilibrium and is considered to be a satisfactory procedure for solving limiting equilibrium problems The factor of safety is determined by dividing the forces resisting movement by those causing movement.

The phreatic surface was modeled for steady state seepage using a reservoir full condition and for sudden drawdown as shown on Figure 6. The results of the stability analyses are shown in Figure 6 and summarized in the following table:

Analysis	FACTOR OF SAFETY	REQUIRED MINUMUM FACTOR OF SAFETY
Downstream Slope Steady State	1.51	1.5
Upstream Slope Steady State	2.18	1.5
Upstream Slope Sudden Drawdown	1.2	1.2

Based upon the results of the preliminary stability analyses, it is our opinion that the proposed cross section will be adequate, with minor adjustments.

3. SETTLEMENT ANALYSIS

A settlement analysis was performed for the maximum section using the results of consolidation tests performed on undisturbed samples obtained from Drill Hole 04-1, 04-2 and Test Pit 04-7 and the computer model EMBANK. A settlement of 48 inches was computed at the center of the maximum section with about 1 inch at the upstream and downstream toes. Eighteen of the 48 inches occurs in the upper 10 feet where collapsible type soils were encountered. Based upon field observations as discussed previously, it is expected that the foundation bedrock will have an irregular surface which could lead to differential movement. It is our opinion that the embankment cannot tolerate this magnitude of settlement without adverse effects (i.e. cracking). It is recommended that excavation of the dam footprint be performed such that settlement is limited to less than 6 inches. This will require excavation of a portion of the overburden as shown in the cross section on Figure 6.

4. FOUNDATION TREATMENT

It is recommended that a portion of the overburden soil be excavated as discussed above to limit settlement. The excavated material can be used as embankment fill. Pre-wetting of this soil should be performed prior to excavation to allow for utilization as fill. A cutoff trench will be required extending through the weathered mudstone and into competent rock.

The field investigations revealed significant fracturing of the bedrock at select locations – principally on the abutments. The results of the permeability tests show that significant seepage loss can be expected through the bedrock abutments. Due to the nature of the foundation bedrock, it is believed that a majority of the seepage will be a result of secondary permeability through fractures and joints, rather than primary permeability. To mitigate the potential harmful effects of large seepage losses, we anticipate that final design to include the following:

A. Impervious Clay Cut-Off Trench

We recommend that an impervious clay cut-off trench extend through the overburden soil and weathered bedrock and be seated a minimum of 5 feet into competent bedrock. Fractures and joints beneath the impervious cut-off and sand filter should be cleaned for a depth of at least twice the width of the fracture opening and filled with dental grout. The base of the cutoff should not be exposed for more than ~24 hours to prevent air slacking and cracking of the mudstone.

B. Grout Curtain

Based on the permeability test results and the condition of the recovered bedrock core, we recommend a foundation grouting program for the abutments. To assess the costs of such a program, a preliminary grout curtain design has been completed. The grout curtain will be located beneath the centerline of an earthfill type structure and will consist of a triple row grout curtain placed up both abutments as shown in Figure 5.

C. Downstream Filter and Drain

A downstream filter and drainage blanket is recommended beneath the downstream side of the dam as shown in Figure 6. This mitigates potential for piping of embankment material and facilitates drainage of seepage which may bypass the cut-off.

A collector toe drain is recommended for the entire length of the dam. In addition to the toe drain, interceptor finger drains should be placed at select locations throughout the downstream footprint of the dam to identify areas where seepage occurs and carry the seepage to the downstream toe drain. Manholes should be placed at the intersection of each finger drain with the toe drain to allow monitoring.

5. OPINION OF PROBABLE COST

Based upon results of the preliminary investigation and the proposed embankment cross section discussed above, a cost analysis has been performed which represents our opinion of probable cost (OPC) associated with construction of the dam embankment. The cost is shown in the following tables below. The value does not include the cost of land or piping to bring water to the reservoir. It should be recognized that the quantity of foundation excavation and, hence, earthfill is based on limited borings across the valley floor and that these quantities may vary significantly when additional data is obtained. The cost assumes that sand, gravel and riprap will be available from sources identified within a 5 mile radius of the site. Although hydraulic analysis and spillway design was beyond the scope of this study, it is assumed that the spillway can be designed to pass around the right abutment.

OPC FOR TOP OF DAM ELEVATION 5550 FEET

Item	Quantity	Unit	Unit Price	Total Price
Mobilization & Demobilization (10%)	1	Lump Sum		$ 750,345.00
Earthfill, Zone I – Dam Embank.	1,401,650	CU. YD.	$ 3.00	$ 4,204,950.00
Earthfill, Zone II – Filter / Drain	69,500	CU. YD.	$ 25.00	$ 1,737,500.00
Rock Riprap	23,700	CU. YD.	$ 30.00	$ 711,000.00
Grout Curtain	25,000	LIN. FT.	$ 30.00	$ 750,000.00
Outlet Pipe & Appurtenant Structures	500	LIN. FT.	$ 200.00	$ 100,000.00
		SUBTOTAL		**$ 8,253,795.00**
Engineering / Contingencies		(Estimated at 30% for Feasibility Stage)		$ 2,476,138.00
		TOTAL		**$ 10,729,934.00**

OPC FOR TOP OF DAM ELEVATION 5560 FEET

Item	Quantity	Unit	Unit Price	Total Price
Mobilization & Demobilization (10%)	1	Lump Sum		$ 1,011,460.00
Earthfill, Zone I – Dam Embank.	2,026,200	CU. YD.	$ 3.00	$ 6,078,600.00
Earthfill, Zone II – Filter / Drain	91,400	CU. YD.	$ 25.00	$ 2,285,000.00
Rock Riprap	29,700	CU. YD.	$ 30.00	$ 891,000.00
Grout Curtain	25,000	LIN. FT.	$ 30.00	$ 750,000.00
Outlet Pipe & Appurtenant Structures	550	LIN. FT.	$ 200.00	$ 110,000.00
		SUBTOTAL		**$ 11,126,060.00**
Engineering / Contingencies		(Estimated at 30% for Feasibility Stage)		$ 3,337,818.00
		TOTAL		**$ 14,463,878.00**

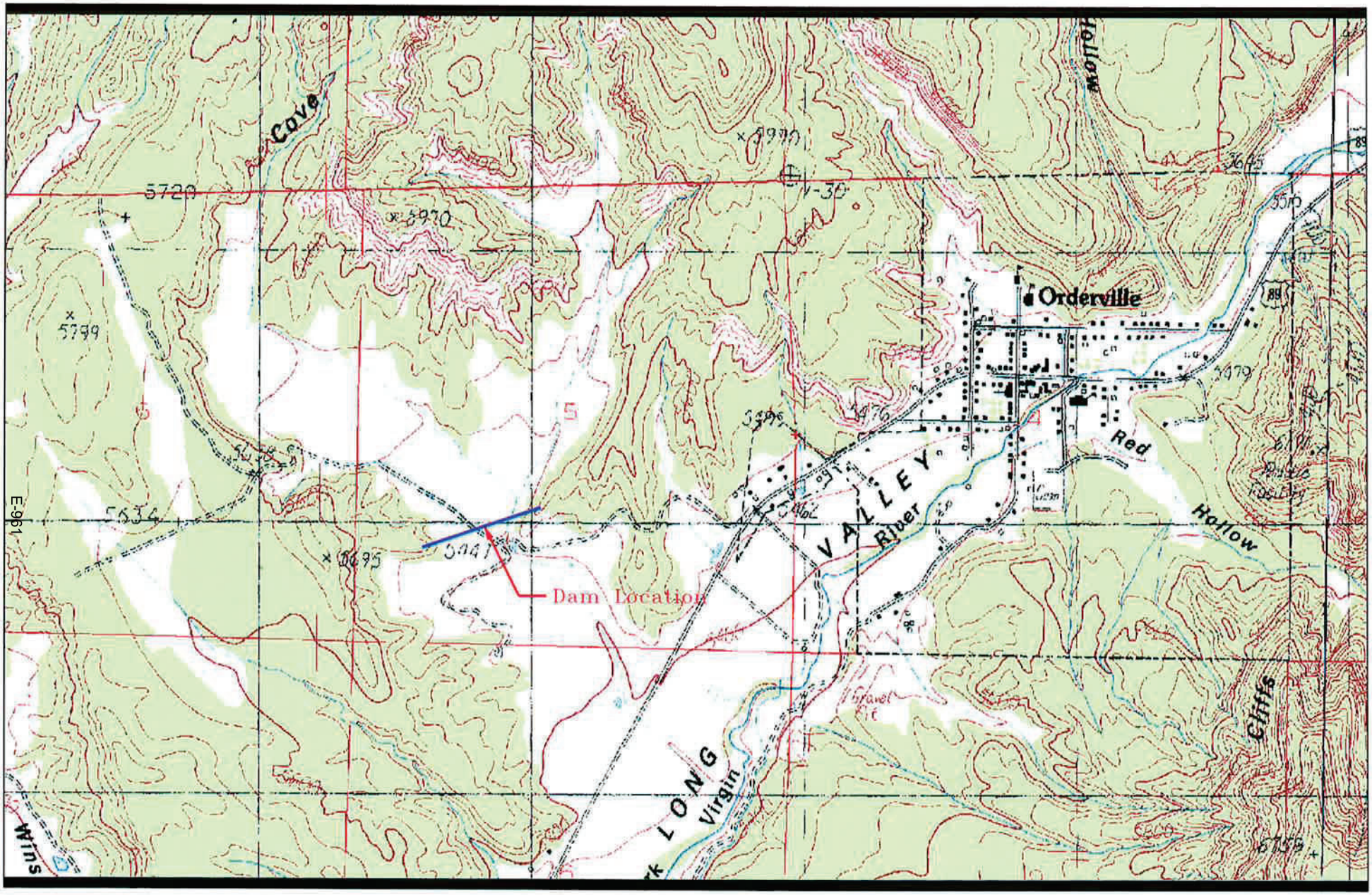
Assuming 10 feet of freeboard, a storage capacity of 6800 ac ft is obtained with the top of dam at elevation 5550 feet, resulting in a cost per acre foot of $1,578. A capacity of 8800 ac ft is obtained with the top of dam at elevation 5560 feet, resulting in a cost per acre foot of $1,644.

6. ADDITIONAL STUDIES REQUIRED FOR FINAL DESIGN

Work required to complete the reservoir design includes the following:

- Hydrologic analysis for freeboard, spillway and outlet work design.
- Outlet works and spillway design.(It appears that the spillway can be efficiently designed to pass around the right abutment.)
- Additional foundation investigation-anticipated to include about one boring every two hundred feet along the embankment alignment.
- Additional borrow investigations to verify that at least 1.5 times the quantity of materials needed for construction exist within the proposed borrow areas.
- Additional laboratory testing to evaluate properties of foundation and embankment materials. These tests will include triaxial shear, and sulfate tests.
- Final stability, seepage, and settlement analyses.
- Final embankment design
- Final design report.
- Preparation of plans and specifications.

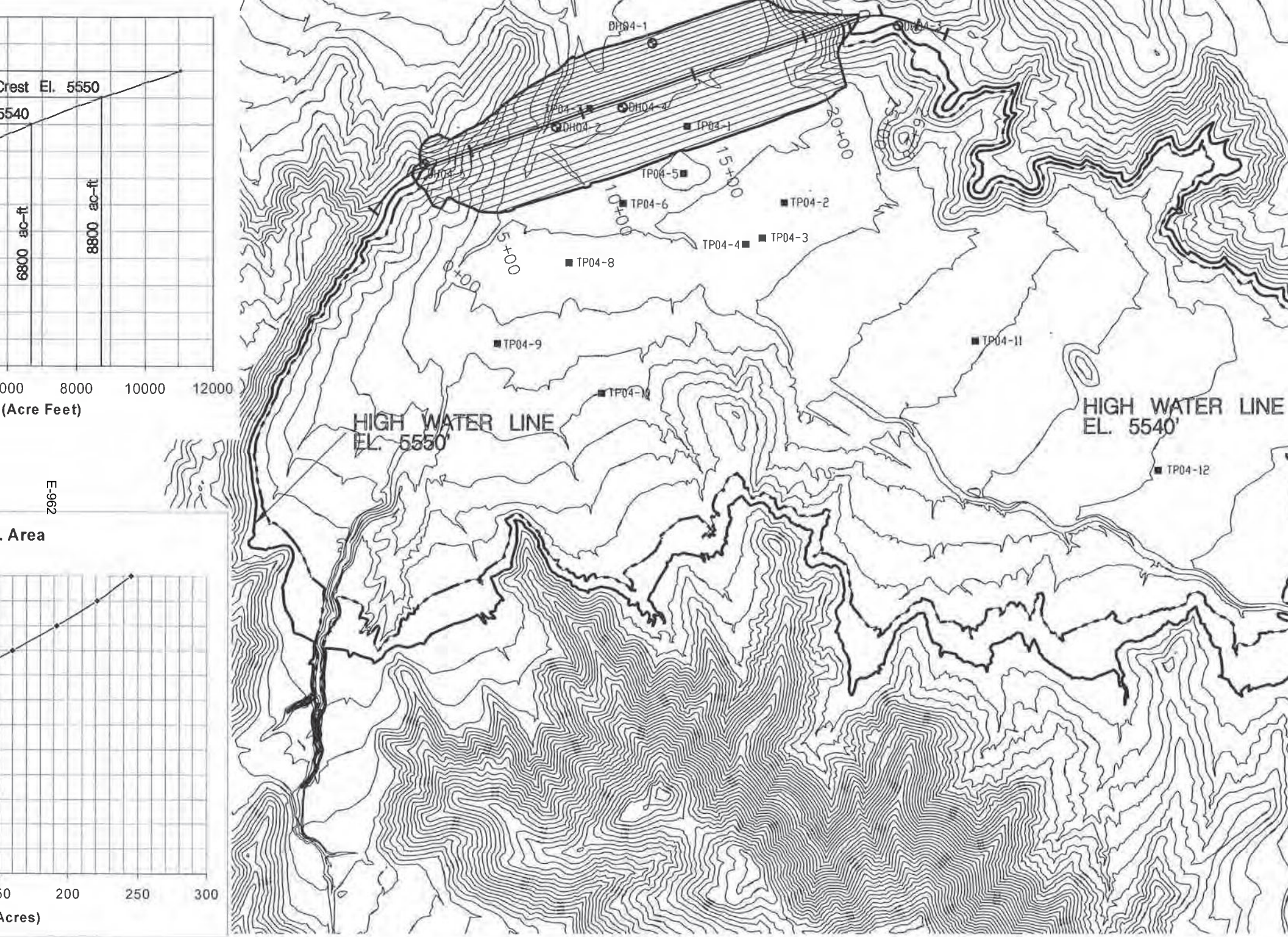
Figures

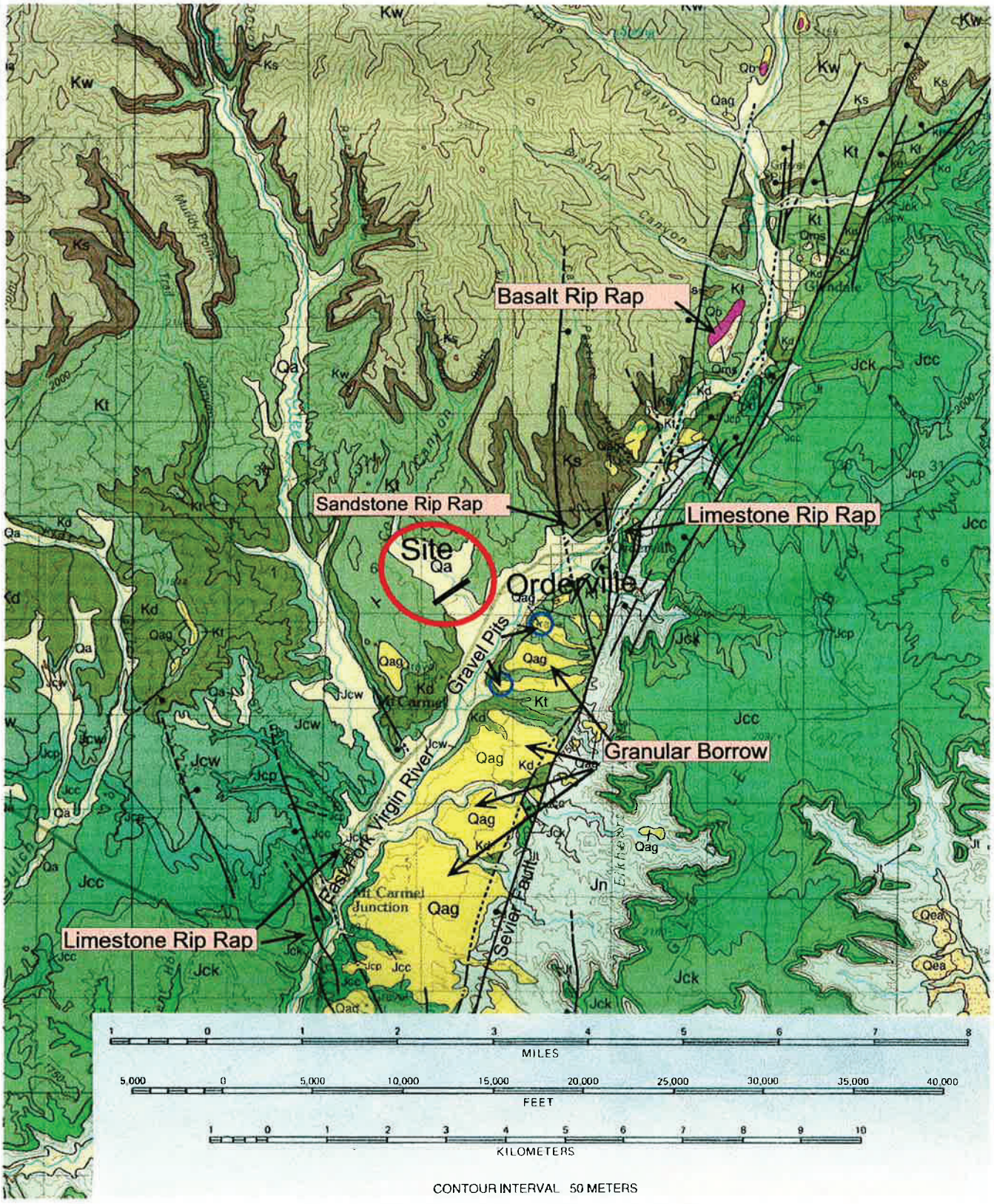


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Figure 1 **SITE PLAN**

Cove Dam
Orderville, Utah


Crest El. 5550
5540
6800 ac-ft
8800 ac-ft
000
8000
10000
12000
(Acre Feet)
E-962
. Area
50
200
250
300
Acres)
DH04-1
DH04-3
DH04-4
DH04-2
DH04-5
TP04-1
TP04-2
TP04-3
TP04-4
TP04-5
TP04-6
TP04-8
TP04-9
TP04-10
TP04-11
TP04-12
20+00
15+00
10+00
5+00
0+00
HIGH WATER LINE
EL. 5550'
HIGH WATER LINE
EL. 5540'

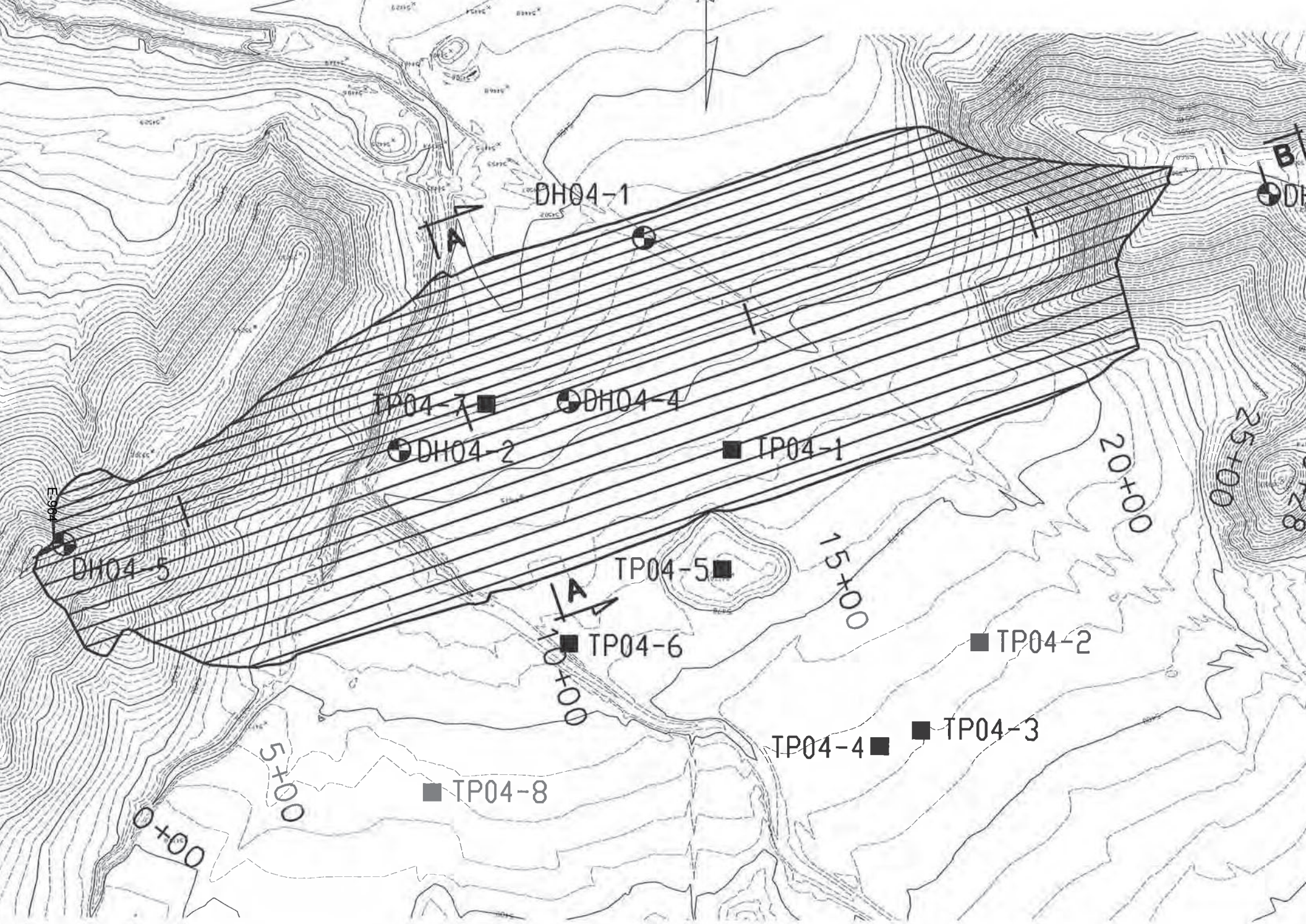


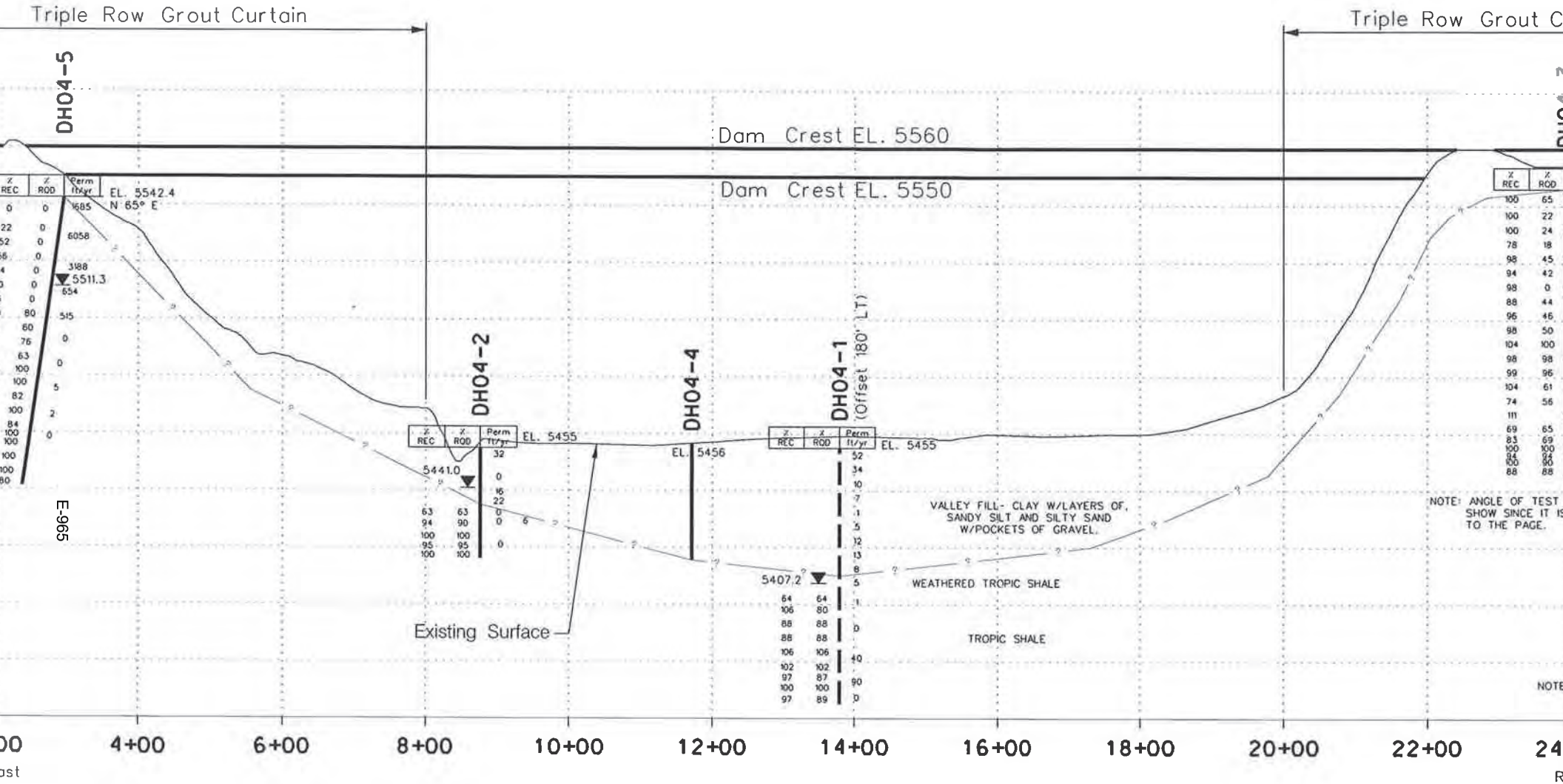
See text for description of Geologic Units

Modifed from Geologic Map of Kane County, Doelling etal, 1989

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Provo, Utah

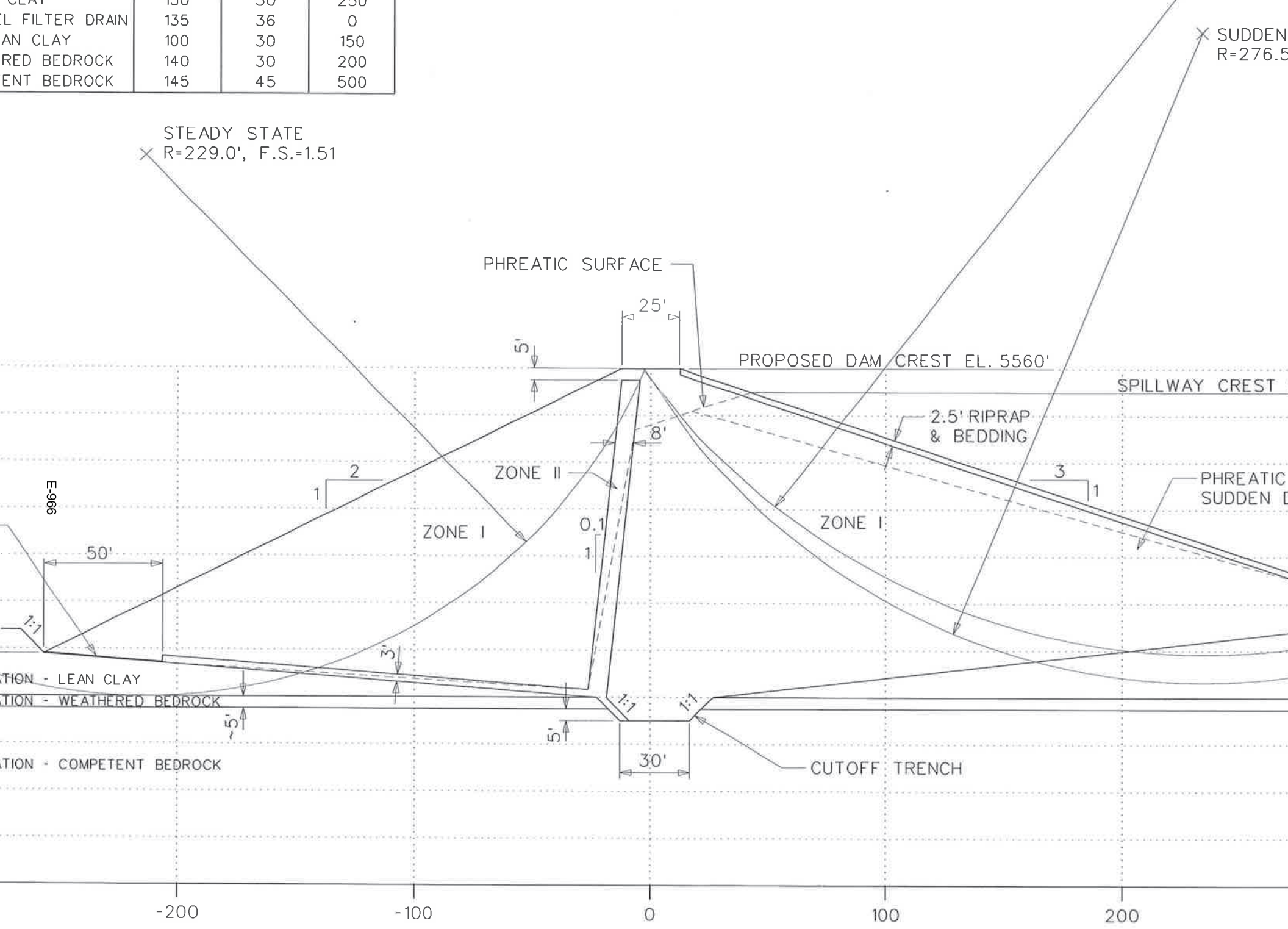
Figure 3 Geologic Map of Cove Dam Area with Potential Borrow Sources
Project *Cove Dam Site, Feasibility Study*
Location *Orderville, Kane County, Utah*


DH04-1
A
TP04-7
DH04-4
DH04-2
TP04-1
DH04-5
TP04-5
A
TP04-6
TP04-2
TP04-4
TP04-3
TP04-8
0+00
5+00
10+00
15+00
20+00
25+00
B



GEOLOGIC CROSS-SECTION (PROFILE)

CLAY	150	30	250
L FILTER DRAIN	135	36	0
AN CLAY	100	30	150
RED BEDROCK	140	30	200
ENT BEDROCK	145	45	500



Borings

DRILL HOLE LOG

BORING NO. 04-1

Sheet: 1 of 2

PROJECT: COVE DAM — PROJECT NO.: 200401.025
CLIENT: K.C.W.C.D. — DATE: 4/13/04
LOCATION: SEE SITE PLAN - MAXIMUM SECTION — ELEVATION: ~5454.0'
DRILLER: D. SAMPSON, N. BAILEY — LOGGED BY: M.H., V.N.B.
EQUIP./DRILL METHOD: CME-55 / N.W. CASING TO 51.5'
DEPTH TO WATER - INITIAL: ▽ N.M. AFTER 24 HOURS: ▽ 46.8' 6/3/04

Elev. (Feet)	Depth (Feet)	Lithology	Sample Type	Sample Rec. (In.)	See Legend	USCS	Material Description	Permeability, ft/yr	Dry Density, pcf	Moisture Content, %	Atter. Liquid Limit, %	Atter. Plasticity Index, %	Gradation Gravel, %	Gradation Sand, %	Gradation Silt/Clay, %	Other Tests
5450							lt. brown, dry, firm — SILTY CLAY W/SAND, calcareous	52								
	5			6	5,3,3	CL-ML										
							lt. brown, dry, hard — LEAN CLAY		120.3	9.8	32	14	0	10	90	CT
5445				8	Pushed 1.00+	CL-1		34								
	10			5	7,9,11	CL	lt. brown, dry, very stiff — CLAY W/SAND									
5440								10								
	15			12	Pushed 1.00+	CL-2	lt. brown, dry, hard — SANDY CLAY		119.4	8.7	37	19	0	17	83	CT
5435								7								
	20			5	9,12,17	CL,SM	lt. brown, dry, very stiff — SILTY CLAY W/SILTY SAND LENSES & LAYERS									
5430								1								
	25			12	Pushed 1.00+	CL-2	lt. brown, dry, hard		112.4	14.3	34	18	0	6	94	CT
5425								5								
	30			6	8,12,13	CL	med. to lt. brown, dry, very stiff, w/white stringers — LEAN CLAY	12								
5420																
	35			18	Pushed 1.00+	CL-2	med. brown, moist, very stiff	13	105.2	17.5	49	31	0	3	97	CT
5415																
	40			18	4,6,8 0.72	CL	med. brown, moist to slightly wet, stiff	8								
5410																
	45			12	Pushed 0.72	CL-2/CH	grayish-med. brown, moist, stiff, w/white stringers — LEAN TO FAT CLAY W/SOME SAND	5	100.7	23.1	50	34	0	6	94	CT
5405							TROPIC SHALE FORMATION									
	50															

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LEGEND

- 2,3,2 ← Blow Count per 6"
- 0.45 ← Torvane (tsf)
- Disturbed Sample
- Core
- 100,60 ← Rock Quality Designation (RQD)
- Percent Sample Recovery
- Undisturbed Sample
- ▽ Groundwater Elevation

UC = Unconfined Compression Test
CT = Consolidation Test
SG = Specific Gravity Test

RB&G ENGINEERING INC.
Provo, Utah

DRILL HOLE LOG

BORING NO. 04-1

Sheet: 2 of 2

PROJECT: COVE DAM — PROJECT NO.: 200401.025
CLIENT: K.C.W.C.D. — DATE: 4/13/04
LOCATION: SEE SITE PLAN - MAXIMUM SECTION — ELEVATION: ~5454.0'
DRILLER: D. SAMPSON, N. BAILEY — LOGGED BY: M.H., V.N.B.
EQUIP./DRILL METHOD: CME-55 / N.W. CASING TO 51.5'
DEPTH TO WATER - INITIAL: ▽ N.M. AFTER 24 HOURS: ▽ 46.8' 6/3/04

Elev. (Feet)	Depth (Feet)	Lith-ology	SAMPLE Type	Rec. (In.)	See Legend	USCS	Material Description	Permeability, ft/yr	Dry Density, pcf	Moisture Content, %	Atter. Liquid Limit, %	Atter. Plasticity Index, %	Gradation Gravel, %	Gradation Sand, %	Gradation Silt/Clay, %	Other Tests
				18	18,28,36	CL	dk. gray, moist, hard **SLIGHTLY SHALEY CLAY** very highly weathered bedrock, w/many gypsum stringers	1								
5400				19	Core 64,64	CH				16.4	80	50	0	0	100	
	55			64	Core 106,80	-	dk. gray **HIGHLY WEATHERED MUDSTONE** few gypsum stringers									
5395							dk. gray **LESS WEATHERED MUDSTONE** shells									
	60			53	Core 88,88	-	dk. gray	0								
5390							**SLIGHTLY WEATHERED MUDSTONE**									
	65			53	Core 88,88	-	dk. gray slickenside									
5385																
	70			64	Core 106,106	-	0.25" clay seam									
5380						CH	white-gray **BENTONITE W/SAND & LIMESTONE GRAVEL**	40		13.2	70	45	0	0	100	
	75			61	Core 102,102	-	dk. gray									
5375							**MUDSTONE**									
	80			35	Core 97,87	-	broken zone									
5370				50	Core 100,100	-	dk. gray, some black corbonaceous lenses	90								
	85						white-gray **BENTONITE**									
5365				44	Core 97,89	-	dk. gray, some black corbonaceous lenses **MUDSTONE**	0								
	90															
5360																
	95															
5355																
	100															

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LEGEND

- 2,3,2 ← Blow Count per 6"
- 0.45 ← Torvane (tsf)
- Disturbed Sample
- Core 100,60 ← Rock Quality Designation (RQD)
- Percent Sample Recovery
- Undisturbed Sample
- ▽ ← Groundwater Elevation

UC = Unconfined Compression Test
CT = Consolidation Test
SG = Specific Gravity Test

RB&G ENGINEERING INC.
Provo, Utah

DRILL HOLE LOG

BORING NO. 04-2

Sheet: 1 of 1

PROJECT: COVE DAM — PROJECT NO.: 200401.025
CLIENT: K.C.W.C.D. — DATE: 4/16/04
LOCATION: SEE SITE PLAN - TOE, LEFT ABUTMENT — ELEVATION: ~5458.0'
DRILLER: D. SAMPSON, N. BAILEY — LOGGED BY: M.H., V.N.B.
EQUIP./DRILL METHOD: CME-55 / N.W. CASING TO 21.5' THEN N.Q. CORE
DEPTH TO WATER - INITIAL: ▽ N.M. AFTER 24 HOURS: ▽ 17.0' 6/3/04

Elev. (Feet)	Depth (Feet)	Lithology	SAMPLE Type	SAMPLE Rec. (In.)	See Legend	USCS	Material Description	Permeability, ft/yr	Dry Density, pcf	Moisture Content, %	Atter. Liquid Limit, %	Atter. Plasticity Index, %	Gradation Gravel, %	Gradation Sand, %	Gradation Silt/Clay, %	Other Tests
	0			9	2,4,6	CL	lt. brown, dry to moist, firm, w/roots — SILTY CLAY	32								
5455																
	5			14	Pushed 1.00+	CL	dk. brown, slightly moist, hard — LEAN CLAY W/GYPSUM STRINGERS									
				7	14,22,33	CL-2	dk. brown, slightly moist, hard	0		12.2	45	31	0	2		98
5450																
	10			10	15,22,33	CL	dk. brown, moist, hard, some gypsum — LEAN CLAY W/SOME SAND SIZE SANDSTONE FRAGMENTS	16								
5445																
	15			18	Pushed 1.00+	CH	dk. brown, moist, hard — FAT CLAY		111.8	19.3	58	34	0	0	100	CT
5440								22								
	20			18	9,15,33	-	dk. gray — VERY HIGHLY WEATHERED MUDSTONE very high slaking, rapid	6								
5435				26	Core 63,63	-	LESS WEATHERED MUDSTONE	0								
	25			56	Core 94,90	CH	dk. gray, dry mech. open 0.2' joint 0.25" clay seam	0		12.5	70	47	0	0	100	
5430																
	30			48	Core 100,100	-	dk. gray, weakly calcareous — MUDSTONE calcareous, high slaking									
5425																
	35			34	Core 95,95	-	a few white silt lenses	0								
5420				36	Core 100,100	-										
	40															
5415																
	45															
5410																
	50															

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LEGEND

- 2,3,2 ← Blow Count per 6"
- 0.45 ← Torvane (tsf)
- Disturbed Sample
- Core 100,60 ← Rock Quality Designation (RQD)
- Percent Sample Recovery
- Undisturbed Sample
- ▽ ← Groundwater Elevation

UC - Unconfined Compression Test
CT - Consolidation Test
SG - Specific Gravity Test

RB&G ENGINEERING INC.
Provo, Utah

DRILL HOLE LOG

BORING NO. 04-3

Sheet: 1 of 2

PROJECT: COVE DAM — PROJECT NO.: 200401.025
CLIENT: K.C.W.C.D. — DATE: 4/26/04
LOCATION: SEE SITE PLAN - RIGHT ABUTMENT — ELEVATION: ~5546.0'
DRILLER: D. SAMPSON, M. BARBOUR — LOGGED BY: M.H., V.N.B.
EQUIP./DRILL METHOD: CME-55 / N.Q. CORE AT 60° FROM HORIZONTAL, TREND S18° E
DEPTH TO WATER - INITIAL: ▽ N.M. AFTER 24 HOURS: ▽ 71.0' 6/3/04

Elev. (Feet)	Depth (Feet)	Lith-ology	Sample Type	Sample Rec. (In.)	See Legend	USCS	Material Description	Permeability, ft/yr	Dry Density, pcf	Atter. Moisture Content, %	Atter. Liquid Limit, %	Atter. Plasticity Index, %	Gradation Gravel, %	Gradation Sand, %	Gradation Silt/Clay, %	Other Tests
5545							gray-brown **CLAY/VERY WEATHERED MUDSTONE**	48								
	5			24	Core 100,65	-	gray-brown to brown-gray gypsum									
5540				60	Core 100,22	-	gray-brown	314								
	10															
5535				61	Core 100,24	CH	gray-brown, dry **SILTY MUDSTONE** calcareous coating, very highly weathered & fractured, multiple angle - haphazard, some gypsum coating on joints, shaley & friable			13.7	54	33	0	0	100	
	15															
5530				23	Core 78,18	-		1245								
	20															
5525				59	Core 98,45	-		1135								
	25						gray-white, some rust staining **BENTONITE**									
							brown **SHALEY MUDSTONE** 100% water loss	1398								
5520	30			56	Core 94,42	-	dk. gray w/white bedding **SILTSTONE/MUDSTONE**	1989								
				59	Core 98,0	-	interbedded dk. gray & brown, gypsum bedding **SILTY MUDSTONE** calcareous									
5515	35							1202								
	40			53	Core 88,44	-	interbedded dk. gray & brown w/white stratification clay seam									
5510																
	45			58	Core 96,46	-	**MUDSTONE** dk. gray w/brown, some rust stains, some shells, slow slaking	736								
5505																
	50			59	Core 98,50	-										

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LEGEND

- 2,3,2 ← Blow Count per 6"
- 0.45 ← Torvane (tsf)
- Core ← Disturbed Sample
- 100,60 ← Rock Quality Designation (RQD)
- Percent Sample Recovery
- Undisturbed Sample
- Groundwater Elevation

UC - Unconfined Compression Test
CT - Consolidation Test
SG - Specific Gravity Test

RB&G ENGINEERING INC.
Provo, Utah

DRILL HOLE LOG

BORING NO. 04-3

Sheet: 2 of 2

PROJECT: COVE DAM — PROJECT NO.: 200401.025
CLIENT: K.C.W.C.D. — DATE: 4/26/04
LOCATION: SEE SITE PLAN - RIGHT ABUTMENT — ELEVATION: ~5546.0'
DRILLER: D. SAMPSON, M. BARBOUR — LOGGED BY: M.H., V.N.B.
EQUIP./DRILL METHOD: CME-55 / N.Q. CORE AT 60° FROM HORIZONTAL, TREND S18° E
DEPTH TO WATER - INITIAL: ▽ N.M. AFTER 24 HOURS: ▽ 71.0' 6/3/04

Elev. (Feet)	Depth (Feet)	Lith-ology	SAMPLE Type	Rec. (In.)	See Legend	USCS	Material Description	Permeability, ft/yr	Dry Density, pcf	Moisture Content, %	Atter. Liquid Limit, %	Atter. Plasticity Index, %	Gradation Gravel, %	Gradation Sand, %	Gradation Silt/Clay, %	Other Tests
							dk. gray									
5500	55		Core	62	104,100	-	more competent, no bedding, shells, open joint at 53.4' to 53.7', 0.2" clay seam **MUDSTONE**	34								
5495	60		Core	59	98,98	-	dk. gray, some white bedding, trace of gypsum	394								
5490	65		Core	59	99,96	-	rust stain & coating **SILTY MUDSTONE**									
5485	70		Core	62	104,61	-	shells very hard septarian nodule	51								
	75		Core	44	74,56	-	gray, high slaking **SHALE**									
5480							gray **BENTONITE**									
	80		Core	62	111,?	-	core is stuck in inner barrel and has not been removed, may contain bentonite 100% water loss	69								
5475	85		Core	41	69,65	-	dk. gray **MUDSTONE** calcareous, some slaking, some lt. gray wavy bedding 40° slickenside	341 0								
5470	90		Core	29	83,69	-	0.25" clay seam									
			Core	60	100,100	-	dk. gray clay seam, not calcareous									
5465	95		Core	28	94,94	-										
			Core	24	100,100	-	lt. gray **BENTONITE** black & white **LIMESTONE/VOLCANIC ASH BENTONITE**									
5460	100		Core	42	88,88	-	dk. gray **MUDSTONE**									

06/16/04 04:02:52 P

LEGEND

- 2,3,2 ← Blow Count per 6"
- 0.45 ← Torvane (tsf)
- Core ← Disturbed Sample
- 100,60 ← Rock Quality Designation (RQD)
- Percent Sample Recovery
- ← Undisturbed Sample
- ▽ ← Groundwater Elevation

UC = Unconfined Compression Test
CT = Consolidation Test
SG = Specific Gravity Test

RB&G ENGINEERING INC.
Provo, Utah

DRILL HOLE LOG

BORING NO. 04-4

Sheet: 1 of 1

PROJECT: COVE DAM — PROJECT NO.: 200401.025
CLIENT: K.C.W.C.D. — DATE: 4/30/04
LOCATION: SEE SITE PLAN - MAXIMUM SECTION — ELEVATION: ~5458.0'
DRILLER: D. SAMPSON, M. BARBOUR — LOGGED BY: M.H., V.N.B.
EQUIP./DRILL METHOD: CME-55 / N.W. CASING
DEPTH TO WATER - INITIAL: ▽ N.M. AFTER 24 HOURS: ▽ DRY AT 29.3' 6/3/04

Elev. (Feet)	Depth (Feet)	Lith-ology	SAMPLE Type	SAMPLE Rec. (In.)	See Legend	USCS	Material Description	Permeability, ft/yr	Dry Density, pcf	Moisture Content, %	Atter. Liquid Limit, %	Atter. Plasticity Index, %	Gradation Gravel, %	Gradation Sand, %	Gradation Silt/Clay, %	Other Tests
5455	0					CL	lt. brown, dry — SANDY LEAN CLAY									
	5															
5450																
	10			7	7,11,14	CL	lt. brown, dry, very stiff — SILTY CLAY									
5445																
	15															
5440																
	20			10	11,14,19	CL	lt. brown, dry, very stiff — SILTY CLAY W/SILTY SAND LENSES									
5435																
	25						gray — harder									
5430																
	30			14	11,15,20	CL/SC	mottled rusty & yellow-brown, slightly moist to dry, hard — SANDY CLAY									
5425																
	35			18	15,32,56	-	brown-gray, slightly moist, hard — VERY HIGHLY WEATHERED MUDSTONE TO VERY HARD CLAY w/gypsum, w/calcite crystals & stringers									
5420																
	40			12	24,66	-	brown-gray, slightly moist, hard — HIGHLY WEATHERED CLAYEY MUDSTONE									
5415							BEDROCK - TROPIC SHALE FORMATION									
	45															
5410																
	50															

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LEGEND

- 2,3,2 ← Blow Count per 6"
- 0.45 ← Torvane (tsf)
- Disturbed Sample
- Core
- 100,60 ← Rock Quality Designation (RQD)
- Percent Sample Recovery
- Undisturbed Sample
- ▽ ← Groundwater Elevation

UC - Unconfined Compression Test
CT - Consolidation Test
SG - Specific Gravity Test

RB&G ENGINEERING INC.
Provo, Utah

DRILL HOLE LOG

BORING NO. 04-5

Sheet: 1 of 2

PROJECT: COVE DAM — PROJECT NO.: 200401.025
CLIENT: K.C.W.C.D. — DATE: 5/4/04
LOCATION: SEE SITE PLAN - LEFT ABUTMENT — ELEVATION: ~5542.4'
DRILLER: D. SAMPSON, M. BARBOUR — LOGGED BY: M.H., V.N.B.
EQUIP./DRILL METHOD: CME-55 / N.Q. CORE AT 60° FROM HORIZONTAL, TREND N65° E
DEPTH TO WATER - INITIAL: ▽ N.M. AFTER 24 HOURS: ▽ 35.0' 6/3/04

Elev. (Feet)	Depth (Feet)	Lithology	Sample Type	Sample Rec. (In.)	See Legend	USCS	Material Description	Permeability, ft/yr	Dry Density, pcf	Moisture Content, %	Atter. Liquid Limit, %	Atter. Plasticity Index, %	Gradation Gravel, %	Gradation Sand, %	Gradation Silt/Clay, %	Other Tests
5540	0															
				0	Core 0,0	-	VERY HIGHLY WEATHERED TROPIC SHALE FORMATION	1685								
5535	5															
	10			13	Core 22,0	-	brown-gray VERY HIGHLY WEATHERED CLAYEY MUDSTONE TO CLAY W/MUDSTONE FRAGMENTS	6058								
5530	15			31	Core 52,0	-	MUDSTONE RUBBLE W/CLAY MATRIX									
5525	20			34	Core 56,0	-	MUDSTONE BROKEN TO RUBBLE	3188								
5520	25			14	Core 24,0	-	brown-gray									
5515	30			48	Core 80,0	-	brown-gray, calcareous	654								
5510	35			58	Core 96,0	-	MOTTLED & MIXED LAYERS OF DARK GRAY & BROWN MUDSTONE more competent, w/random gypsum stringers, near vertical fractures at 33' to 38', some friable shaley layers 1" to 2" thick									
5505	40			60	Core 100,80	CL-2	brown-gray, dry	515		4.7	43	26	0	9	91	
	45			64	Core 90,60	-	w/clay seams, shells									
5500	50					CL-2	dk. gray, dry, shells CALCAREOUS MUDSTONE	0		12.6	47	24	0	2	98	

06/16/04 04:03:11 PM

LEGEND

- 2,3,2 — Blow Count per 6"
- 0.45 — Torvane (tsf)
- Core — Disturbed Sample
- 100,60 — Rock Quality Designation (RQD)
- Percent Sample Recovery
- Undisturbed Sample
- Groundwater Elevation

UC - Unconfined Compression Test
CT - Consolidation Test
SG - Specific Gravity Test

RB&G ENGINEERING INC.
Provo, Utah

DRILL HOLE LOG

BORING NO. 04-5

Sheet: 2 of 2

PROJECT: COVE DAM — PROJECT NO.: 200401.025
CLIENT: K.C.W.C.D. — DATE: 5/4/04
LOCATION: SEE SITE PLAN - LEFT ABUTMENT — ELEVATION: ~5542.4'
DRILLER: D. SAMPSON, M. BARBOUR — LOGGED BY: M.H., V.N.B.
EQUIP./DRILL METHOD: CME-55 / N.Q. CORE AT 60° FROM HORIZONTAL, TREND N65° E
DEPTH TO WATER - INITIAL: ▽ N.M. AFTER 24 HOURS: ▽ 35.0' 6/3/04

Elev. (Feet)	Depth (Feet)	Lith-ology	SAMPLE Type	SAMPLE Rec. (In.)	See Legend	USCS	Material Description	Permeability, ft/yr	Dry Density, pcf	Moisture Content, %	Atter. Liquid Limit, %	Atter. Plasticity Index, %	Gradation Gravel, %	Gradation Sand, %	Gradation Silt/Clay, %	Other Tests
				59	Core 98,76	-	dk. gray									
5495	55			54	Core 98,63	-	dk. gray									
5490	60			53	Core 100,100	-	dk. gray, few shells — SHALEY MUDSTONE, friable, very slow slaking									
5485	65			60	Core 100,100	-	dk. gray, no gypsum, w/big white shells									
	70			54	Core 90,82	-										
5480							SHALE TO BENTONITE									
	75			60	Core 100,100	-	dk. gray w/few white lenses — CALCAREOUS MUDSTONE									
5475							dk. to lt. gray, very soft dk. gray — SHALEY BENTONITE									
	80			50	Core 84,84	-	dk. gray									
5470				12	Core 100,100	-	CALCAREOUS MUDSTONE									
	85			60	Core 100,100	-										
5465							very soft — SHALEY BENTONITE									
	90			60	Core 100,100	-	dk. gray — CALCAREOUS MUDSTONE									
5460	95			52	Core 100,100	-										
							LIMESTONE									
5455	100			24	Core 80,80	-	dk. gray — CALCAREOUS MUDSTONE W/SHELLS									

Permeability, ft/yr: 0, 5, 2, 0

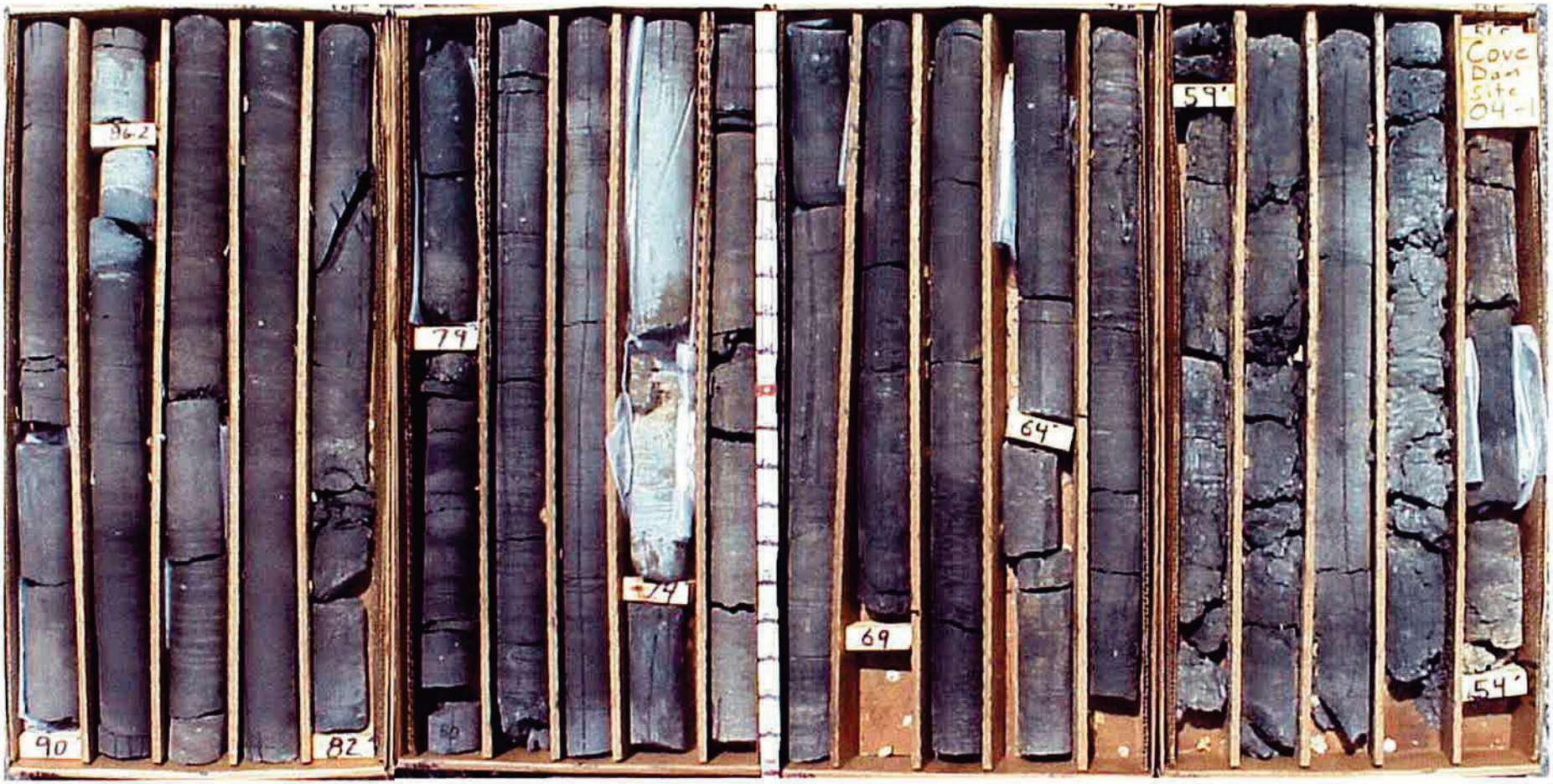
LEGEND
- 2,3,2 ← Blow Count per 6"
- 0.45 ← Torvane (tsf)
- Core ← Disturbed Sample
- 100,60 ← Rock Quality Designation (RQD)
- Percent Sample Recovery
- Undisturbed Sample
- Groundwater Elevation

UC - Unconfined Compression Test
CT - Consolidation Test
SG - Specific Gravity Test

06/16/04 10:49:46 AM

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Top



Bottom

E-976

Depth Cored
51.5 to 90 feet

NQ Core Dia. 1.875 in.
Length of Core Box 2 ft.

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Provo, Utah

Figure Core Photos, Drill Hole # 04-1 *Center Section*
Project *Cove DamSite Feasibility Study*
Location *Orderville, Kane County, Utah*

04-2

Top



Bottom

E-977

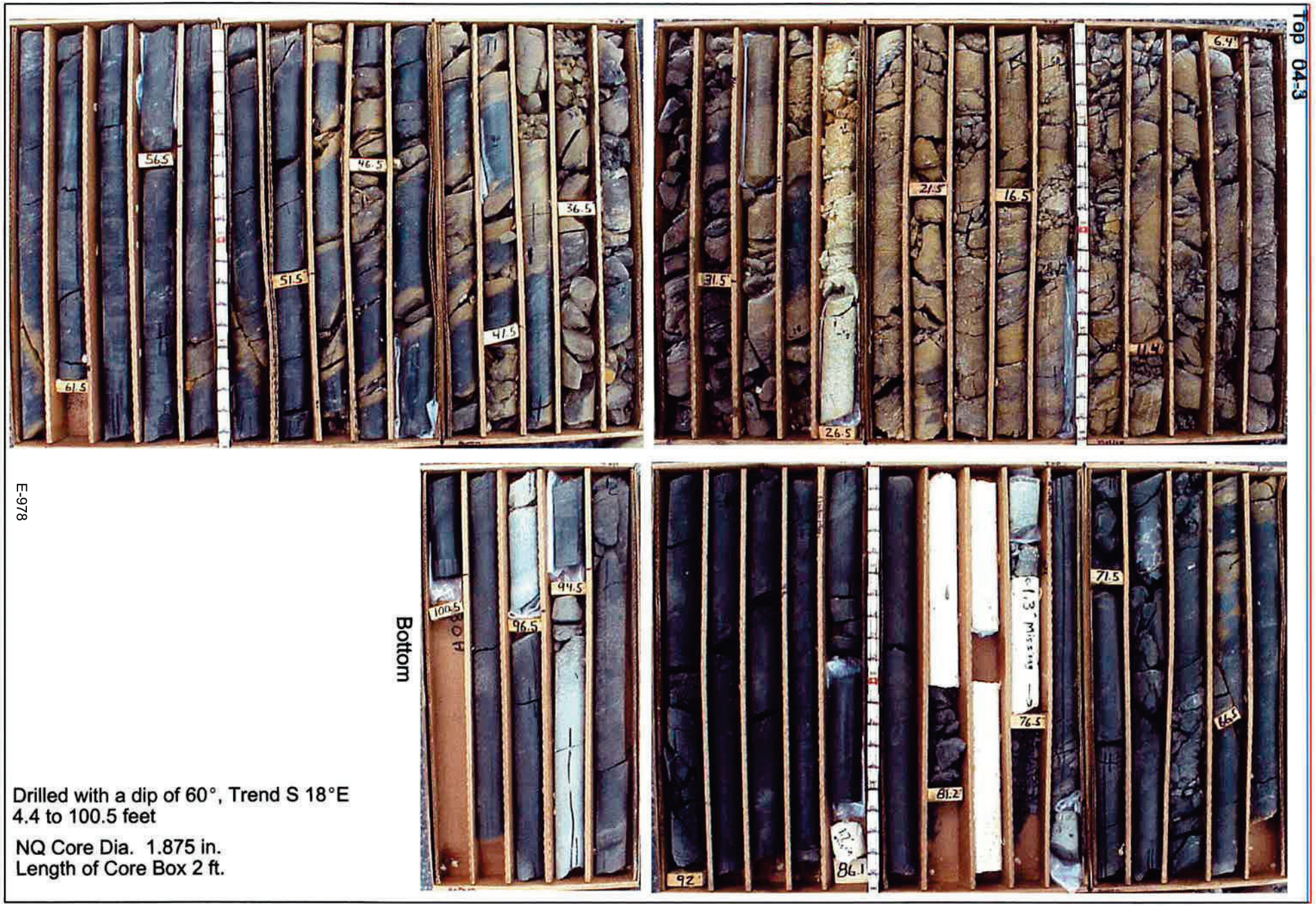
Depth Cored
21.5 to 39 feet

NQ Core Dia. 1.875 in.
Length of Core Box 2 ft.

RB&G
ENGINEERING INC.
Provo, Utah

Figure Core Photos, Drill Hole # 04-2 ~~Center~~ Max Section
Project *Cove DamSite Feasibility Study*
Location *Orderville, Kane County, Utah*

near toeof slope @ left abutment



Drilled with a dip of 60°, Trend S 18°E
4.4 to 100.5 feet

NQ Core Dia. 1.875 in.
Length of Core Box 2 ft.

RB&G ENGINEERING INC.
Provo, Utah

Figure Core Photos, Drill Hole # 04-3 *Right Abutment*
Project *Cove Dam Site Feasibility Study*
Location *Orderville, Kane County, Utah*



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ENGINEERING INC.
Provo, Utah

Figure Core Photos, Drill Hole # 04-5 *Left Abutment*
Project *Cove Dam Site Feasibility Study*
Location *Orderville, Kane County, Utah*

Test Pits

TEST PIT LOG

PIT NO. 04–1

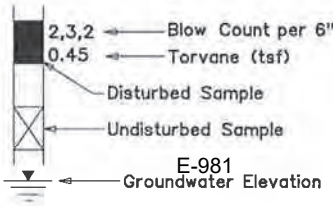
Sheet: 1 of 1

PROJECT: COVE DAM — PROJECT NO.: 200401.025
CLIENT: K.C.W.C.D. — DATE: 6/1/04
LOCATION: SEE SITE PLAN — ELEVATION: ~5463.0'
LOGGED BY: M. STILSON
EQUIP./DRILL METHOD: 310 SE J.D. BACKHOE
DEPTH TO WATER - INITIAL: ▽ DRY — AFTER 24 HOURS: ▽ DRY

Elev. (Feet)	Depth (Feet)	Lith-ology	SAMPLE Type	SAMPLE Type	SAMPLE USCS	Material Description	Dry Density, pcf	Moisture Content, %	Atter. Liquid Limit, %	Atter. Plasticity Index, %	Gradation Gravel, %	Gradation Sand, %	Gradation Silt/Clay, %	Other Tests
5460				3 Rings Block Bucket	CL-1	1" fine silty sand layer		4.8	26	12	0	3	97	
	5			Ring Block	CL-2	**LEAN CLAY** lt. brown to brown, dry, hard, some pinhole structure, minor mineral stringers	95.1	6.4	35	16	0	2	98	
5455						1" fine silty sand layer								
	10			Ring Block	CL-2			3.4	31	15	0	26	74	
						1" fine silty sand layer								
				Bag	CL	1" fine silty sand layer								
5450														
	15													
5445														
	20													

06/15/04
11:02:09 AM

LEGEND



UC = Unconfined Compression Test
CT = Consolidation Test
SG = Specific Gravity Test

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Provo, Utah

TEST PIT LOG

PIT NO. 04–2

Sheet: 1 of 1

PROJECT: COVE DAM
PROJECT NO.: 200401.025
CLIENT: K.C.W.C.D.
DATE: 6/2/04
LOCATION: SEE SITE PLAN
ELEVATION: ~5474.0'
LOGGED BY: M. STILSON
EQUIP./DRILL METHOD: 310 SE J.D. BACKHOE
DEPTH TO WATER - INITIAL: ▽ DRY AFTER 24 HOURS: ▽ DRY

Elev. (Feet)	Depth (Feet)	Lithology	SAMPLE Type	SAMPLE Type	SAMPLE USCS	Material Description	Dry Density, pcf	Moisture Content, %	Atter. Liquid Limit, %	Atter. Plasticity Index, %	Gradation Gravel, %	Gradation Sand, %	Gradation Silt/Clay, %	Other Tests
5470	5			Bag	CL	**LEAN CLAY W/FINE SAND** lt. brown to brown, very dry, hard, sand intermixed throughout entire depth of test pit, some distinct pockets but no continuous layers, some pinhole structure, macro-hole structure in upper 3', trace minerals		8.6	40	20	0	2	98	
				Bag	CL-2									
5465	10			Bag	CL									
				Bag	CL-1			5.8	31	13	0	12	88	
5460	15													
5455	20													

06/11/04
10:58:58 AM

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LEGEND

2,3,2 ← Blow Count per 6"
0.45 ← Torvane (tsf)
Disturbed Sample
Undisturbed Sample
Groundwater Elevation

UC = Unconfined Compression Test
CT = Consolidation Test
SG = Specific Gravity Test

TEST PIT LOG

PIT NO. 04-3

Sheet: 1 of 1

PROJECT: COVE DAM — PROJECT NO.: 200401.025
CLIENT: K.C.W.C.D. — DATE: 6/2/04
LOCATION: SEE SITE PLAN — ELEVATION: ~5476.0'
LOGGED BY: M. STILSON
EQUIP./DRILL METHOD: 310 SE J.D. BACKHOE
DEPTH TO WATER - INITIAL: ▽ DRY — AFTER 24 HOURS: ▽ NOT MEASURED

Elev. (Feet)	Depth (Feet)	Lithology	Sample Type	Sample Type	USCS	Material Description	Dry Density, pcf	Moisture Content, %	Atter. Liquid Limit, %	Atter. Plasticity Index, %	Gradation Gravel, %	Gradation Sand, %	Gradation Silt/Clay, %	Other Tests
5475	0		Bag	SP		**SAND W/GRAVEL** medium grained sand, fine grained gravel					25	73	2	
			Bag	CL										
				SM	2" silty sand layer									
	5													
5470			Bag	CL		**LEAN CLAY W/SAND** lt. brown to brown, dry, hard, intermixed, fine, some pinhole structure, some silt lenses, calcite stringers								
			Bag	CL										
	10			SP-SM	2" sand w/silt layer									
5465				SM	2" silty sand layer									
			Bag	CL										
	15													
5460														
	20													

06/15/04
11:02:30 AM

LEGEND

2,3,2 ← Blow Count per 6"
0.45 ← Torvane (tsf)
Disturbed Sample
Undisturbed Sample
Groundwater Elevation

UC = Unconfined Compression Test
CT = Consolidation Test
SG = Specific Gravity Test

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TEST PIT LOG

PIT NO. 04-4

Sheet: 1 of 1

PROJECT: COVE DAM | PROJECT NO.: 200401.025
CLIENT: K.C.W.C.D. | DATE: 6/2/04
LOCATION: SEE SITE PLAN | ELEVATION: ~5475.0'
LOGGED BY: M. STILSON
EQUIP./DRILL METHOD: 310 SE J.D. BACKHOE
DEPTH TO WATER - INITIAL: ▽ DRY AFTER 24 HOURS: ▼ NOT MEASURED

Elev. (Feet)	Depth (Feet)	Lith-ology	SAMPLE Type	SAMPLE Type	SAMPLE USCS	Material Description	Dry Density, pcf	Moisture Content, %	Atter. Liquid Limit, %	Atter. Plasticity Index, %	Gradation Gravel, %	Gradation Sand, %	Gradation Silt/Clay, %	Other Tests
				Bag	CL									
5470	5				SM	2" sand layer at 5.5'					0	82	18	
				Bag	CL	**LEAN CLAY** lt. brown to brown, dry, hard, some small sand pockets, pinhole structure, trace minerals								
				Bag	CL									
5465	10													
5460	15													
	20													

06/15/04
11:02:45 AM

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LEGEND

2,3,2 ← Blow Count per 6"
0.45 ← Torvane (tsf)
Disturbed Sample
Undisturbed Sample
Groundwater Elevation

UC - Unconfined Compression Test
CT - Consolidation Test
SG - Specific Gravity Test

TEST PIT LOG

PIT NO. 04-5

Sheet: 1 of 1

PROJECT: COVE DAM
CLIENT: K.C.W.C.D.
LOCATION: SEE SITE PLAN
EQUIP./DRILL METHOD: 310 SE J.D. BACKHOE
DEPTH TO WATER - INITIAL: ▽ DRY AFTER 24 HOURS: ▽ NOT MEASURED

PROJECT NO.: 200401.025
DATE: 6/2/04
ELEVATION: ~5477.0'
LOGGED BY: M. STILSON

Elev. (Feet)	Depth (Feet)	Lith-ology	SAMPLE Type	SAMPLE Type	USCS	Material Description	Dry Density, pcf	Moisture Content, %	Atter. Liquid Limit, %	Atter. Plasticity Index, %	Gradation Gravel, %	Gradation Sand, %	Gradation Silt/Clay, %	Other Tests
					CL	**LEAN CLAY**								
5475														
				Bag	GP	**GRAVEL W/SAND** fairly clean, sub-angular, mostly 0.75" to 3" sizes, a few cobbles up to 12"								
	5													
				Bag	CH				58	34				
5470						**HEAVILY WEATHERED MUDSTONE** dk. brown, moist, very hard								
				Bag	CH				59	31				
	10													
5465														
	15													
5460														
	20													

06/15/04
11:03:01 AM

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LEGEND

2,3,2 ← Blow Count per 6"
0.45 ← Torvane (tsf)
Disturbed Sample
Undisturbed Sample
Groundwater Elevation

UC = Unconfined Compression Test
CT = Consolidation Test
SG = Specific Gravity Test

TEST PIT LOG

PIT NO. 04-6

Sheet: 1 of 1

PROJECT: COVE DAM
CLIENT: K.C.W.C.D.
LOCATION: SEE SITE PLAN
EQUIP./DRILL METHOD: 310 SE J.D. BACKHOE
DEPTH TO WATER - INITIAL: ▽ DRY AFTER 24 HOURS: ▽ NOT MEASURED

PROJECT NO.: 200401.025
DATE: 6/2/04
ELEVATION: ~5466.0'
LOGGED BY: M. STILSON

Elev. (Feet)	Depth (Feet)	Lith-ology	SAMPLE Type	SAMPLE Type	SAMPLE USCS	Material Description	Dry Density, pcf	Moisture Content, %	Atter. Liquid Limit, %	Atter. Plasticity Index, %	Gradation Gravel, %	Gradation Sand, %	Gradation Silt/Clay, %	Other Tests
5465	0													
				Bag	CL									
	5													
5460				Bag	CL	**LEAN CLAY W/FINE SAND** lt. brown to brown, dry, hard, intermixed, some sand pockets, pinhole structure, minerals								
				Bag	CL									
	10													
5455				Bag	CL									
	15													
5450														
	20													

06/11/04
10:59:49 AM

LEGEND

2,3,2 ← Blow Count per 6"
0.45 ← Torvane (tsf)
Disturbed Sample
Undisturbed Sample
▽ Groundwater Elevation

UC = Unconfined Compression Test
CT = Consolidation Test
SG = Specific Gravity Test

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TEST PIT LOG

PIT NO. 04–7

Sheet: 1 of 1

PROJECT: COVE DAM — PROJECT NO.: 200401.025
CLIENT: K.C.W.C.D. — DATE: 6/2/04
LOCATION: SEE SITE PLAN — ELEVATION: ~5456.0'
LOGGED BY: M. STILSON
EQUIP./DRILL METHOD: 310 SE J.D. BACKHOE
DEPTH TO WATER - INITIAL: ▽ DRY — AFTER 24 HOURS: ▽ NOT MEASURED

Elev. (Feet)	Depth (Feet)	Lith-ology	Sample Type	Sample Type	USCS	Material Description	Dry Density, pcf	Moisture Content, %	Atter. Liquid Limit, %	Atter. Plasticity Index, %	Gradation Gravel, %	Gradation Sand, %	Gradation Silt/Clay, %	Other Tests
5455	0					**LEAN CLAY** dry, pinhole structure, macro-holes to 3'								
				Ring	CL-1		82.0	9.1	28	11	0	13	87	
				2 Blocks	CL-ML		86.9	6.5	26	6	0	10	90	CT
						SILTY CLAY								
	5													
5450				Block Bucket	CL-2				37	18	0	3	97	DS
						LEAN CLAY lt. brown to brown, dry, hard, pinhole structure								
				Block	CL-2		89.6	9.1	33	15	0	3	97	
	10													
5445														
				Bag	CL									
	15													
5440														
	20													

06/14/04
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LEGEND

2,3,2 ← Blow Count per 6"
0.45 ← Torvane (tsf)
Disturbed Sample
Undisturbed Sample
Groundwater Elevation

UC - Unconfined Compression Test
CT - Consolidation Test
SG - Specific Gravity Test
DS - Direct Shear Test

TEST PIT LOG

PIT NO. 04–8

Sheet: 1 of 1

PROJECT: COVE DAM — PROJECT NO.: 200401.025
CLIENT: K.C.W.C.D. — DATE: 6/2/04
LOCATION: SEE SITE PLAN — ELEVATION: ~5475.0'
LOGGED BY: M. STILSON
EQUIP./DRILL METHOD: 310 SE J.D. BACKHOE
DEPTH TO WATER - INITIAL: ▽ DRY — AFTER 24 HOURS: ▽ NOT MEASURED

Elev. (Feet)	Depth (Feet)	Lith-ology	SAMPLE Type	SAMPLE Type	SAMPLE USCS	Material Description	Dry Density, pcf	Moisture Content, %	Atter. Liquid Limit, %	Atter. Plasticity Index, %	Gradation Gravel, %	Gradation Sand, %	Gradation Silt/Clay, %	Other Tests
						SILTY CLAY W/SAND lt. brown to brown, dry, hard, pinhole structure								
				Bag	CL-1			6.9	33	14	0	6	94	
5470	5													
				Bag	CL	**LEAN CLAY** lt. brown to brown, dry, hard, pinhole structure, minerals								
				Bag	CL-2			6.7	46	25	0	2	98	
5465	10													
				Bag	CL									
5460	15													
	20													

06/11/04
11:00:17 AM

LEGEND

2,3,2 ← Blow Count per 6"
0.45 ← Torvane (tsf)
Disturbed Sample
Undisturbed Sample
Groundwater Elevation

UC = Unconfined Compression Test
CT = Consolidation Test
SG = Specific Gravity Test

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Provo, Utah

TEST PIT LOG

PIT NO. 04–9

Sheet: 1 of 1

PROJECT: COVE DAM — PROJECT NO.: 200401.025
CLIENT: K.C.W.C.D. — DATE: 6/2/04
LOCATION: SEE SITE PLAN — ELEVATION: ~5483.0'
LOGGED BY: M. STILSON
EQUIP./DRILL METHOD: 310 SE J.D. BACKHOE
DEPTH TO WATER - INITIAL: ▽ DRY AFTER 24 HOURS: ▽ NOT MEASURED

Elev. (Feet)	Depth (Feet)	Lith-ology	SAMPLE Type	SAMPLE Type	SAMPLE USCS	Material Description	Dry Density, pcf	Moisture Content, %	Atter. Liquid Limit, %	Atter. Plasticity Index, %	Gradation Gravel, %	Gradation Sand, %	Gradation Silt/Clay, %	Other Tests
5480	0			Bag	CL									
	5			Bag	CL-2	**LEAN CLAY W/FINE SAND** lt. brown to brown, dry, hard, pinhole structure, trace minerals		7.8	37	21	0	1	99	
5475				Bag	CL									
	10			Bag	CL-2			6.3	31	15	0	6	94	
5470														
	15													
5465														
	20													

06/11/04
11:00:31 AM

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LEGEND

2,3,2 ← Blow Count per 6"
0.45 ← Torvane (tsf)
Disturbed Sample
Undisturbed Sample
Groundwater Elevation

UC = Unconfined Compression Test
CT = Consolidation Test
SG = Specific Gravity Test

TEST PIT LOG

PIT NO. 04–10

Sheet: 1 of 1

PROJECT: COVE DAM — PROJECT NO.: 200401.025
CLIENT: K.C.W.C.D. — DATE: 6/2/04
LOCATION: SEE SITE PLAN — ELEVATION: ~5500.0'
LOGGED BY: M. STILSON
EQUIP./DRILL METHOD: 310 SE J.D. BACKHOE
DEPTH TO WATER - INITIAL: ▽ DRY AFTER 24 HOURS: ▽ NOT MEASURED

Elev. (Feet)	Depth (Feet)	Lith-ology	SAMPLE Type	SAMPLE Type	USCS	Material Description	Dry Density, pcf	Moisture Content, %	Atter. Liquid Limit, %	Atter. Plasticity Index, %	Gradation Gravel, %	Gradation Sand, %	Gradation Silt/Clay, %	Other Tests
				Bag	CL-2			6.9	38	20	0	6	94	
5495	5			Bag	CL	**LEAN CLAY** lt. brown to brown, dry, hard, trace pinhole structure, more minerals, trace sand at 3'								
				Bag	CL-2			8.5	43	22	0	6	94	
5490	10			Bag	CL									
5485	15													
	20													

06/11/04
11:00:46 AM

LEGEND

2,3,2 ← Blow Count per 6"
0.45 ← Torvane (tsf)
Disturbed Sample
Undisturbed Sample
▽ ← Groundwater Elevation

UC = Unconfined Compression Test
CT = Consolidation Test
SG = Specific Gravity Test

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TEST PIT LOG

PIT NO. 04-11

Sheet: 1 of 1

PROJECT: COVE DAM — PROJECT NO.: 200401.025
CLIENT: K.C.W.C.D. — DATE: 6/2/04
LOCATION: SEE SITE PLAN — ELEVATION: ~5498.0'
LOGGED BY: M. STILSON
EQUIP./DRILL METHOD: 310 SE J.D. BACKHOE
DEPTH TO WATER - INITIAL: ▽ DRY — AFTER 24 HOURS: ▽ NOT MEASURED

Elev. (Feet)	Depth (Feet)	Lith-ology	SAMPLE Type	SAMPLE Type	SAMPLE USCS	Material Description	Dry Density, pcf	Moisture Content, %	Atter. Liquid Limit, %	Atter. Plasticity Index, %	Gradation Gravel, %	Gradation Sand, %	Gradation Silt/Clay, %	Other Tests
5495	0			Bag	CL-ML	**SILTY CLAY W/SAND** lt. brown to brown, dry, hard, pinhole structure, fine sand - intermixed		4.4	20	5	0	43	57	
	5			Bag	CL-ML									
5490														
	10			Bag	CL-2	**LEAN CLAY W/SAND** lt. brown to brown, dry, hard, pinhole structure, fine sand - intermixed		5.7	34	16	0	17	83	
				Bag	CL-ML	**SILTY CLAY W/SAND** lt. brown to brown, dry, hard, pinhole structure, fine sand - intermixed								
5485	15													
5480	20													

06/11/04
11:01:01 AM

LEGEND

2,3,2 ← Blow Count per 6"
0.45 ← Torvane (tsf)
Disturbed Sample
Undisturbed Sample
Groundwater Elevation

UC = Unconfined Compression Test
CT = Consolidation Test
SG = Specific Gravity Test

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Provo, Utah

TEST PIT LOG

PIT NO. 04–12

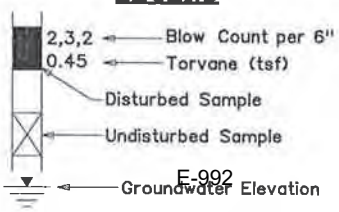
Sheet: 1 of 1

PROJECT: COVE DAM — PROJECT NO.: 200401.025
CLIENT: K.C.W.C.D. — DATE: 6/2/04
LOCATION: SEE SITE PLAN — ELEVATION: ~5520.0'
LOGGED BY: M. STILSON
EQUIP./DRILL METHOD: 310 SE J.D. BACKHOE
DEPTH TO WATER - INITIAL: ▽ DRY — AFTER 24 HOURS: ▽ NOT MEASURED

Elev. (Feet)	Depth (Feet)	Lith-ology	SAMPLE Type	SAMPLE Type	USCS	Material Description	Dry Density, pcf	Moisture Content, %	Atter. Liquid Limit, %	Atter. Plasticity Index, %	Gradation Gravel, %	Gradation Sand, %	Gradation Silt/Clay, %	Other Tests
				Bag	CL-ML	**SILTY CLAY W/SAND** lt. brown to brown, dry, hard								
5515	5			Bag/ Block	ML	shows layering **SANDY SILT** lt. brown to brown, dry, hard		4.4		NP	0	47	53	
5510	10			Bag	CL-ML	**SILTY CLAY W/SAND** lt. brown to brown, dry, hard								
				Bag	CL-2	**LEAN CLAY** lt. brown to brown, dry, hard		7.2	36	16	0	2	98	
5505	15													
	20													

06/11/04
11:01:14 AM

LEGEND



UC = Unconfined Compression Test
CT = Consolidation Test
SG = Specific Gravity Test

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Provo, Utah

TEST PIT LOG

PIT NO. 04–13

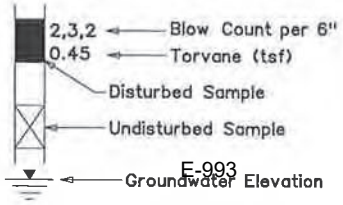
Sheet: 1 of 1

PROJECT: COVE DAM
PROJECT NO.: 200401.025
CLIENT: K.C.W.C.D.
DATE: 6/2/04
LOCATION: SEE SITE PLAN
ELEVATION: ~5548.0'
LOGGED BY: M. STILSON
EQUIP./DRILL METHOD: 310 SE J.D. BACKHOE
DEPTH TO WATER - INITIAL: ▽ DRY AFTER 24 HOURS: ▽ NOT MEASURED

Elev. (Feet)	Depth (Feet)	Lith-ology	SAMPLE Type	SAMPLE Type	SAMPLE USCS	Material Description	Dry Density, pcf	Moisture Content, %	Atter. Liquid Limit, %	Atter. Plasticity Index, %	Gradation Gravel, %	Gradation Sand, %	Gradation Silt/Clay, %	Other Tests
						6" clay layer								
				Bag	SM									
						8" clay layer								
5515	5					**SILTY SAND W/CLAY LAYERS**								
				Bag	SM	lt. brown to brown, dry								
						12" clay layer								
				Bag	SM									
5510	10													
				Bag	SM									
5505	15													
	20													

06/11/04
11:01:30 AM

LEGEND



UC = Unconfined Compression Test
CT = Consolidation Test
SG = Specific Gravity Test

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Laboratory Testing

Table 1

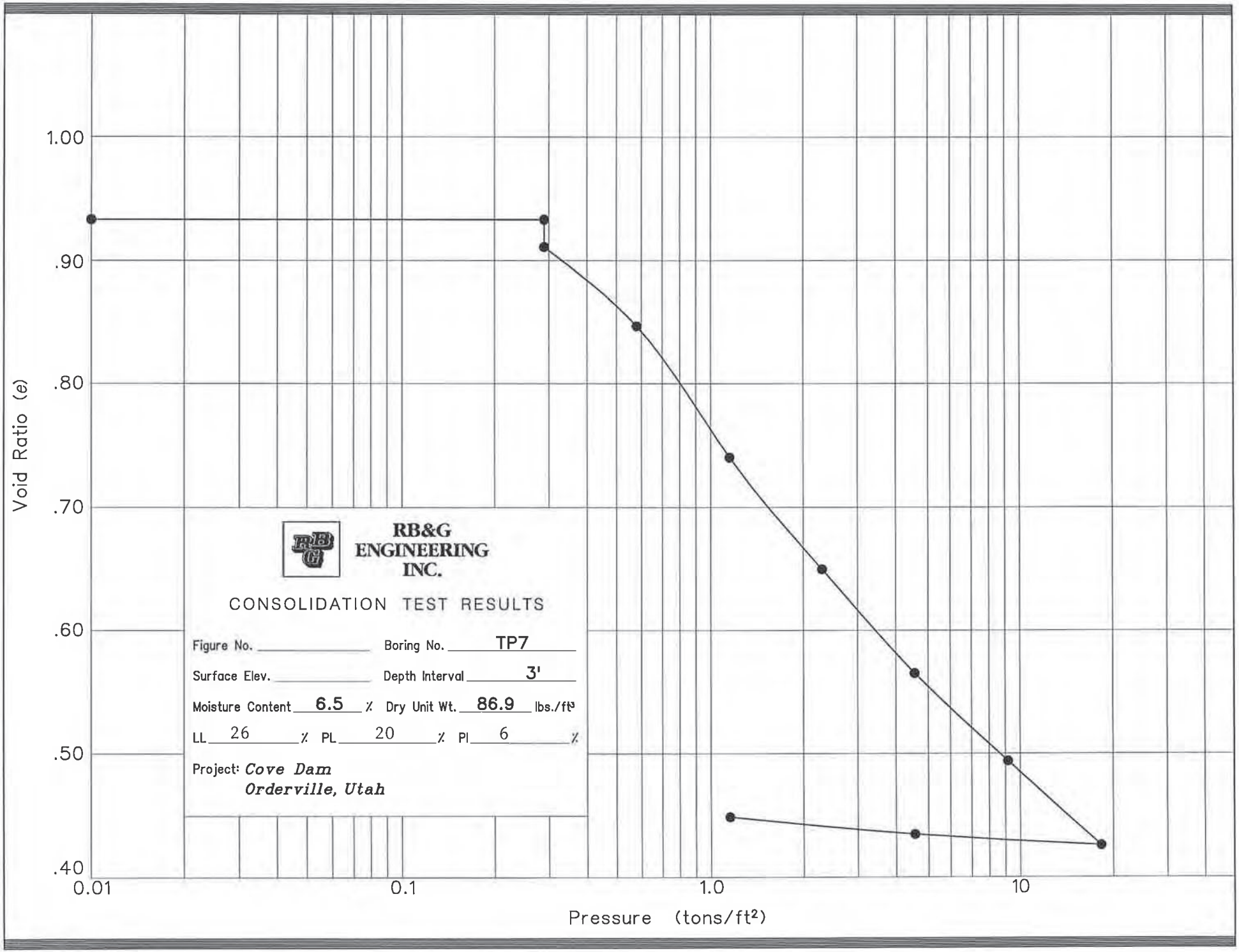
SUMMARY OF TEST DATA

PROJECT Cove Dam
LOCATION Kane County, Utah

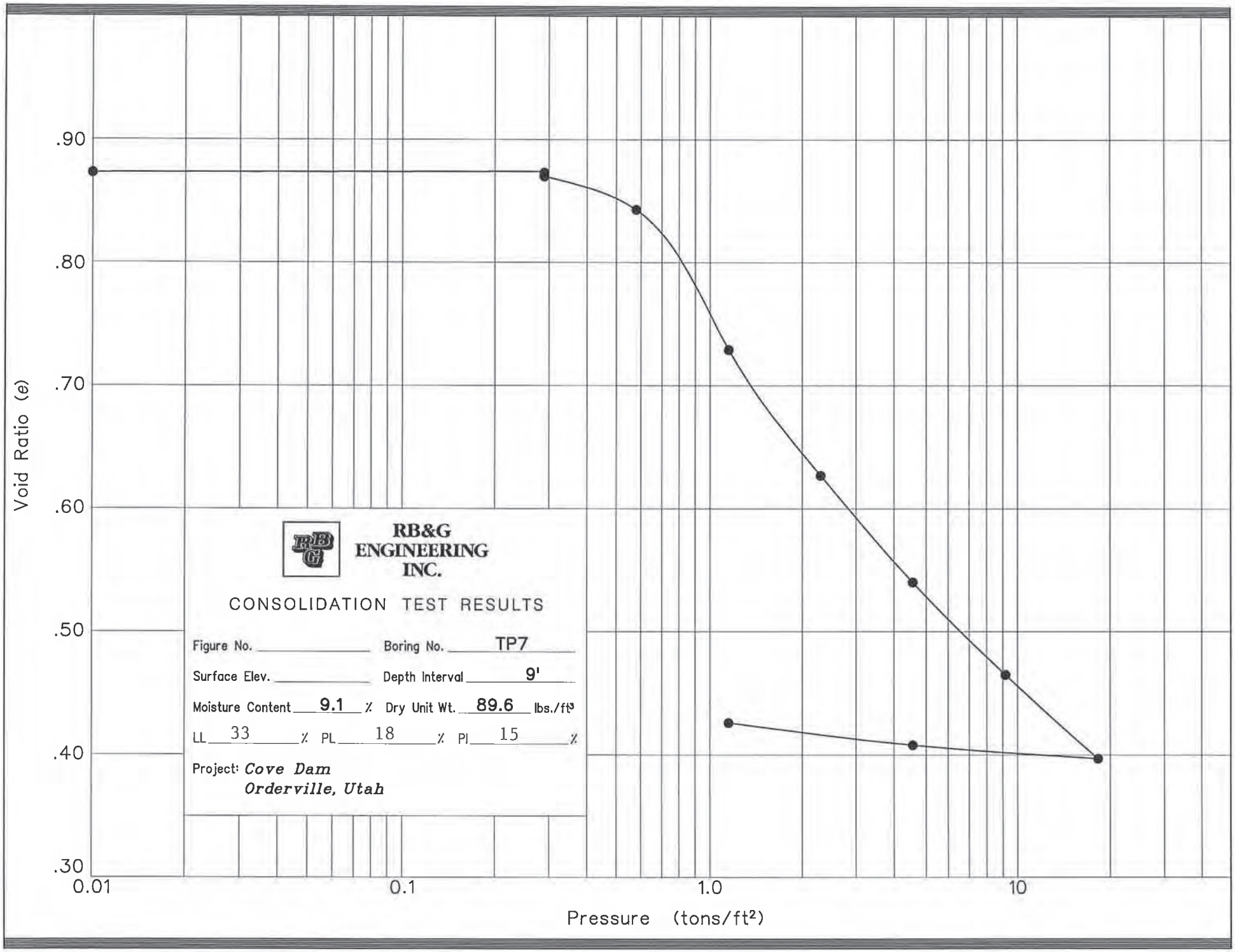
PROJECT NO. 200401-025
FEATURE

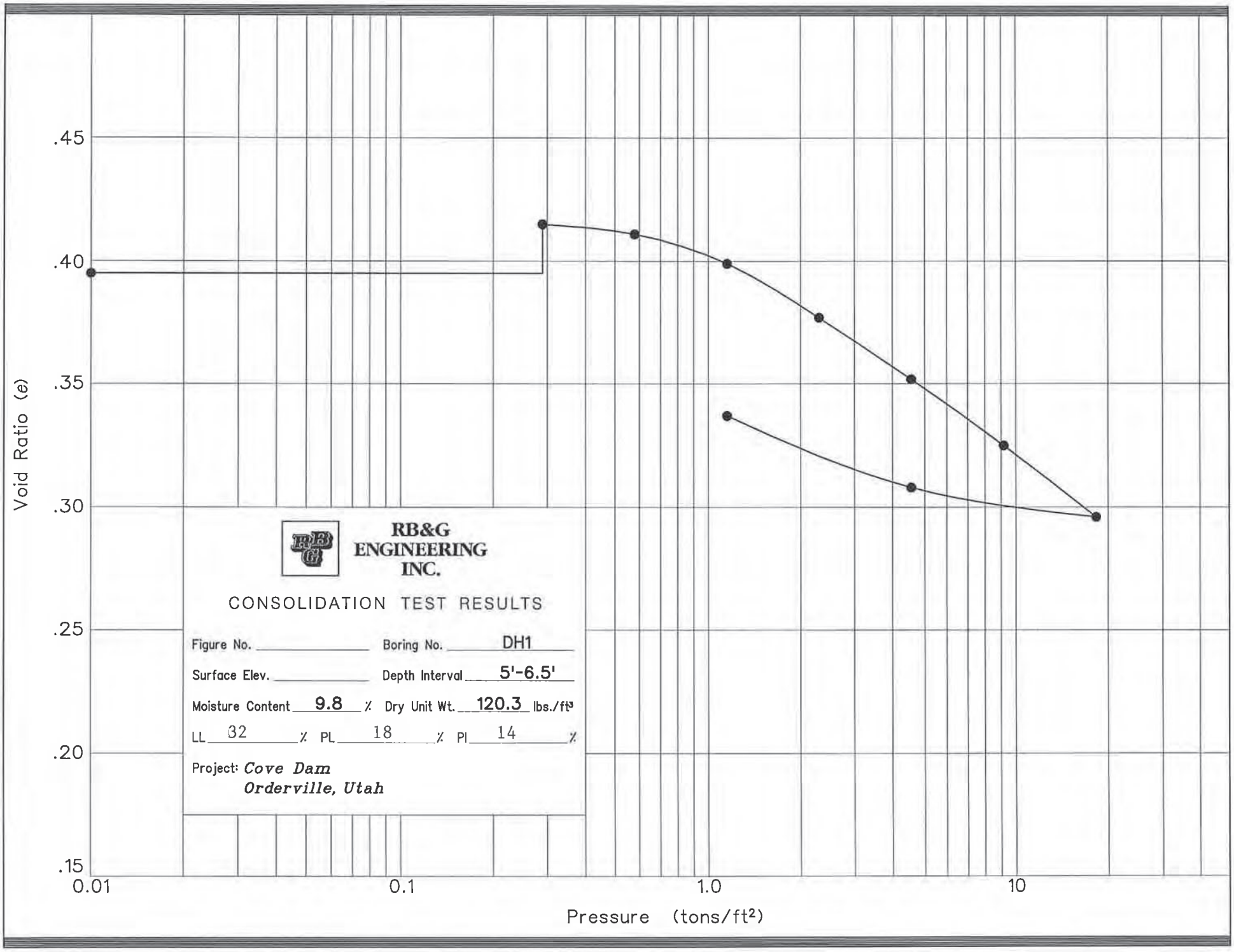
HOLE NO.	DEPTH BELOW GROUND SURFACE (ft)	MATERIAL	IN-PLACE		PINHOLE TEST RESULTS	ATTERBERG LIMITS			MECHANICAL ANALYSIS			UNIFIED SOIL CLASSIFICATION SYSTEM (modified)
			DRY UNIT WEIGHT (pcf)	MOISTURE (%)		LIQUID LIMIT (%)	PLASTIC LIMIT (%)	PLASTICITY INDEX (%)	PERCENT GRAVEL	PERCENT SAND	PERCENT SILT & CLAY	
DH-1	5-6	Soil	120.3	9.8		32	18	14	0	10	90	CL-1
	15-16.5	Soil	119.4	8.7		37	18	19	0	17	83	CL-2
	25-26.5	Soil	112.4	14.3		34	16	18	0	6	94	CL-2
	35-36.5	Soil	105.2	17.5		49	18	31	0	3	97	CL-2
	45-46	Soil	100.7	23.1		50	16	34	0	6	94	CL-2/CH
	53	Bedrock		16.4		82	30	50	0	0	100	CH
	73	Bedrock		13.2		70	25	45	0	0	100	CH
DH-2	6.5-8	Soil		12.2		45	14	31	0	2	98	CL-2
	15-16.5	Soil	111.8	19.3		58	24	34	0	0	100	CH
	26	Bedrock		13.5		70	23	47	0	0	100	CH
DH-3	14	Bedrock		13.7		54	21	33	0	0	100	CH
DH-5	41	Bedrock		4.7		43	17	26	0	9	91	CL-2
	48	Bedrock		12.6		47	23	24	0	2	98	CL-2
TP-1	3-4	Soil		4.8	ND2	26	16	12	0	3	97	CL-1
	6-7	Soil		6.4	ND2	35	19	6	0	2	98	CL-2
	9-10	Soil		3.4	ND3	31	16	15	0	26	74	CL-2
TP-2	6-7	Soil		8.6		40	20	20	0	2	98	CL-2
	12-12.5	Soil		5.8	ND3	31	18	13	0	12	88	CL-1
TP-3	0-1	Soil							25	73	2	SP
TP-4	5.5	Soil							0	82	18	SM
TP-5	6	Bedrock				58	24	34				CH
	9	Bedrock				59	28	31				CH
TP-7	2	Soil	82.0	9.1	ND2	28	17	11	0	13	87	CL-1
	2-3	Soil	86.9	6.5	ND3	26	20	6	0	10	90	CL-ML
	6-7	Soil		4.0	ND2	37	19	18	0	3	97	CL-2
	9-10	Soil	89.6	9.1		33	18	15	0	3	97	CL-2
TP-8	3-4	Soil		6.9	ND3	33	19	14	0	6	94	CL-1
	9-10	Soil		6.7	ND2	46	21	25	0	2	98	CL-2
TP-9	6-7	Soil		7.8		37	16	21	0	1	99	CL-2
	12-12.5	Soil		6.3		31	16	15	0	6	94	CL-2
TP-10	3-4	Soil		6.9		38	18	20	0	6	94	CL-2
	9-10	Soil		8.5		43	21	22	0	6	94	CL-2
TP-11	3-4	Soil		4.4		20	15	5	0	43	57	CL-ML
	9-10	Soil		5.7		34	18	16	0	17	83	CL-2
TP-12	6-7	Soil		4.4				NP	0	47	53	ML
	12-12.5	Soil		7.2		36	20	16	0	2	98	CL-2

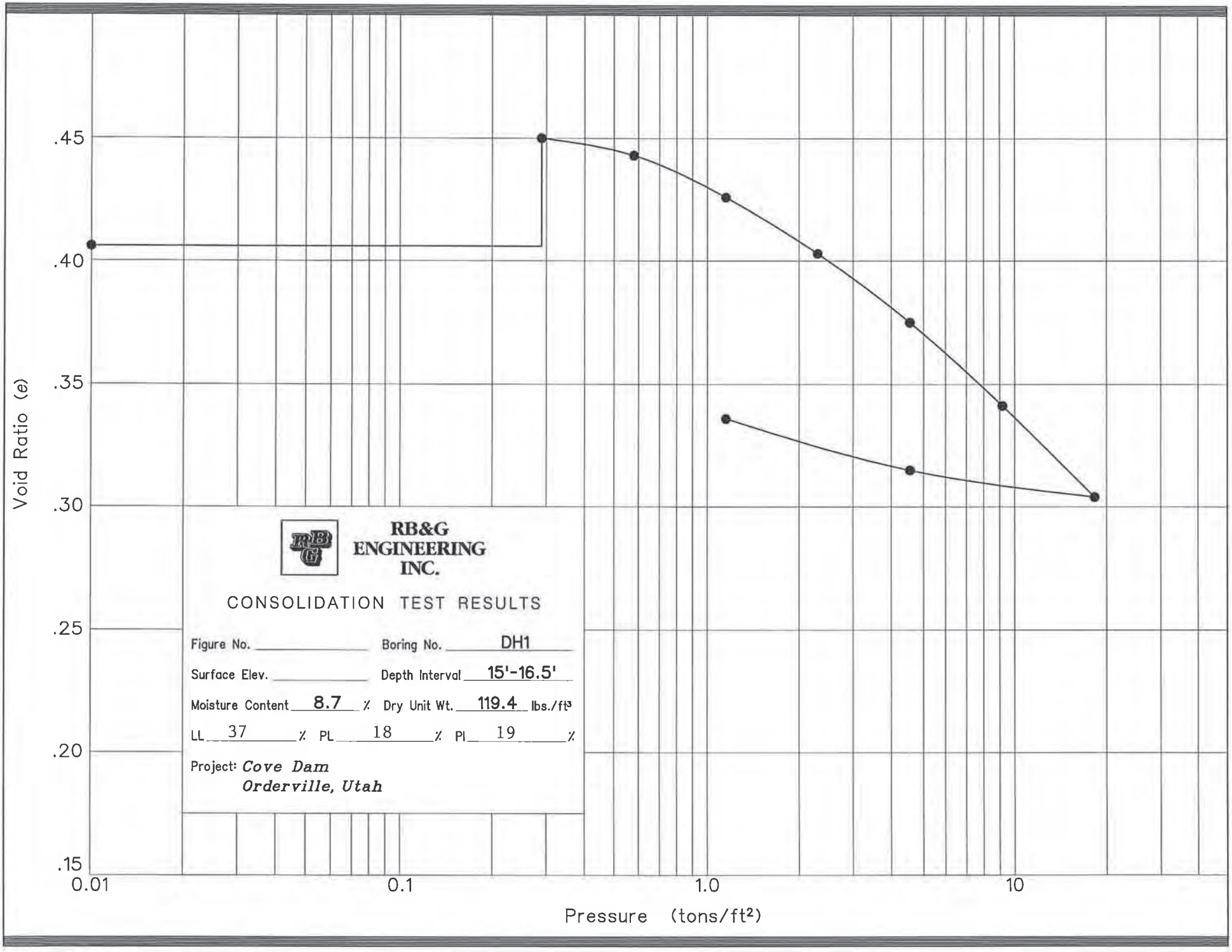
NP=Nonplastic


1.00
.90
.80
.70
.60
.50
.40
Void Ratio (e)
0.01
0.1
1.0
10
Pressure (tons/ft²)
RB&G
ENGINEERING
INC.
CONSOLIDATION TEST RESULTS
Figure No. _____ Boring No. TP7
Surface Elev. _____ Depth Interval 3'
Moisture Content 6.5 % Dry Unit Wt. 86.9 lbs./ft³
LL 26 % PL 20 % PI 6 %
Project: Cove Dam
Orderville, Utah

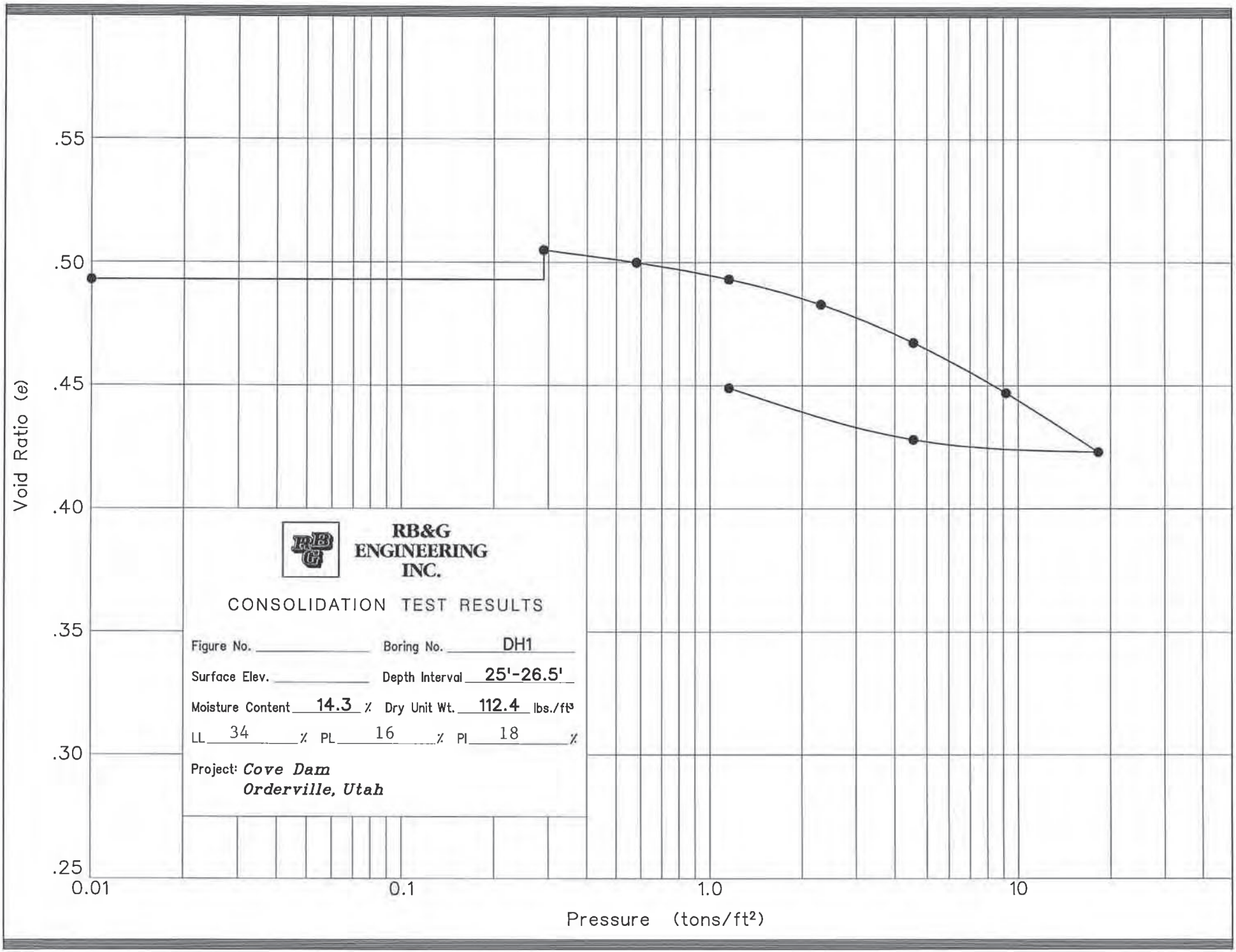
E-996


.90
.80
.70
.60
.50
.40
.30
Void Ratio (e)
0.01
0.1
1.0
10
Pressure (tons/ft²)
RB&G
ENGINEERING
INC.
CONSOLIDATION TEST RESULTS
Figure No. _____ Boring No. TP7
Surface Elev. _____ Depth Interval 9'
Moisture Content 9.1 % Dry Unit Wt. 89.6 lbs./ft³
LL 33 % PL 18 % PI 15 %
Project: Cove Dam
Orderville, Utah

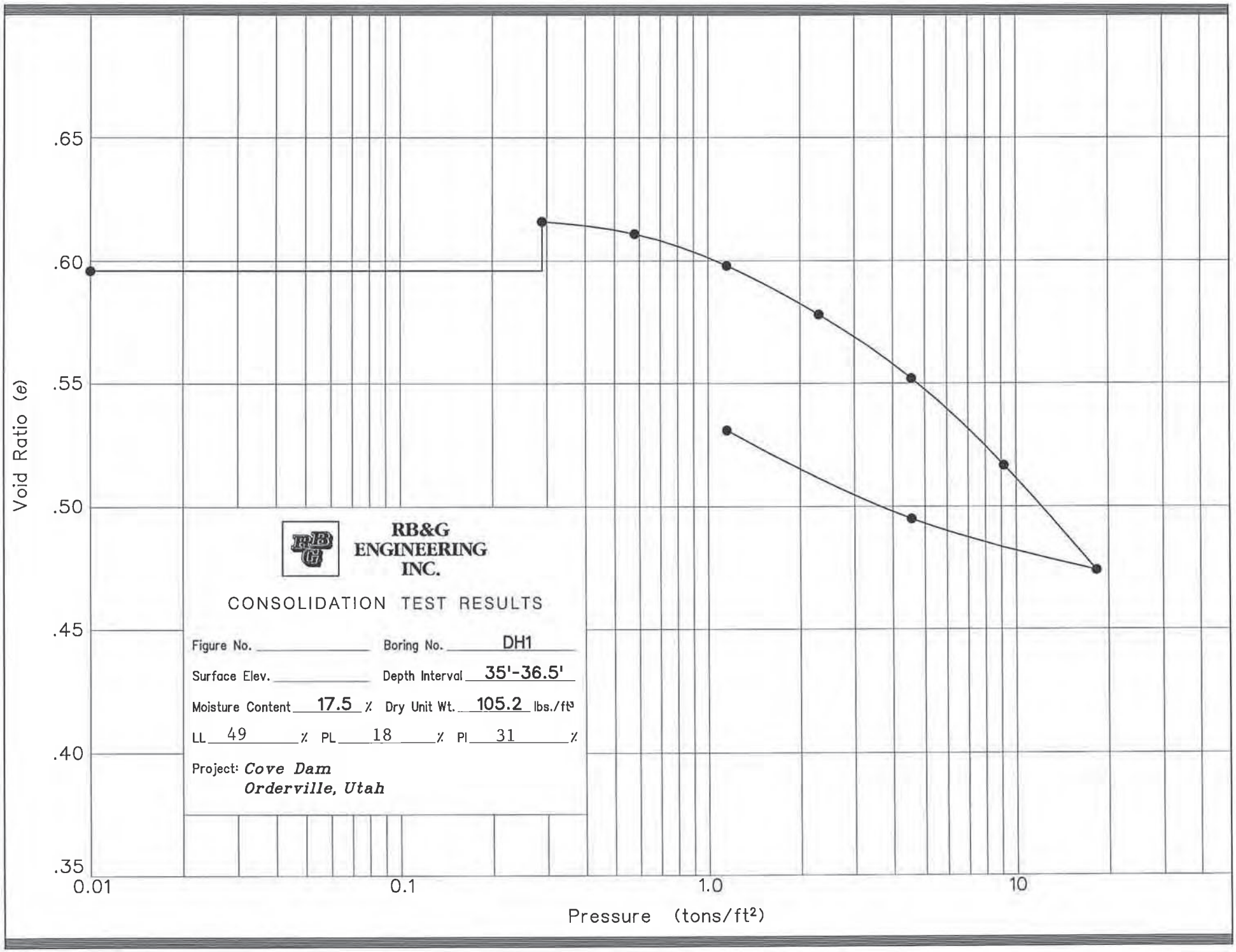

.45
.40
.35
.30
.25
.20
.15
Void Ratio (e)
0.01
0.1
1.0
10
Pressure (tons/ft²)
RB&G ENGINEERING INC.
CONSOLIDATION TEST RESULTS
Figure No.
Boring No. DH1
Surface Elev.
Depth Interval 5'-6.5'
Moisture Content 9.8 % Dry Unit Wt. 120.3 lbs./ft³
LL 32 % PL 18 % PI 14 %
Project: Cove Dam
Orderville, Utah


.45
.40
.35
.30
.25
.20
.15
Void Ratio (e)
0.01
0.1
1.0
10
Pressure (tons/ft²)
RB&G ENGINEERING INC.
CONSOLIDATION TEST RESULTS
Figure No.
Boring No. DH1
Surface Elev.
Depth Interval 15'-16.5'
Moisture Content 8.7 % Dry Unit Wt. 119.4 lbs./ft³
LL 37 % PL 18 % PI 19 %
Project: Cove Dam
Orderville, Utah

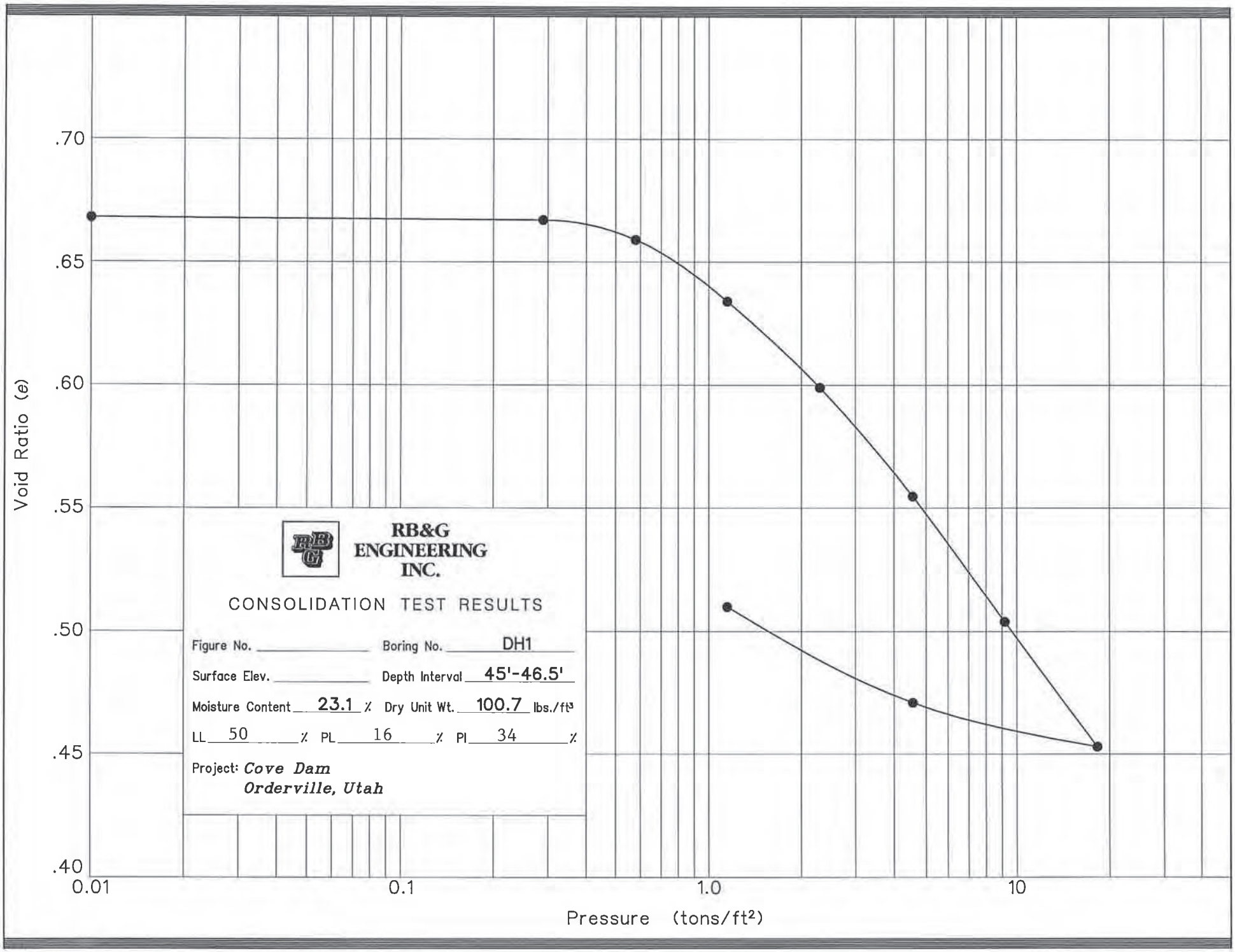
E-999


.55
.50
.45
.40
.35
.30
.25
Void Ratio (e)
0.01
0.1
1.0
10
Pressure (tons/ft²)
RB&G ENGINEERING INC.
CONSOLIDATION TEST RESULTS
Figure No. _____ Boring No. DH1
Surface Elev. _____ Depth Interval 25'-26.5'
Moisture Content 14.3 % Dry Unit Wt. 112.4 lbs./ft³
LL 34 % PL 16 % PI 18 %
Project: Cove Dam
Orderville, Utah

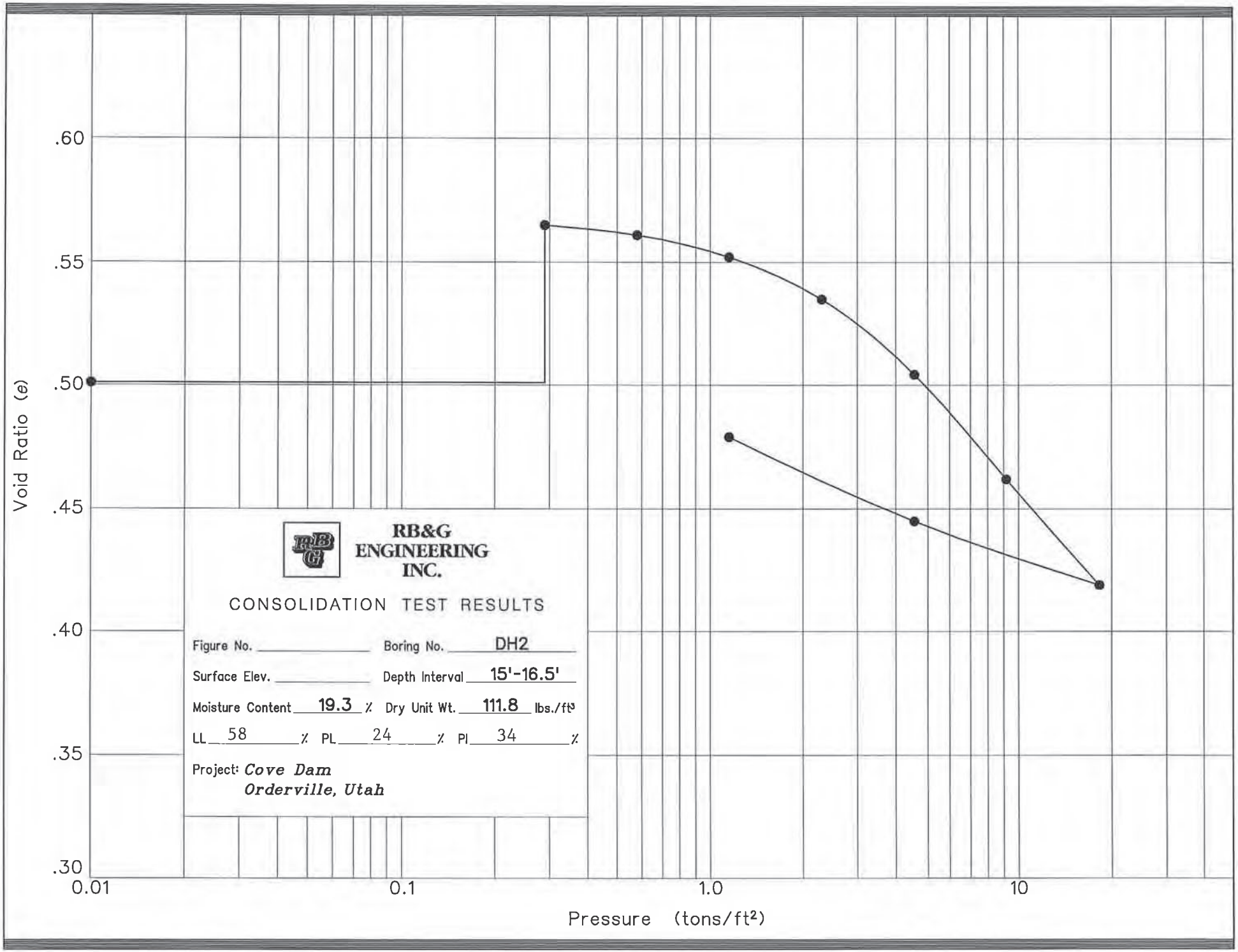
E-1000


.65
.60
.55
.50
.45
.40
.35
Void Ratio (e)
0.01
0.1
1.0
10
Pressure (tons/ft²)
RB&G ENGINEERING INC.
CONSOLIDATION TEST RESULTS
Figure No.
Boring No. DH1
Surface Elev.
Depth Interval 35'-36.5'
Moisture Content 17.5 % Dry Unit Wt. 105.2 lbs./ft³
LL 49 % PL 18 % PI 31 %
Project: Cove Dam
Orderville, Utah

E-1001


.70
.65
.60
.55
.50
.45
.40
Void Ratio (e)
0.01
0.1
1.0
10
Pressure (tons/ft²)
RB&G ENGINEERING INC.
CONSOLIDATION TEST RESULTS
Figure No. _____ Boring No. DH1
Surface Elev. _____ Depth Interval 45'-46.5'
Moisture Content 23.1 % Dry Unit Wt. 100.7 lbs./ft³
LL 50 % PL 16 % PI 34 %
Project: Cove Dam
Orderville, Utah

E-1002


.60
.55
.50
.45
.40
.35
.30
Void Ratio (e)
0.01
0.1
1.0
10
Pressure (tons/ft²)
RB&G ENGINEERING INC.
CONSOLIDATION TEST RESULTS
Figure No. _____ Boring No. DH2
Surface Elev. _____ Depth Interval 15'-16.5'
Moisture Content 19.3 % Dry Unit Wt. 111.8 lbs./ft³
LL 58 % PL 24 % PI 34 %
Project: Cove Dam
Orderville, Utah

E-1003

RB&G ENGINEERING INC.
1435 West 820 North, Provo, Utah 84601
801 374-5771 Provo
801 521-5771 Salt Lake City

PROJECT NO.	200401.025

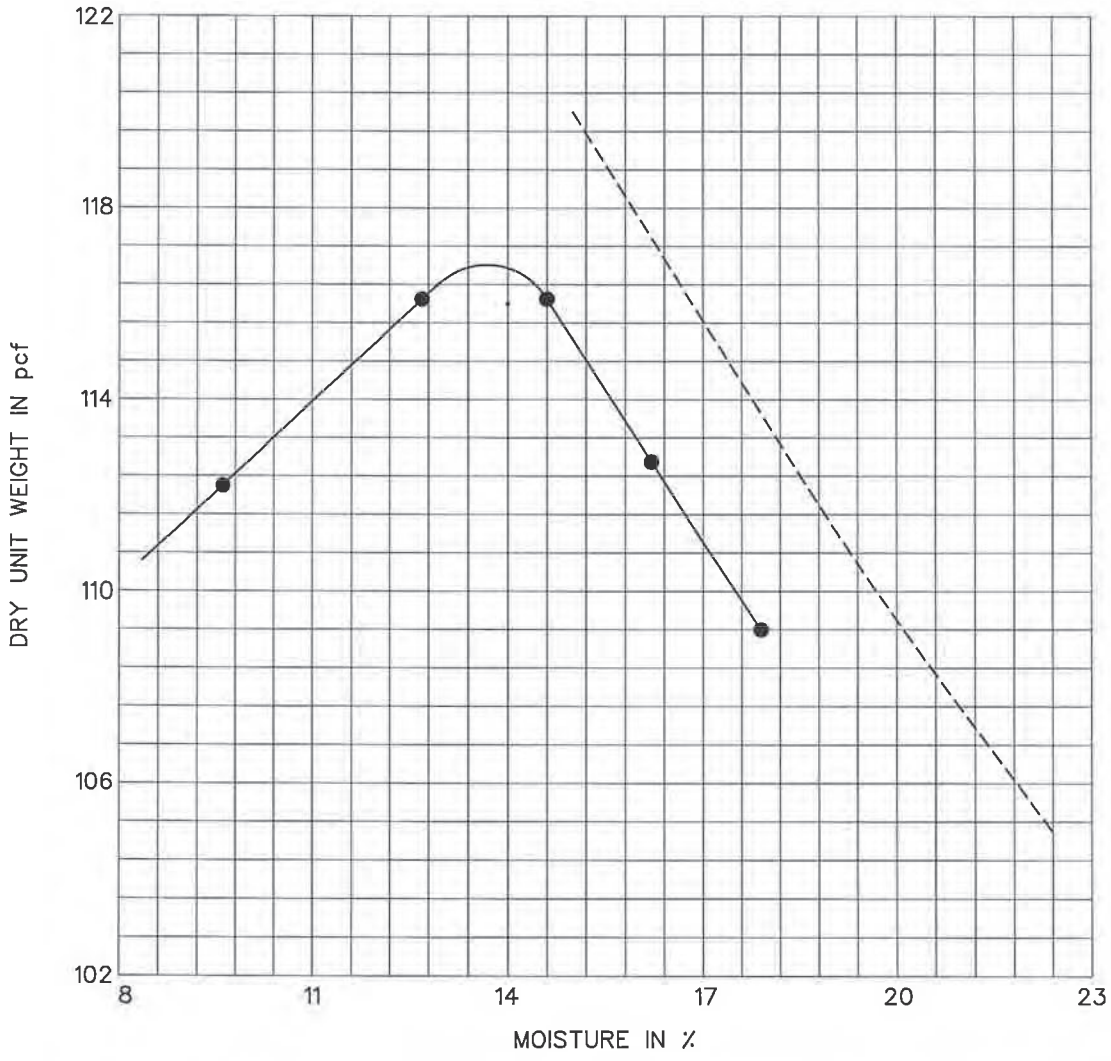
MOISTURE-DENSITY RELATION (PROCTOR)

Project	COVE DAM			Date	6/9/04
Location	ORDERVILLE, UTAH / TEST PIT NO. 1 AT 3'			Technician	G. PEASLEE
Material Description	LT. BROWN TO BROWN LEAN CLAY	USCS	CL-1	Method	ASTM D 698

Procedure Used[1]	A
Classification Procedure[2]	Test

[1] A-No. 4 Sieve, B-⅜" Sieve, C-¾" Sieve
[2] Visual as per ASTM D 2488, Test as per ASTM D 2487

Preparation Method	Moist
Rammer Used	Manual
As-Received Moisture Content (%)	-



Maximum Dry Density (pcf)	**116.0**
Optimum Moisture Content (%)	**14.0**
Modified Maximum Density (pcf)	
Modified Optimum Moisture Content (%)	

– – – – – 100% Saturation Curve

Specific Gravity of Soil	2.70	Est.

OVERSIZE CORRECTION-ASTM D 4718

Specific Gravity of Soil +¾		
Percent Oversize		

Type of Specific Gravity is BULK Unless Otherwise Indicated

RB&G ENGINEERING INC.
1435 West 820 North, Provo, Utah 84601
801 374-5771 Provo
801 521-5771 Salt Lake City

PROJECT NO.	200401.025

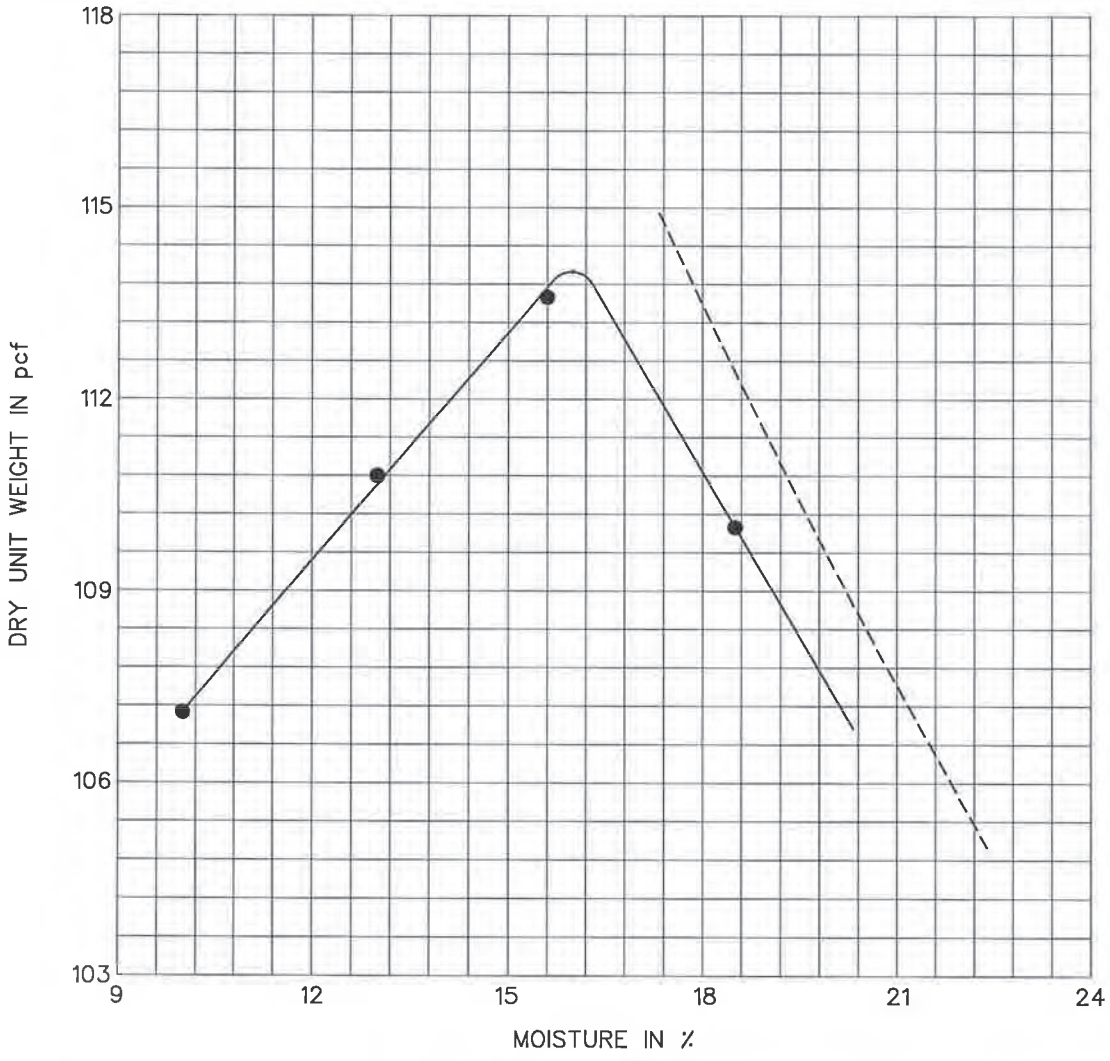
MOISTURE-DENSITY RELATION (PROCTOR)

Project	COVE DAM			Date	6/9/04
Location	ORDERVILLE, UTAH / TEST PIT NO. 7 AT 3'-4'			Technician	G. PEASLEE
Material Description	LT. BROWN TO BROWN SILTY CLAY	USCS	CL-ML	Method	ASTM D 698

Procedure Used[1]	A
Classification Procedure[2]	Test

[1] A-No. 4 Sieve, B-3/8" Sieve, C-3/4" Sieve
[2] Visual as per ASTM D 2488, Test as per ASTM D 2487

Preparation Method	Moist
Rammer Used	Manual
As-Received Moisture Content (%)	-



Maximum Dry Density (pcf)	114.0
Optimum Moisture Content (%)	16.0
Modified Maximum Density (pcf)	
Modified Optimum Moisture Content (%)	

------ 100% Saturation Curve

Specific Gravity of Soil	2.70	Est.

OVERSIZE CORRECTION-ASTM D 4718

Specific Gravity of Soil +3/4		
Percent Oversize		

Type of Specific Gravity is BULK Unless Otherwise Indicated

RB&G ENGINEERING INC.
1435 West 820 North, Provo, Utah 84601
801 374-5771 Provo
801 521-5771 Salt Lake City

PROJECT NO.	200401.025

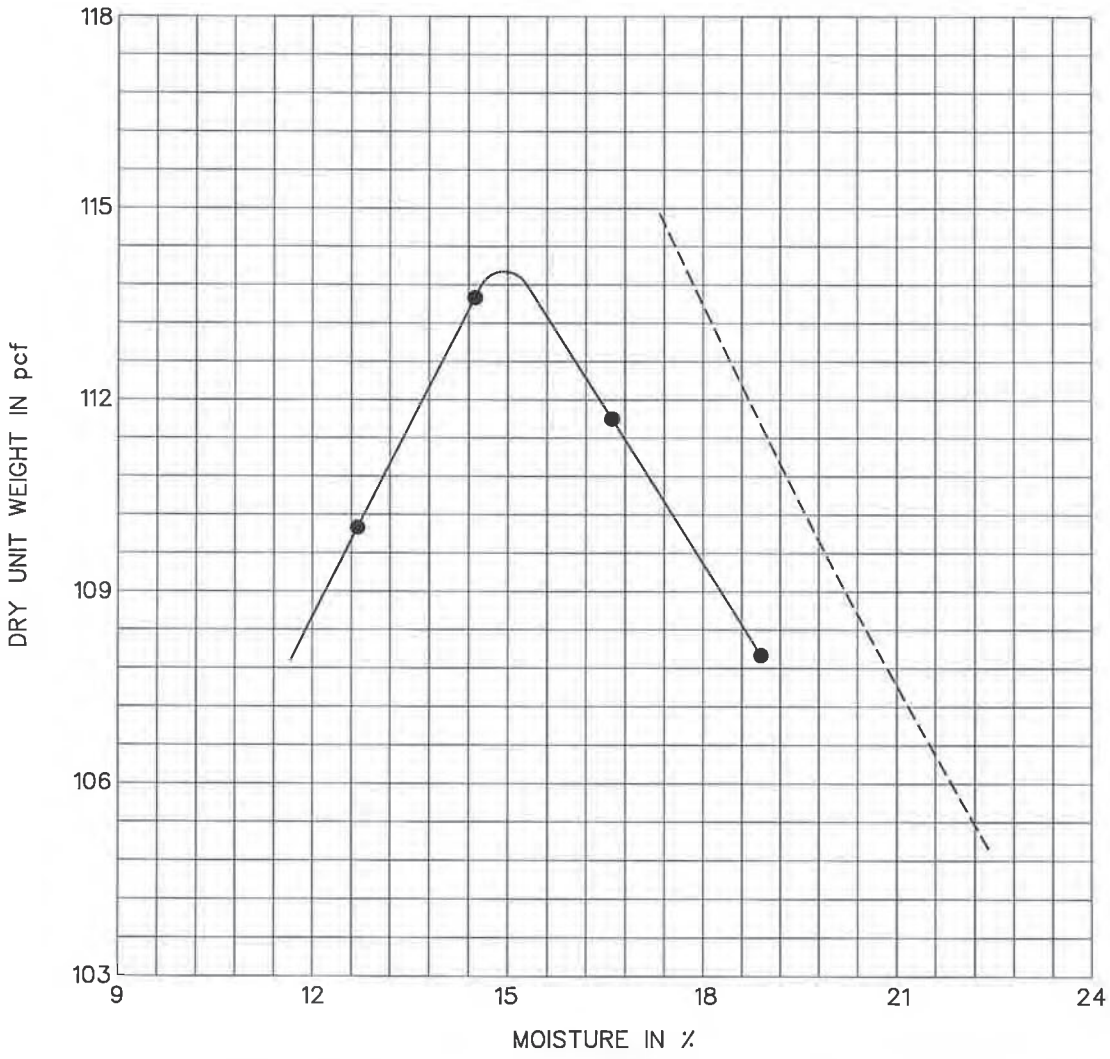
MOISTURE-DENSITY RELATION (PROCTOR)

Project	COVE DAM			Date	6/9/04
Location	ORDERVILLE, UTAH / TEST PIT NO. 7 AT 6'			Technician	G. PEASLEE
Material Description	LT. BROWN TO BROWN LEAN CLAY	USCS	CL-2	Method	ASTM D 698

Procedure Used[1]	A
Classification Procedure[2]	Test

[1] A-No. 4 Sieve, B-⅜" Sieve, C-¾" Sieve
[2] Visual as per ASTM D 2488, Test as per ASTM D 2487

Preparation Method	Moist
Rammer Used	Manual
As-Received Moisture Content (%)	4.0



Maximum Dry Density (pcf)	**114.0**
Optimum Moisture Content (%)	**15.0**
Modified Maximum Density (pcf)	
Modified Optimum Moisture Content (%)	

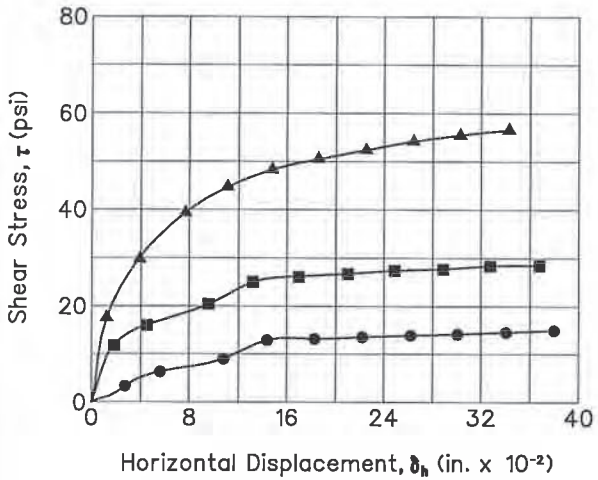
– – – – – 100% Saturation Curve

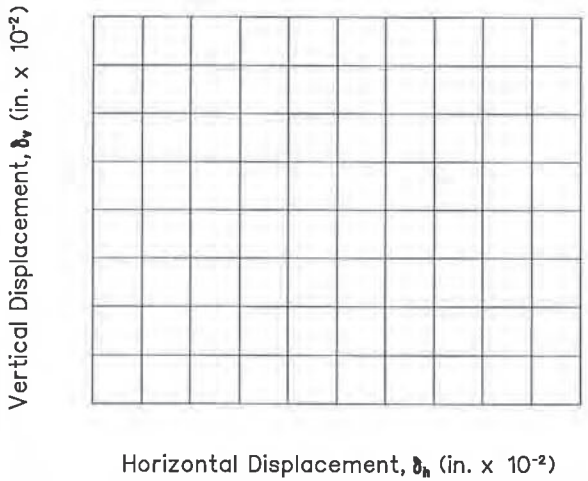
Specific Gravity of Soil	2.70	Est.

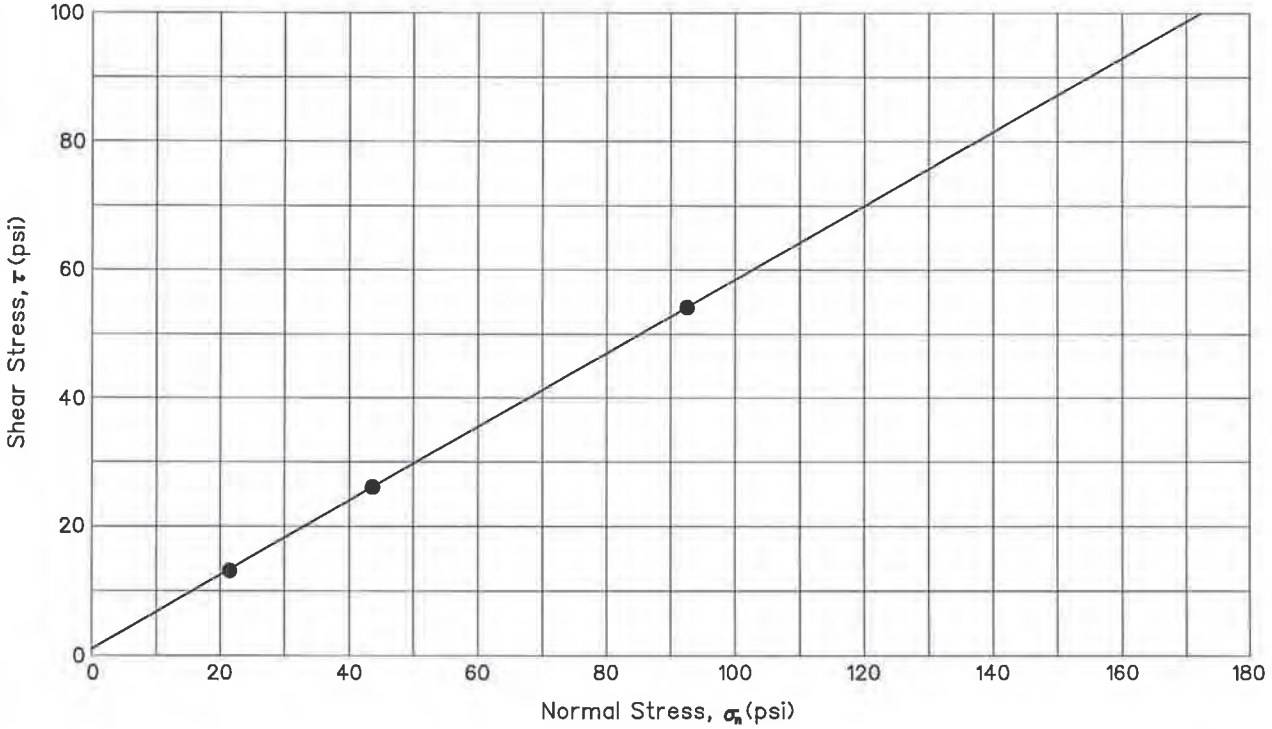
OVERSIZE CORRECTION-ASTM D 4718

Specific Gravity of Soil +¾		
Percent Oversize		

Type of Specific Gravity is BULK Unless Otherwise Indicated







Test No. or Symbol	Sample Size (inches)	Sample Data		Degree of Saturation (%)	Normal Stress δn (psi)	Maximum Shear Stress τ (psi)	Strain Rate (inches/minute)	Shear Strength Parameters	
		Dry Density (pcf)	Moisture Content (%)					Friction Angle ϕ (degrees)	Cohesion (c/psi)
●	2.375	80.4	10.4	~100	21.5	12.9	.0013	29.9	1
■	2.375	82.3	10.4	~100	43.7	26.1	.0013		
▲	2.375	87.1	8.5	~100	92.6	54.2	.0013		

E-1007

RB&G ENGINEERING INC.
Provo, Utah

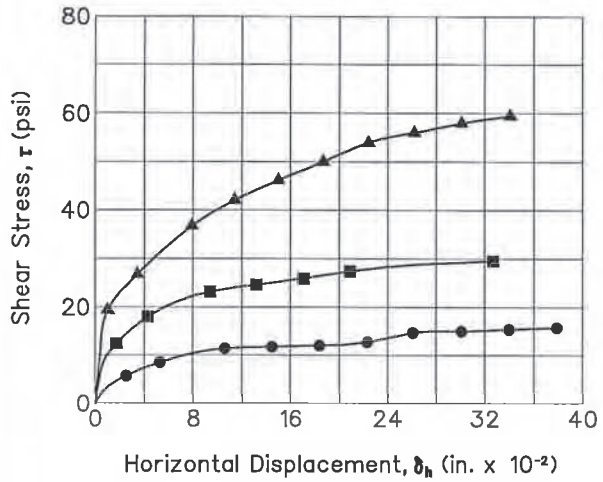
DIRECT SHEAR TEST

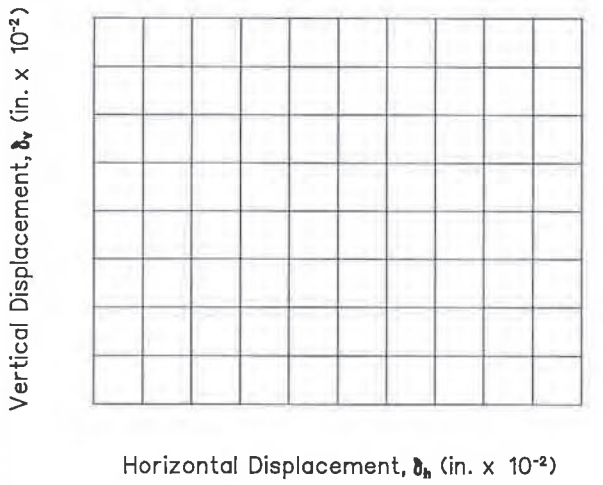
Project: *Cove Dam*
Orderville, Utah

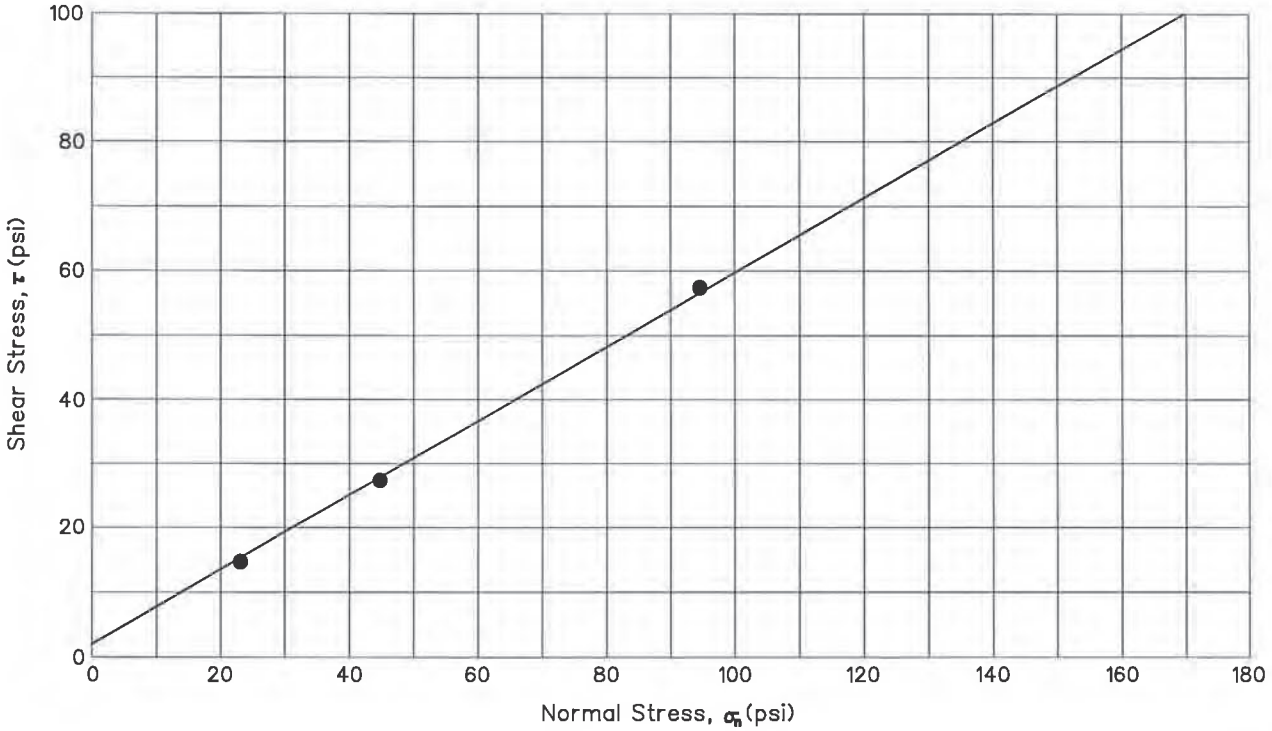
HOLE NO.: TP7

DEPTH: 6'

Figure







REMOLDED SAMPLE COMPACTED TO 98% MAXIMUM DENSITY

Test No. or Symbol	Sample Size (inches)	Sample Data: Dry Density (pcf)	Sample Data: Moisture Content (%)	Degree of Saturation (%)	Normal Stress σ_n (psi)	Maximum Shear Stress τ (psi)	Strain Rate (inches/minute)	Shear Strength Parameters: Friction Angle φ (degrees)	Shear Strength Parameters: Cohesion (c/psi)
●	2.375	111.5	15.1	100	23.1	14.7	.0013	30.2	2
■	2.375	111.5	15.1	100	44.8	27.4	.0013		
▲	2.375	111.5	15.1	100	94.6	57.9	.0013		

E-1008

RB&G ENGINEERING INC.
Provo, Utah

DIRECT SHEAR TEST

Project: *Cove Dam*
Orderville, Utah

HOLE NO.: TP7

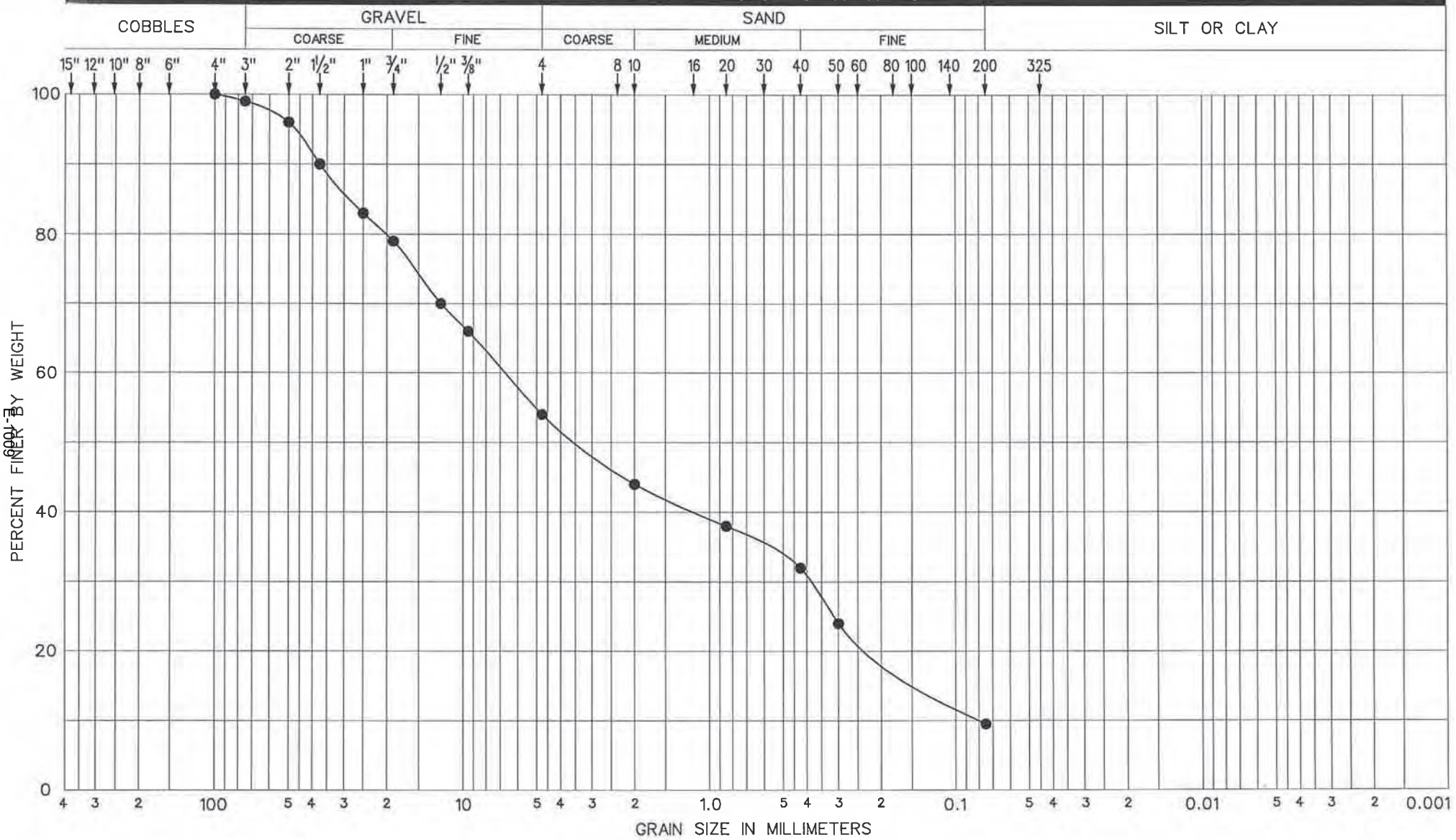
DEPTH: 6'

Figure

RB&G ENGINEERING INC.
1435 West 820 North, Provo, Utah 84601
801 374-5771 Provo
801 521-5771 Salt Lake City

PROJECT NO.	200401.025

SIEVE ANALYSIS (GRADATION)



6004-3

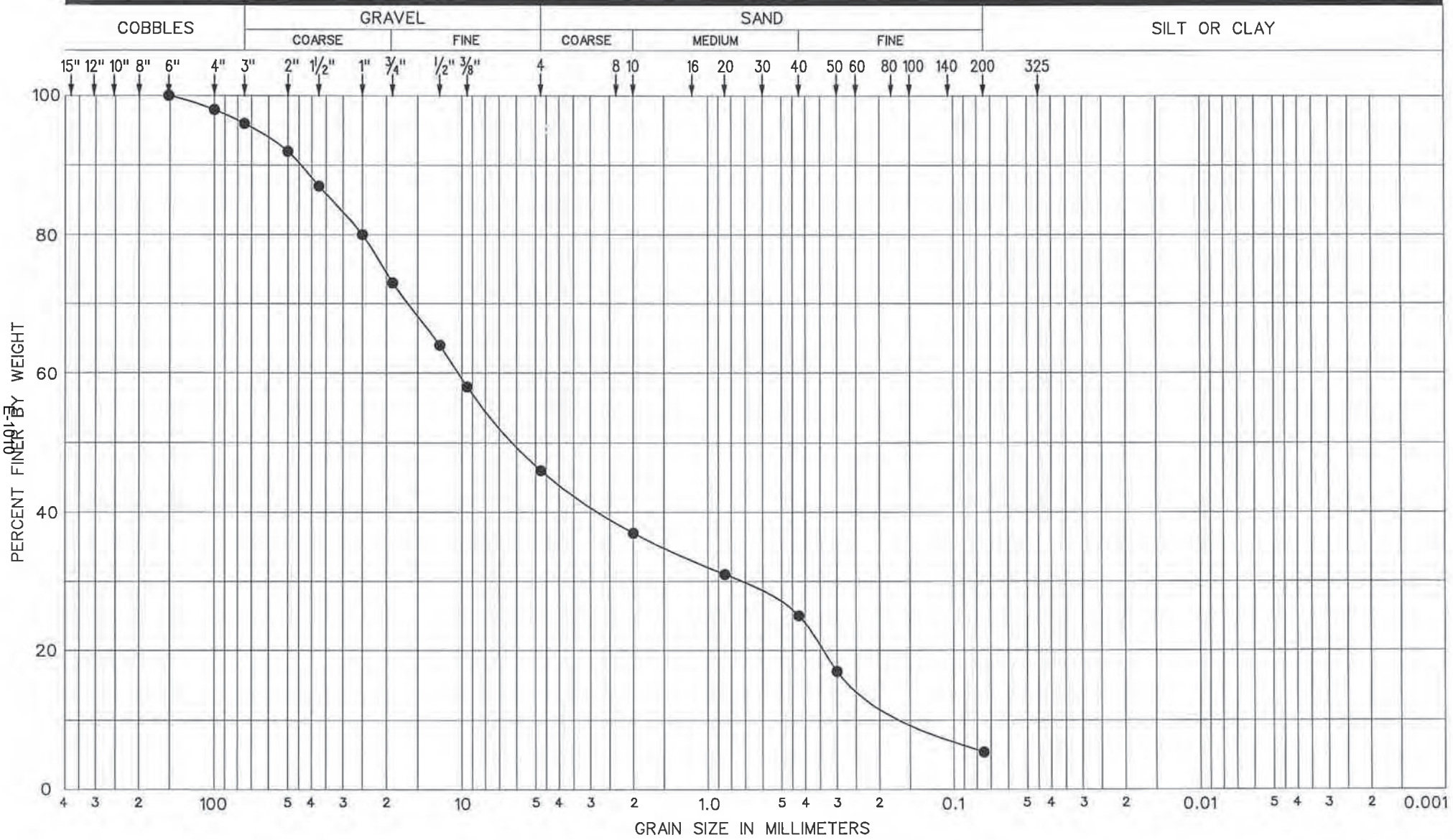
Project	COVE DAM		
Location	ORDERVILLE, UTAH		
Sample No./Depth	ROSE PIT		
Material Description	WELL GRADED GRAVEL W/SILT & SAND	USCS	GW-GM

Date	6/10/04
Technician	K. BRADFORD
Procedure	PLAIN WATER
Method	ASTM C117, C136, C566

RB&G ENGINEERING INC.
1435 West 820 North, Provo, Utah 84601
801 374-5771 Provo
801 521-5771 Salt Lake City

PROJECT NO.	200401.025

SIEVE ANALYSIS (GRADATION)



E-1070

Project	COVE DAM		
Location	ORDERVILLE, UTAH		
Sample No./Depth	TATE PIT		
Material Description	POORLY GRADED GRAVEL W/SAND	USCS	GP

Date	6/10/04
Technician	K. BRADFORD
Procedure	PLAIN WATER
Method	ASTM C117, C136, C566

Appendix

DIVISION OF WATER RESOURCES
Engineering Geology Section
1594 West North Temple, Suite 210
Box 145201
Salt Lake City, Utah 84114-6201

MEMORANDUM

October 6, 1997

Post-it® Fax Note 7671	Date 10/6/97	# of pages ▶ 15
To Brad Price	From Dan Aubrey	
Co./Dept. RB46	Co. Water Resources	
Phone #	Phone # 538-7283	
Fax # 801-374-5773	Fax #	

TO: Ben Everitt
Chief Geologist

FROM: Dan Aubrey
Engineering Geologist

SUBJECT: Test Pits At Cove Dam Site Near Orderville, Kane County, Utah.

Introduction and Location

On Wednesday, June 4th at the request of Kane County Water Conservancy District I supervised the digging of a number of test pits along the proposed alignments for two offstream damsites in the lower reaches of Cove Canyon. The lower alignment, including both abutments is located in the SW¼ of Sec.5, T41S, R7W, SLB&M. The right abutment of the upper alignment is located in the SE¼ of Sec. 6, while the left abutment is located in the NW¼ of Sec. 5, T41S, R7W, SLB&M (see Figure 1). A total of nine test pits were located and logged, six pertaining to the upper alignment and three along the lower alignment (see Figure 1).

These sites had been identified during a reconnaissance level inventory of Virgin River damsites during the mid- to late 1980's. Not until 1996 did this location receive any further attention concerning its viability as a potential damsite(s). Franson-Nobel & Associates, Inc., in June of 1996, completed a reconnaissance level evaluation, in part, to help in the preparation of preliminary cost estimates. Continued interest in the site by both the Kane County Water Conservancy District and the Washington County Water Conservancy District resulted in this first review of the site from a geology and geotechnical point of view.

Given a storage of 6,700 acre-feet, a dam at the lower alignment would have to be approximately 98 feet high and at the upper alignment a dam would have to be about 103 feet high to store this amount of water. A dam of this height at the upper site may require the placement of a dike in the saddle just upstream of the right abutment.

Geologic Setting

The proposed Cove damsites are located in an alluvial valley, tributary to Long Valley and the East Fork Virgin River, that has been cut into a sequence of Cretaceous and Tertiary sedimentary rocks consisting mostly of sandstone and shale. Based on a review of pertinent geologic maps and literature the bedrock exposed in the abutments and underlying the alluvium in the reservoir basins is of the Cretaceous aged Tropic Shale Formation. The shale is predominantly gray, carbonaceous, calcareous, and includes bentonitic horizons and thin lenticular sandstones. The residual soil is a silty to sandy clay (CL to CH). Capping abutment ridges is a thin light brown deposit of gravel containing pebbles and cobbles of gray and red

quartzite, grey to black chert, and grey limestone. Alluvium which covers the flat valley floor of the Cove is predominantly light to medium brown, fine to very fine grained sand with silt, and clay.

Based on research of water well logs, depth to bedrock in Long Valley (underlying the East Fork Virgin River) is approximately 50 feet. Making the assumption that tributaries are graded to the main valley results in projected depth to bedrock under the lower alignment of about 40-45 feet, and under the upper alignment of about 35-40 feet. The valley is approximately 1,000 feet wide at the lower alignment and about 1,500 feet wide at the upper alignment.

Discussion of Test Pits and Geotechnical Considerations

Figure 2 is a graphic representation of the materials encountered in the test pits. In general the materials encountered were very fine grained sand to silt and clay (SM, ML, & CL). The two test pits (#'s 2 & 7) located at the base of the right abutment, at each damsite, encountered some gravel. The gravel is contributed from the colluvial slopes of the abutment. Test pit #5 which was located in the drainage near the left abutment of the upper alignment encountered the most granular material. Here 6.5 feet of poorly graded sandy gravel contains cobbles to 14" diameter. Calcite (calcium carbonate) stringers are moderately abundant to very abundant in the test pits below 6 or 7 feet, in most of the test pits. Restricted access prevented us from placing test pits on or near the left abutments of either alignment.

Based on the test pits it appears that there is an abundance of cohesive material available for dam construction, however, the test pits did not identify an adequate source of granular material. At this level of investigation (considering only the geology and geotechnical aspects) it does not appear that one alignment has any advantage over the other.

Geologic Hazards

Following digging of the test pits, I performed a preliminary geologic hazards review of the sites. The summary of geologic hazards (see Table 1) accompanies this report. While most of the hazards listed in the summary, rate in the unlikely hazards category there are two geologic hazards which fall into the probable category and five which rate as possible hazards. These are identified as follows:

Probable Hazards — 1. Ground shaking due to an earthquake centered on the nearby Sevier Fault, and 2. Expansive clays which occur in the Tropic Formation throughout southern Utah.

Possible Hazards -- 1. Liquefaction, 2. Tectonic subsidence, and 3. Slope failure are all related to proximity of the Sevier Fault. 4. Collapsible soils and 5. Pipable/Erodible hazards are related to the identification in the test pits of very fine grained sand and non-cohesive silt.

Further study will be necessary to determine what impact these seven hazards might have on a dam constructed at either of these sites.

Conclusions and Recommendations

Based on information from the test pits and geologic hazards evaluation the following conclusions can be reached:

1. There is an abundance of cohesive material available, including some bentonite outcroppings in the Tropic Shale.

2. Only a very limited amount of granular material is available, and nothing that is suitable as rip rap was identified.
3. At this level of investigation one site does not seem to have any substantial advantage over the other.
4. Either site is capable of storing 6,700 acre-feet of water.
5. Proximity of these sites to the Sevier Fault and the presence of expansive clays and very fine grained non-cohesive soils are geologic hazards.
6. As part of a preliminary design, additional studies should address specific hazards.

The following recommendations are suggested:

1. A seismic hazards evaluation of the Sevier Fault will be needed to determine what impact this hazard might have on these damsites.
2. Laboratory testing of soil samples is necessary to determine if a soils/foundation hazard exists.
3. A careful cost estimate ought to be prepared for these sites so a benefit /cost ratio can be developed.
4. From a geologic and geotechnical view the next step would be to pursue investigation of the subsurface conditions by drilling, sampling and testing (permeability, blow counts, etc.) along the proposed alignment.

ABLE # 1

SUMMARY OF GEOLOGIC HAZARDS

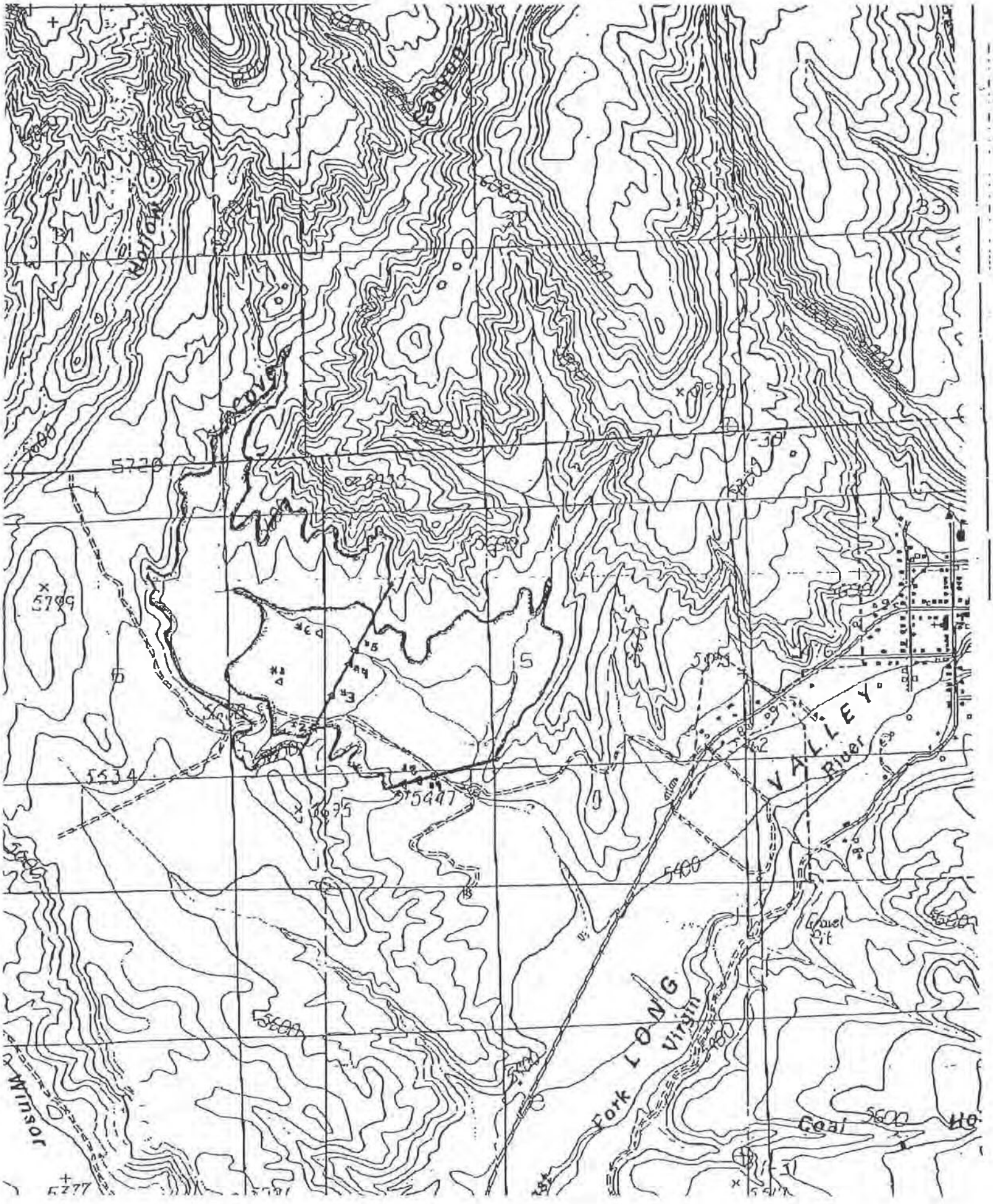
COVE DAMSITES

	Hazard Rating*			Further Study Recommended**
	Probable Hazard	Possible Hazard	Unlikely Hazard	
Earthquake				
Ground shaking	E,F			G
Liquefaction		AF		S
Surface faulting			X	
Tectonic deformation		E,RB		G
Slope failure		A,RB		G
Seiche			X	
Slope Failure (Non-seis)				
Rock fall			X	
Landslide			X	
Debris flow			X	
Found/Embank Problems				
Collapsible soils		AF		S
Expansive clays	F,A			S
Sensitive clays			X	
Organic soils			X	
Soluble salts			X	
Erodable/Erodible		E		S
Karst			X	
Differential settlement			X	
Non-engineered fill			X	
Hydrologic				
Shallow ground-water			X	
Springs/Seeps			X	
Flooding				
Stream/Lake			X	
Upstream dam failure			X	
Spillway capacity			X	
Dam overtopping			X	

*Hazard Rating - Probable-evidence is strong that the hazard exists and mitigation measures should be taken. Possible-hazard may exist, but evidence is uncertain and further study is recommended. Unlikely-no evidence was found to indicate that the hazard is present.

Abbreviations; E = embankment, F = foundation, AF = alluvial foundation, BF = bedrock foundation, A = abutments, RB = reservoir basin, SL = shore line, DST = down stream toe, UST = up stream toe, DSF = down stream face, USF = up stream face, SP = spillway, & NA = Not applicable.

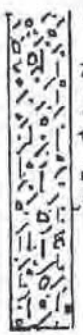
**Further Study (S-soil/foundation, G-geotecnical/engineering, H-hydrologic, SIP-study in progress, MIP-mitigation measures in progress) is recommended to address the hazard (see Conclusions and Recommendations).


5720
5709
5534
5447
5400
5600
Josuw
Fork
Virgin
River
Gravel
Pit
Coal
Hollow

Upper Alignment

ML-CL
lt-md tan, calcareous sandy clayey silt to sandy silty clay. sand fine to very fine grained. dry, loose to compact with depth calcite stringers 7"-14"

TP #2



ML-CL
md brn to gy-brn 20% caliche covered gravel and cobbles to 12'. mostly sandy clayey silt to silty sandy clay
dry, loose
calcareous.
sand very fine grained.
gravel subrounded to subangular

TP #3



SM-ML-CL
md orange-brn to brn silty sand to sandy clayey silt to sandy silty clay
dry, loose, crumbles easily.
calcareous
calcite stringers from 7' to 14'.
clay content increased with depth
sand very fine grained.

TP #4



SM-ML-CL
lt orange-brn silty sand to sandy clayey silt to sandy silty clay.
dry, loose, crumbles easily.
calcareous
calcite stringers from 6" to 14.5"
clay content increases with depth, more compact.
roots to 6' deep

TP #5



GP, CH
poorly graded sand, gravel mix with cobbles to 14", 0"-6.5" caliche coated, subangular to rounded gravel. most gravel to less than 3" dia.
6.5' to 13' damp to moist, grey clay-high plasticity, white calcite stringers throughout. calcareous.

TP #6



SM-CH
ground cove
close to wi
spaced brn
sand to ma
and boulde
0"-2½' gr
silty sand
loose, crumi
2½'-12' gra
to clay. lt
md gy-br
calcareous
stringers

E-1017

Lower Alignment

Legend

- Clay
- Silt
- Sand
- Gravel

TP #1



CL-CH
lt-brn to md-gy-brn sandy, silty clay.
dry, loose, dense from 8"-12".
calcareous - abundant calcite stringers below 8". dense clay is gy.
occasional pebbles in upper 5'.

TP #2



SM-ML-CL
light brown silty sand to sandy silt to sandy, silty clay
dry, loose crumbles easily
calcareous

TP #3



SM-ML-CL
light brown silty sand to sandy silt to sandy, silty clay
dry, loose crumbles easily clay content increase with depth, more compact.
calcareous, calcite stringers from 6"-15"

See Map for Test Pit Locatic

Figure #2

22-144 200 SHEETS

Importance of alfalfa hay and reason for use in determining the Cove Reservoir Project Cost/Benefit ratio.

Alfalfa is a key part of the western United States agricultural business and has been for a long time. Western states have a played a key role in alfalfa's historical development in the United States which has led to its current status as the nation's third most important agricultural crop. Its production in the west was worth $8.5 billion in 2018. Currently, alfalfa is a critical rotation crop and cash crop in all western states.

1. **Alfalfa Hay is a Major Animal Feed Source for Livestock in Southwestern Utah –** Alfalfa hay is a major feed source that supports livestock, milk production, and other industries in southwestern Utah. Although alfalfa is not the most profitable crop grown in southwest Utah, it competes well with grain and vegetable crops. Moreover, the risk of growing alfalfa is much lower than many other crops, making year-to-year profits steady. Alfalfa is resilient to unpredictable weather conditions and alfalfa markets have remained much more constant than other crops. Utah has a long-lasting demand for livestock feed, which produces local food for consumers. A study conducted in 2020 (reference "the importance of western alfalfa production article) showed that 10 of the 11 western states studied, reported that alfalfa is increasing in acreage or importance in their state and anticipated that this trend would continue. The most frequent reasons cited for this trend is increased demand by an expanding dairy industry, other market demands, and a lack of profitable alternative crops.
2. **High Quality Hay Can be Grown in Southwestern Utah –** Higher quality alfalfa hay can be grown in the project area due to the high elevation in the area. Research has shown that producers' fields located in the central part of Utah from 5,000 to 7,000 feet in elevation can grow exceptionally high qualify hay. The higher quality is attributed to cooler growing-season temperatures at high elevations. Alfalfa cultivators with greater fall dormancy are often better adapted to the shorter growing seasons at higher elevations, and slower growth initiation can improve alfalfa quality. Cooler temperatures seem to reduce alfalfa stem elongation, resulting in a higher leaf-to-stem ratio for alfalfa grown at higher elevations. Non-fibrous carbohydrates are the needed source of energy in beef finishing and dairy cow diets, which include starch and water-soluble carbohydrates like sugars and fructans, as well as readily digestible fiber. Non-fibrous carbohydrates are especially valuable in beef finishing diets because the marbling that makes meat tender and juicy requires high-energy feed.
3. **High Water Use Efficiency –** Alfalfa has a greater water use efficiency than most other crops. Alfalfa has deeper roots (as deep as 15 feet in some places) and a longer growing season than many other crops. Additionally, the entire aboveground portion of the plant is harvested multiple times per year.
4. **Irrigation Flexibility –** As a perennial, naturally drought-tolerant crop, alfalfa has incredible tolerance to irregular irrigation. In fact, irrigation can stop at almost any point in the season without causing long-term damage to the crop. Alfalfa goes dormant when it is water-stressed, but usually completely rebounds when irrigation continues (Lindenmeyer et al., 2011). This flexibility can be a critical aspect for potential water banking/leasing programs. It also reduces risks associated with drought and water

delivery systems failures, because water delivery issues could decimate many annual crops with poor irrigation flexibility.

5. **Low Input –** Unlike many annual and perennial crops, alfalfa requires few chemical inputs. Alfalfa is a perennial legume and requires no nitrogen fertilizer, which is often one of the most expensive inputs for annual crops. Nitrogen contamination of water from increased corn acreage in the Midwest is a major concern that resulted in part from declining alfalfa production in that region. A portion of most nitrogen fertilizer applications also volatilize into the atmosphere adding to the greenhouse gas effect. In addition to less nitrogen, alfalfa also requires much less pesticides and tillage than most annual and even perennial crops.
6. **Resilient and Adaptable –** Few crops are as resilient to difficult growing conditions as alfalfa. It can grow in almost any elevation and almost any type of soil (from sandy to clay soils). This is critical for crops in southwest Utah, where elevation changes are drastic, and soils vary widely. Grain, fruit, nut, and vegetable crops are much more sensitive to weather conditions and often fail when early or late frosts occur. Alfalfa can also utilize rainfall better than many other annual crops. As a perennial crop, established alfalfa utilizes rainfall in the early spring long before most annual crops are even planted.
7. **Benefits Other Crops in Rotation –** Alfalfa works with soil bacteria to convert nitrogen in the atmosphere to forms usable by plants. After alfalfa is terminated, large quantities of nitrogen can remain in the soil. This can usually result in savings of about $150/acre during the two crops that follow alfalfa from withholding or reducing nitrogen fertilizer applications (Yost et al., 2014b; Creech et al., 2015). In addition to nitrogen, crops that follow alfalfa in a crop rotation generally yield up to 10-15% greater and require less pesticides (Stanger and Lauer, 2008; Yost et al., 2014a). Alfalfa can also be grown with grasses in pastures providing nitrogen for the grasses, increased production during the hot summer months when cool- season grasses are less productive, and beneficially using soil water below pasture grass roots.
8. **Improves Soil, Water, and Air Quality –** Perennial crops like alfalfa help reduce soil erosion, which is one of the primary causes of irreversible soil degradation. Alfalfa also can often improve some physical (aggregate stability) and biological (organic matter and potentially mineralizable nitrogen) properties of soil (Congreves et al., 2015). Most annual crops require multiple passes of annual tillage, especially in organic production. Tillage is a major contributor to soil erosion. Most strategies that involve changing fertilizer management only offer small improvements, whereas the addition of a perennial crop like alfalfa could nearly meet the nitrogen reduction goals (Iowa nutrient reduction strategy, 2012). Alfalfa is highly valued by organic and conventional farmers alike for its soil health- building characteristics.
9. **Supports Wildlife Habitats** – The water used to irrigate alfalfa can create lush oases for wildlife habitats. Various wildlife species including birds, herbivores and important species such as foxes, hawks and eagles are abundant in alfalfa fields.
10. **Pollinator and Insect Diversity –** The health of bees and other pollinators are vital to the fruit and vegetable industries throughout the West. Alfalfa (mainly mature plants on field edges, ditches, seed alfalfa production, etc.) is one of the major sources of pollen. Other beneficial insects that keep pest insects in check are commonly found in alfalfa fields and provide benefit to the agro-ecosystem for neighboring crops.

11. **Harvest Flexibility and Storage** -The harvest window for alfalfa is much wider than many other crops. Although the quality of the crop will decrease as alfalfa matures, quality is often not overly critical unless alfalfa is being used for lactating dairy cows. This allows for high amounts of flexibility. Furthermore, the arid West also usually provides rain-free days between cutting and baling to produce excellent quality hay. Unlike some fruits and vegetables, alfalfa-like grain crops that are properly dried and stored can maintain its quality for long periods of time. It does not need to enter the market or be consumed quickly. This allows farmers to stockpile feed for their livestock or store their products until markets and prices are favorable.

The price of alfalfa hay was selected for determining the benefits of the Cove Reservoir project because of its importance as a major feed source, its economic value, and suitability to Utah's local climate and growing season. Other benefits of alfalfa hay include its water use efficiency, status as a drought-tolerant crop, minimal need for fertilizer, importance as a rotational crop, and the benefits provided toward increasing pollination.

INTERDISCIPLINARY TEAM ANALYSIS RECORD CHECKLIST

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NEPA Log Number:

File/Serial Number:

Project Leader: James Holland (BLM project leader)

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STAFF REVIEW OF PROPOSAL:

NP/NI/PI NC	Resource	Date Reviewed	Signature	Review Comments (required for all NIs and PIs. PIs require further analysis.)
			CRITICAL ELEMENTS	
NI	Air Quality *(C. Gubler)*	08/01/19	/s/ C. Gubler	Emissions would be expected as part of the project however because it is a short term project impacts to air quality would be negligible.
NP	Areas of Critical Environmental Concern *(D. Gunn)*	06/10/19	/s/ Dan Gunn	There are no ACEC's identified within the project area.
NI	Cultural Resources *(B.Storm)*	9/13/19	/s/ Brian Storm	A cultural resources Class III inventory (project # U18TN0544) was conducted in the Black Knoll rip rap pit project area and Bald Knoll community pit in June 2019. The June 2019 inventory resulted in the identification of two new sites (42KA8972 and 42KA8973) and two isolated finds in the Black Knoll project area. Both sites are small surface lithic scatters sans diagnostic artifacts or features; the sites are recommended not eligible for inclusion to NRHP. Isolated finds (IO-6, IO-7) consisted of one and four flakes, respectively. The isolates have been fully documented, are not eligible for inclusion to the NRHP, and no additional research or preservation is required. A cultural resources Class III inventory (project # U84BL0697) was completed in the project area in July 1984. The original inventory identified two sites (42KA2677 and 42KA2678) within the project area. Neither site was located during the June 2019 inventory or during a 2018 inventory (project # U18ES0434). The sites were recommended not eligible for inclusion to the NRHP. The June 2019 inventory resulted in no new cultural resources being identified in the Bald Knoll project area. A cultural resources Class III inventory (project # U07BL0560) was completed for the initial pit in May 2007. The inventory resulted in the identification of two new sites (42KA6331 and 42KA6332) at the south end of the project area. Both sites are recommended as eligible for inclusion to the NRHP. Site 42KA6331 was visited in 2019. Expansion of the Bald Knoll community pit to the north will result in no adverse effect to historic properties, but the boundary of the pit needs to be

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				updated/altered to exclude these two sites to ensure adverse effects to the historic properties will be avoided by all future use of the pit.
NI	Environmental Justice *(C. Stewart))*	8/2/19	/s/ Clay Stewart	The proposed action would not have a disproportionate effect on low income or minority communities because these communities, in general, do not exist near the project areas.
NP	Farmlands (Prime or Unique) *(J. Reese)*	8/28/19	/s/ J. Reese	There are no farmlands within the proposed project area.
NI	Floodplains *(J. Holland)*	7/24/2019	/s/ James R Holland	No floodplains exist in the proposed project area.
NI	Invasive, Non-native Species *(L. Lefevre)*	7/24/19	/s/ Levi L. LeFevre	There are some invasive species present in the area, but are unlikely to be significantly impacted by the proposed action
PI	Native American Religious Concerns *(B.Storm)*	9/13/19	/s/ Brian Storm	Native American religious concerns will be identified by Tribal response to NEPA mailing as part of the Proposed Cove Reservoir Project EA. Such concerns are usually associated with potential impacts to prehistoric archaeological sites of their ancestors, which they consider as traditional cultural properties. As long as project stipulations are followed and traditional cultural properties including but not limited to prehistoric archaeological sites are avoided, no concerns are anticipated. Access and ceremonial use of any sacred site or traditional cultural property both known and unknown to the BLM will not be limited by proceeding with this project.
NP	Threatened, Endangered or Candidate Plant Species *(C. Gubler)*	08/01/2019	/s/ C. Gubler	
NI	Threatened, Endangered or Candidate Wildlife Species *(L. Church)*	7/24/19	/s/ L. Church	
NP	Wastes (hazardous or solid) *(T. Linton)*	9/9/19	/s/ T. Linton	No known or visible hazardous waste apparent at these locations.
NI	Water Quality *(J. Holland)*	7/24/2019	/s/ James R Holland	Because of the distance to surface water, the depth to ground water in the proposed project area, and the type of action that is being proposed, it is highly unlikely that any water resources would be affected.
NP	Wetlands/Riparian Zones *(L. Church)*	7/25/19	/s/L. Church	
NP	Wild and Scenic Rivers *(D. Gunn)*	6/10/19	/s/ Dan Gunn	There are no Wild and Scenic Rivers within the project area.
NP	Wilderness *(D. Gunn)*	6/10/19	/s/ Dan Gunn	There is no designated wilderness within the project area.
OTHER RESOURCES / CONCERNS*				
NI	Rangeland Health Standards and Guidelines *(C. Gubler)*	07/25/19	/s/ C. Gubler	Impacts to Rangeland health are not expected rip rap pits are in volcanic areas. Mining these areas for rock should not have an overall impact on rangeland health.
NI	Livestock Grazing *(J. Reese)*	08/28/2019	/s/ J. Reese	Impacts to Livestock grazing are expected to be minimal. The proposed sites consist mostly of Rock and do not produce enough forage to impact livestock grazing.
NI	Woodland / Forestry *(J. Reese)*	08/28/2019	/s/ J. Reese	Sites consist mainly of Pinyon and Juniper and are considered invaded sites not woodlands.

NP/NI/PI NC	Resource	Date Reviewed	Signature	**Review Comments** (required for all NIs and PIs. PIs require further analysis.)
NI	Vegetation *(J. Reese)*	08/28/2018	/s J. Reese	Impacts to vegetation would be minimal on these sites because they have mostly been invaded by Pinyon and Juniper and because of the rock content they are not expected to produce much vegetation.
NI	Fish and Wildlife *(L. Church)*	7/25/19	/s/ L. Church	Construction and maintenance that included vegetation removal in species that could support neotropical migratory birds should occur after neotropical Migratory bird nesting periods to prevent the potential for impacts to nesting birds April 15 –Aug 15, if clearance work by a qualified biologist precludes presence construction and maintenance outside of emergency maintenance could occur
NI	Soils *(J. Reese)*	08/28/2019	/s/ J. Reese	BMP's for soils should be included in the project design and stipulations. If BMP's are adhered to impacts to soils in the project areas would be minimal.
NI	Recreation *(D. Gunn)*	6/10/19	/s/ Dan Gunn	Recreational opportunities exist within the project area but are unlikely to be significantly impacted by approval and implementation of this project.
NI	Visual Resources *(D. Gunn)*	6/10/19	/s/ Dan Gunn	The project area lies within lands classified as VRI Classes III and IV, which allow for moderate to high levels of change to the characteristic landscape. The 2008 Kanab Field Office RMP states that VRM Class III and IV objectives "are applied as necessary to allow for exploration and the associated infrastructure to support mineral resource development in accordance with the Energy Policy and Conservation Act…"
NI	Geology /Paleontology *(J. Holland)*	7/24/2019	/s/ James R Holland	No unique geology exists within the proposed project area. Because of the igneous rock type found in the proposed pit area, no paleontological resources are present.
NI	Lands / Access *(Brandon Johnson)*	9/11/2019	/s/ Brandon Johnson	No rights-of-way or conflicting land use authorizations exist within the proposed project area. Access to pits would be off of existing roads on the KFO travel management plan.
NI	Fuels / Fire Management *(C. Gubler)*	08/01/19	/s/ C. Gubler	No impacts to fuels or fire management are forseen as a result of implementation of the proposed action.
NI	Socio-economics *(C. Stewart)*	8/2/19	/s/ Clay Stewart	The economic base for the area is primarily ranching and some mining. Nearby communities are supported by tourism (including outdoor recreation), construction, and light industry. There would be no displacements or disruption to established business or uses of the area.
NP	*BLM Natural Areas (D. Gunn)*	6/10/19	/s/ Dan Gunn	There are no BLM Natural Areas within the project area.

FINAL REVIEW:

Reviewer Title	Date	Signature	Comments
NEPA Coordinator (C. Stewart)	9/24/19		
Field Manager (W. Bunting)	9/24/19	Cheryl Stewart (for)	

NOTE: Review Comments should include information explaining how the specialist came to their conclusion - how does he/she know the element/resource is not present (site visit and date of visit, familiarity with location, etc.). For all 'NIs' give a brief explanation as to why that element/resource would not be impacted.

* The list of Other Resources / Concerns to be considered may vary by individual field office. Note: Native American Trust Responsibilities should be considered for FO's with Indian Mineral interests.

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OTHER RESOURCES / CONCERNS*				
NI	Rangeland Health Standards and Guidelines *(C. Gubler)*	07/25/19	/s/ C. Gubler	Impacts to Rangeland health are not expected rip rap pits are in volcanic areas. Mining these areas for rock should not have an overall impact on rangeland health.
NI	Livestock Grazing *(J. Reese)*	08/28/2019	/s/ J. Reese	Impacts to Livestock grazing are expected to be minimal. The proposed sites consist mostly of Rock and do not produce enough forage to impact livestock grazing.
NI	Woodland / Forestry *(J. Reese)*	08/28/2019	/s/ J. Reese	Sites consist mainly of Pinyon and Juniper and are considered invaded sites not woodlands.

NP/NI/PI NC	Resource	Date Reviewed	Signature	**Review Comments** (required for all NIs and PIs. PIs require further analysis.)
NI	Vegetation *(J. Reese)*	08/28/2018	/s J. Reese	Impacts to vegetation would be minimal on these sites because they have mostly been invaded by Pinyon and Juniper and because of the rock content they are not expected to produce much vegetation.
NI	Fish and Wildlife *(L. Church)*	7/25/19	/s/ L. Church	Construction and maintenance that included vegetation removal in species that could support neotropical migratory birds should occur after neotropical Migratory bird nesting periods to prevent the potential for impacts to nesting birds April 15 –Aug 15, if clearance work by a qualified biologist precludes presence construction and maintenance outside of emergency maintenance could occur
NI	Soils *(J. Reese)*	08/28/2019	/s/ J. Reese	BMP's for soils should be included in the project design and stipulations. If BMP's are adhered to impacts to soils in the project areas would be minimal.
NI	Recreation *(D. Gunn)*	6/10/19	/s/ Dan Gunn	Recreational opportunities exist within the project area but are unlikely to be significantly impacted by approval and implementation of this project.
NI	Visual Resources *(D. Gunn)*	6/10/19	/s/ Dan Gunn	The project area lies within lands classified as VRI Classes III and IV, which allow for moderate to high levels of change to the characteristic landscape. The 2008 Kanab Field Office RMP states that VRM Class III and IV objectives "are applied as necessary to allow for exploration and the associated infrastructure to support mineral resource development in accordance with the Energy Policy and Conservation Act…"
NI	Geology /Paleontology *(J. Holland)*	7/24/2019	/s/ James R Holland	No unique geology exists within the proposed project area. Because of the igneous rock type found in the proposed pit area, no paleontological resources are present.
NI	Lands / Access *(Brandon Johnson)*	9/11/2019	/s/ Brandon Johnson	No rights-of-way or conflicting land use authorizations exist within the proposed project area. Access to pits would be off of existing roads on the KFO travel management plan.
NI	Fuels / Fire Management *(C. Gubler)*	08/01/19	/s/ C. Gubler	No impacts to fuels or fire management are forseen as a result of implementation of the proposed action.
NI	Socio-economics *(C. Stewart)*	8/2/19	/s/ Clay Stewart	The economic base for the area is primarily ranching and some mining. Nearby communities are supported by tourism (including outdoor recreation), construction, and light industry. There would be no displacements or disruption to established business or uses of the area.
NP	*BLM Natural Areas (D. Gunn)*	6/10/19	/s/ Dan Gunn	There are no BLM Natural Areas within the project area.

FINAL REVIEW:

Reviewer Title	Date	Signature	Comments
NEPA Coordinator (C. Stewart)	9/24/19		
Field Manager (W. Bunting)	9/24/19	Cheryl Stewart (for)	

NOTE: Review Comments should include information explaining how the specialist came to their conclusion - how does he/she know the element/resource is not present (site visit and date of visit, familiarity with location, etc.). For all 'NIs' give a brief explanation as to why that element/resource would not be impacted.

* The list of Other Resources / Concerns to be considered may vary by individual field office. Note: Native American Trust Responsibilities should be considered for FO's with Indian Mineral interests.

AMENDMENT ONE TO THE
STATE-BASED PROTOTYPE PROGRAMMATIC AGREEMENT
BETWEEN THE
US DEPARTMENT OF AGRICULTURE,
NATURAL RESOURCES CONSERVATION SERVICE UTAH STATE OFFICE,
AND THE
UTAH STATE HISTORIC PRESERVATION OFFICER,
REGARDING CONSERVATION ASSISTANCE

WHEREAS, the Agreement was executed on April 4, 2015; and

WHEREAS, the Natural Resources Conservation Service (NRCS) Utah has requested that its Agreement be amended to primarily update the April 4, 2015 SPPA, which sunsets on April 4, 2025 and to further define training requirements for NRCS Utah's CRS personnel and its Conservation Planners and Partners; to provide more specific review procedures for NRCS Utah undertakings; and to fully revise the Appendices of the SPPA to further define conservation measures and their potential to affect cultural resources and historic properties; and

WHEREAS, NRCS Utah will send a copy of this executed amendment to the NRCS FPO, SHPO, and the Advisory Council on Historic Preservation;

NOW, THEREFORE, in accordance with Stipulation XV of the Agreement, NRCS Utah and the Utah State Historic Preservation Office (SHPO) agree that the Agreement is hereby amended to read as follows:

1. Amend the Agreement so it reads as follows:

STATE-BASED PROTOTYPE PROGAMMATIC AGREEMENT
BETWEEN THE
US DEPARTMENT OF AGRICULTURE,
NATURAL RESOURCES CONSERVATION SERVICE, UTAH STATE OFFICE
AND THE
UTAH STATE HISTORIC PRESERVATION OFFICE
REGARDING CONSERVATION ASSISTANCE

WHEREAS, the United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) administers numerous voluntary assistance programs, special initiatives, and grant and emergency response programs for soil, water, and related resource conservation activities available to eligible private producers, States, commonwealths, Federally Recognized Tribal governments, other government entities, and other applicants for conservation assistance, pursuant to the Agricultural Act of 2018 (2018 Farm Bill, Public Law 113-79); Soil Conservation and Domestic Allotment Act of 1935 (Public Law 74-46, 16 U.S.C. 590 a-f, as amended); the Flood Control Act of 1944 (Public Law 78-534, as amended); the Watershed Protection and Flood Prevention Act (Public Law 83-566, as amended, 16 U.S.C. 1001-1012); the Agricultural and Food Act of 1981 (Public Law 97-98, 95 Stat. 1213); the Agricultural Credit Act (Public Law 95-3341, Title IV, Section 403); Food, Agriculture, Conservation and Trade Act of 1990 (Public Law 101-624); the Flood Control Act of 1936 (Public Law 74-738); the Food Security Act of 1985 (Public Law 99-198, as amended); the Federal Agricultural Improvement and Reform Act of 1996 (Public Law 104-127); and executive and secretarial orders, implementing regulations and related authorities; and

WHEREAS, NRCS, through its conservation assistance programs and initiatives, provides assistance for activities with the potential to affect historic properties eligible for or listed in the National Register of Historic Places (NRHP), including National Historic Landmarks (NHLs) and therefore constitute undertakings subject to review under Section 106 of the National Historic Preservation Act (NHPA), 16 U.S.C. 470f, and its implementing regulations, 36 CFR Part 800, including the provisions of these regulations addressing NHLs at 36 CFR Part 800.10; and

WHEREAS, NRCS has determined that the requirement to take into account the effects to historic properties of its undertakings may be more effectively and efficiently fulfilled through the use of a Prototype Programmatic Agreement (Prototype Agreement); and

WHEREAS, the NRCS Utah State Office has consulted with the Utah State Historic Preservation Officer/SHPO (SHPO) and followed the instructions in the ACHP letter that accompanied the Prototype Agreement, dated November 21, 2014; and

WHEREAS, NRCS also is responsible for fulfilling the requirements of the National Environmental Policy Act (NEPA), including the use of categorical exclusions, and coordinating NEPA and Section 106 reviews, as appropriate; and

WHEREAS, NRCS developed this Prototype Agreement in consultation with the National Conference of State Historic Preservation Officers (NCSHPO) and its members, interested Indian tribes, Native Hawaiian Organizations (NHO), interested historic preservation organizations, (such as the National Trust for Historic Preservation), and the Advisory Council on Historic Preservation (ACHP); and

WHEREAS, in accordance with 36 CFR Part 800.14(b)(4), the ACHP has designated this agreement as a Prototype Agreement, which allows for the development and execution of subsequent prototype agreements by individual NRCS State office(s) (State-based Prototype Agreements) to evidence compliance with Section 106; and

WHEREAS, this State-based Prototype Agreement (SPPA) for Utah conforms to the NRCS Prototype Agreement as designated by the ACHP on November 21, 2014, and therefore, does not require the participation or signature of the ACHP when the NRCS Utah State Office and Utah SHPO agree to the terms of the State-based Prototype Agreement; and

WHEREAS, this Prototype Agreement replaces the 2002 nationwide "Programmatic Agreement among the United States Department of Agriculture Natural Resources Conservation Service, the Advisory Council on Historic Preservation, and the National Conference of State Historic Preservation Officers relative to Conservation Assistance," as amended in 2011 and 2012, which expired on November 20, 2014; and

WHEREAS, the NRCS State Conservationist is the responsible federal agency official within the state for all provisions of Section 106, including consultation with the SHPO, NHOs, and government-to government consultation with Indian tribes to negotiate the State-based Prototype Agreement; and

WHEREAS, the State-based Prototype Agreement does not apply to undertakings occurring on or affecting historic properties on Tribal lands, as defined by Section 301(14) of the NHPA, without prior agreement and execution of a State-based Prototype Agreement with the concerned Indian tribe; and

WHEREAS, the NRCS has consulted with the Tribes in Utah and has invited the referenced Indian tribe(s) to enter into this State-based Prototype Agreement as a signatory; and

WHEREAS, this Prototype Agreement does not modify the NRCS' responsibilities to consult with Indian tribes and NHOs on all undertakings that might affect historic properties and properties of religious and cultural significance to them, regardless of where the undertaking is located, without prior agreement by the concerned Indian tribe or NHO, and recognizes that historic properties of religious and cultural significance to an Indian tribe or NHO may be located on ancestral homelands or on officially ceded lands near or far from current settlements; and

WHEREAS, when NRCS conducts individual Section 106 reviews for undertakings under this State-based Prototype Agreement, it shall identify and invite other agencies, organizations, and individuals to participate as consulting parties; and

NOW, THEREFORE, the NRCS Utah State Office and the Utah SHPO agree that undertakings in Utah shall be implemented in accordance with the following stipulations in order to take into account the effect of the undertaking on historic properties.

STIPULATIONS

NRCS shall ensure that the following stipulations are met and carried out:

I. Applicability.

a. Once executed by the NRCS and the Utah SHPO, this State-based Prototype Agreement sets forth the review process for all NRCS undertakings subject to Section 106 in the State of Utah.

b. Execution of this State-based Prototype Agreement supersedes any existing State Level Agreement with Utah SHPO executed under the previous NRCS nationwide Programmatic Agreement, but does not replace any existing project-specific Section 106 agreements (Memoranda of Agreement or Programmatic Agreements).

c. This State-based Prototype Agreement applies only when there is a Federal Preservation Officer (FPO) in the NRCS National Headquarters (NHQ) who meets the Secretary of the Interior's Professional Qualification Standards (48 FR 44716).

d. This State-based Prototype Agreement applies only where there is staffing or access to staffing (through contracted services or agreements with other agencies or Indian tribes) who meet the Secretary of Interior's Professional Qualification Standards.

II. Roles and Professional Qualifications.

a. The NRCS Utah State Conservationist is responsible for oversight of its performance under this State-based Prototype Agreement.

b. NRCS Utah shall ensure all NRCS staff or individuals carrying out Section 106 historic preservation compliance work on its behalf, including the NRCS Utah's Archaeological Program Specialists (APS) are appropriately qualified to coordinate the reviews of resources and historic properties as applicable to the resources and historic properties being addressed (site, building, structure, landscape, resources of significance to Indian tribes, NHOs, and other concerned communities). Thus, these staff and consultants must meet the Secretary of the

Interior's Professional Qualification Standards and have the knowledge to assess the resources within an undertaking's area of potential effects (APE).

c. The Utah State Conservationist is responsible for consultation with the Utah SHPO, as well as the government-to-government consultation with Tribes in the development of any consultation protocols. These responsibilities may not be delegated to any other staff, nor carried out on behalf of NRCS by another federal agency.

d. NRCS Utah APS or professional consultants shall provide technical historic property and resource information to the State Conservationist for use in Section 106 findings and determinations, after appropriate consultations with the SHPO, Indian tribes, and discussions with the landowner. The APS shall monitor and oversee the archaeological resources work and reporting of all NRCS Conservation Planners, Partner employees (Partners), and professional service consultants related to NRCS Utah undertakings. The APS shall make recommendations to the NRCS Utah State Conservationist in determining whether an undertaking has the potential to affect historic properties, triggering Section 106 review, pursuant to 36 CFR Part 800.3(a).

e. NRCS Utah Conservation Planners and Partners involved in implementing this State-based Prototype Agreement, after completion of NRCS' web, classroom, and field awareness training acquired through USDA's AgLearn training site, shall work with the APS personnel, as feasible, in completing historic preservation compliance (Section 106) field records for the agricultural producer's (NRCS Utah's client or voluntary applicant for assistance) files and for use in producing initial historic property identification records (as set forth and outlined in NRCS' operational guidance, the National Archaeological Resources Procedures Handbook, Title 190, Part 601).

f. NRCS Utah APS personnel shall oversee development of the scopes of work for investigation of the APEs for identified undertakings (see 36 CFR Part 800.4). NRCS Utah may use professional service contractors or consultants to assist with Archaeological resources compliance studies. NRCS Utah shall ensure these contractors meet the Secretary of Interior's Professional Qualifications Standards.

g. NRCS Utah remains responsible for all consultation with the SHPO, Indian tribes and THPOs, and all determinations of NRHP eligibility and effect. NRCS Utah may not delegate consultation for findings and determinations to professional services consultants or producers/applicants for conservation assistance.

h. Utah SHPO, if provided sufficient data on a proposed undertaking and APE for the proposed undertaking by the NRCS Utah state office shall consult and provide a response to NRCS within thirty (30) calendar days. The definition of sufficient data is provided in 36 CFR Part 800.11.

i. The ACHP shall provide technical guidance, participate in dispute resolution, and monitor the effectiveness of this agreement, as appropriate.

III. Training.

a. NRCS Utah shall require its Conservation Planners and Partners completing Archaeological resources identification and evaluation work to complete, at a minimum, the NRCS Web-based (in USDA AgLearn) and field Archaeological Resources Training modules. This training must be completed prior to completing archaeological resources compliance work and must be completed within the first year of employment with the NRCS. NRCS will also encourage personnel conducting archaeological resources identification and evaluation work to participate in the ACHP's Section 106 *Essentials* course.

b. NRCS Utah shall require APS personnel overseeing Archaeological resource work to take the NRCS archaeological Resources Training Modules (awareness training) and the ACHP's Section 106 *Essentials* course, or a course with similar content, if approved by the NRCS FPO. Training must be completed within the first calendar year after execution of this Agreement or within the first year of employment for new NRCS Utah APS personnel. NRCS APS personnel shall review and update training completion with their supervisors and include their training in their Individual Development Plans.

c. NRCS Utah may invite the Utah SHPO, Native American Tribal staff, and Tribal Historic Preservation Officers to participate in presentations at agency classroom or field trainings.

d. NRCS Utah shall encourage all personnel completing or overseeing archaeological resources work on behalf of the NRCS to take additional appropriate specialized training as provided by the Utah SHPO, Indian tribes, NHOs, the ACHP, National Park Service, General Services Agency or other agencies, as feasible.

IV. Lead Federal Agency.

a. For any undertaking for which NRCS Utah is the lead Federal agency for Section 106 purposes per 36 CFR Part 800.2(a)(2), NRCS Utah shall follow the terms of this State-based Prototype Agreement. NRCS Utah shall notify the Utah SHPO and the appropriate Native American Tribes of its involvement in the undertaking and the involvement of other State or Federal agencies, if any.

b. For any undertaking for which NRCS Utah is not the lead Federal agency for Section 106 purposes, including those undertakings for which NRCS Utah provides technical assistance to other USDA or other federal agencies, the terms of this State-based Prototype Agreement shall not apply to that undertaking. If the lead Federal agency agrees, NRCS may follow the approved alternative procedures in place for that agency.

V. Review Procedures.

a) In consultation with the Utah SHPO, NRCS Utah shall identify those undertakings with little to no potential to affect historic properties and list those undertakings in Appendix A of this State-based Prototype Agreement. Upon the determination by NRCS Utah that a proposed undertaking is included in Appendix A, further consultation for that undertaking is not required.

b) The list of undertakings provided in Appendix A may be modified through consultation and written agreement between NRCS Utah's State Conservationist and the Utah SHPO without requiring an amendment to this State-based Prototype Agreement. NRCS Utah's State Office will maintain the master list and will provide an updated list to all consulting parties with an explanation of the rationale (metadata) for classifying the undertakings accordingly.

c) Undertakings not identified in Appendix A shall require further review as outlined in Stipulation V.c of this State-based Prototype Agreement. Specific procedures used by NRCS Utah to streamline the Section 106 review process can be found in Appendix B, C, and D to this State-based Prototype Agreement; and in the NRCS National Archaeological Resources Procedures Handbook, Title 190, Part 601.

    1. NRCS may provide its proposed APE, identification of historic properties and/or scope of identification efforts, and assessment of effects in a single transmittal to the Utah SHPO and Indian Tribes, provided this documentation meets the substantive standards in 36 CFR Part 800.4-5 and 800.11.

    2. NRCS shall attempt to avoid adverse effects to historic properties whenever possible; where historic properties are located in the APE, NRCS shall describe how it proposes to modify, buffer, or move the undertaking to avoid adverse effects to historic properties.

    3. Where the NRCS proposes a finding of "no historic properties affected" or "no adverse effect" to historic properties, the Utah SHPO and Indian Tribes shall have 30 calendar days from receipt of this documented description and information to review it and provide comments. The NRCS shall take into account all timely comments.

        i. If the SHPO/Indian Tribe, or another consulting party, disagrees with NRCS' findings and/or determination, it shall notify the NRCS within the 30 calendar day time period. The NRCS shall consult with the SHPO/Indian Tribe/NHO or other consulting party to attempt to resolve the disagreement. If the disagreement cannot be resolved through this consultation, NRCS shall follow the dispute resolution process in Stipulation VIII below.

ii. If the SHPO or Indian Tribe does not respond to the NRCS within the 30 calendar day period and/or the NRCS receives no objections from other consulting parties, or if the SHPO/Indian Tribe concurs with the NRCS' determination and proposed actions to avoid adverse effects, the NRCS shall document the concurrence/lack of response within the review time noted above, and may move forward with the undertaking.

4. Where a proposed undertaking may adversely affect historic properties, NRCS Utah shall describe proposed measures to minimize or mitigate the adverse effects, and follow the process in 36 CFR Part 800.6, including consultation with other consulting parties and notification to the ACHP, to develop a Memorandum of Agreement to resolve the adverse effects.

VI. Emergency and Disaster Management Procedures (Response to Emergencies).

a. NRCS Utah shall notify the Utah SHPO immediately or within 48 hours of the emergency determination, following the NRCS Emergency Watershed Program (EWP) final rule (see Section 216, P.L. 81-516 Final Rule, 7 CFR Part 624 (April 2005).

b. The NRCS Utah State office shall prepare procedures for exigency (following the rules for NRCS' EWP regarding immediate threat to life and property requiring, response within 5 days) in consultation with the SHPO.

c. If the NRCS Utah State office has not developed specific procedures for responding to exigencies, NRCS Utah shall follow the recently approved guidelines for Unified Federal Review issued by the Department of Homeland Security, Federal Emergency Management Service (DHS, FEMA), the Council on Environmental Quality (CEQ), and the ACHP in July 2014, or the procedures in 36 CFR Part 800.12(b).

VII. Post Review Discoveries of Archaeological Resources Or Historic Properties and Unanticipated Effects to Historic Properties.

a. Where construction has not yet begun and an archaeological resource is discovered after Section 106 review is complete, NRCS Utah shall consult to seek avoidance or minimization strategies in consultation with Utah SHPO, and/or to resolve adverse effects in accordance with 36 CFR Part 800.6.

b. NRCS Utah shall ensure that every contract for assistance includes provisions for halting work/construction in the area when potential historic properties are discovered or unanticipated effects to historic properties are found after implementation, installation, or construction has begun. When such a discovery occurs, the producer who is receiving financial assistance or their contractor shall immediately notify NRCS Utah's State Conservationist's Office, APS personnel, supervisory NRCS personnel for the area, and the landowner/applicant.

1. NRCS Utah's APS shall inspect the discovery within 24 hours, if weather permits. In consultation with the local NRCS official (field office supervisor or District or Area Conservationist), concerned Indian tribes, the Utah SHPO, the NRCS State engineer or program supervisor, as appropriate, the landowner/producer (whomever NRCS is assisting), the APS shall establish a protective buffer zone surrounding the discovery. This action may require inspection by tribal experts in addition to APS.

2. All of NRCS Utah's contact with media shall occur only under the direction of the NRCS Public Affairs Officer, as appropriate, and the State Conservationist.

3. Security shall be established to protect the resources/historic properties, workers, and private property. Local law enforcement authorities will be notified in accordance with applicable State law and NRCS policy in order to protect the resources. Construction and/or work may resume outside the buffer only when the State Conservationist determines it is appropriate and safe for the resources and workers.

4. NRCS Utah's APS shall notify Utah SHPO and the ACHP no later than 48 hours after the discovery and describe NRCS' assessment of the National Register eligibility of the property, as feasible and proposed actions to resolve any adverse effects to historic properties. The eligibility determination may require the assessment and advice of concerned Indian tribes, Utah SHPO, and technical experts (such as historic landscape architects) not employed by NRCS.

5. Utah SHPO and ACHP shall respond within 48 hours from receipt of the notification with any comments on the discovery and proposed actions.

6. NRCS Utah shall take any comments provided into account and carry out appropriate actions to resolve any adverse effects.

7. NRCS Utah shall provide a report to the SHPO and the ACHP of the actions when they are completed.

c. When human remains are discovered, the NRCS Utah shall follow all applicable federal, Tribal, and state burial laws and ordinances, including the Native American Graves Protection and Repatriation Act, and implementing regulations, when on tribal or federal lands, and related human rights and health statutes, where appropriate. NRCS shall also refer to the ACHP's Policy Statement regarding *Treatment of Burial Sites, Human Remains and Funerary Objects* and the ACHP's Section 106 Archaeology Guidance. NRCS Utah shall also follow USDA and NRCS policy on treatment of human remains and consultation.

   1. NRCS Utah's discovery, treatment, and repatriation of human remains and burial objects will further comply with Utah Code Title 9 Chapter 8a Part 3, Section 309 (UT Code 9-8a-

309) when located on private lands in Utah.

VIII. Dispute Resolution.

a. Should any consulting or signatory party to this State-based Prototype Agreement object to any actions proposed or the manner in which the terms of the agreement are implemented, NRCS Utah's State Conservationist and APS personnel shall consult with such party to resolve the objection. If the State Conservationist determines that such objection cannot be resolved, they will:

   1. Forward all documentation relevant to the dispute, including NRCS Utah's State Conservationist's proposed resolution, to the NRCS FPO and Senior Policy Official (SPO Deputy Chief for Science and Technology) and the ACHP. The ACHP shall provide the FPO, SPO, and the State Conservationist with its advice on the resolution of the objection within thirty (30) days of receiving adequate documentation. Prior to reaching a final decision on the dispute, NRCS Utah shall prepare a written response that takes into account any timely advice or comments regarding the dispute from the ACHP and any signatory or consulting parties, and provide them with a copy of this written response. NRCS Utah will then proceed according to its final decision.

   2. If the ACHP does not provide its advice regarding the dispute within the thirty (30) day time period, NRCS Utah may make a final decision on the dispute and proceed. Prior to reaching such a final decision, NRCS Utah shall prepare a written response that takes into account any timely comments regarding the dispute from the signatories and consulting parties and provide them and the ACHP with a copy of the written response.

b. The responsibility of the NRCS Utah State office to carry out all other actions subject to the terms of this agreement that are not the subject of the dispute remains unchanged.

c. Any consulting party to State-based Prototype Agreement may request the ACHP provide its advisory opinion regarding the substance of any finding, determination, or decision regarding compliance with its terms.

d. At any time during the implementation of the State-base Prototype Agreement, a member of the public may submit an objection pertaining to this agreement to NRCS Utah's State Conservationist, in writing. Upon receiving such an objection, the State Conservationist shall notify the NRCS SPO and FPO, and Utah SHPO; take the objection into account; and consult with other consulting parties as appropriate to resolve the objection. The NRCS State Conservationist shall notify the SPO, FPO, and Utah SHPO the outcome of this process.

IX. Public Involvement.

NRCS Utah's State Conservationist will ensure the public is involved in the development of this State-based Prototype Agreement and participates in Section 106 review as set forth above in Section V (reference to other parties).

X. Annual Reporting and Monitoring.

a. Every year following the execution of this agreement, the NRCS Utah State Conservationist shall provide all consulting parties (including those parties who participate in the consultation but do not sign the agreement) and the FPO a summary report detailing work undertaken pursuant to its terms, including a list of undertakings falling under Appendix [A] as well as undertakings that required further review; a summary of the nature and content of meetings held with SHPO/Indian tribes/NHOs; and an assessment of the overall effectiveness of the State-based Prototype Agreement. Such report shall include any scheduling changes proposed, any problems encountered, and any disputes and objections received in NRCS' efforts to carry out the terms of this agreement.

    1. The NRCS FPO shall use the state reports to provide, through the NRCS SPO, an annual report to the ACHP.

    2. The State Conservationist shall use the state report to assess the need for annual meetings with the SHPO/Indian tribes/NHO each fiscal year.

b. NRCS Utah's State Conservationist will participate in an annual review with the NRCS Regional Conservationist regarding the effectiveness of the prototype agreement and submit a written (email) report following this review to the SPO (Deputy Chief for Science and Technology).

c. NRCS Utah's State Conservationist or Utah SHPO may request that the ACHP participate in any annual meeting or agreement review.

XI. Compliance With Applicable State Law and Tribal Law (When on Tribal Lands).

NRCS Utah shall comply with relevant and applicable state law, including permit requirements on state land, and with relevant and applicable tribal law, when on tribal lands.

XII. Duration of Prototype Agreement.

This State-based Prototype Agreement for NRCS Utah will be in effect for 10 years from the date of execution unless amended or terminated pursuant to Stipulation XIII below.

XIII. Amendment and Termination.

a. This State-based Prototype Agreement may be amended if agreed to in writing by all signatories. The amendment will be effective on the date a copy, signed by all of the signatories, is filed with the NRCS FPO, SPO, and the ACHP.

b. If any signatory to this State-based Prototype Agreement, or the ACHP, determines that its provisions will not or cannot be carried out, that party shall immediately consult with the other parties to attempt to develop an amendment per Stipulation XII.A. If within 30 calendar days, or other time period agreed upon by the signatories, an amendment cannot be agreed upon, any signatory or the ACHP may terminate the agreement upon written notification to the other signatories.

c. If this State-based Prototype Agreement is terminated or expires without being extended via the amendment process described above, and prior to continuing work on any undertaking, NRCS shall comply with 36 CFR Part 800 for all individual undertakings in Utah.

XIV. NRCS Utah will consider requests from other USDA agencies to become a signatory to the State-based Prototype Agreement following formal written requests and appropriate discussion with and approval by the NRCS, FPO, and SPO; and joint USDA Agency-NRCS State Office consultation with the ACHP, NCSHPO, and other consulting parties, as appropriate. Such inclusion of the USDA agency may require amendment to this State-based Prototype Agreement.

XV. Approval.

Execution of this State-based Prototype Agreement by NRCS Utah and Utah SHPO and implementation of its terms evidence that NRCS has taken into account the effects of its undertakings in Utah on historic properties and afforded the ACHP a reasonable opportunity to comment.

APPENDIX A

NRCS Utah Activities, Enhancements, and Practices With No Potential to Affect Historic Properties

Pursuant to Stipulation V.a of the NRCS Utah SPPA, and in accordance with 36 CFR Part 800. 3(a)(1), NRCS Utah has determined that the following conservation activities, enhancements, and practices constitute undertakings with no potential to affect historic properties. These determinations have been made in consultation with the NRCS Utah State Conservationist, NRCS Conservation Specialists, and the Utah SHPO. NRCS Utah is not required to conduct further consultation under Section 106 for the general activities and conservation measures included in this Appendix.

I. General Activities with No Potential to Affect Archaeological Resources:

In accordance with 36 CFR Part 800.3(a)(1), NRCS Utah has determined that the following general activities have no potential to affect historic properties, and thus require no further consultation under Section 106.

a) Conservation Planning or Technical Assistance (I.a). NRCS Utah has determined that providing general conservation planning and technical assistance has no potential to affect historic properties. This assistance is primarily focused on management and is completed in the office or in the field. Planning and technical assistance involves no ground disturbance activities that would necessitate a cultural resources inventory.

b) CPAs, DIAs, and CEMAs (I.b). NRCS Utah has determined that Conservation Planning Activities (CPAs), Design and Implementation Activities (DIAs), and Conservation Evaluation and Monitoring Activities (CEMAs) have no effect on Archaeological resources. CPAs produce conservation plans that document participant objectives, existing resource concerns, participant decisions regarding conservation practices, and activities that will be used to address identified resource concerns. DIAs produce designs, prescriptions, or other instructions for implementing a single conservation practice or a system of conservation practices derived from the participant's conservation plan. Lastly, CEMAs produce results of an evaluation, monitoring, test, or assessment. As with general conservation planning, these activities do not result in ground disturbance that would necessitate Section 106 compliance and an Archaeological resources field review.

c) Highly Erodible Land and Wetland Determinations (I.c). NRCS Utah has determined that the determination of Highly Erodible Lands (HEL) and Wetlands has no potential to affect historic properties when completed in the office and involving no ground disturbing activities. Wetlands determinations are occasionally completed in the field utilizing a hand-dug test pit to identify reduxomorphic features (color patterns in soils). Under such circumstances, Conservation Planners will shift the location of test pits to avoid impacts to Archaeological resources and coordinate with NRCS Utah APS.

d) NRCS Snow Survey and Climate Monitoring Data Collection (I.d). NRCS Utah has determined that standard survey data collection at Snow Courses, Snow Telemetry (SNOTEL) locations, and Soil Climate Analysis Network (SCAN) locations has no potential to affect historic properties. Data collection at these locations occurs electronically or is collected by hand with the use of probes and shovels to measure existing snowpacks. No surface disturbance is associated with any of these data collection methods. Establishment of new SNOTEL, Snow Course, and/or SCAN locations has the potential to affect historic properties. Should the establishment of new locations become necessary, NRCS Utah will complete a pedestrian Archaeological resources inventory and Section 106 consultation prior to construction.

e) NRCS Utah Soil Survey and Geotechnical Testing (I.e). NRCS Utah has determined that limited soil survey testing utilizing hand-dug test pits, hand probes, and/or augers has no potential to affect historic properties, provided that such testing is shifted to avoid impacts to Archaeological resources, and provided that the testing is located on privately-owned land. Similarly, NRCS Utah has determined that limited geotechnical auger testing of sediment fill and earthen fill structures associated with dam rehabilitation work has no potential to affect historic properties, provided that such geotechnical testing is shifted to avoid impacts to Archaeological resources, and provided that the geotechnical testing is located on privately-owned land. If either activity is located on Federal, State, or Tribal-Administered lands, or if heavy equipment (i.e., backhoes, tractors, excavators, etc.) will be used, then the activities are considered to have potential to affect historic properties. Under such circumstances, a pedestrian Archaeological resources inventory and Section 106 consultation will be required.

f) Acquisition of Lands and Easements (I.f). NRCS Utah has determined that the acquisition of lands and conservation easements has no effect on Archaeological resources. These are considered administrative actions that do not authorize ground disturbance.

g) Leases, Easements, Rights-of-Way, and Permits (I.g). NRCS Utah has determined that the issuing of leases, easements, rights-of-way, and/or permits (not including grazing permits) has no effect on Archaeological resources. These are considered administrative actions that do not authorize ground disturbance.

h) Renewal, Transfer, and/or Administration of Grazing Leases (I.h). NRCS Utah has determined that the renewal or transfer of grazing leases/permits, and other permit administrative actions where types of animals do not change, numbers of animal unit months (AUMs) do not increase, or seasons of use do not change has no effect on Archaeological resources. These are considered administrative actions that do not authorize ground disturbance.

i) Issuing or Renewal of Existing Rights-of-Way (I.i). NRCS Utah has determined that issuing rights-of-way for existing developments or renewal of existing rights-of-way has no effect on Archaeological resources. These are considered administrative actions that do not authorize ground disturbance.

II. Conservation Measures with No Potential to Affect Archaeological Resources:

In accordance with 36 CFR Part 800. 3(a)(1), NRCS Utah has determined that the following categories of conservation measures have no potential to affect Archaeological resources, and no further consultation under Section 106 is required for their implementation. As such, conservation measures within these categories are exempted from Archaeological resources field reviews. Common examples for each category are listed in Table 1. The examples in Table 1 are not intended to be all-inclusive, and there may be unique situations that require additional coordination with NRCS Utah's APS personnel. If any of the conservation practices described in Table 1 are associated with undertakings occurring on public or Tribal lands, or involve extenuating circumstances as defined in Appendix B of the NRCS Utah SPPA, then consideration of the effects of the undertaking is necessary and coordination with NRCS APS personnel is required.

a) Management Conservation Measures Without Ground Disturbance (II.a). NRCS has determined that management conservation measures have no effect on Archaeological resources when applied without ground disturbance.

b) Herbicidal or Biological Vegetation Treatments (II.b). NRCS has determined that vegetation treatments using herbicidal or biological applications have no effect on Archaeological resources. No ground disturbance is associated with conservation measures applied in this manner. If known or suspected Indigenous gathering areas are located near the proposed practice, coordination with NRCS APS personnel is required.

c) Conservation Measures in Croplands or Areas of Existing Disturbance (II.c). NRCS has determined that conservation measures have no effect on Archaeological resources when applied to croplands and areas that have been previously and completely disturbed by agricultural or mechanical means and depth of proposed practices will not exceed the depth of previous disturbance, and where no Archaeological resources exist and there are no indirect effects to extant Archaeological resources.

d) Fencing Construction/Maintenance with Minimal Disturbance (II.d). NRCS has determined that fence construction and/or modifications of existing fence lines has no effect on Archaeological resources when construction/maintenance does not require ground disturbance beyond placement of posts; where construction or maintenance will not result in concentrations of animals; where construction/maintenance does not require creation of two-track trails from vehicles; and where the potential for significant Archaeological resources is low. Similarly, placement of wildlife markers and structures on fencing has no effect on Archaeological resources.

e) Minor Operations and Maintenance Activities (II.e). NRCS has determined that conservation measures related to minor, routine, or preventive operations and maintenance activities associated with existing facilities and infrastructure have no effect on Archaeological resources provided that the structures are less than 50 years old. Such actions generally do not require new construction or ground disturbance.

f) Temporary or Ground Surface Conservation Measures (II.f). NRCS has determined that conservation measures have no effect on Archaeological resources when applied as temporary structures, or when the conservation measures are limited to hand tools and/or surface activities that will not involve ground disturbance.

Table 1. Common Examples of Conservation Measures with No Potential to Affect Archaeological Resources

Category	Common Examples
a. Management Conservation Measures Without Ground Disturbance (II.a)	Drainage Water Management; Dust Management; Feed Management; Forage Harvest Management; Integrated Pest Management; Irrigation Water Management; Nutrient Management; Prescribed Grazing; Residue & Tillage Management; Saline and Sodic Soil Management; Upland Wildlife Habitat Management; Wetland Wildlife Habitat Management
b. Herbicidal or Biological Vegetation Treatments (II.b)	Brush Management Utilizing Herbicidal or Biological Control Measures; Herbaceous Weed Treatment Utilizing Herbicidal or Biological Control Measures
c. Conservation Measures in Croplands or Areas of Existing Disturbance (II.c)	Alley Cropping; Conservation Cover; Contour Farming; Cover Crops; Crop Rotation; Cross Wind Trap Strips; Field Borders; Filter Strips; Firebreaks; Forest Stand Improvement; Fuel Breaks; Grassed Waterway; High Tunnels; Hedgerow Plantings; Irrigation Pivots (excluding towers, subsurface pipelines); Land Clearing and Smoothing; No Tillage/Reduced Tillage Farming; Pasture and Hay Planting; Range Planting; Riparian Herbaceous Cover; Riparian Forest Buffer; Soil Amendments; Strip-Cropping; Surface Roughening; Tree/Shrub/Vegetation Plantings; Wheel Line Irrigation Sprinklers (excluding subsurface pipelines, risers); Windbreaks/Shelterbelts/Herbaceous Wind Barriers; Wildlife Habitat Planting; Woody Residue Treatment
d. Fencing Construction/Maintenance With Minimal Disturbance (II.d)	Access Control; Electric Fencing; Fence Markers; Fence Removal/Replacement Along Existing Corridors; Fence Construction/Replacement Without Corridor Preparation/Blading; Temporary Fencing; T-Post Fencing
e. Minor Operations and Maintenance Activities (Less Than 50 Years Old) (II.e)	Air Filtration and Scrubbing; Combustion System Improvement; Energy-Efficient Agricultural Operation; Energy-Efficient Lighting Systems; Energy-Efficient Building Envelopes; Fan Installation/Replacement; Field Operations Emissions Reduction; Groundwater Testing; Irrigation Headgate Replacement; Light Replacements; Obstruction Removal; Pumping Plant Installation/Replacement; Roof Runoff Systems; Solar Power Conversion; Sprinkler Nozzle Replacement; Storage Tank Replacement; Structures for Wildlife; Tree/Shrub Pruning; Watering Facility Replacement
f. Temporary or Ground Surface Conservation Measures (II.f)	Surface/Temporary Animal Mortality Facilities; Chipping/Mulching Vegetation Treatment; Lop and Scatter Woody Residue Treatments; Portable Livestock Shelters; Surface Irrigation/Watering Systems; Surface/Temporary Compost Facilities; Vegetation Treatment Utilizing Hand Tools

III. Activities with No Potential to Affect Historic Irrigation Systems

In accordance with 36 CFR Part 800. 3(a)(1), NRCS Utah has determined that the following activities have no potential to affect historic irrigation systems, and thus require no further consultation under Section 106. These activities are limited to privately-owned irrigation systems and are not applicable to systems operated, managed, or administered by the U.S. Bureau of Reclamation or the U.S. Bureau of Indian Affairs.

a. Routine maintenance of irrigation systems and other associated structures where there is no change to the exterior of the structure or exterior features thereof (III.a).

b. Maintenance or replacement of non-historic irrigation features such as pumping stations, relift stations, head gates, flumes, manholes, culverts, fish-screens, diversions, and other constructed irrigation system features (III.b).

c. Short-term (less than one year) disturbance of an irrigation feature for boring or open-cut crossings when the feature will be restored to its original condition (III.c).

d. Mowing and brushing within previously disturbed areas, and general maintenance of existing landscaping along access roads, trails, levees, canals, laterals, and ditches (III.d).

e. Terrestrial and aquatic weed removal from within earthen or lined canals or laterals (III.e).

f. Draining, cleaning, or grading within an existing prism without changing the profile; and dredging where dredged materials are deposited in previously disturbed areas (III.f).

g. Clearing of sediment or debris from stilling basins, forebays, canals, laterals, ditches, conduits, siphons, drains, and other constructed features where the clearing occurs in previously disturbed areas, and the sediment or debris is placed in previously disturbed areas (III.g).

h. Placement of scientific equipment within the existing channel of streams or rivers where access and placement of the equipment and accessing the work site involves no new ground disturbance (III.h).

i. Restoration of existing rip rap, or placement of additional rip rap on top of existing rip rap, when using the same type of materials and maintaining original design criteria, and when the undertaking does not occur on a structure or a prehistoric site (III.i).

j. Setting a stationary or cleaning screen at an existing head gate (III.j).

k. Placement of a crossing for a pivot or wheel line irrigation system (III.k).

IV. Coordination with Archaeological Program Specialists to Determine Effects

Conservation Planners and Partners will coordinate with NRCS Utah's APS if there is uncertainty as to whether certain activities or conservation measures have the potential to affect

Archaeological resources. This coordination must occur prior to implementation.

V. Annual Updates to this Appendix

NRCS Utah recognizes that the standards and definitions for the conservation activities, enhancements, and practices are subject to changes on an annual basis. Similarly, NRCS Utah also recognizes that additional conservation activities, enhancements, and practices are added on an annual basis as the focus of conservation changes over time. To address these changes, NRCS Utah will submit an updated version Table 1 of this Appendix to the Utah SHPO and other consulting parties, as appropriate and as needed. As specified in Stipulation V.b of the NRCS Utah SPPA, the list of undertakings provided in this Appendix may be modified through consultation and written agreement between the NRCS Utah State Conservationist and the Utah SHPO without requiring an amendment to the NRCS Utah SPPA.

APPENDIX B

Procedures for NRCS Practices that occur on State or Federal Lands, or that involve external funding or permitting

UDAF, TLA, DNR, BOR, and USFS have elected to be signatories on this SPPA and the terms of this SPPA are applicable to these projects. However, coordination with Archaeological Resources Specialists from these Federal and State agencies is still required, thus necessitating a greater level of involvement of NRCS APS. For projects that involve Public (Federal and State-managed) Lands, lands administered by BIA or BOR, permitting from another federal agency, or that involve non-NRCS external funding (UDAF, BOR, DWR/WRI funding), completion and submission of a Archaeological Resources Review Form to NRCS Archaeological Resources Specialist is required, even when all practices would be considered to have no potential to affect Archaeological resources under the terms of this SPPA.

For such contracts, the following procedures will be followed:

I. An Archaeological Resources review form and accompanying shapefiles will be submitted to NRCS Utah APS for review.

II. NRCS Utah APS will complete any needed coordination with other agency Archaeological resources specialists.

III. NRCS Utah APS will complete a literature review, including review of SEGO, BLM GLO survey plats and patents, archival maps and photographs, and other sources as appropriate.

IV. In the event that a field visit or Archaeological resources inventory is needed, this inventory will be completed by a DOI SOI qualified archaeologist.

V. Following completion of a full literature review by APS, a completed, signed, and approved Archaeological Resources Review Form will generally be sent back to the Conservation Planner provided all proposed activities are included within Appendix B of this SPPA.

VI. An approved Archaeological Resources Review form will generally be sufficient for cooperating agency records, and consultation and reporting requirements for these projects will be met through submission of an annual report including summary statistics on these projects to the Utah SHPO, Tribes, and signatories to this SPPA.

APPENDIX C

NRCS Utah Summary Annual Reporting Requirements

I. When cumulative conservation activities, enhancements, and practices encompass an area of 10 acres or less in size or less that three linear miles, and where no historic properties would be adversely affected by the proposed undertaking, projects will be summarized in an annual report that is submitted to the Utah SHPO and Tribes rather than subjected to individual reporting.

II. When cumulative conservation activities, enhancements, and practices encompass an area of 100 acres or less in size and have been inventoried by trained NRCS Utah Field Office Staff with no findings, projects will be summarized in an annual report that is submitted to the Utah SHPO and Tribes rather than subjected to individual reporting.

III. Projects not meeting the above criteria will be subject to individual reporting and consultation requirements.

USDA Natural Resources Conservation Service
U.S. DEPARTMENT OF AGRICULTURE

NRCS Utah Archaeological Resources Procedures

Appendix D



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I. INTRODUCTION

The NRCS General Manual 420, Part 401 **(GM 420 Part 401)** formally establishes NRCS policy regarding responsibilities to historic and archaeological properties under the National Historic Preservation Act **(NHPA)** of 1966, it's implementing regulations, 36 CFR Part 800, and other related authorities. Among other things, GM 420 Part 401 defines general and lead Federal Agency responsibilities, NRCS personnel responsibilities, consulting party responsibilities, and how the NRCS considers archaeological resources in NRCS programs and activities. In addition, GM 420 Part 401 discusses the use and training of NRCS personnel and conservation partners for limited archaeological resources identification efforts.

The *NRCS National Archaeological Resources Procedures Handbook* **(H 190 Part 601)** was developed by the NRCS in addition to GM 420 Part 401 in order to provide a procedural reference and guidance on processes the NRCS, it's conservation partners, and it's consultants use to identify, evaluate and protect archaeological resources, including historic properties, in compliance with the NHPA, 36 CFR Part 800, and other related authorities. This document provides additional guidance on responsibilities of the NRCS in the archaeological resources compliance process, and provides additional procedures in the identification, avoidance, and determination of effects on archaeological resources that may be impacted by NRCS undertakings.

Both GM 420 Part 401 and H190 Part 601 serve as the primary guidance documents for compliance with the NHPA by the NRCS in Utah. In accordance with GM 420 Part 401.34, and following the guidance issued in GM 420 Part 401.43, NRCS Utah has developed the following guidance document for use by NRCS Utah personnel, its conservation partners, and subcontractors for undertakings implemented by the NRCS within the State of Utah. These procedures, when applied in accordance with the NRCS Utah SPPA, serve as alternative procedures to Advisory Council on Historic Preservation **(ACHP)** regulations (i.e., substitutes for all or part of Subpart B of the regulations) pursuant to 800.14(a) and Section 110(a)(2)(E) of the NHPA. These procedures provide a streamlined Section 106 compliance process appropriate for conservation technical and financial assistance, and other activities carried out by NRCS Utah.

II. RESPONSIBILITIES FOR SECTION 106 COMPLIANCE FOR NRCS UTAH

Responsibilities for compliance with Section 106 for NRCS Utah undertakings are as follows:

a) **The NRCS Utah State Conservationist.** The NRCS Utah State Conservationist is the responsible Federal Official for archaeological resources compliance for NRCS undertakings within the State of Utah. The NRCS Utah State Conservationist has approval authority for all NRCS undertakings and is responsible for committing NRCS Utah to take the appropriate actions in order to comply with Section 106. Importantly, the NRCS Utah State Conservationist is responsible for conducting archaeological resources consultation with the Utah State Historic Preservation Office **(SHPO)**, Federal and State Agencies, Tribal Historic Preservation Offices **(THPOs)**, Tribes, and other interested parties.

b) **District Conservationists.** NRCS Utah District Conservationists are responsible for ensuring that the provisions for compliance with Section 106 and with NRCS Utah archaeological resources policies are implemented in their areas and offices.

c) **State Archaeologist and Area Archaeological Program Specialists (APS).** The NRCS Utah State Archaeologist oversees the Archaeological program and the implementation of archaeological resources compliance policies for all NRCS undertakings in Utah. The work of the State Archaeologist is supplemented by Area APS staff. State and Area APS personnel provide oversight and quality assurance reviews during conservation planning and provide training to NRCS Utah personnel and partnering conservation planners who help identify archaeological resources during the planning process. The APS personnel are also responsible for providing direct assistance to NRCS Area and Field Office staff to complete archaeological resources inventories and evaluations when needed.

d) **NRCS Utah Personnel and Conservation Partners (Conservation Planners).** In situations where conservation planning authority occurs at the field office level, NRCS Utah personnel are responsible for assisting in the identification of archaeological resources that may be impacted as a result of NRCS undertakings. NRCS personnel are further assisted in these efforts by conservation partners such as the Utah Association of Conservation Districts **(UACD)** and the Utah Department of Agriculture and Food **(UDAF)**, among others. The archaeological resources identification process often involves completion of a pedestrian archaeological resources inventory of those areas within a conservation plan that will be subjected to physical disturbance, and submitting the pertinent review forms and paperwork to the APS for review and approval.

e) **Agricultural Producers, Applicants for Assistance, and Project Sponsors (Cooperators).** Each year, agricultural producers, applicants for assistance, and project sponsors seek technical and financial assistance from NRCS Utah to implement conservation undertakings throughout the state. Because the financial assistance is comprised of Federal funding delivered through a variety of NRCS conservation programs, the undertaking is subject to review under Section 106 of the NHPA and its implementing regulations. Cooperator responsibilities in the Section 106 compliance process include working with Conservation Planners to help identify archaeological resources on their property, project implementation when authorized to do so, and making all necessary efforts to avoid and minimize impacts to archaeological resources that are identified during the conservation planning process. As the property owners and the project applicants, all Cooperators are fully entitled and are encouraged to participate in the Section 106 process as a consulting party.

III. NRCS UTAH TRAINING REQUIREMENTS FOR PARTICIPATION IN ARCHAEOLOGICAL RESOURCES INVENTORIES

The NRCS GM 420 Part 401.24 states that all NRCS personnel and conservation partners responsible for planning or implementing NRCS undertakings will receive training for consideration of archaeological resources in conservation planning. To facilitate this process the NRCS developed a National Archaeological Resources Training Series available on AgLearn. Part 1 is an online course designed to familiarize personnel with laws and

regulations underlying the archaeological resources compliance process. The course also provides basic information on how to consider archaeological resource issues in conservation planning, how to conduct archaeological resource inventories during the conservation planning process, and how to identify archaeological resources in the field.

The Archaeological Resources Part II training consists of a two-day formal training session provided by the NRCS Utah APS. Day one of the training is typically classroom based and covers the specific requirements for archaeological resource compliance in Utah. Day two of the training is generally a field day and personnel visit archaeological sites and learn basic field techniques and inventory methods. The goals of the program are to:

a.) Provide a basic understanding of laws that govern historic preservation;
b.) Raise awareness of archaeological resources in a variety of contexts; and
c.) Incorporate archaeological resources and issues into conservation planning.

As stipulated in the NRCS Utah Planner Certification requirements, all NRCS Utah personnel and conservation partners wishing to qualify as certified planners must complete the National Archaeological Resources Training Series within one year of being hired. In addition, NRCS Utah requires that Conservation Planners receive supplemental archaeological resources training every five years as part of the Conservation Planner re-certification process. This supplemental training will require Conservation Planners to take the Archaeological Resources Part II training.

Conservation Planners who successfully complete the National Archaeological Resources Training Series and the supplemental training every five years are authorized to conduct basic, limited archaeological resources investigations in accordance with the guidelines discussed later in this fieldwork procedures manual. The National Archaeological Resources Training Series is **NOT** designed to train individuals as professional or even *'paraprofessional'* archaeologists. Rather, these programs and policies have been implemented to promote awareness, identification and protection of archaeological resources in NRCS Utah conservation planning. The training program is part of a broad effort to streamline the compliance process while ensuring maximum consideration of historic properties. In all instances, NRCS Utah APS personnel serve as the technical specialists and are ultimately responsible for quality control and assurance related to archaeological resources compliance on NRCS Utah undertakings.

IV. DEFINING ARCHAEOLOGICAL RESOURCES

Archaeological resources are defined by the NRCS through the National Archaeological Resources Training Series as "…the physical evidence of past activities and accomplishments of people." Broadly, archaeological resources may include both tangible traces (i.e., buildings, structures, objects, sites, districts, etc.) and less tangible traces (landscapes, vistas, locations of archaeological value, etc.) of archaeological activity and significance. Although many different elements of human activity may be defined as archaeological resources, the NRCS focuses primarily on three main categories: archaeological sites, isolated occurrences, and Traditional Cultural Properties.

a) **Archaeological Sites.** Traces of past activity that are tangible are usually classified as archaeological sites based on considerations of the age of archaeological remains, the density and diversity of artifacts and features, and the spatial arrangements of remains

within the area under consideration. For NRCS Utah undertakings, the minimum criteria for defining archaeological resources as archaeological sites are displayed below in Table 1.

Table 1. NRCS Utah Criteria for Defining Archaeological Sites

The location contains remains of past human activity that are at least 50 years old and meets one of the following criteria:

A. Contains at least 10 artifacts of a single class (e.g., 10 sherds) within a 10-meter (50-foot) diameter area, except when all pieces appear to originate from a single source (e.g., one ceramic pot, one glass bottle); or

B. Contains at least 15 artifacts which include at least 2 classes of artifact types (e.g., sherds, nails, glass, lithic debris) within a 10-meter diameter area; or

C. Contains one or more archaeological features in temporal association with any number of artifacts; or

D. Possesses two or more temporally associated archaeological features without artifacts.

Federal law and NRCS policy stipulate that all archaeological resources meeting the criteria for archaeological site definition be evaluated for eligibility for the NRHP. All NRHP eligibility determinations are the responsibility of NRCS Utah APS personnel and are developed in consultation with the Utah SHPO and other required or interested participants in the archaeological resources review process. The criteria used to determine eligibility for the NRHP are shown below in Table 2.

Table 2. NRHP Eligibility Criteria (Per 36 CFR Part 60.4)

The quality of significance in American history, architecture, archeology, engineering, and culture is present in districts, sites, buildings, structures, and objects that possess integrity of location, design, setting, materials, workmanship, feeling, and association, and:

A. That are associated with events that have made a significant contribution to the broad patterns of our history; or

B. That are associated with the lives of persons significant in our past; or

C. That embody the distinctive characteristics of a type, period, or method of construction, or that represent the work of a master, or possess high artistic values, or that represent a significant and distinguishable entity whose components may lack individual distinction; or

D. That have yielded, or may be likely to yield, information important in prehistory or history.

An archaeological site that possesses sufficient integrity and meets one or more of the Criteria listed in Table 2 is eligible for the NRHP and is considered a *Historic Property*. This is a very specific term for archaeological resources that are either "… included in or eligible for inclusion in the National Register." It is important to note that historic properties can include both prehistoric and historical archaeological sites, and that the term is not used for sites determined to be not eligible for the NRHP. Those archaeological sites determined to be historic properties are afforded special protection under Federal law and NRCS policy. Conservation planning must take into account potential impacts to these archaeological resources in particular, and take appropriate steps to avoid, minimize, or mitigate any adverse effects that may result from NRCS Utah activities.

b) **Traditional Cultural Properties.** A Traditional Cultural Property **(TCP)** is a place that is significant for its association with cultural practices or beliefs of a living community. Such locations are rooted in that community's history and are important in maintaining the continuing cultural identity of the community. The significance of a TCP is derived from the role the location plays in a community's historical beliefs, customs, and practices.

   Some TCPs may not contain any material remains. They must still be taken into account during archaeological resources planning. Such places will normally become known to the Conservation Planner during the archaeological resources review as the result of questioning participants, informants, local residents, or through consultation with Federally Recognized Indian Tribes. Treatment of TCPs during the conservation planning process will require the assistance of the informant and should also involve NRCS Utah APS personnel.

c) **Isolated Occurrences.** An isolated occurrence **(IO)** may be sub-categorized as "isolated artifacts" in instances where a single artifact or a small group of artifacts (flakes, pot sherds, cans, etc.) are identified and do not constitute a site, as defined above. An "isolated feature" is defined as a archaeological feature (ditches, fence lines, power line, roads, depressions, etc.) that does not have any other features or artifacts present that would further qualify it as a site.

V. NRCS UTAH PROCEDURES FOR COMPLETING ARCHAEOLOGICAL RESOURCES INVESTIGATIONS

The number of steps that may be necessary to fully consider archaeological resources in any given situation may vary depending on whether such resources are found in the work area, whether they are significant, and other circumstances. The following discussion details the steps that Conservation Planners must follow to complete the archaeological resources compliance process. It is always wise (and legally mandated) to begin the archaeological resources review process as early as possible in conservation planning.

a) **Obtain Consent from the Cooperator.** Prior to the initiation of the archaeological resources investigation process, Conservation Planners are required to meet with the prospective Cooperator and complete the *Authorization for NRCS Release of Conservation Plan File Information* form. This form is utilized by NRCS Utah to inform Cooperators of the consultation process that is required as part of the conservation planning process.

Completion of the form by the Cooperator provides consent for the NRCS to enter into the consultation process with the appropriate consulting parties, and to disclose information related to resources that are located on the property controlled by the Cooperator.

b) Review the SPPA to determine if all Practices are Included in Appendix A.

1. Conservation Planners who have successfully completed NRCS Utah's Archaeological Resources training series will review each practice to determine if they have no potential to effect historic properties, as described in Appendix A.
2. The respective District Conservationist will also review the project and confirm that all practices are included in Appendix A, and that no extenuating circumstances exist.
3. If all practices are included in Appendix A and no extenuating circumstances exist as described in Appendix B (Project does not involve Tribal, Public Lands or other State, Federal, or Tribal agencies, USACE or other Federal permitting, or non-NRCS Funding), then the project does not require further Archaeological Resources Review, and this is noted on the NRCS-CPA-52 Environmental Worksheet.
4. If there is any uncertainty on whether practices are included in Appendix A, APS will be contacted for further coordination.

c) Prepare an Archaeological Resources Review Form. For projects that involve practices that are subject to archaeological resources review, Conservation Planners will begin preparation of the *NRCS Utah Archaeological Resources Review Form*. This form is utilized by NRCS Utah to guide Conservation Planners through the archaeological resources review process.

1. Provide Administrative Information for the Undertaking. Conservation Planners will provide basic administrative information about the conservation plan that is being considered by completing Part A of the Form. The Administrative Information will identify the respective Cooperator, the NRCS Utah contract number that is associated with the undertaking, and the funding source that is being used to implement the undertaking,

2. Describe the Proposed Undertaking. Conservation Planners will provide a basic description of the undertaking by completing Part B of the Form. Conservation Planners will provide a written description of the undertaking, and will list the conservation activities, enhancements, and/or practices that will be involved in the implementation. Conservation planners will review Appendix A of the NRCS Utah SPPA to determine whether a planned conservation activity, enhancement, or practice for a given undertaking is subject to further archaeological resources investigation.

   Each conservation activity, enhancement, and practice involved in a conservation plan will be considered individually for its potential to affect archaeological resources. If a planned conservation activity, enhancement, and practice is not covered in Appendix A of the NRCS Utah SPPA, it will be assumed that it has the potential to affect archaeological resources and will treated as an undertaking that is subject to review.

3. Describe the Area of Potential Effects **(APE)**. Conservation Planners will provide a basic description of the APE for the undertaking in Part C of the Form. This will include a description of the conditions, history of land use, and disturbance activities that have occurred within the APE; and will include a legal description of the APE. Land ownership must also be included in the description of the APE to determine if the undertaking will involve coordination with another state or Federal agency.

4. Complete a Pre-field Information Review**.** Conservation Planners will summarize the results of the pre-field information review by completing Part D of the Form. If it is determined that a conservation plan involves conservation activities, enhancements, and/or practices that have potential to affect archaeological resources, Conservation Planners will proceed with the archaeological resources review process. Conservation Planners will complete a pre-field information review, and this information will be used to determine whether or not NRCS APS personnel need to be involved in the investigation. If the undertaking involves Federal, State, or Tribal land; Non-NRCS funding, Federal permitting, if NRCS Utah is a cooperating Federal agency; if planning authority for an undertaking is above the field office level; or if any extenuating circumstances exist (e.g. 100+ acres of physical disturbance of undeveloped ground; archaeological resources are present; undertaking involves 4 or more cooperators, etc.); Conservation Planners are required to request direct assistance from NRCS APS personnel before proceeding with the archaeological resources investigation.

d) Complete an Archaeological Resources Inventory. If the criteria for involving NRCS APS personnel do not apply to an undertaking (i.e., only private lands are involved in the contract) and the total cumulative APE of the contract is under 100 acres, Conservation Planners that have successfully completed the NRCS Archaeological Resources Training Part I and II Series will proceed with a pedestrian archaeological resources inventory of the undertaking. This pedestrian inventory will focus on those conservation activities, enhancements, and/or practices that are subject to review for archaeological resources investigation, and the goal of the inventory shall be the identification of any visible archaeological resources that could potentially be impacted by implementation of the undertaking.

When completing a pedestrian archaeological resources inventory of the undertaking, it is important for Conservation Planners to begin by interviewing the property owner or land manager to see if they have any knowledge of any archaeological resources on the property. Under most circumstances, these individuals have extensive knowledge of the property and can provide Conservation Planners with an idea of what to expect during an inventory. During the pedestrian inventory, Conservation Planners will inventory the affected areas in parallel transects spaced no more than 50 feet (15 meters) apart. Conservation Planners will inspect the areas for environmental indicators (water, landforms, etc.) that may provide clues to the presence of archaeological resources. Conservation Planners are encouraged to use a variety of methods to track their progress and record their findings (GPS data, photography, drawings, written descriptions, etc.), but Conservation Planners should also be aware that collection of artifacts or materials during the inventory is strictly prohibited.

e) **Report the Results of the Review to the NRCS Utah APS .** Once Parts A, B, C, and D of the *NRCS Utah Archaeological Resources Review Form* have been completed, Conservation Planners will complete Part E of the Form, which provides information about the archaeological resources inventory. If a pedestrian archaeological resources inventory is completed as described above, then Conservation Planners will provide a description of the inventory methods that were used, and the conditions that were encountered during the inventory. Conservation Planners shall complete the process by reporting the results of the inventory and summarizing the investigation, and they will submit an electronic copy of the review form to the NRCS APS for further review and final approval.

At a minimum, Conservation Planners will submit Shapefiles of practices subject to Archaeological Resources review or a 1:24,000 topographic location map showing the proposed undertaking and the areas that were inventoried for archaeological resources. This map shall be submitted with *NRCS Utah Archaeological Resources Review Form* to the NRCS APS, and the map or shapefiles should display the location of any archaeological resources that were identified during the pedestrian inventory. Additional maps such as aerial photography, planning maps, and engineering designs are welcome and encouraged, but they are supplemental to the topographic location map.

f) **Complete the NRCS APS Review and Implement the Undertaking.** Once the review form and topographic map have been submitted to the NRCS Utah APS, the APS will review the materials and complete a literature review for the undertaking with the Utah SHPO to determine if any previous inventories or archaeological resources have occurred within the APE. The NRCS APS will provide management recommendations and a formal determination of project effects for the proposed undertakings. These will be provided to Conservation Planners with completed and signed archaeological resources review form. If further information is needed, or if NRCS Utah APS personnel are needed to provide further assistance for an undertaking, Conservation Planners will be notified of such needs. Under no circumstances will Cooperators be allowed to implement an undertaking until given authorization to proceed from the NRCS APS.

NRCS Utah field offices will retain a copy of all archaeological resources review forms, site documentation, associated materials, and correspondence as part of the conservation planning materials for a proposed undertaking. A central filing of all archaeological resources review forms, reports, archaeological site documentation, and consultation will be maintained by APS staff.

If the design, nature, or the extent of the proposed undertaking should change after the archaeological resources review process has been completed, Conservation Planners will initiate the Section 106 review process again for the new/revised undertaking. Conservation Planners will be required to submit an updated review form and project map to the NRCS Utah APS for review, and the NRCS Utah APS will review the revised undertaking as described above.

VI. GENERAL PLANNING GUIDANCE

At the conclusion of the archaeological resources investigation, and prior to the implementation of an undertaking, Conservation Planners shall meet with Cooperators and

equipment operators to hold a preconstruction meeting to address any questions or concerns. Conservation Planners are encouraged to invite NRCS APS personnel to such meetings, particularly if any archaeological resources avoidance areas have been identified that could be impacted during implementation. Conservation Planners shall inform the Cooperators and equipment operators of the boundaries and extent of the proposed undertaking and will provide them with the appropriate data (maps, GIS data, GPS points, etc.) to help identify the boundaries of the undertaking and any avoidance areas. If any changes in the design or configuration of the undertaking result from the preconstruction meeting, Conservation Planners should notify the District Conservationist and take the appropriate steps to modify the undertaking. The NRCS APS should also be notified of any such changes, so that further consideration of archaeological resources can be undertaken.

If archaeological resources are present within the APE, Conservation Planners shall inform Cooperators of their responsibility towards archaeological resources prior to project implementation. Conservation Planners and NRCS Utah APS Personnel shall take the appropriate measures to ensure that the archaeological resources avoidance areas are clearly identified before the undertaking can be implemented. Archaeological resources, and any buffer areas deemed appropriate, shall be clearly marked for avoidance with lathe, flagging tape, paint, etc. prior to the implementation of the project. All markings for archaeological resources shall be removed after implementation has been completed. Conservation Planners shall inform the Cooperators and equipment operators of the presence of the archaeological resources, and will provide them with the appropriate data (maps, GIS data, GPS points, etc.) to help identify their location. The Cooperator and the equipment operator shall be briefed about their responsibilities for the protection and preservation of archaeological resources during implementation of the undertaking, and they will be provided with instructions for the treatment of archaeological resources in the event of a discovery or unintentional impact.

Once an undertaking has been implemented and completed, Conservation Planners shall complete a follow-up inspection of the affected area to ensure that the undertaking was completed according to the design specified in the conservation plan. The Conservation Planner will also review the archaeological resources to ensure that they were appropriately avoided during implementation. If any changes in the design or configuration of the undertaking are observed during the follow-up inspection, or if damage to historic properties is observed, Conservation Planners should notify the District Conservationist and take the appropriate steps to modify the undertaking. The NRCS APS should also be notified of any such changes, so that further consideration of archaeological resources can be undertaken.

VII. CATEGORIZING ARCHAEOLOGICAL RESOURCES COMPLIANCE FOR NRCS UTAH UNDERTAKINGS

The policies and procedures established by the NRCS in GM 420 Part 401, H190 Part 601, the NRCS Utah SPPA, and this document have been designed to streamline the Section 106 compliance process for the efficient delivery of technical and financial conservation assistance. As discussed below, NRCS Utah has developed a simplified three-category archaeological resources compliance system that can be used to classify each undertaking according to the specific set of circumstances that are involved. These classifications are primarily used for annual reporting purposes. To be classified within a given category,

Conservation Planners shall submit a completed *NRCS Utah Archaeological Resources Review Form* to the NRCS APS for each undertaking. The form shall provide the administrative information, legal description, and pre-field information for the undertaking, and it shall list all of the conservation activities, enhancements, and practices that are proposed. Information provided on the *NRCS Utah Archaeological Resources Review Form* will be used to classify the undertaking according to the three categories discussed in the following sections. In turn, the classification will allow the NRCS APS personnel and Conservation Planners to identify the level of planning, consultation processes, and timing for implementation that is appropriate for each undertaking.

a) Category I. Category I undertakings are defined by NRCS Utah as those undertakings comprised entirely of conservation activities, enhancements, and practices with little or no potential to affect historic properties as defined in Appendix A of the NRCS Utah SPPA. Category I undertakings also include those where the total cumulative APE of all practices subject to archaeological resources review is under ten acres or less than three linear miles and no historic properties will be affected by the undertaking.

b) Category II. Category II undertakings are defined by NRCS Utah as small-scale undertakings that are limited in size and scope. Generally, Category II undertakings involve contracts in which the cumulative APE of all practices subject to archaeological resources review is between 10- 100 acres and can be inventoried by Conservation Planners who have successfully completed the NRCS Archaeological Resources Part I and II training. Category II status is limited to undertakings where NRCS Utah has been determined to be the lead Federal agency for the purposes of Section 106, and where the undertakings occur exclusively on privately-owned lands.

c) Category III. Category III undertakings are defined by NRCS Utah as undertakings that involve **Extenuating Circumstances** that warrant further consideration of archaeological resources and typically require the direct involvement of APS staff. Category III status is limited to those undertakings that meet the criteria discussed below and are limited to undertakings where NRCS Utah has been determined to be the lead Federal agency for the purposes of Section 106. Extenuating circumstances, as defined by NRCS Utah, include the following:

1. Undertaking Involves other Federal, Tribal, or State Agencies. Undertakings that involve Public (Federal and State-managed) lands, lands administered by BIA or BOR, permitting from another federal agency, or that involve non-NRCS external funding (UDAF, BOR, DWR/WRI funding) require direct involvement of APS staff, even when all practices would be considered to have no potential to affect archaeological resources under the terms of the SPPA. These undertakings generally require coordination between NRCS Utah APS and external APS staff associated with the cooperating Federal, Tribal, or State agency.

2. Undertaking Involves More Than 100 Acres of Physical Disturbance of Undeveloped Ground. Undertakings that involve more than 100 acres of physical disturbance of undeveloped ground require additional consideration for archaeological resources. Undertakings of such size require a systematic, intensive pedestrian archaeological resources inventory, and such inventories must be designed and directly supervised by a qualified professional archaeologist.

3. Undertaking has Archaeological Resources Present. Additional consideration must be given to those undertakings where archaeological sites or TCPs are identified during the pre-field information review, or when archaeological sites or TCPs are identified during the pedestrian archaeological resources inventory. This policy does not apply to isolated occurrences. Once identified, Conservation Planners must notify the NRCS Utah State or Area APS and schedule a field visit. The NRCS Utah APS will formally document the archaeological resource and determine its eligibility for the NRHP.

   To be considered as a Category III undertaking, the NRCS Utah APS will coordinate with Conservation Planners to ensure that the proposed conservation activities, practices, or enhancements can be designed to avoid the archaeological resource by at least 50 feet to reduce or eliminate impacts to the archaeological resource. Additional consultation is required for archaeological resources that cannot be avoided by 50 feet during implementation.

4. Undertaking Involves 4 or More Cooperators. In accordance with GM 420 Part 401 and H190 Part 601, additional consideration is given to those undertakings that involve 4 or more cooperators. Such undertakings involve cooperation among multiple property owners, require a variety of permits and notifications, and have a higher public profile. Under such circumstances, assistance may be necessary to complete any required fieldwork authorizations or permits, and to complete public outreach, reporting, and consultation processes as outlined in Section 106.
5. General Concern. If Conservation Planners feel that there is general concern for archaeological resources at any point, they are encouraged to seek the direct assistance of NRCS Utah APS personnel. NRCS Utah APS personnel can assist the Conservation Planner with the review process and can assist with the field inventory. NRCS Utah APS personnel can also meet with the respective Cooperator to address any issues or concerns that the Cooperator may have with the archaeological resources investigation.

6. NRCS Utah is a Cooperating Federal Agency for the Undertaking. Implementation in accordance with Section 106 and its implanting regulations is required for undertakings where NRCS Utah functions as a cooperating agency for the purposes of Section 106. Such undertakings are often the focus of large-scale studies such as Environmental Assessments **(EAs)** or Environmental Impact Statements **(EISs)** that require interagency cooperation, consultation, and public outreach. As stated above, full compliance is necessary to establish lead and cooperating Federal agencies; to complete any required fieldwork authorizations or permits; and to complete the reporting and consultation process.

7. Planning Authority for an Undertaking is Higher than the NRCS Utah Field Office. Implementation in accordance with Section 106 and its implanting regulations is required for undertakings where conservation planning authority is at a level higher than the NRCS Utah Field offices. These undertakings are often related to watershed planning, emergency watershed protection, fire rehabilitation, or dam rehabilitation, among other categories. As stated above, full compliance is necessary to establish lead and cooperating Federal agencies; to complete any required fieldwork

authorizations or permits; and to complete the reporting and consultation processes outlined in Section 106.

8. Undertaking has Archaeological Resources Present That **Cannot** be Avoided by at Least 50 Feet. Implementation in accordance with Section 106 and its implanting regulations is required for undertakings where archaeological resources are identified during the pre-field information review or pedestrian archaeological resources inventory that cannot be avoided by 50 feet during implementation. Conservation Planners must notify the NRCS Utah APS and schedule a field visit when archaeological resources are identified within the planning area. The NRCS Utah APS will formally document the archaeological resource, determine its eligibility for the NRHP, and assess the effects of the undertaking on the archaeological resource. NRCS Utah will complete the reporting and consultation process as outlined in Section 106 to determine eligibility for the NRHP and to determine project effects.

9. Category III undertakings that will involve adverse effects to historic properties as defined in 36 CFR Part 800.5.a.1. For such undertakings, NRCS Utah will resolve the adverse effects through the development of a treatment plan detailing the measures that will be used to minimize and mitigate the effects to the historic properties in accordance with 36 CFR Part 800.6. This treatment plan will be developed through consultation among the NRCS, the Utah SHPO, and other consulting parties, as appropriate. The ACHP will be invited to participate in the consultation process as well. Once the treatment plan and measures to minimize and mitigate the adverse effects are agreed upon by the consulting parties, a Memorandum of Agreement **(MOA)** will be executed and implemented pursuant to compliance with Section 106.

VIII. CRITERIA FOR ASSISTANCE FROM NRCS UTAH APS PERSONNEL

Participation in the National Archaeological Resources Training Series and the recertification every five years authorizes NRCS Utah to utilize its personnel and conservation partners in completing basic archaeological resources identification. In accordance with the SPPA, the use of trained personnel for completing archaeological resources investigations is limited to those undertakings where NRCS Utah has been determined to be the lead Federal agency for the purposes of Section 106, where no extenuating circumstances exist, and where the undertakings occur exclusively on privately-owned lands. Utilizing the three-category archaeological resources compliance system, Table 3 presents the criteria that are used to determine if an undertaking requires further assistance from NRCS Utah APS personnel.

Table 3. Criteria for Assistance from NRCS Utah APS Personnel

Category	APS Required?	Description
Category I	**NO**	**Category I undertakings have little or no potential to affect historic properties. A review of such undertakings can be completed by Conservation Planners and submitted to the NRCS APS for approval without direct APS assistance.**

Category II	**NO**	**Category II undertakings are limited in size and scope and lack extenuating circumstances that would otherwise involve additional consideration for archaeological resources. Pedestrian inventories for Category II undertakings can be completed by Conservation Planners and submitted to the NRCS APS for approval without direct assistance.**
Category III	**YES**	**Category III undertakings warrant further consideration of archaeological resources due to the extenuating circumstances that are involved. Direct assistance from NRCS APS personnel is therefore necessary.**

IX. IMPLEMENTATION TIMING

Because of the critical importance of timing for its Cooperators, NRCS Utah has developed specific guidance for the timing of implementation on its undertakings from the standpoint of archaeological resources compliance. Timing for implementation can vary according to the specific circumstances of an undertaking, but timing can generally be determined according to the three- category archaeological resources compliance system. The timing of implementation for each category is discussed in the following sections.

a) **Category I.** For Category I undertakings, implementation shall proceed with a determination of 'no potential to cause effects' in accordance with 36 CFR Part 800.3(a)1. Implementation shall proceed once the NRCS APS has returned a signed copy of the *NRCS Utah Archaeological Resources Review Form* to the Conservation Planner. Conservation Planners will maintain a signed copy of the form with the conservation plan for the undertaking.

b) **Category II.** For Category II undertakings, implementation shall proceed with a determination of 'no historic properties affected' in accordance with 36 CFR Part 800.4(d)(1). Implementation shall proceed once the NRCS APS has returned a signed copy of the *NRCS Utah Archaeological Resources Review Form* to the Conservation Planner. Conservation Planners will maintain a signed copy of the form with the conservation plan for the undertaking, and implementation shall occur as stated in the design specifications stated in the conservation plan.

c) **Category III.** For Category III undertakings, implementation shall proceed at the discretion of the NRCS APS upon the completion of fieldwork with a determination of 'no historic properties affected' in accordance with 36 CFR Part 800.4(d)(1). Implementation shall proceed through communication between the NRCS APS and the Conservation Planner. If archaeological sites or TCPs are present within the APE, and the proposed conservation activities, enhancements, and/or practices can be modified to avoid the resource with a buffer zone of no less than 50 feet (15 meters), then implementation can proceed in accordance with the design specifications stated in the conservation plan. NRCS Utah APS personnel will meet with the Conservation Planner to document the archaeological resources and evaluate them for eligibility for the NRHP. Once the Section 106 consultation process has been completed, the NRCS APS will return a signed copy of the *NRCS Utah Archaeological Resources Review Form* to the Conservation Planner. Conservation Planners will maintain a signed copy of the form and any associated archaeological resources reports and consultation letters with the conservation plan for the undertaking.

If, after the consultation process, an avoided archaeological resource has been determined eligible for the NRHP, then Cooperators must ensure that the archaeological resources remain avoided and unaffected to the extent that the eligibility of the archaeological resource for the NRHP is not adversely affected. Avoidance shall last for the lifespan of the conservation activity, enhancement, and/or practice that is being planned. However, if an avoided archaeological resource is determined not eligible for the NRHP through the consultation process, further avoidance measures are unnecessary and can be maintained at the discretion of the property owner.

For Category III undertakings involving adverse effects to historic properties, NRCS Utah will implement undertakings in accordance with Section 106 of the NHPA and its implementing regulations found in 36 CFR Part 800. NRCS Utah will resolve the adverse effects through the development of a treatment plan detailing the measures that will be used to minimize and mitigate the effects to the historic properties in accordance with 36 CFR Part 800.6. This treatment plan will be developed through consultation among the NRCS, the Utah SHPO, and other consulting parties, as appropriate. The ACHP will be invited to participate in the consultation process as well. Once the treatment plan and measures to minimize and mitigate the adverse effects are agreed upon by the consulting parties, an MOA will be executed and implemented pursuant to compliance with Section 106.

Once the mitigation work and the Section 106 consultation process has been completed, the NRCS APS will authorize implementation and will return a signed copy of the *NRCS Utah Archaeological Resources Review Form* to the Conservation Planner. Conservation Planners will maintain a signed copy of the form and any associated archaeological resources reports and consultation letters with the conservation plan for the undertaking.

X. REPORTING ARCHAEOLOGICAL RESOURCES INVESTIGATIONS

As specified in stipulation V of the NRCS Utah SPPA, NRCS Utah will report the findings of all of its archaeological resources investigations to the Utah SHPO, Native American Tribes, consulting parties, NRCS National Headquarters, and the ACHP. The timing and nature of such reporting shall vary according to the specific circumstances for each undertaking. Generally, reporting will be completed in accordance with the three-category archaeological resources compliance system. Specific timing for reporting is shown in Table 4 and is discussed in the following sections.

a) **Category I.** NRCS Utah will synthesize information for all Category I undertakings and shall include the information within the annual summary report that is to be provided to all consulting parties and the NRCS Federal Preservation Officer **(FPO)** in accordance with Stipulation X of the NRCS Utah SPPA.

b) **Category II**. For Category II undertakings, NRCS Utah will also summarize these in a section of the annual summary report that is to be provided to all consulting parties and the NRCS Federal Preservation Officer **(FPO)** in accordance with Stipulation X of the NRCS Utah SPPA.

c) **Category III Undertakings.** For Category III undertaking, NRCS Utah shall consult with the Utah SHPO, Native American Tribes, and other consulting parties, as appropriate, on a case-by-case basis. NRCS Utah shall consult with the Utah SHPO, Native American Tribes, and other consulting parties, as appropriate, to define the APE, identify and evaluate historic properties that may be affected by the undertaking, determine project effects, and identify strategies for resolving adverse effects. NRCS Utah will provide GIS shapefiles for these undertakings to the Utah SHPO, and to other consulting parties as deemed necessary. Information on these undertakings shall be included within the annual summary report that is to be provided to all consulting parties, the general public, and the NRCS FPO in accordance with Stipulation X of the NRCS Utah SPPA.

It is important to note that reporting the results of archaeological resources investigations by NRCS Utah does not authorize access to those archaeological resources that are identified during the review process. Most of these archaeological resources are located on privately-owned lands, and they cannot be accessed without landowner consent. Reporting the archaeological resources investigations also does not provide authorization to collect artifacts and materials associated with the archaeological site or TCP. These materials are considered the property of the landowner, and collection of such materials is prohibited.

Table 4. Summary of Implementation, Reporting, and Consultation Timing for NRCS Utah Undertakings

Category	APS Required?	Implementation Timing	Reporting & Consultation Timing
Category I	NO	Implementation shall proceed with a determination of 'no potential to affect historic properties' after a completed archaeological resource review form is received from the NRCS Utah APS.	Combined Annual report to SHPO, NHQ, Consulting parties
Category II	NO	Implementation shall proceed with a determination of 'no historic properties affected' after completed archaeological resources review form is received from the NRCS Utah APS.	Combined Annual report to SHPO, NHQ, Consulting parties
Category III	YES	A determination of project effects is required prior to implementation, and work CANNOT proceed until the review process is completed and completed archaeological resources review form is received from NRCS Utah APS.	Case-by-case basis with SHPO, consulting parties; also summarized in Annual report to SHPO, NHQ, Consulting parties

XI. UNANTICIPATED DISCOVERIES AND TREATMENT OF HUMAN REMAINS

a) **Unanticipated Discoveries.** NRCS Utah will treat the unanticipated discovery of archaeological resources in accordance with Stipulation VII.b of the NRCS Utah SPPA, with GM 420 Part 401.24, with H 190 Part 601.29, and with 36 CFR 800.13 of the ACHP regulations.

b) Human Remains. NRCS Utah will treat the unanticipated discovery of archaeological resources in accordance with Stipulation VII.c of the NRCS Utah SPPA, with H 190 Part 601.29(6), and with 36 CFR Part 800.13 of the ACHP regulations. If human remains are identified during conservation planning or during the implementation of a conservation activity, enhancement, or practice, all activities deemed likely to impact the remains will cease and the following steps shall be taken.

1. Contact the Appropriate Authorities. NRCS Utah personnel will contact the respective County Sheriff where the discovery is made. NRCS Utah personnel will also contact NRCS APS personnel. The Utah SHPO shall also be notified.

2. If the remains are determined to be Native American in origin and are not considered to be part of a crime scene by the Sheriff, NRCS Utah will follow the procedures outlined in U.C.A. 9-9-401 on private land. On Federal or Tribal land, NRCS Utah will follow procedures established in Section 3 of the Native American Graves Protection and Repatriation Act **(NAGPRA)**.

3. If the remains are determined not to be part of a crime scene and are not Native American in origin, NRCS Utah will consult with the Utah SHPO and other consulting parties, as appropriate, to develop a mitigation plan for treating the remains.

4. NRCS Utah personnel and Cooperators will take all appropriate measures (barriers, fencing, temporary coverings, etc.) to protect the remains in place until the plan for treating the remains has been properly implemented.

XII. AVOIDANCE OF ARCHAEOLOGICAL RESOURCES, ANTICIPATORY DEMOLITION, AND WITHDRAWAL OF ASSISTANCE.

a) Avoidance of Archaeological Resources. In accordance with Subpart C of H 190 Part 601.22(C), and in accordance with Section 110 of the NHPA, Cooperators receiving technical and financial assistance from NRCS Utah shall make all necessary efforts to avoid and minimize impacts to archaeological resources that are identified during the conservation planning process. This is of particular importance for those archaeological resources determined eligible for the NRHP. The policy of avoidance of archaeological resources shall remain in place for the duration of the lifespan of the conservation activity, enhancement, and practice that is being implemented, in accordance with NRCS Farm Bill Programs rules. Failure to avoid historic properties could potentially result in a determination of adverse effects, mitigation where appropriate, contract termination, and withdrawal of technical and financial assistance.

In accordance with the criteria for identifying Category III undertakings outlined above, conservation activities, enhancements, and practices can be redesigned to avoid archaeological resources by a 50-foot buffer during the implementation process in an effort to streamline the delivery of conservation assistance in a timely manner. If, after the consultation process, an avoided archaeological resource has been determined eligible for the NRHP, then Cooperators must ensure that the archaeological resources remain avoided as described above. However, if an avoided archaeological resource is determined not eligible for the NRHP through the consultation process, further avoidance measures are unnecessary.

b) Anticipatory Demolition. As stated in H 190 Part 601.27.A(2), NRCS Utah will not

provide technical or financial assistance to Cooperators who intentionally destroy, remove, or otherwise adversely affect historic properties within a conservation planning area in an effort to evade compliance with Section 106 of the NHPA. If such damages occur, NRCS Utah shall insure that Federal assistance is not used to cause or further an adverse impact to a archaeological resource. Under these circumstances, NRCS will follow its Procedures for the Withdrawal of Assistance found in GM 420 Part 401.23 and H 190 Part 601.27.

c) **Withdrawal of Technical and Financial Assistance.** Both GM 420 Part 401.23 and H 190 Part 601.27 outline the process for the withdrawal of assistance that NRCS Utah shall follow in situations where an adverse effect has occurred or is likely to occur through a Cooperator's refusal to implement feasible mitigation measures. NRCS Utah will take the appropriate measures to document and assess the impacts and will document the actions and events leading to the withdrawal of assistance. The extent and duration of the withdrawal shall vary according to the conservation activity, enhancement, or practice under which the impact might have occurred, and may also vary at the discretion of the NRCS Utah State Conservationist.

SIGNATORY PAGE

STATE-BASED PROTOTYPE PROGAMMATIC AGREEMENT
BETWEEN THE
US DEPARTMENT OF AGRICULTURE,
NATURAL RESOURCES CONSERVATION SERVICE, UTAH STATE OFFICE
AND THE
UTAH STATE HISTORIC PRESERVATION OFFICE
REGARDING CONSERVATION ASSISTANCE

EMILY FIFE

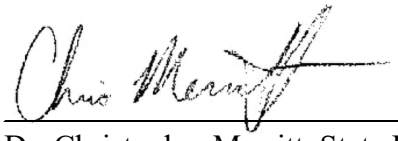
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Emily Fife, State Conservationist
Natural Resources Conservation Service
Salt Lake City, Utah

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Date: 3/12/2025

Dr. Christopher Merritt, State Historic Preservation Officer Utah
State Historic Preservation Office
Salt Lake City, Utah

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Kelly Pehrson (Mar 25, 2025 16:10 MDT)

Date: 03/25/2025

Kelly Pehrson, Deputy Commissioner
Utah Department of Agriculture and Food
Salt Lake City, Utah

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Michelle McConkie Date: March 11, 2025

Michelle McConkie, Director,
School and Institutional Trust Lands Administration
Salt Lake City, Utah

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Michael Canning
Michael Canning (Mar 27, 2025 07:41 MDT)

Date: 03/27/2025

Mike Canning, Deputy Director
Utah Department of Natural Resources
Utah Division of Wildlife Resources

Sarah Scott (Mar 25, 2025 10:58 MDT)

03/25/2025

Financial Manager II
DWR

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REGARDING CONSERVATION ASSISTANCE



Date:

Rick Baxter, Provo Area Manager
Utah Bureau of Reclamation
Provo, Utah

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Date:

Christopher Carlton,
Regional Forester, Forest Service
Intermountain Region Ogden, Utah