FEASIBILITY INVESTIGATION

CRYSTAL RIVER OFF-STREAM RESERVOIRS

SEWELL RANCH

August 27, 2009

PREPARED FOR

West Divide Water Conservancy District

PREPARED BY

Grand River Consulting Corporation
Sopris Engineering LLC
ERO Resources Corporation

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1.0 BACKGROUND

The Crystal River is over-appropriated. Natural water supplies are in-sufficient to satisfy irrigation, residential, and instream flow demands. The lower portion of the river is commonly dry during late summer. Many existing residential water users located in un-incorporated areas do not have a reliable legal water supply.

The West Divide Water Conservancy District (West Divide) currently provides augmentation water to about 20 existing water users in the Crystal River watershed, extending from locations near the Town of Carbondale to above the Town of Redstone. This regional augmentation program was adjudicated by the Water Court in Case No. 99CW320 and has historically used water from Ruedi Reservoir to augment the out-of-priority depletions of its customers. Augmentation contracts for these contractees were granted prior to 2004, at a time when the Colorado Division of Water Resources determined that the Crystal River watershed could be included within the District's decreed regional augmentation program. The augmentation program allowed individual water users to obtain well permits for residential properties; such permits would otherwise be difficult to secure.

In 2004, the Colorado Division of Water Resources administratively determined that the Crystal River portion of the District's regional augmentation program service area could no longer be operated without injury to senior water rights. As a result of this determination, approximately 20 existing water users no longer have a reliable legal water supply. In addition, it is currently very difficult for other rural residents in the area to obtain well permits or a legal water supply.

Crystal River water demands have been quantified in several recent studies. In 2003 and in 2005, Grand River Consulting evaluated potential water demands in the Crystal River watershed, under a contract with the Colorado River District. These studies concluded that as much as 12,000 acre feet of additional water could be required to meet existing irrigation demands in drought years, and that instream flow demands are even greater.

1.1 SEWELL RANCH

The Sewell Ranch is located adjacent to the Crystal River at a location approximately 5 miles upstream of Carbondale, Colorado (Figure 1). The owners of this ranch, Jason and Jayme Sewell, have expressed a potential interest in developing a cooperative water storage project on their ranch. This cooperative project would supply water for a portion of the Crystal River demands outlined above, as well as supply supplemental irrigation water for the Sewell Ranch and at times when available, provide flow enhancements for the Colorado Water Conservation Board (CWCB) instream flows on the lower Crystal River .

1.2 STUDY OBJECTIVES

West Divide is interested in developing water storage in the Crystal River watershed that would provide a reliable augmentation water supply for its existing customers, as well as future customers in the area. West Divide is also interested in developing water supplies that could ultimately be used for irrigation and instream water uses.

This study evaluates the feasibility of six off-channel reservoir sites on the Sewell Property. The primary and cooperative water supply objectives of the reservoirs are to:

1. Develop in-basin augmentation water supplies for approximately 20 existing West Divide contractees who no longer have a reliable legal water supply.

2. Provide supplemental late season irrigation water for use on the Sewell Property.

3. Develop in-basin augmentation supplies for potential future West Divide customers, to the extent that water storage may exceed the demands for the above objectives.

4. Provide water for CWCB instream flow maintenance of the Crystal River.

Engineering feasibility and cost estimates for the reservoirs have been developed by Sopris Engineering. The detailed results of the Sopris Engineering Study are provided in Attachment 1, and are summarized herein. A detailed environmental investigation has also been completed by ERO Resources Corporation (Attachment 2).

2.0 DESCRIPTION OF RESERVOIRS

Six potential off-channel reservoir sites on the Sewell Property have been identified (Figure 1). Two design options have been considered for each site. The first option is to construct a non-jurisdictional dam which would be less than 10 feet in height. The second option would increase the embankment height over 10 feet, to a height that optimizes use of the site. The potential range in capacity for each reservoir is summarized on Table 1.

Table 1
Potential Reservoir Capacities (acre feet)

	Non-Jurisdictional (less than 10' in height)	Jurisdictional (greater than 10' in height)
No. 1	7.2	23.5
No. 2	-	9.7
No. 3	67.6	118.9
No. 4	35.5	60.2
No. 5	91.8	165.2
No. 6	91.0	165.1

2.1 RESERVOIR NO. 1

Reservoir No. 1 is located in the valley bottom adjacent to Thompson Creek. The site is an open grass land surrounded by sparse cottonwood and aspen trees, historically and currently used as pasture land. This reservoir could range in capacity from about 7 acre feet to 23 acre feet. The storage facility would be filled with water diverted in a gravity ditch from Thompson Creek. Reservoir releases would be made to Thompson Creek immediately below the reservoir, and the releases would accrue to the Crystal River. This reservoir could be either a lined or unlined facility. If lined, the reservoir would be filled in-priority during snowmelt, and releases would occur in conjunction with water supply demands. If un-lined, water from Reservoir No. 1 would be designed to recharge Thompson Creek at a specified rate, and this recharge would offset (augment) out-of-priority domestic or irrigation diversions that are made at other locations in the Crystal River watershed.

2.2 RESERVOIRS NOS. 2 – 6

Reservoirs Nos. 2 through 6 are situated on a terrace west of the Crystal River. This terrace is at an elevation about 6,580 feet, approximately 200 feet in elevation above the Crystal River. The terrace is currently dry-land pasture, although it has a history of flood irrigation by the Sweet Jessup Canal which is situated along the perimeter of the terrace. These reservoirs have a

cumulative capacity that could exceed 500 acre feet. Water from the Crystal River would be stored in-priority during snowmelt runoff in Reservoirs Nos. 2 through 6. The water could be pumped into the reservoirs from the river. If a carriage agreement could be developed with the owner of the Sweet Jessup Canal, it may be possible to fill the reservoirs with Crystal River water by gravity. These reservoirs would be lined to minimize seepage losses.

3.0 WATER RIGHTS AND WATER SUPPLY

It is anticipated that the reservoirs would be filled in-priority pursuant to Crystal River basin water rights that been have previously decreed for use by the District. Crystal River water rights that are adjudicated for use by West Divide have been reviewed (Table 2). It has been determined that these conditional water rights will provide a viable and reliable source of supply to the proposed storage facilities.

Table 2
Primary West Divide Conditional Water Rights
Crystal River Watershed

Water Right	Source	Adjudication Date	Amount
Placita Reservoir	Crystal River	20-Jun-58	62,000 acre feet
Osgood Reservoir	Crystal River	20-Jun-58	128,728 acre feet
Avalanche Canal and Siphon	Crystal River	20-Jun-58	830 cfs
Yank Creek Reservoir	Yank Creek	5-Nov-71	13,695 acre feet
Fourmile Canal	Yank Creek	5-Nov-71	85 cfs

3.1 RESERVOIR NO. 1

Reservoir No. 1 would be filled with water diverted from Thompson Creek. Within the Thompson Creek watershed, West Divide has an adjudicated storage right for 13,695 acre feet in association with the Yank Creek Reservoir. Yank Creek is an upstream tributary from Reservoir No. 1. West Divide also has a decreed direct flow water right from Yank Creek for the Fourmile Canal. The Fourmile Canal is a West Divide Project planned diversion facility from Yank Creek to the Fourmile Creek watershed.

We anticipate that West Divide's water rights for the Yank Creek Reservoir and for the Fourmile Canal would be transferred downstream to Reservoir No.1 though a Water Court action. These rights have a 1971 adjudication date, which is junior to many irrigation rights on lower Thompson Creek and the Crystal River. It is estimated that the 1971 rights would be in-priority for about two months during the snowmelt runoff season. Given the small size of Reservoir No.1, the reservoir could easily fill in a single day during the snowmelt runoff period.

3.2 RESERVOIRS NOS. 2 – 6

Reservoirs Nos. 2 through 6 would be filled with water diverted from the Crystal River; either via a pump station adjacent to the Sewell Ranch or through the Sweet Jessup Canal if approval of

the canal's owner can be obtained. West Divide has an adjudicated storage and direct flow rights at upstream locations on the Crystal River (Table 2). A small portion of these storage and direct flow rights would be transferred downstream for use in Reservoirs Nos. 2 through 6. The 1958 priority date for the Crystal River water rights is also relatively junior. It is estimated that these rights would be in-priority for about two months during the snowmelt runoff season. As with Reservoir No. 1, the remaining reservoirs could easily fill in a short period during the snowmelt runoff period without injury to any decreed rights.

Water right administration of the Crystal River has been reviewed with the Division of Water Resources. From this review it has been determined that the reservoir sites are in a location that can satisfy the water supply objectives previously outlined. The reservoirs can provide a reliable source of augmentation water to key calling water rights, and are also located upstream of key instream flow and irrigation demands.

4.0 ENVIRONMENTAL CONSIDERATIONS

Environmental and permitting issues associated with the potential reservoir sites have been evaluated at a reconnaissance level. The purpose of this assessment was to identify any fatal flaws that may exist from a permitting standpoint that would preclude development of one or more of the reservoirs. Key permits that may be required could include a Section 404 permit from the Corps of Engineers, and a Pitkin County 1041 permit.

Based on this review, we have determined that each of the reservoirs can likely be permitted and that any environmental effects from reservoir construction and operation can be mitigated. The most significant environmental issues are associated with Reservoir No.1 which is partially situated within the mapped floodplain of Thompson Creek. A brief overview of key environmental issues is provided below.

4.1 WETLANDS

One wetland about 0.44 acres in size occurs in the footprint of Reservoir No.1. This wetland may be non-jurisdictional, in that it may occur in response to water seepage from a local irrigation ditch. If the wetland is non-jurisdictional, it will not be regulated pursuant to Section 404 of the Clean Water Act. Even if this wetland is found to be jurisdictional, it is likely that the loss of the wetland can be mitigated and that a 404 permit from the U.S. Army Corps of Engineers can be obtained. No wetlands are associated with the other reservoir sites.

4.2 RIPARIAN AREAS

None of the reservoirs are situated within the 100 foot riparian setback associated with Pitkin County regulations.

4.3 FLOODPLAINS

A portion of Reservoir No.1 is situated within the mapped 100 year floodplain of Thompson Creek. It is likely that a Pitkin County permit for construction in the floodplain may be required for Reservoir No. 1 only.

4.4 THREATENED AND ENDANGERED SPECIES

With the possible exception of the Bald Eagle, the reservoir areas are <u>not</u> suitable habitat for the listed species that are of concern in the region. Potential impacts to the Bald Eagle and to endangered fish in the lower Colorado River will require further evaluation, although any impacts to these species can likely be mitigated. Informal consultation with the U.S. Fish and

Wildlife Service regarding these issues is recommended.

4.5 MIGRATORY BIRDS

Habitat for Migratory Birds occurs in the project area, particularly in trees and shrubs along local irrigation ditches, Thompson Creek, and scattered throughout the property. To avoid violating the Migratory Bird Treaty Act, it is recommended that clearing and grubbing for the project occur outside of the nesting season, or between about September 1 and March 31. The Migratory Bird nesting season is typically from April 1 to August 31.

5.0 COST ESTIMATES

Sopris Engineering has developed detailed costs estimates for each reservoir alternative (Attachment 1). These estimates include costs associated with engineering, permitting, reservoir construction, inlet facilities, and outlet facilities. For Reservoirs Nos. 2 through 6, the potential construction and operational costs of a Crystal River pump station have not been estimated. Also, the cost of Water Court action has not been included, nor have any costs associated with the use of the Sewell Ranch been considered.

A summary of estimated costs is provided in Table 3. Unit costs are estimated to range from a low of $5,200 per acre foot to a high of over $30,000 per acre foot. Unit costs are most favorable for Reservoir Nos. 3 through 6. Unit costs are highest for the smallest reservoir sites (Reservoirs No. 1 and No.2). As previously noted, it may be possible to operate Reservoir No.1 as a recharge pit in which case a liner may not be required and overall costs may decline by 15 % or more.

Table 3
Estimated Reservoir Costs (1)

Reservoir Option	Capacity	Total Cost	Cost per Acre Foot
No.1: Non-Jusidictional (2)	7.2 AF	$225,500	$31,450
No.1: Jusidictional	23.5 AF	$471,300	$20,020
No.2: Non-Jusidictional	9.7 AF	$369,675	$38,270
No.3: Non-Jusidictional	67.6 AF	$464,475	$6,870
No.3: Jusidictional	118.9 AF	$722,400	$6,080
No.4: Non-Jusidictional	35.5 AF	$299,705	$8,450
No.4: Jusidictional	60.2 AF	$471,545	$7,835
No.5: Non-Jusidictional	91.8 AF	$555,035	$5,500
No.5: Jusidictional	165.2 AF	$908,740	$5,500
No.6: Non-Jusidictional	91.0 AF	$588,436	$6,470
No.6: Jusidictional	165.1 AF	$944,425	$5,200

(1) Estimates for Reservoirs Nos. 2 through 6 do not include a pump station from the Crystal River (if one is needed).

(2) If Reservoir No. 1 is operated as a recharge pit, liner costs will be reduced and project costs may decrease by 15 % or more.

6.0 SUMMARY

Additional detailed engineering and environmental investigations will be required to fully evaluate these alternatives. Based on our reconnaissance level study, we offer the following conclusions and recommendations.

6.1 CONCLUSIONS

Six reservoir sites have been evaluated with potential storage capacity ranging from about 7 acre feet to over 165 acre feet. All six of the reservoir sites are viable from an engineering, construction and permitting perspective. The reservoirs can be reliably filled each year with water rights decreed for use by West Divide. Development costs are expected to range from about $5,500 to over $31,000 per acre foot, depending upon the size and location of the reservoir. These development costs do not include land acquisition costs, the construction of a Crystal River pump station (if needed) or the cost of Water Court actions. In addition, each storage alternative could satisfy the existing augmentation demands and some future demands of West Divide.

6.1.1 RESERVOIR NO. 1

Reservoir No.1 is relatively small (7 to 23 acre feet) and may not be of adequate capacity to provide concurrent benefits to West Divide, the Sewell Ranch and for CWCB instream flow enhancements. The high cost of Reservoir No.1 could be substantially reduced if the facility is operated as a recharge pit.

6.1.2 RESERVOIRS NOS. 2 - 6

Water storage on the upper terrace (Reservoirs Nos. 2 through 6) could collectively exceed 500 acre feet. Reservoirs Nos. 2 through 6 could store enough water to provide concurrent benefits to both the Sewell Ranch and West Divide. If multiple reservoirs were constructed on the terrace, water may also be available for instream flow uses or irrigation uses on the lower Crystal River.

The upper terrace reservoirs (Nos. 2 through 6) may be the most cost effective, particularly if a favorable water carriage agreement with the owner of the Sweet Jessup Canal can be secured. If a carriage agreement cannot be secured, and Reservoirs Nos. 2 through 6 must be filled from a pump station on the Crystal River, development and operational costs will substantially increase.

6.2 RECOMMENDATIONS

At this time, we offer the following recommendations and future actions:

1. We recommend a workshop with the owners of the Sewell Ranch to discuss these study results and to confirm their interest in proceeding with the project.

2. On a short-term basis, if acceptable to the Sewell's, it may be appropriate to pursue the development of Reservoir No.1 at a height that is acceptable from a visual and land use perspective. This reservoir could be operated as a recharge pit and would be of adequate capacity to satisfy existing augmentation demands of West Divide, as well as a moderate level of future demands. This facility would have a small capacity and would provide little water for use by the Sewell's or others.

3. On a long-term basis, it may be appropriate to consider the development of one or more reservoirs on the upper terrace of the ranch (Reservoirs Nos. 2 through 6). These larger storage facilities are of adequate capacity to supply water for irrigation use by the Sewell's and to provide water for instream flow enhancement on the Crystal River. The economic viability of these reservoir sites will largely depend upon the ability to secure a favorable water carriage agreement from the owner of the Sweet Jessup Canal. Discussions regarding a carriage contract should be pursued as a first step towards the development of these reservoirs.

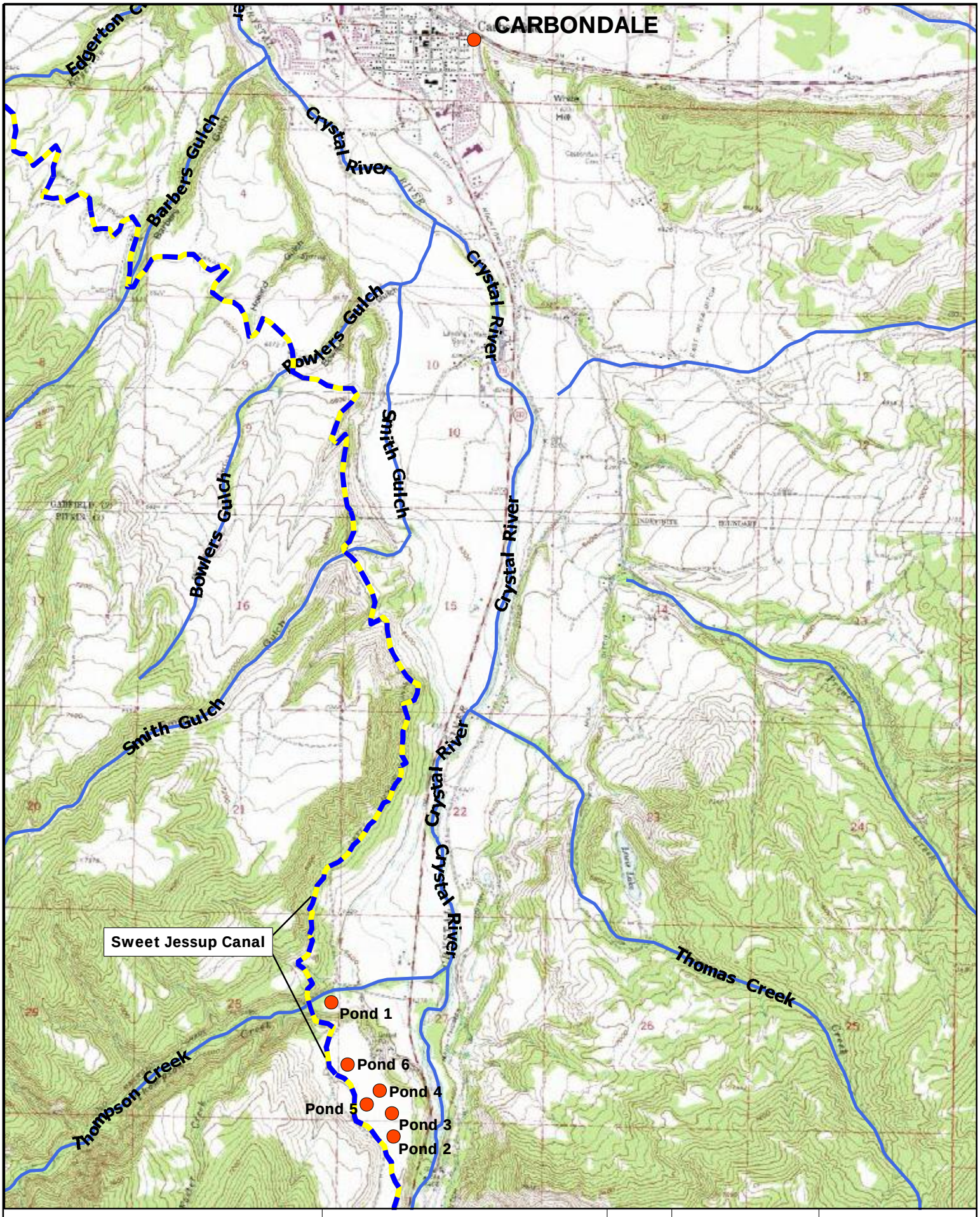

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Figure 1
Vicinity Map
Pitkin County, Colorado

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Date: 08-01-2009
Map By: M.P.
File Name: crystalponds.map

GrandRiver Consulting Corporation

Attachment 1

Sopris Engineering Feasibility Study

Feasibility Study

for

Sewell Ranch Off Stream Reservoirs
Pitkin County, Colorado

Prepared for:

Grand River Consulting

SE Project Number: 28159
August 13, 2009

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I. Brief Overview

This project consists of creating off stream reservoirs to allow storage of waters for the releasing of waters back into the Crystal River during dry or drought periods. This report was prepared base on our engineering studies, site evaluations, meeting with Grand River Consulting, and meeting with the Sewell Ranch representatives. Three different sites were analyzed for the use of constructing reservoirs on the Ranch. The first site (lower site) is situated in the Thompson Creek watershed, approximately 1/2 mile upstream of the confluence of Thompson Creek and the Crystal River. This site is an open undisturbed grass land surrounded by sparse cottonwood and aspen trees, which has been used as pasture land. The Second site (upper site) is situated on the ridge line between the Crystal River and Thompson Creek. This site is a natural bench that is currently used as pasture land and has a history of being farmed with flood irrigation. The third site is an old gravel pit within a small drainage that lies north east of the upper site at a lower elevation. This site is not practical for reservoir/s, given the steep relief of the drainage and the small area of the gravel pit. Please see Exhibit A for an overview map of the sites.

The majority of the water for the reservoirs is to be captured during the spring runoff, and then released during dry periods or droughts. Water conveyance improvements will be required on all of the sites, along with the grading that is required for constructing reservoirs and other appurtenances. The water from the reservoirs will discharge into the Crystal River at the confluence of the Crystal River and Thompson Creek.

II. Introduction

The Off Stream Reservoir areas are on the private land of the Sewell Ranch, which is located in Pitkin County and will require approvals from said county and other regulatory agencies such as the Colorado Division of Water Resources - Department of Natural Resources and US Army Corps of Engineers. Pitkin County will most likely require this project to go through an Activity Envelope process during the planning stage, and then, at a minimum, require an Earthmoving Permit, prior to construction. No building permit is required as long as the structure/building is less than 200 square feet. Pitkin County will also require clarification of adequate water rights. The Office of the State Engineer, Division of Water Resources regulates the construction of reservoirs and will require, at a minimum, a filing of a Notice of Intent to Construct a Non Jurisdictional Water Impoundment Structure. If the reservoir is a Jurisdiction Size Dam then the Dam must be approved by the State Engineers. At the lower site the US Army Corps of Engineers regulates any disturbances within the waters of the US and if it is determined that this site is regulated by the Corps than a Permit may be required. The lower site is designated in Zone A on the 08097C0033C Flood Insurance Rate Map, which is regulated by the Federal Emergency Management Agency (FEMA) and will require a study of this area to determine the effects the proposed reservoir has on the Base Flood Elevation. Pitkin County is the regulatory agency for FEMA and will require a Flood Plain Development Permit prior to construction activity. Additional permits, that will be required prior to

construction, will include a Storm Water Management Permit and Fugitive Dust Permit that are regulated by the Colorado Department of Health.

III. Water Supply

The water Supply to the lower site is most efficiently supplied by gravity from Thompson Creek. The existing diversion on Thompson Creek does not have a head gate and will require improvements. The diversion that is currently being used by the Sewell Ranch for irrigation needs is a culvert that is plugged with a tarp dam to shut off the turnout ditch. The existing irrigation ditch can be utilized to convey the water from Thompson Creek to the proposed reservoir, or the ditch can be improved by installing a pipeline from the new head gate to the reservoir. The pipeline will need to be designed to adequately convey both irrigation and reservoir inflows. A splitter box and weir will need to be designed and constructed to allow the separation of the historical irrigation flows and the flows for filling the proposed reservoir. Thompson Creek has high silt content therefore a silt trap is recommended to be designed and constructed to reduce the maintenance cost of the reservoir. This silt trap can be designed as part of the reservoir by construction of a concrete trough, which will allow for easy removal of silts during times when the reservoir storage level is low.

The upper site supply water is most efficiently supplied from the Crystal River via the Sweet Jessup Canal, which conveys waters to the Crystal River Ranch for irrigation needs. The upper site can be supplied by pumping water up to the site from Thompson Creek or the Crystal River, but the initial cost for the pump station and infrastructure is substantially higher in cost. The maintenance and electrical cost will be higher than gravity fed waters from the Sweet Jessup Canal. An agreement will be required with the Sweet Jessup Canal owners to allow the use of the ditch to convey water to the upper site. A head gate and weir structure will need to be designed and constructed on the Sweet Jessup Canal for waters to fill the reservoirs.

It is suggested that the upper site be designed with a number of different reservoirs that cascade from the first receiving reservoir to the other down gradient reservoir/s. This preliminary reservoir can be designed large enough to act as a natural silt trap and have a structure incorporated for ease of removing of the silt during low storage. This will reduce the maintenance cost of the other reservoirs on the upper site.

IV. Reservoir Design

The construction and administration of reservoirs are regulated by the Office of the State Engineer Division of Water Resources that classifies dams in a number of different categories. This project can be designed under the Category of Non-Jurisdictional or as Jurisdictional. Non-Jurisdictional Size Dams are smaller in size than Jurisdictional size dams. Plans and specifications are not required to be submitted for the construction of a Non-Jurisdictional dam, but a Notice of Intent to Construct a Non-Jurisdictional Water Impoundment Structure is required and is to be submitted to the Division Engineer of the Water Division 4 (Glenwood Springs) 50633 U.S. Hwy 6&24 / P.O. Box 396 Glenwood

Springs Colorado 81602. Jurisdictional size dams must be approved by the State Engineer prior to construction. A Jurisdictional dam has any of the following:

A. Have a statutory height greater than 10 feet to the spillway crest.
B. Have a volume greater than 100 acre feet of water
C. Cover more than 20 acres at the high water line.

Plans, Specifications and design reports must be submitted for a Jurisdictional dam, which includes documentation and calculations to support the design of the reservoir. An application and filing fee must accompany the submittal. The fee is based off of the estimated engineering and construction cost and calculated at a rate of $3.00 per $1000.00 of the estimated cost or fraction thereof, but not less than $100.00 nor more than $3000.00. The state dam safety engineer will make periodic inspections during construction to check the progress of work and to ensure compliance with the approved plans. A final inspection must be performed and construction certified by the owner's engineer before water may be stored.

A Hydrology Study will need to be performed on all of the reservoir alternatives. This study includes the natural inflow of waters from storm runoff events and the hydrological/ geophysical effects the stored waters will have on the reservoir itself. This study will need to include a complete failure analysis of the reservoir embankment and the effects that discharging waters may have on downstream properties, structures, including the possibility of loss of life. The volume of inflow water from a storm event is required for designing a safe and reliable spillway. The State Engineer can request and review this study and as a part of the procedure in determining the hazard classification of the reservoir. Depending on the classification of the reservoir/s, there may be additional requirements by the State Engineer, which can include but are not limited to the development of an emergency plan in writing detailing what procedures need to be implemented during an emergency. It is our opinion that the classification should be low for the reservoirs, due to the distance to the nearest existing structure and the size of the reservoirs being proposed.

The state requires that any reservoir embankment have a maximum slope of 2 foot horizontal to 1 foot vertical on the downstream slope of the dam and the upstream slope to be not greater than 3 foot horizontal to 1 foot vertical. Soil analysis will be required on the embankment material for verification and design recommendations. This includes the maximum incline for embankment slopes, the prevention of any sloughing of soils, during a quick draw down of stored waters, of the reservoir and the stability of the embankment during complete saturation. We recommend the maximum slope of 3 to 1 on any wetted bank as a guideline to allow safe exit from a reservoir by a person or animal.

It is recommended that the reservoirs be designed as Jurisdictional dams. By having a depth greater than 10 feet, this will decrease the surface area to volume ratio, which will decrease the amount of evaporation loss per capacity volume and reduce the cost per stored acre foot of water. Additionally by designing multiple reservoirs, at the upper site, that cascade in series from one reservoir to the next, the upper reservoir/s can be drained into a

lower reservoir and decrease the surface area, which will result in decreased evaporation volume.

ERO Resources Corporation has completed a site assessment on the lower site and has designated some wetland and riparian zones on the lower site, (please see Crystal River Wetland Delineation Memo). Wetlands are regulated by the US Army Corps of Engineers and will need to be assessed as to the quality of wetlands or if they are manmade by the existing irrigation ditch. Pitkin County additionally regulates wetlands and riparian zones beyond the US Army Corps that requires a 100 foot buffer from the high water line of any stream, and the maintenance of a 25 foot buffer from any wetlands and /or riparian areas identified.

Hepworth-Pawlak Geotechnical, Inc. (HP) has completed a site assessment on the lower site to determine the soil composition. Three test pits were dug with an excavator to perform soil profile test, (please see attached report). Ground water was present and observation wells were installed to monitor the elevation of groundwater. It is not recommended to have the bottom of the reservoir lower than the groundwater level.

It is recommended that the reservoirs be lined to minimize or eliminate losses from leaks into the soil. We have researched a number of pond liners including chemical liners and polyethylene liners. Two applicable products known as (ESS-13), a chemical line, which can be supplied by Seepage Control, Inc. and (PPL-24) a polyethylene liner, which can be supplied by Bend Tarp and Liner, Inc. (BTL) were used for our analysis for the cost of liners.

A polyethylene liner is the preferred type of liner if the ponds are to be dry for any extended period of time and should have close to zero loss. The polyethylene liner needs to be made of HDPL/LDPE fabric that is UV resistance, have a high puncture and tear resistance, have excellent cold crack characteristics and is fish and plant safe. A number of polyethylene liners that are on the market require a pad (sand or manmade) to be installed below the liner for protection from punctures. PPL-24 does not require this pad and this cost was not included in this analysis. It is recommended that a ribbon of geotextile overlayment (typically 8oz. per square yard non-woven needle-punched polypropylene) referred to as "GEO" to be installed over the liner on the upper perimeter of the reservoir. The GEO is to be keyed into the anchor trench or shelf right along with the liner itself; this adds a degree of safety. By installing this addition, the edge of the reservoir is less slippery (ie: kids, dogs, deer etc. can get out more easily) and gives added protection to prevent physical damage to the liner from animal tracking, mechanical equipment, UV degradation, etc. This particular pond liner in most cases can be installed in one day, after the reservoir bottom and embankment are smooth graded.

A chemical liner that is environmentally safe will be required. A chemical liner is not recommended if the reservoir is to be empty for an extended period of time and if the desire is to have close to no loss of waters. The ESS-13 liner analyzed can be applied in two different methods, water born application or as a soil born application. We would recommend the soil born application be used during the construction of the reservoir. This

application requires over excavation of the reservoir wetted surfaces by one foot, followed by mixing the chemical into the removed soil. The treated soil is then placed and compacted in (2) 6" lifts. This liner's cost is contingent on the amount of chemical required based on the type of select soils that are available. The select soil must be free of rocks and preferably consist primarily of clay. Seepage Control, Inc. will analyze the select soil and determine the application rate of ESS-13 to meet specified needs. ESS-13 is a self healing liner that prevents leakage due to wild and domestic animal tracking in the reservoir.

If the reservoir is full then ESS-13 can be applied directly to the water (water born application). This requires that the pond remain full, with no releases of water. The ESS-13 product is then broadly applied in over the reservoir area for efficient dispersal of chemical. The chemical will disperse and settle in the water within 24 hours. The reservoir will initially become clouded, then over time become clear indicating that the application is complete. ESS-13 is a vegetable oil based product so during the water born application the gills of fish can become coated, causing suffocation. If there are any fish in the pond, they should be removed before an application of ESS-13.

V. Water Outfall

The waters from the reservoir are ultimately to be released in to the Crystal River. Both sites are situated on the west side of State Hwy 133 and the Crystal lies on the east. Crossing the highway right-of-way can be problematic and require permitting from Colorado Division of Transportation along with the acquisition of easements from the land owners that lie between the highway and the Crystal River. The most efficient route for the water to reach the Crystal River is via Thompson Creek for a short distance, upstream and through it's crossing under the highway to the confluence with the Crystal River. The outfall of waters from the lower reservoir site will consist of installation of a head gate, measuring devise and pipeline and/or ditch back to Thompson creek.

The outfall of water from the upper site reservoir/s is most efficiently conveyed through a pipeline along the alignment of the existing access road to the upper bench. This alignment will minimize the disturbance of natural vegetation. As with the lower site a measuring devise and head gate will need to be incorporated. If the upper site includes multiple reservoirs, a pipeline system with valves can be incorporated to transport water from reservoir to reservoir allowing for efficient water storage management.

VI. Project Cost

The design cost of this project varies depending on whether Jurisdictional Reservoirs are desired for the required volume or if Non-Jurisdictional Reservoirs will provide sufficient storage. Additional time will be required in the approval process, associated with the State Engineer's review, for Jurisdictional Reservoirs, plus the additional application fee submitted with the design review package.

The approval process within Pitkin County, at a minimum, will require an Earthmoving Permit. This permit will need to take into account the transport and placement of the spoils to a receiving site from the reservoir, if the site is not balanced. Pitkin County will require

a Flood Plain Development Permit for the lower site. The County will require a study of the Thompson Creek Water Shed and the establishment of Base Flood Elevations (BFE) adjacent to the proposed reservoir and the verification that the BFE is not adversely affected. Pitkin County does not have off stream reservoirs as a land use in there regulations and the plan will need to be presented, then Pitkin County will decide whether or not if an Activity Envelope/Site Plan Approval process will be required. If an Activity Envelope is required, then the scope of the application is set during a pre-application conference, and the Planner will identify applicable review standards, fees, submission requirements, etc.

We have analyzed the construction cost, from a number of different reservoir designs for this project. The largest cost per acre foot associated with this project is the earth moving to create the reservoirs. This cost is assuming that the availably of pervious and impervious soils with the correct characteristics are available and in sufficient quantities on site for the construction of the reservoir embankments. A soils investigation will need to be performed for verification of the soils to help with the design of the reservoir/s embankment.

The natural slope, along with the desired shape and depth of a given reservoir are the major factors in determining the required volume of soil to be moved. A survey base drawing of the existing conditions with contours at an adequate interval will need to be produced prior to creation of construction drawing and grading models that will define the earthwork volumes. Sewell Ranch has indicated that there are a number of areas on the ranch that excess spoils can be placed if the reservoir site cannot be balanced although we assumed no offsite export/import of earthen materials will be needed.

The water conveyance system for this site will require installation of head gates, weirs, pipeline and/or ditch and valves. Flow needs and system requirements will need to be analyzed for sizing of these items. We assumed that at the lower site the inflow conveyance improvements to Reservoir 1 would include the installation of a head-gate & weir, utilizing the existing ditch with the installation of a splitter box. This splitter box will split the shared inflow in the ditch between the irrigation flows of the Sewell Ranch and flow to Reservoir 1. The out fall would consist of a lake outlet pipe, regulation valve and pipeline directly discharging into Thompson Creek. These items cost would remain relatively constant whether jurisdictional or non-jurisdictional.

The first step in the conveyance system for the upper site is to have an agreement for the use of the Sweet Jessup Canal with the current owner. As part of this agreement the maintenance and future improvements to the Canal need to be analyzed. The pipe system for the upper site will need to be designed to accommodate the filling and emptying of the reservoir with one line to each reservoir. This will be more efficient then the installation of redundant pipelines with individual lines for filling and for discharge. This system will require the installation of head gates, weirs, valves and pipelines sized to meet the desired flows. We have not specifically analyzed the cost of a pumping system from the Crystal River and Thompson Creek.

We have not analyzed the maintenance cost associated with this project, except for the reliability of the liners

We have included an estimated cost for each reservoir. All reservoirs except Reservoir 2 have Non-Jurisdictional and Jurisdictional design and costs. The following is a list of the reservoirs, summary of cost, and calculated cost per acre foot of water for construction:

Lower Site
Reservoir 1 as Non-Jurisdictional $31,450 per Acre Foot
Reservoir 1 Volume 7.17 Acre Feet

Mobilization	1	LS	2,750	2,750
Clearing and Grubbing	1	LS	1,700	1,700
Top Soil Placed	1,475	CY	6.00	8,850
Cut and Fill Placed	8,280	CY	2.70	22,356
Import Soil	4,020	CY	5.00	20,100
Liner Soil Cover	1,360	CY	6.00	8,160
Liner	73,600	SF	0.37	27,232
Geotextile	14,500	SF	0.10	1,450
Liner Installation	1	LS	4,000	4,000
Inlet Headgate	1	LS	7,000	7,000
Splitter Box	1	LS	5,000	5,000
12" Outlet	300	LF	30	9,000
12" Valve	1	LS	1,200	1,200
Outlet Weir	1	LS	3,500	3,500
Sediment Trough	1	LS	15,000	15,000
Restoration	1.35	Acre	2,000	2,700
CA	1	LS	15,000	15,000
Design	1	LS	15,000	15,000
Permitting	1	LS	10,000	10,000
Hydrology Study	1	LS	25,000	25,000
		Sub-Total		$ 204,998
		10% Contingence		$ 20,500
		Total		$ 225,498

Assumptions:

1. Export and Import material to either remain on Ranch or be from barrow site on Ranch.
2. Soils onsite are adequate for pervious and impervious needs to make dam structure.
3. Hydrology study will classify reservoir as No-Hazard / No-Risk.
4. Topsoil on this site is 1 foot in depth.
5. 2700 CY of topsoil placed in stock pile.

Reservoir 1 Jurisdictional $20,020 per Acre Foot
Reservoir 1 Volume 23.54 Acre Feet

	Quantity	Unit	Unit Cost	Total
Mobilization	1	LS	6,850	6,850
Clear and Grubbing	1	LS	2,700	2,700
Top Soil Placed	4,000	CY	6.00	24,000
Cut and Fill Placed	6,800	CY	2.70	18,360
Import Soil	40,800	CY	5.00	204,000
Liner Soil Cover	1,380	CY	6.00	8,280
Liner	74,400	SF	0.37	27,528
Geotextile	44,500	SF	0.10	4,450
Liner Installation	1	LS	4,000	4,000
Inlet Headgate	1	LS	7,000	7,000
Splitter Box	1	LS	5,000	5,000
12" Outlet	360	LF	30	10,800
12" Valve	1	LS	1,200	1,200
Outlet Weir	1	LS	3,500	3,500
Sediment Trough	1	LS	20,000	20,000
Restoration	2.88	Acre	2,000	5,760
CA	1	LS	15,000	15,000
Design	1	LS	20,000	20,000
Permitting	1	LS	15,000	15,000
Hydrology Study	1	LS	25,000	25,000
		Sub-Total		$ 428,428
		10% Contingence		$ 42,843
		Total		$ 471,271

Assumptions:

1. Export and Import material to either remain on Ranch or be from barrow site on Ranch.
2. Soils onsite are adequate for pervious and impervious needs to make dam structure.
3. Hydrology study will classify reservoir as No-Hazard / No-Risk.
4. Topsoil on this site is 1 foot in depth.
5. 2750 CY of topsoil placed in stock pile.

Upper Site
Reservoir 2 Non-Jurisdictional $38,270 per Acre Foot
Reservoir 2 Volume 9.66 Acre Feet

	Quantity	Unit	Unit Cost	Total
Mobilization	1	LS	5,700	5,700
Clearing and Grubbing	1	LS	1,600	1,600
Top Soil Placed	1,700	CY	6.00	10,200
Cut and Fill Placed	9,000	CY	2.70	24,300
Export Soil	1,800	CY	2.50	4,500
Liner Soil Cover	1,100	CY	6.00	6,600
Liner	58,400	SF	0.37	21,608
Geotextile	30,300	SF	0.10	3,030
Liner Installation	1	LS	4,000	4,000
Inlet Headgate	1	LS	10,000	10,000
12" Inlet Pipe	50	LF	30	1,500
12" Outlet Pipe	4,950	LF	35	173,250
12" Valve	1	LS	1,200	1,200
Outlet Weir	1	LS	3,500	3,500
Sediment Trough	1	LS	15,000	15,000
Restoration	1.64	Acre	2,000	3,280
CA	1	LS	16,000	16,000
Design	1	LS	15,000	15,000
Permitting	1	LS	10,000	10,000
Hydrology Study	1	LS	10,000	10,000
Soils investigation	1	LS	1,500	1,500
		Sub-Total		$ 336,068
		10% Contingence		$ 33,607
		Total		$ 369,675

Assumptions:

1. Export and Import material to either remain on Ranch or be from barrow site on Ranch.
2. Soils onsite are adequate for pervious and impervious needs to make dam structure.
3. Hydrology study will classify reservoir as No-Hazard / No-Risk.
4. Topsoil on this site is 1 foot in depth.
5. This reservoir will be Phase 1 of the upper site.
6. 2150 CY of topsoil placed in stock pile.
7. Hydrology Study was assumed to be done once for all Reservoirs 2-6. Cost divided equal to each Reservoir.
8. The 12" Outlet Pipe to Thompson Creek was assumed to be constructed with Reservoir 2. No cost was shared with any other reservoir.

Reservoir 3 Non-Jurisdictional $6,870 per Acre Foot
Reservoir 3 Volume 67.63 Acre Feet

	Quantity	Unit	Unit Cost	Total
Mobilization	1	LS	7,550	7,550
Clearing and Grubbing	1	LS	6,400	6,400
Top Soil Placed	3,375	CY	6.00	20,250
Cut and Fill Placed	25,018	CY	2.70	67,549
Export Soil	37,388	CY	2.50	93,470
Liner Soil Cover	6,225	CY	6.00	37,350
Liner	336,250	SF	0.37	124,413
Geotextile	78,320	SF	0.10	7,832
Liner Installation	1	LS	8,000	8,000
12" In/Outlet Pipe	100	LF	30	3,000
12" Valve	2	LS	1,200	2,400
Restoration	3.27	Acre	2,000	6,540
CA	1	LS	15,000	15,000
Design	1	LS	5,000	5,000
Permitting	1	LS	5,000	5,000
Hydrology Study	1	LS	2,000	10,000
Soils investigation	1	LS	5,000	2,500
		Sub-Total		$ 422,253
		10% Contingence		$ 42,225
		Total		$ 464,478

Assumptions:

1. Export and Import material to either remain on Ranch or be from barrow site on Ranch.
2. Soils onsite are adequate for pervious and impervious needs to make dam structure.
3. Hydrology study will classify reservoir as No-Hazard / No-Risk.
4. Topsoil on this site is 1 foot in depth.
5. Reservoir 2 is complete including the Outlet pipe line.
6. 12,450 CY of topsoil placed in stock pile.
7. Hydrology Study was assumed to be done once for all Reservoirs 2-6. Cost divided equal to each Reservoir.

Reservoir 3 Jurisdictional $6,080 per Acre Foot
Reservoir 3 Volume 118.87 Acre Feet

	Quantity	Unit	Unit Cost	Total
Mobilization	1	LS	11,850	11,850
Clearing and Grubbing	1	LS	6,400	6,400
Top Soil Placed	3,250	CY	6.00	19,500
Cut and Fill Placed	25,000	CY	2.70	67,500
Export Soil	120,000	CY	2.50	300,000
Liner Soil Cover	6,280	CY	6.00	37,680
Liner	339,220	SF	0.37	125,511
Geotextile	149,540	SF	0.10	14,954
Liner Installation	1	LS	8,000	8,000
12" In/Outlet Pipe	130	LF	30	3,900
12" Valve	2	LS	1,200	2,400
Restoration	3.27	Acre	2,000	6,533
CA	1	LS	15,000	15,000
Design	1	LS	5,000	10,000
Permitting	1	LS	5,000	15,000
Hydrology Study	1	LS	5,000	10,000
Soils investigation	1	LS	5,000	2,500
		Sub-Total		$ 656,728
		10% Contingence		$ 65,673
		Total		$ 722,401

Assumptions:

1. Export and Import material to either remain on Ranch or be from barrow site on Ranch.
2. Soils onsite are adequate for pervious and impervious needs to make dam structure.
3. Hydrology study will classify reservoir as No-Hazard / No-Risk.
4. Topsoil on this site is 1 foot in depth.
5. Reservoir 2 is complete including the Outlet pipe line.
6. 12,560 CY of topsoil placed in stock pile.
7. Hydrology Study was assumed to be done once for all Reservoirs 2-6. Cost divided equal to each Reservoir.

Reservoir 4 Non-Jurisdictional $8,450 per Acre Foot
Reservoir 4 Volume 35.48 Acre Feet

	Quantity	Unit	Unit Cost	Total
Mobilization	1	LS	4,600	4,600
Clearing and Grubbing	1	LS	4,000.00	4,000
Top Soil Placed	3,035	CY	6.00	18,210
Cut and Fill Placed	25,800	CY	2.70	69,660
Import Soil	2,250	CY	5.00	11,250
Liner Soil Cover	3,380	CY	6.00	20,280
Liner	182,470	SF	0.37	67,514
Geotextile	52,250	SF	0.10	5,225
Liner Installation	1	LS	8,000	8,000
12" In/Outlet Pipe	600	LF	30	18,000
12" Valve	2	LS	1,200	2,400
Restoration	2.91	Acre	2,000	5,820
CA	1	LS	15,000	15,000
Design	1	LS	5,000	5,000
Permitting	1	LS	5,000	5,000
Hydrology Study	1	LS	5,000	10,000
Soils investigation	1	LS	5,000	2,500
		Sub-Total		$ 272,459
		10% Contingence		$ 27,246
		Total		$ 299,705

Assumptions:

1. Export and Import material to either remain on Ranch or be from barrow site on Ranch.
2. Soils onsite are adequate for pervious and impervious needs to make dam structure.
3. Hydrology study will classify reservoir as No-Hazard / No-Risk.
4. Topsoil on this site is 1 foot in depth.
5. Reservoir 2 is complete including the Outlet pipe line.
6. 6,760 CY of topsoil placed in stock pile.
7. Hydrology Study was assumed to be done once for all Reservoirs 2-6. Cost divided equal to each Reservoir.

Reservoir 4 Jurisdictional $7,835 per Acre Foot
Reservoir 4 Volume 60.18 Acre Feet

	Quanity	Unit	Unit Cost	Total
Mobilization	1	LS	7,400	7,400
Clearing and Grubbing	1	LS	6,400.00	6,400
Top Soil Placed	8,820	CY	6.00	52,920
Cut and Fill Placed	25,800	CY	2.70	69,660
Export Soil	37,450	CY	2.50	93,625
Liner Soil Cover	3,500	CY	6.00	21,000
Liner	189,000	SF	0.37	69,930
Geotextile	98,400	SF	0.10	9,840
Liner Installation	1	LS	8,000	8,000
12" In/Outlet Pipe	600	LF	30	18,000
12" Valve	2	LS	1,200	2,400
Restoration	8.50	Acre	2,000	17,000
CA	1	LS	15,000	15,000
Design	1	LS	5,000	10,000
Permitting	1	LS	5,000	15,000
Hydrology Study	1	LS	5,000	10,000
Soils investigation	1	LS	5,000	2,500
		Sub-Total		$ 428,675
		10% Contingence		$ 42,868
		Total		$ 471,543

Assumptions:

1. Export and Import material to either remain on Ranch or be from barrow site on Ranch.
2. Soils onsite are adequate for pervious and impervious needs to make dam structure.
3. Hydrology study will classify reservoir as No-Hazard / No-Risk.
4. Topsoil on this site is 1 foot in depth.
5. Reservoir 2 is complete including the Outlet pipe line.
6. 7000 CY of topsoil placed in stock pile.
7. Hydrology Study was assumed to be done once for all Reservoirs 2-6. Cost divided equal to each Reservoir.

Reservoir 5 Non-Jurisdictional $5,500 per Acre Foot
Reservoir 5 Volume 91.76 Acre Feet

	Quanity	Unit	Unit Cost	Total
Mobilization	1	LS	9,200	9,200
Clearing and Grubbing	1	LS	8,250	8,250
Top Soil Placed	3,850	CY	6.00	23,100
Cut and Fill Placed	31,550	CY	2.70	85,185
Export Soil	38,243	CY	2.50	95,608
Liner Soil Cover	8,260	CY	6.00	49,560
Liner	446,100	SF	0.37	165,057
Geotextile	87,400	SF	0.10	8,740
Liner Installation	1	LS	8,000	8,000
12" In/Outlet Pipe	150	LF	30	4,500
12" Valve	2	LS	1,200	2,400
Restoration	3.74	Acre	2,000	7,480
CA	1	LS	15,000	15,000
Design	1	LS	5,000	5,000
Permitting	1	LS	5,000	5,000
Hydrology Study	1	LS	5,000	10,000
Soils investigation	1	LS	5,000	2,500
		Sub-Total		$ 504,580
		10% Contingence		$ 50,458
		Total		$ 555,037

Assumptions:

1. Export and Import material to either remain on Ranch or be from barrow site on Ranch.
2. Soils onsite are adequate for pervious and impervious needs to make dam structure.
3. Hydrology study will classify reservoir as No-Hazard / No-Risk.
4. Topsoil on this site is 1 foot in depth.
5. Reservoir 2 is complete including the Outlet pipe line.
6. 16,500 CY of topsoil placed in stock pile.
7. Hydrology Study was assumed to be done once for all Reservoirs 2-6. Cost divided equal to each Reservoir.

Reservoir 5 Jurisdictional $5,500 per Acre Foot
Reservoir 5 Volume 165.15 Acre Feet

	Quantity	Unit	Unit Cost	Total
Mobilization	1	LS	15,300	15,300
Clearing and Grubbing	1	LS	8,250	8,250
Top Soil Placed	3,710	CY	6.00	22,260
Cut and Fill Placed	31,540	CY	2.70	85,158
Export Soil	156,500	CY	2.50	391,250
Liner Soil Cover	8,330	CY	6.00	49,980
Liner	449,930	SF	0.37	166,474
Geotextile	168,250	SF	0.10	16,825
Liner Installation	1	LS	8,000	8,000
12" In/Outlet Pipe	175	LF	30	5,250
12" Valve	2	LS	1,200	2,400
Restoration	3.74	Acre	2,000	7,480
CA	1	LS	15,000	15,000
Design	1	LS	5,000	5,000
Permitting	1	LS	5,000	15,000
Hydrology Study	1	LS	5,000	10,000
Soils investigation	1	LS	5,000	2,500
		Sub-Total		$ 826,127
		10% Contingence		$ 82,613
		Total		$ 908,740

Assumptions:

1. Export and Import material to either remain on Ranch or be from barrow site on Ranch.
2. Soils onsite are adequate for pervious and impervious needs to make dam structure.
3. Hydrology study will classify reservoir as No-Hazard / No-Risk.
4. Topsoil on this site is 1 foot in depth.
5. Reservoir 2 is complete including the Outlet pipe line.
6. 16,660 CY of topsoil placed in stock pile.
7. Hydrology Study was assumed to be done once for all Reservoirs 2-6. Cost divided equal to each Reservoir.

Reservoir 6 Non-Jurisdictional $6,470 per Acre Foot
Reservoir 6 Volume 90.97 Acre Feet

	Quantity	Unit	Unit Cost	Total
Mobilization	1	LS	9,800	9,800
Clearing and Grubbing	1	LS	8,300	8,300
Top Soil Placed	4,260	CY	6.00	25,560
Cut and Fill Placed	30,550	CY	2.70	82,485
Export Soil	50,050	CY	2.50	125,125
Liner Soil Cover	8,130	CY	6.00	48,780
Liner	439,130	SF	0.37	162,478
Geotextile	80,640	SF	0.10	8,064
Liner Installation	1	LS	8,000	8,000
12" In/Outlet Pipe	275	LF	30	8,250
12" Valve	2	LS	1,200	2,400
Restoration	4.10	Acre	2,000	8,200
CA	1	LS	15,000	15,000
Design	1	LS	5,000	5,000
Permitting	1	LS	5,000	5,000
Hydrology Study	1	LS	5,000	10,000
Soils investigation	1	LS	5,000	2,500
		Sub-Total		$ 534,942
		10% Contingence		$ 53,494
		Total		$ 588,436

Assumptions:

1. Export and Import material to either remain on Ranch or be from barrow site on Ranch.
2. Soils onsite are adequate for pervious and impervious needs to make dam structure.
3. Hydrology study will classify reservoir as No-Hazard / No-Risk.
4. Topsoil on this site is 1 foot in depth.
5. Reservoir 2 is complete including the Outlet pipe line.
6. 16,260 CY of topsoil placed in stock pile.
7. Hydrology Study was assumed to be done once for all Reservoirs 2-6. Cost divided equal to each Reservoir.

Reservoir 6 Jurisdictional $5,200 per Acre Foot
Reservoir 6 Volume 165.06 Acre Feet

	Quantity	Unit	Unit Cost	Total
Mobilization	1	LS	15,900	15,900
Clearing and Grubbing	1	LS	8,300	8,300
Top Soil Placed	4,135	CY	6.00	24,810
Cut and Fill Placed	30,725	CY	2.70	82,958
Export Soil	169,275	CY	2.50	423,188
Liner Soil Cover	8,195	CY	6.00	49,170
Liner	442,455	SF	0.37	163,708
Geotextile	154,345	SF	0.10	15,435
Liner Installation	1	LS	8,000	8,000
12" In/Outlet Pipe	300	LF	30	9,000
12" Valve	2	LS	1,200	2,400
Restoration	4.10	Acre	2,000	8,200
CA	1	LS	15,000	15,000
Design	1	LS	5,000	5,000
Permitting	1	LS	5,000	15,000
Hydrology Study	1	LS	5,000	10,000
Soils investigation	1	LS	5,000	2,500
		Sub-Total		$ 858,568
		10% Contingence		$ 85,857
		Total		$ 944,425

Assumptions:

1. Export and Import material to either remain on Ranch or be from barrow site on Ranch.
2. Soils onsite are adequate for pervious and impervious needs to make dam structure.
3. Hydrology study will classify reservoir as No-Hazard / No-Risk.
4. Topsoil on this site is 1 foot in depth.
5. Reservoir 2 is complete including the Outlet pipe line.
6. 16,387 CY of topsoil placed in stock pile.
7. Hydrology Study was assumed to be done once for all Reservoirs 2-6. Cost divided equal to each Reservoir.

VII. Conclusion

We believe that the installation of off stream reservoirs at the lower and upper sites is feasible with proper planning and coordination with the regulator agencies. The average cost per acre foot of water for Non-Jurisdictional Reservoir on the lower site is approximately $31,450 and for Jurisdictional Reservoir is approximately $20,020 as designed. On the upper site the average cost for a Non-Jurisdictional Reservoir is $7,710 and $6,585 for a Jurisdictional Reservoir. These findings are conceptual only and more engineering study and evaluations are needed during the development of these off stream reservoirs.

VIII. Appendices

- General vicinity map
- Reservoir maps

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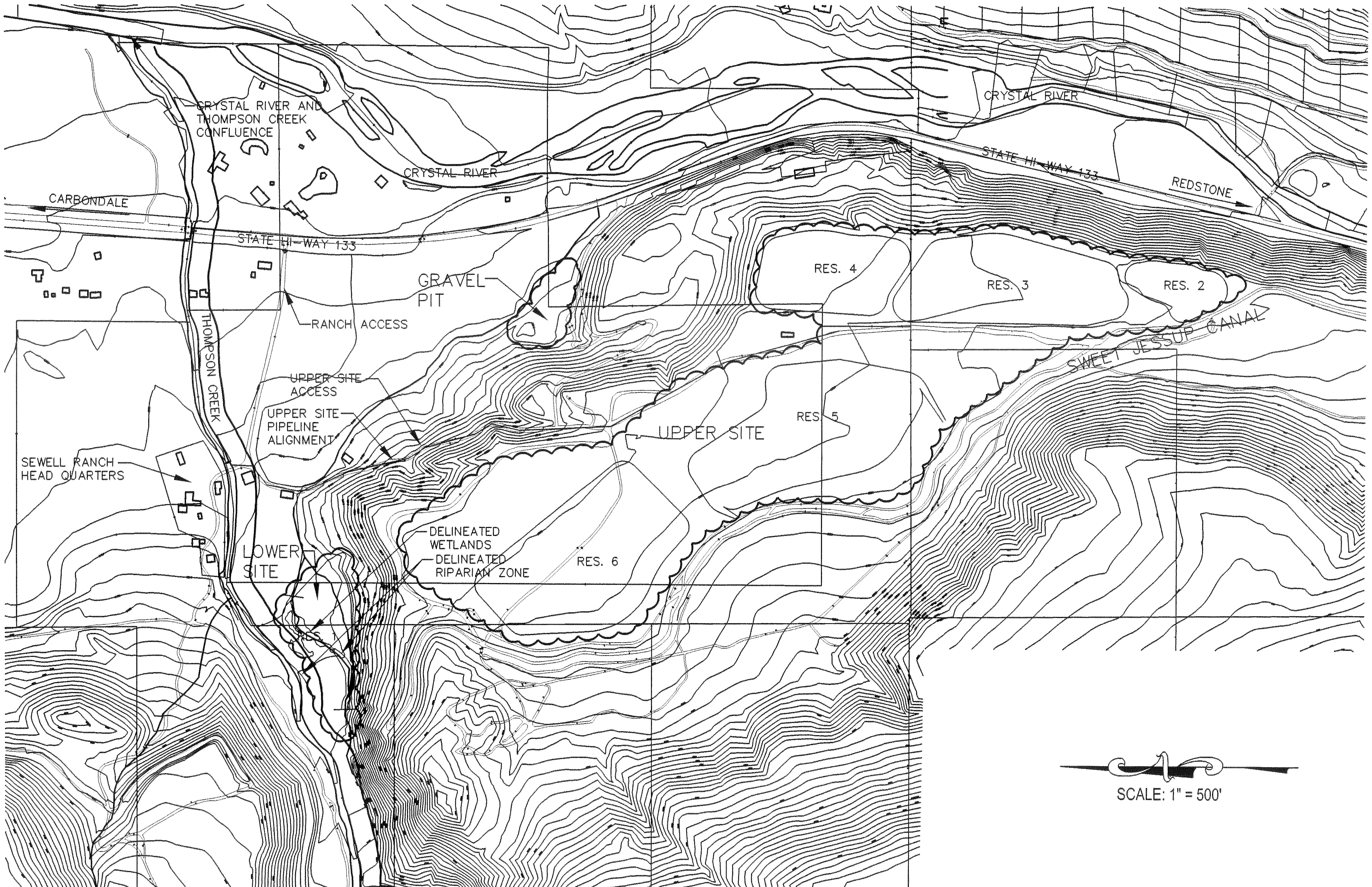

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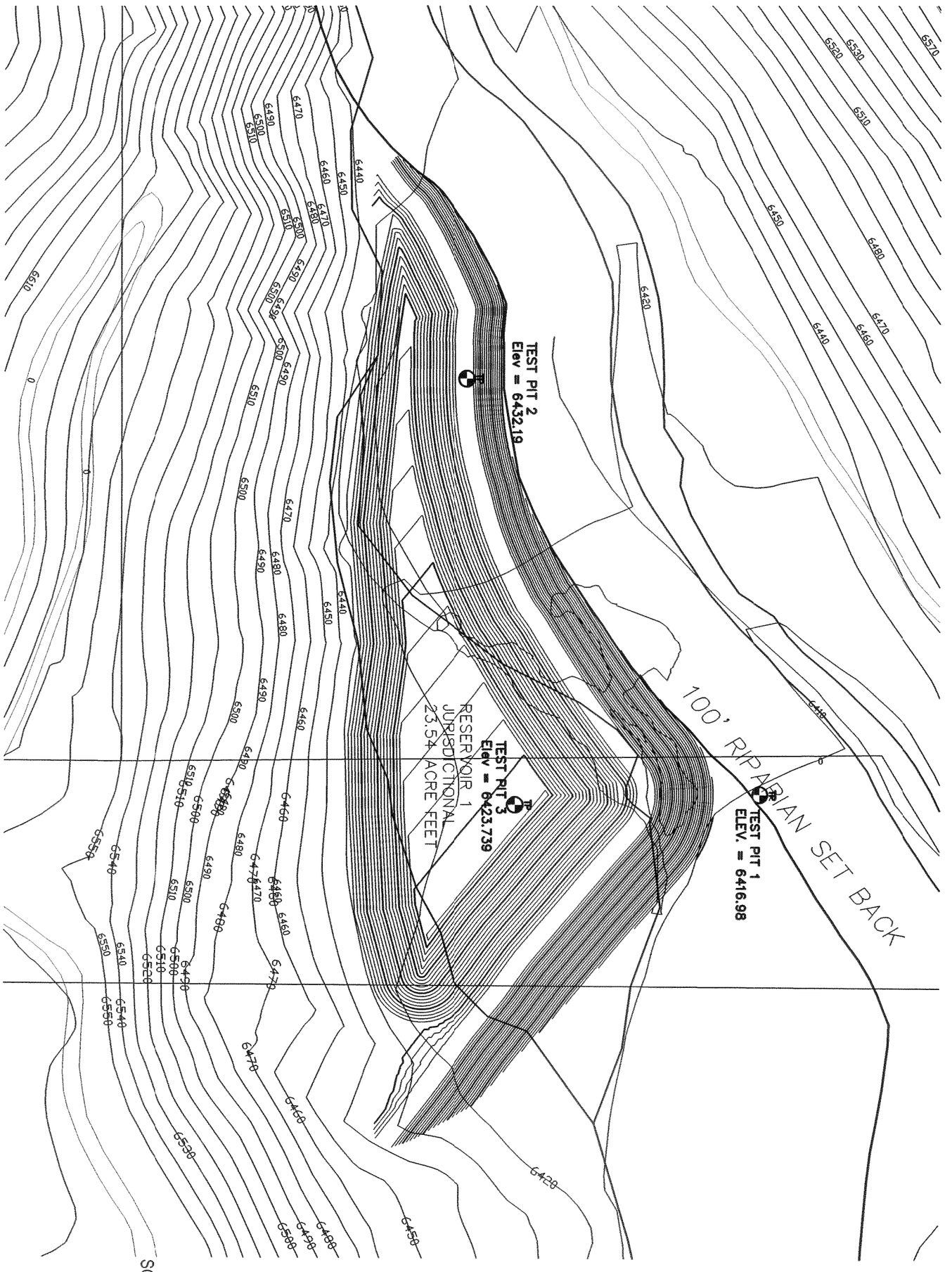
NO.	REVISION	BY	DATE

CRYSTAL RIVER STORAGE
PITKEN COUNTY, COLORADO

EXHIBIT MAP

VICINITY MAP

DATE: 08-13-09
JOB NO. 280159
SHEET 1 OF 12



SCALE: 1" = 100'

DATE: 08-13-09	CRYSTAL RIVER STORAGE	NO.	REVISION	BY	DATE
JOB NO. 280159	PITKEN COUNTY, COLORADO				
SHEET 3 OF 12	EXHIBIT MAP				
	RESERVOIR 1 JURISDICTIONAL				

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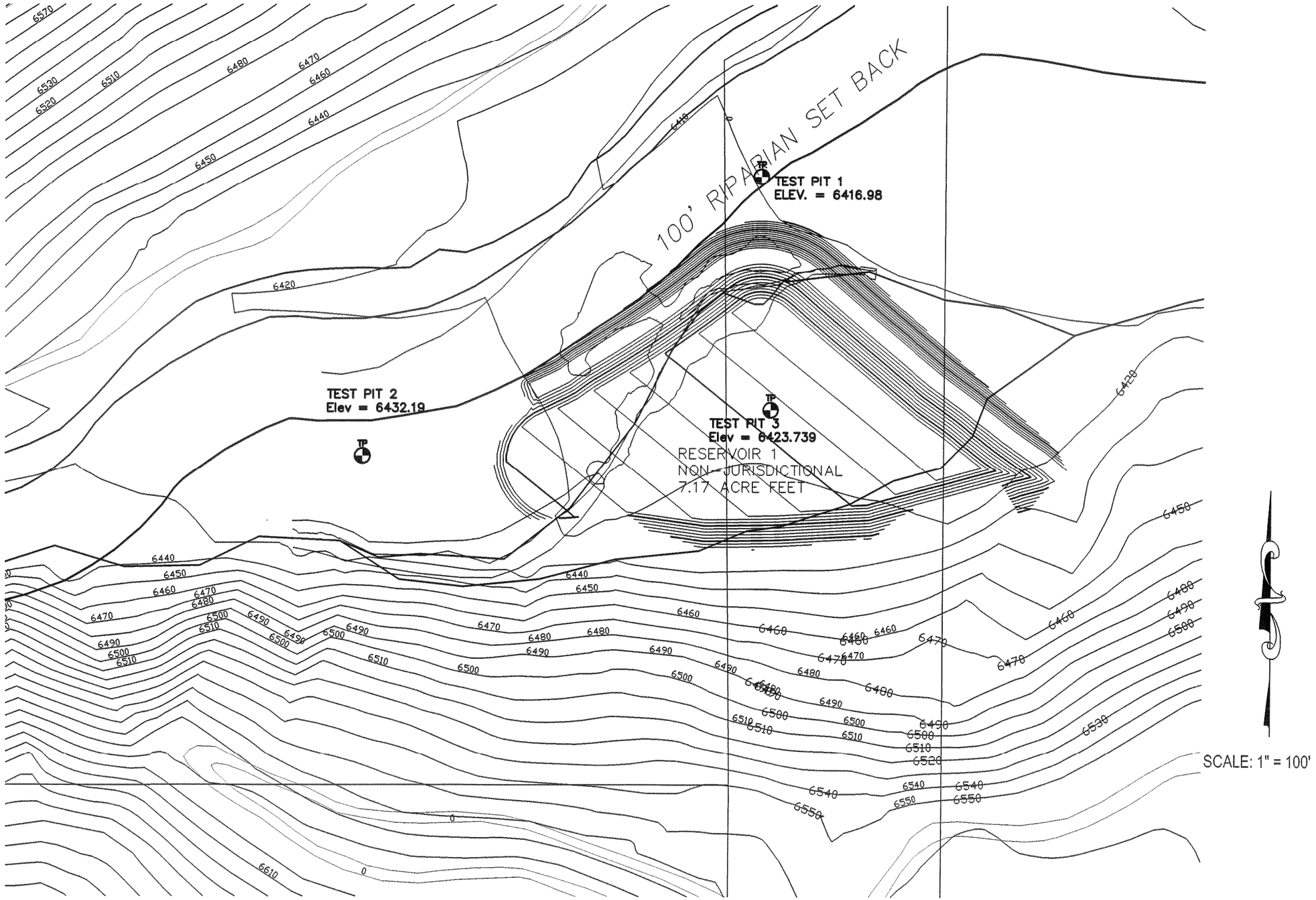

NO.	REVISION	BY	DATE

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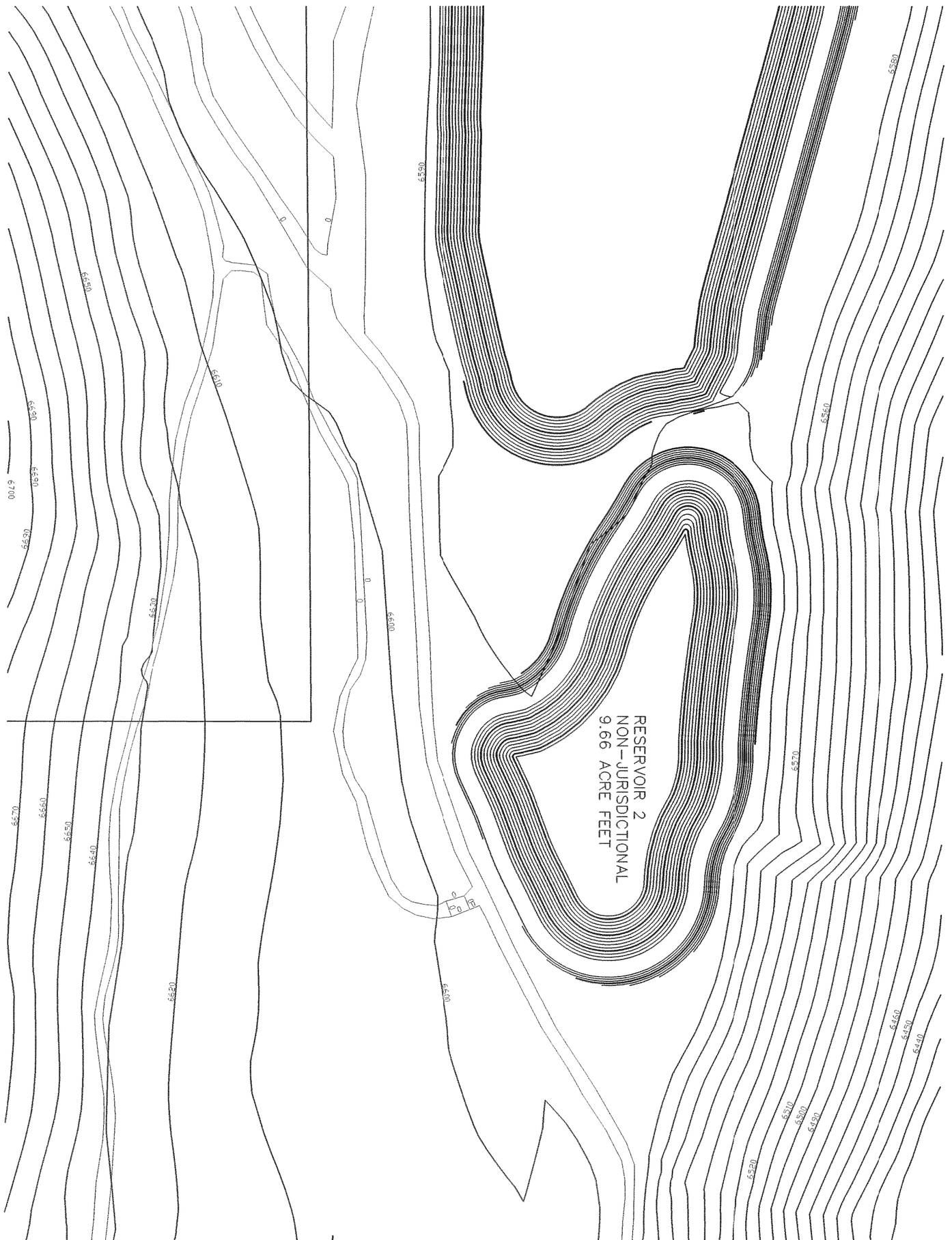
CRYSTAL RIVER STORAGE
PITKEN COUNTY, COLORADO

EXHIBIT MAP

RESERVOIR 1 NON-JURISDICTIONAL

DATE: 08-13-09
JOB NO. 280159
SHEET 2 OF 12



SCALE: 1" = 100'

DATE: 08-13-09	CRYSTAL RIVER STORAGE PITKEN COUNTY, COLORADO	NO.	REVISION	BY	DATE
JOB NO. 280159	EXHIBIT MAP				
SHEET 4 OF 12	RESERVOIR 2 NON- JURISDICTIONAL				

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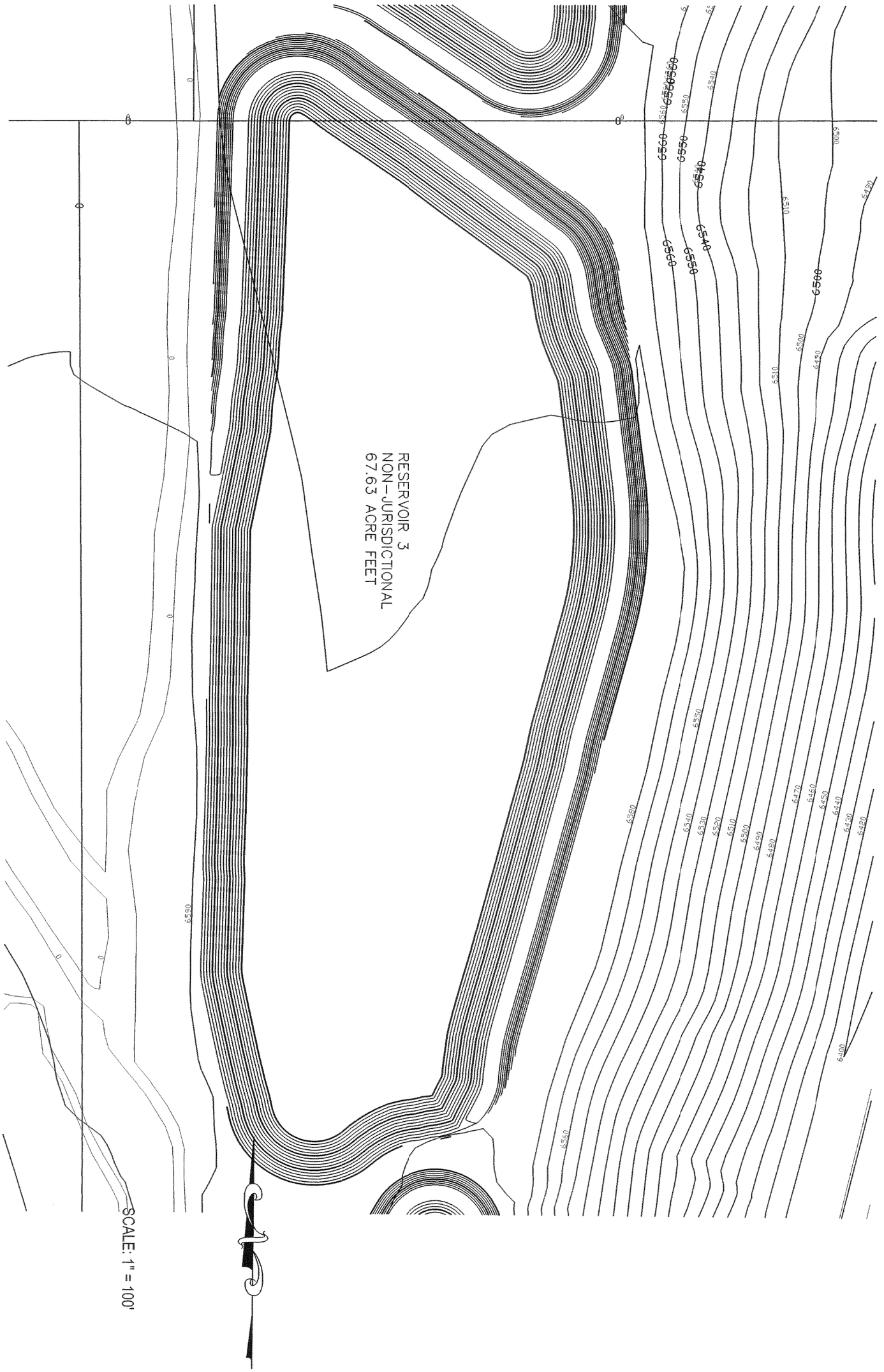

SHEET 5 OF 12	CRYSTAL RIVER STORAGE	NO.	REVISION	BY	DATE
JOB NO. 280159	PITKEN COUNTY, COLORADO				
DATE: 08-13-09	EXHIBIT MAP				
	RESERVOIR 3 NON-JURISDICTIONAL				

SOPRIS ENGINEERING, LLC.
CIVIL CONSULTANTS
502 MAIN STREET
CARBONDALE, CO 81623
(970) 704-0311
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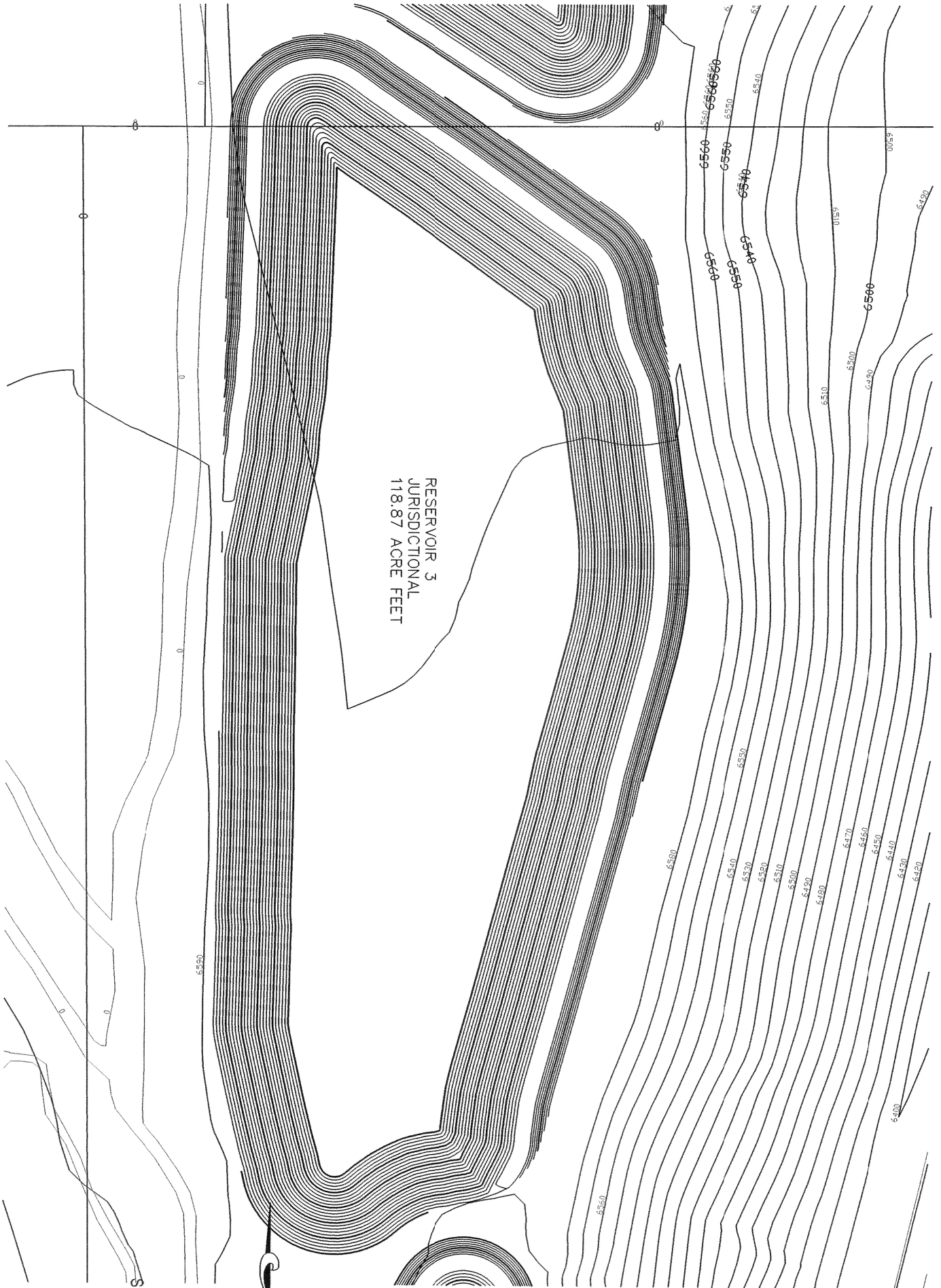

SHEET 6 OF 12	CRYSTAL RIVER STORAGE	NO.	REVISION	BY	DATE
JOB NO. 280159	PITKEN COUNTY, COLORADO				
DATE: 08-13-09	EXHIBIT MAP				
	RESERVOIR 3 JURISDICTIONAL				

SOPRIS ENGINEERING, LLC.
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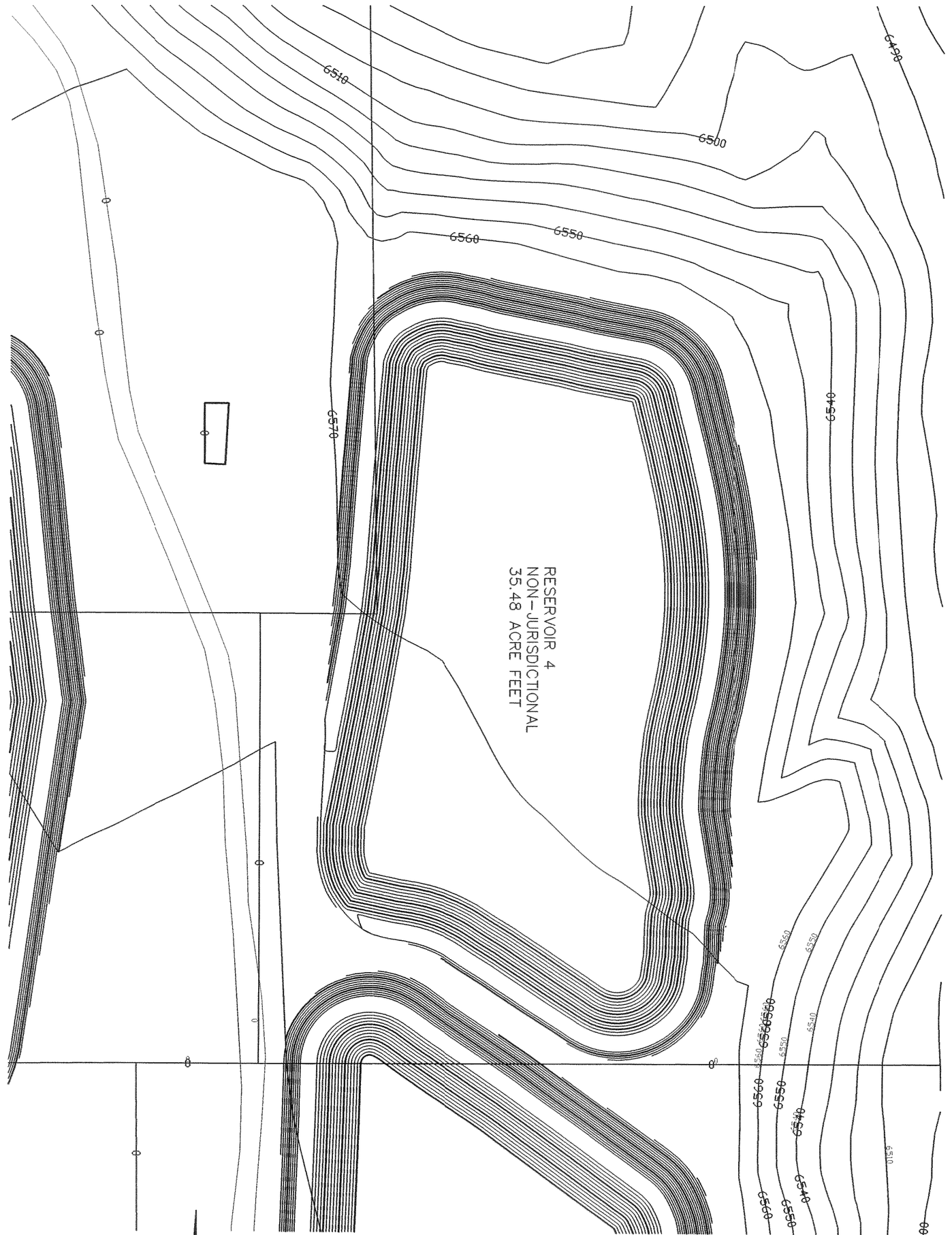

SCALE: 1" = 100'

SHEET 7 OF 12	CRYSTAL RIVER STORAGE PITKEN COUNTY, COLORADO	NO.	REVISION	BY	DATE
JOB NO. 280159	EXHIBIT MAP				
DATE: 08-13-09	RESERVOIR 4 NON-JURISDICTIONAL				

SOPRIS ENGINEERING, LLC.
CIVIL CONSULTANTS
502 MAIN STREET
CARBONDALE, CO 81623
(970) 704-0311
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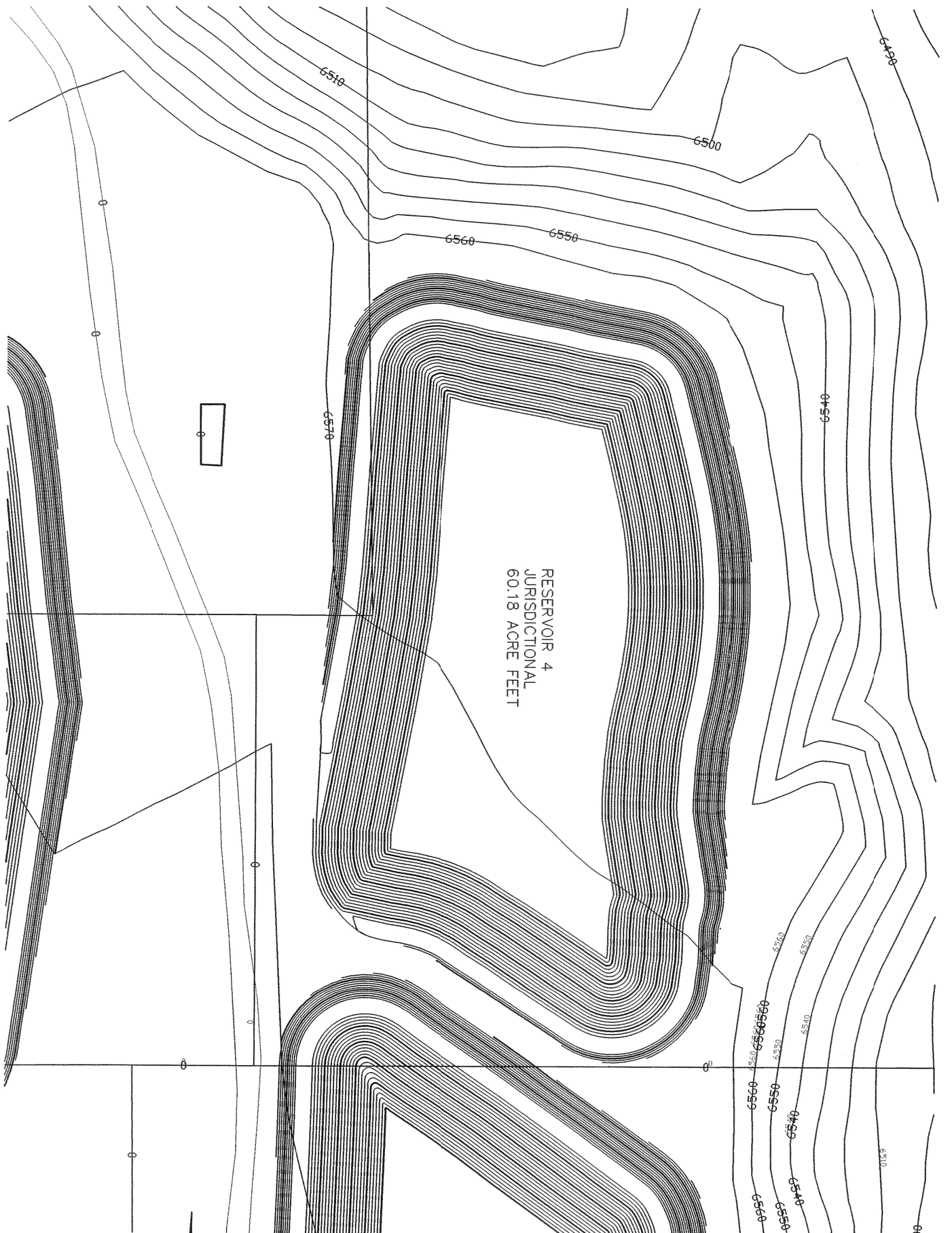

SCALE: 1" = 100'

SHEET 8 OF 12	CRYSTAL RIVER STORAGE	NO.	REVISION	BY	DATE
JOB NO. 280159	PITKEN COUNTY, COLORADO				
DATE: 08-13-09	EXHIBIT MAP				
	RESERVOIR 4 JURISDICTIONAL				

SOPRIS ENGINEERING, LLC.
CIVIL CONSULTANTS
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(970) 704-0311
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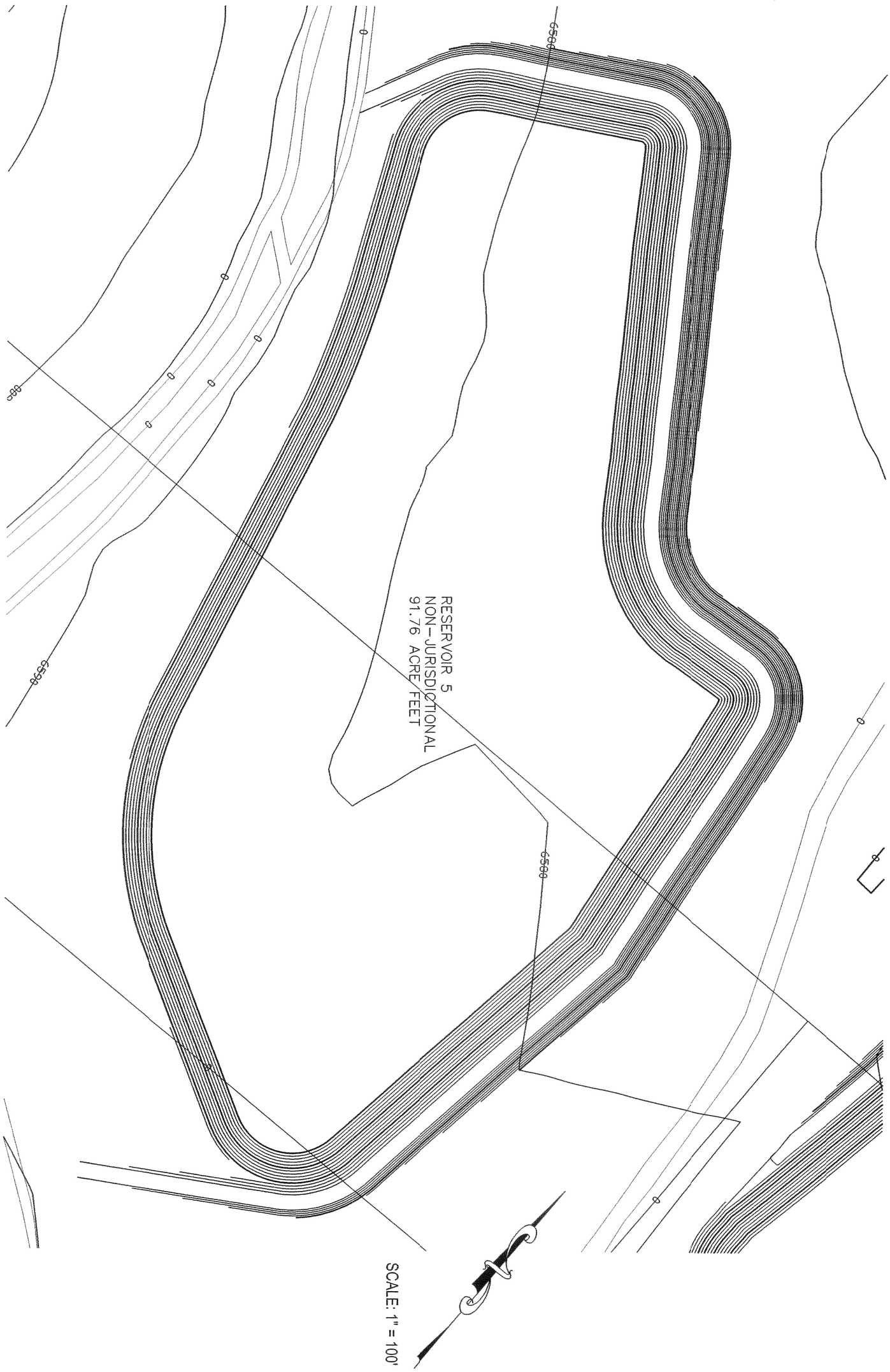
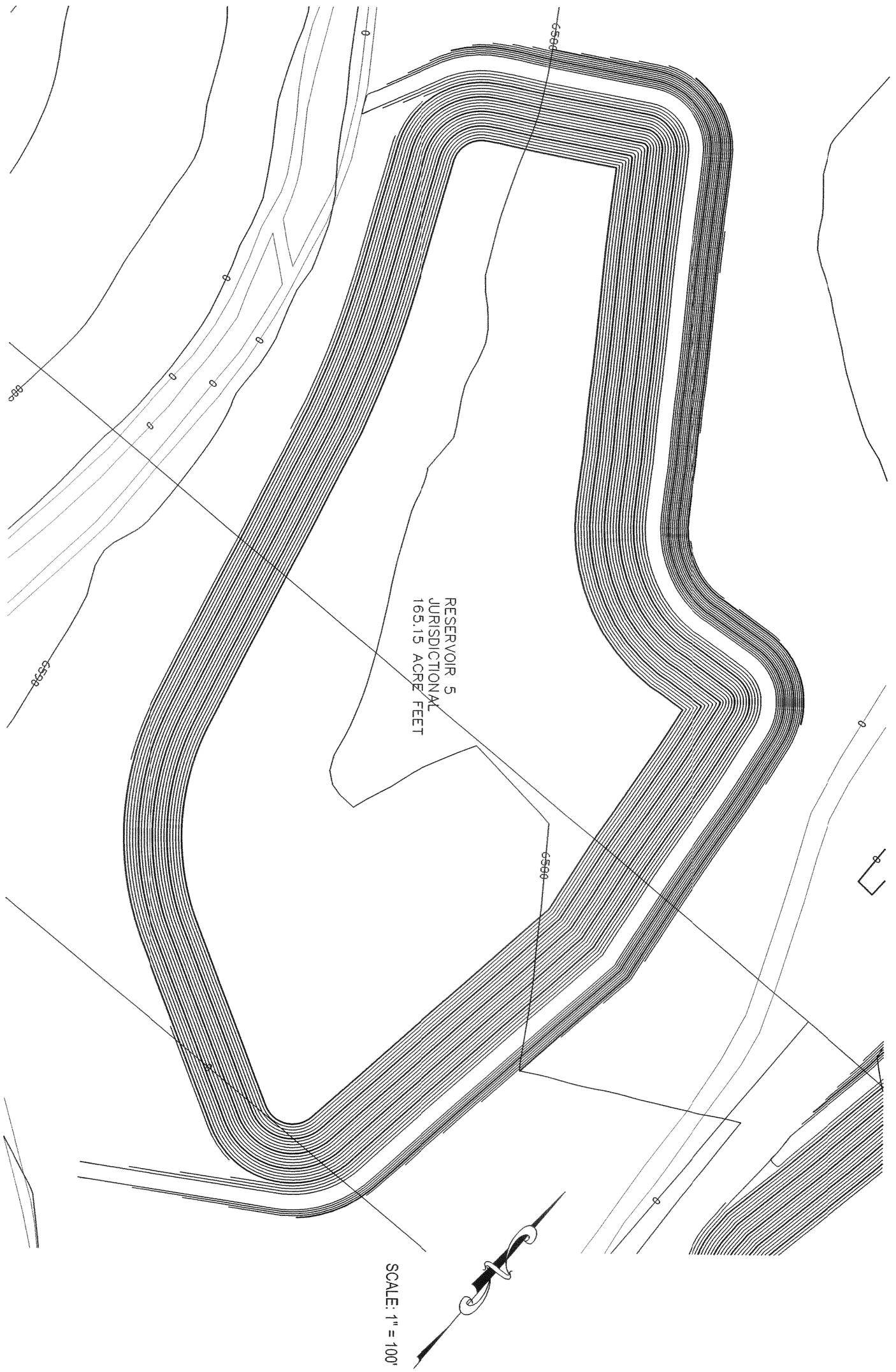


CRYSTAL RIVER STORAGE PITKEN COUNTY, COLORADO	NO.	REVISION	BY	DATE	SOPRIS ENGINEERING, LLC. CIVIL CONSULTANTS 502 MAIN STREET CARBONDALE, CO 81623 (970) 704-0311 FAX: (970)-704-0313
EXHIBIT MAP					
RESERVOIR 5 NON-JURISDICTIONAL					

DATE: 08-13-09
JOB NO. 280159
SHEET 9 OF 12



SHEET 10 OF 12	CRYSTAL RIVER STORAGE	NO.	REVISION	BY	DATE
JOB NO. 280159	PITKEN COUNTY, COLORADO				
DATE: 08-13-09	EXHIBIT MAP				
	RESERVOIR 5 JURISDICTIONAL				

SOPRIS ENGINEERING, LLC.
CIVIL CONSULTANTS
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(970) 704-0311
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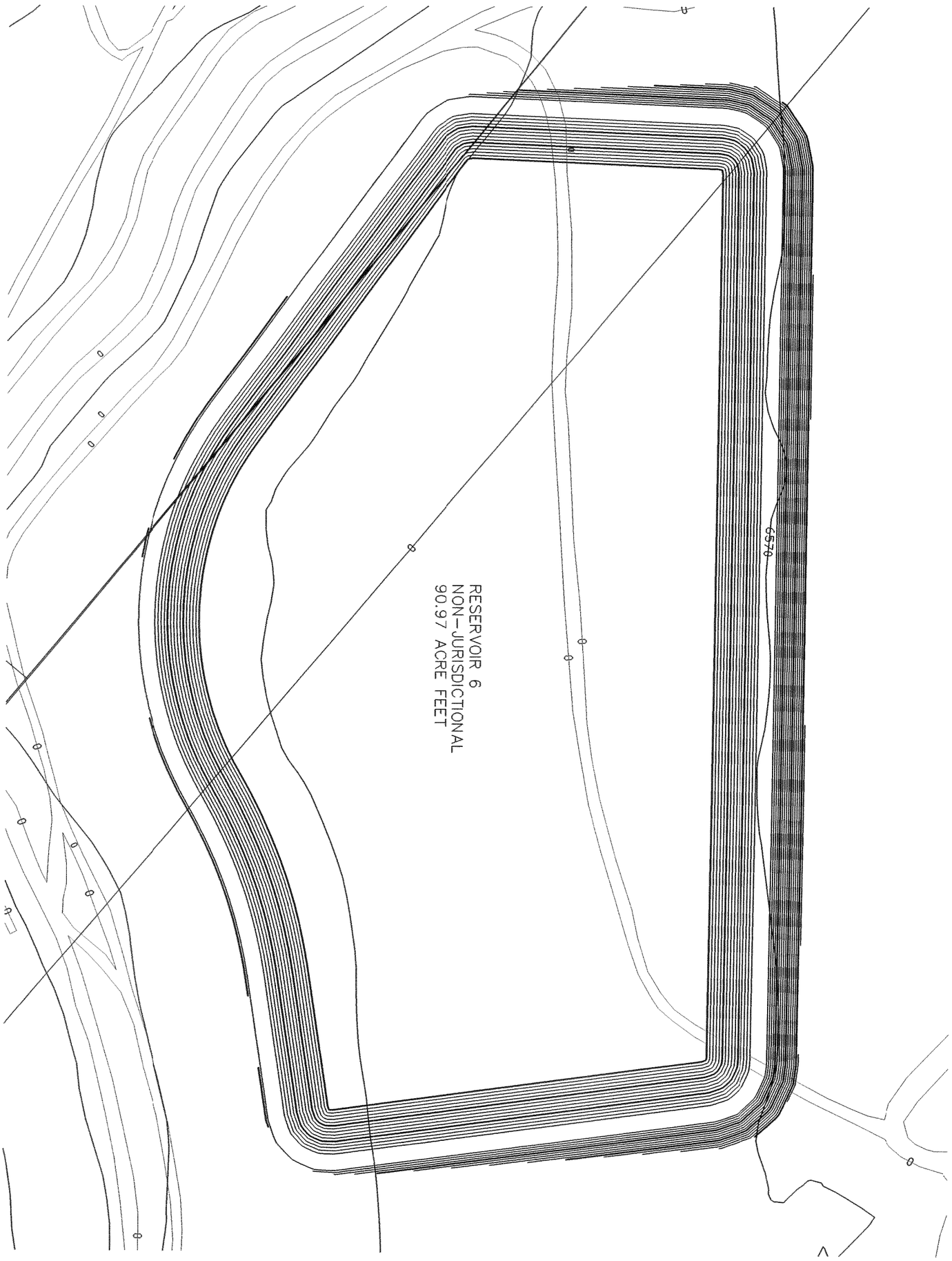


SCALE: 1" = 100'

SHEET 11 OF 12

JOB NO. 280159

DATE: 08-13-09

CRYSTAL RIVER STORAGE

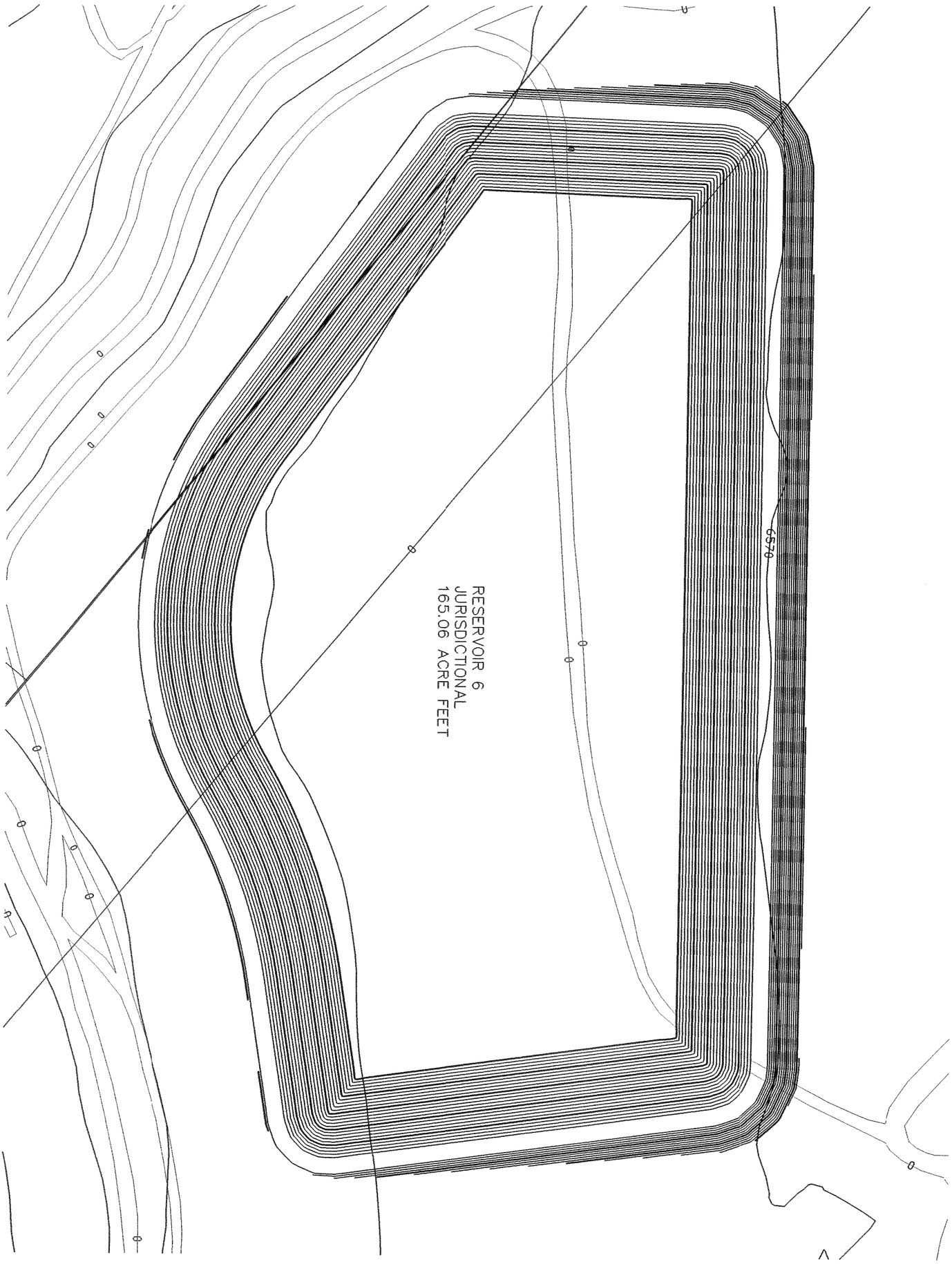
PITKEN COUNTY, COLORADO

EXHIBIT MAP

RESERVOIR 6 NON-JURISDICTIONAL

NO.	REVISION	BY	DATE

SOPRIS ENGINEERING, LLC.
CIVIL CONSULTANTS
502 MAIN STREET
CARBONDALE, CO 81623
(970) 704-0311
FAX: (970)-704-0313



SCALE: 1" = 100'

SHEET 12 OF 12	CRYSTAL RIVER STORAGE	NO.	REVISION	BY	DATE
JOB NO. 280159	PITKEN COUNTY, COLORADO				
DATE: 08-11-09	EXHIBIT MAP				
	RESERVOIR 6 JURISDICTIONAL				

SOPRIS ENGINEERING, LLC.
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CARBONDALE, CO 81623
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HP Geotech
HEPWORTH-PAWLAK GEOTECHNICAL

Hepworth-Pawlak Geotechnical, Inc.
5020 County Road 154
Glenwood Springs, Colorado 81601
Phone: 970-945-7988

Fax: 970-945-8454
email: hpgeo@hpgeotech.com

July 28, 2009

Sopris Engineering
Attn: Quint Nichol
502 Main Street, Suite A3
Carbondale, Colorado 81623

Job No.109 158A

Subject: Preliminary Geotechnical Study, Proposed Reservoir No. 1, Sewell Ranch, 6333 Highway 133, Pitkin County, Colorado

Dear Quint:

As requested, Hepworth-Pawlak Geotechnical, Inc. performed a geotechnical study for preliminary design of the proposed reservoir at the subject site. The study was conducted in accordance with our agreement for geotechnical engineering services to Sopris Engineering dated May 19, 2009. The data obtained and our recommendations based on the proposed construction and subsurface conditions encountered are presented in this report.

Proposed Construction: The reservoir is proposed next to Thompson Creek and west of Highway 133 as shown on Figure 1. The excavation material in the reservoir area is proposed to be used for construction of a homogeneous earth embankment. Cut and fill depths could be up to about 10 feet. The cut depth is expected to be limited by the groundwater level of the irrigated field and steepness of the uphill terrace escarpment. The reservoir will be off stream and fed by ditch water. The reservoir will be lined with an impervious synthetic membrane.

If the proposed construction is significantly different from that described above, we should be notified to re-evaluate the recommendations presented in this report.

Site Conditions: The proposed reservoir is located on a relatively narrow and flat terrace set back 100 feet from Thompson Creek. A steep escarpment borders the south side of the reservoir site and rises about 120 feet to an upper terrace level. Active ditches flood irrigate the reservoir site that mainly consists of field grass with a very tall and old cottonwood tree at the east end. Scattered cobbles and small boulders are exposed at ground surface as well as some marshy areas. The ground surface slopes gently down to the northeast with about 10 feet of elevation difference in the reservoir site.

Subsurface Conditions: The subsurface conditions were evaluated by observing 3 exploratory pits dug at the approximate locations shown on Figure 1. The logs of the pits are presented on Figure 2. The subsoils encountered, below about one foot of topsoil and up to 4 feet of loose, silty clayey sand with organics, consist of relatively dense, sandy gravel, cobbles and small boulders to the pit depths of 7 to 10 feet. Results of a gradation analysis performed on a sample of the gravel (minus 5 inch fraction) obtained from Pit 1 are presented on Figure 3. The laboratory test results are summarized in Table 1. Free water was encountered at depths of about 2 to 4 feet in the pits. The upper soils were very moist to wet. The near surface rock at the site appears to be the Maroon Formation.

Conclusions and Recommendations: Development of the site appears feasible based on geotechnical considerations. Constraints include the shallow groundwater level and the steep uphill slope. Excavation material will be derived from both the upper sand and the underlying gravel soils that should be suitable for the earthen embankment construction. Excavation dewatering and drying of the cut material for embankment construction could be needed. The topsoil should be stripped from the project site. The sand soils should additionally be removed from beneath the proposed embankment area and mixed with the gravel material in the embankment construction. Organics and rocks larger than about 8 inches should be excluded from the embankment fill. The uphill slope of the reservoir is proposed to roughly match the existing terrace escarpment. The natural slope appears relatively stable at a grade of about 2 horizontal to 1 vertical but has not been evaluated for stability as part of this study. Proposed reservoir embankment slopes of 2 to 1 appear suitable for the lined reservoir and a dry slope condition. The slope stability should be evaluated as part of the preliminary design of the proposed reservoir grading plan. Additional evaluations could also be needed depending on the desired reservoir configuration and grading.

Limitations: This study has been conducted in accordance with generally accepted geotechnical engineering principles and practices in this area at this time. We make no warranty either express or implied. The conclusions and recommendations submitted in this report are based upon the data obtained from the exploratory pits excavated at the locations indicated on Figure 1 and to the depths shown on Figure 2, the proposed type of construction, and our experience in the area. Our findings include interpolation and extrapolation of the subsurface conditions identified at the exploratory pits and variations in the subsurface conditions may not become evident until excavation is performed.

This report has been prepared for the exclusive use by our client for preliminary design purposes. We are not responsible for technical interpretations by others of our information. As the project evolves, we should provide continued consultation and evaluations to develop design level recommendations. We recommend on-site

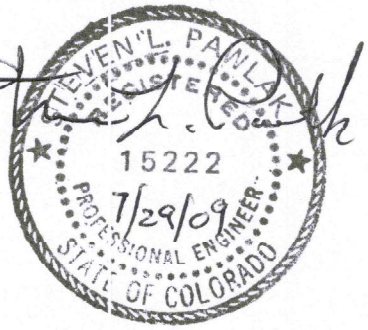
observation of excavations and testing of structural fill by a representative of the geotechnical engineer.

If you have any questions or need further assistance, please let us know.

Respectfully Submitted,

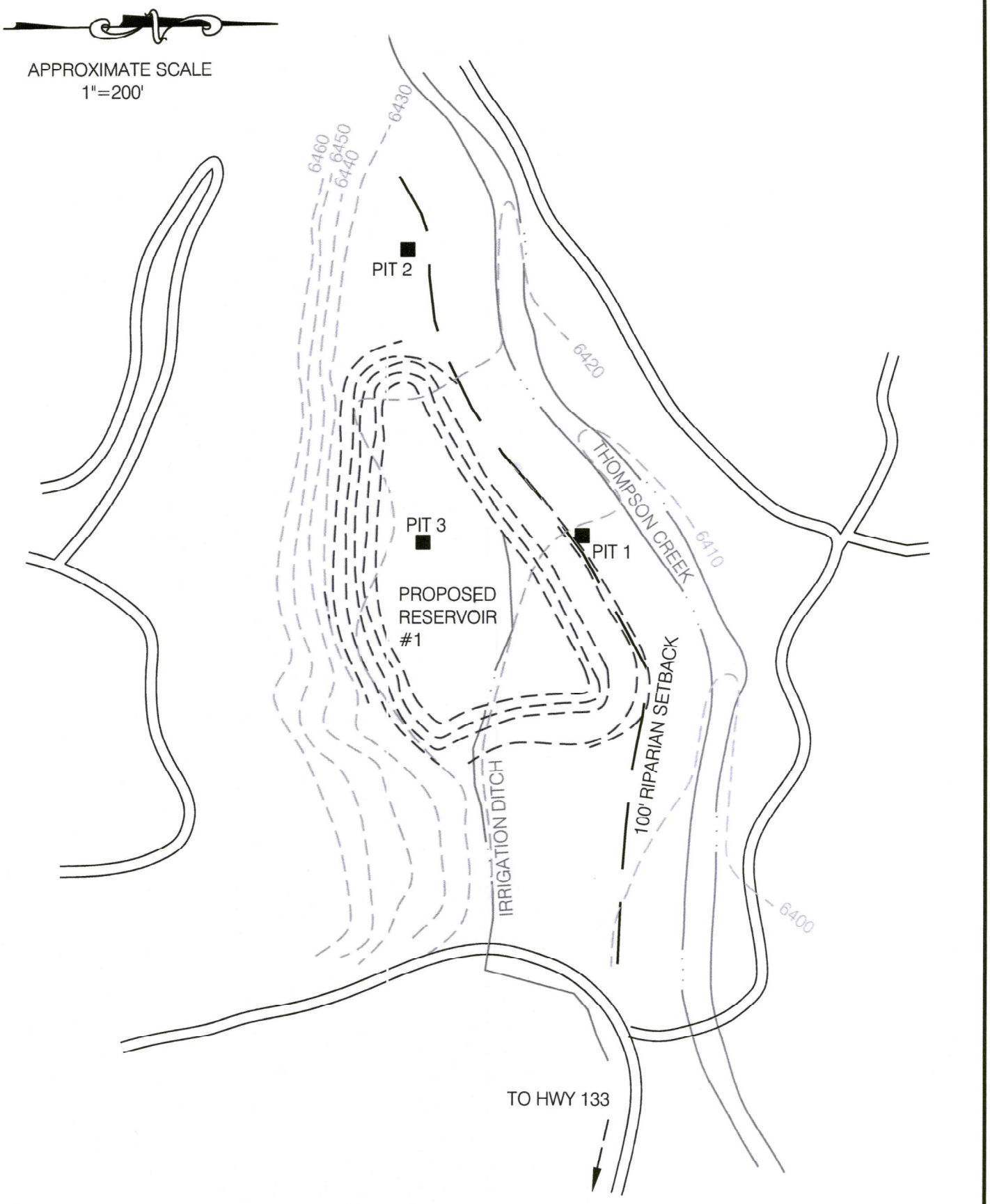
HEPWORTH - PAWLAK GEOTECHNICAL, INC.

Steven L. Pawlak, P.E.

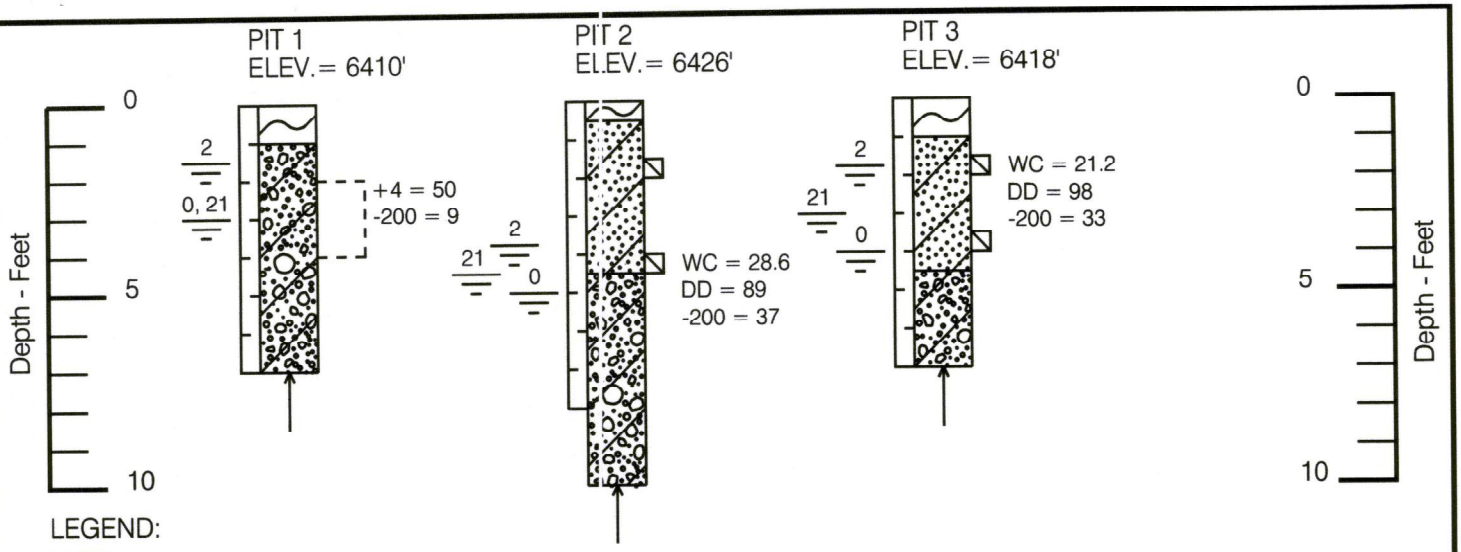


SLP/djb

attachments Figure 1 – Location of Exploratory Pits
Figure 2 – Logs of Exploratory Pits
Figure 3 – Gradation Test Results
Table 1 – Summary of Laboratory Test Results



109 158A	HP Geotech Hepworth–Pawlak Geotechnical	LOCATION OF EXPLORATORY PITS	Figure 1



LEGEND:

TOPSOIL; organic sandy clayey silt, dark brown

SAND (SM); silty, slightly clayey and gravelly, loose, wet, dark brown, some organics.

GRAVEL, COBBLES and BOULDERS (GM-GP); slightly silty, sandy, dense, wet, brown, rounded rocks.

2" Diameter hand driven liner sample.

Disturbed bulk sample.

0,2 Free water level in pit and number of days following excavating measurement was made.

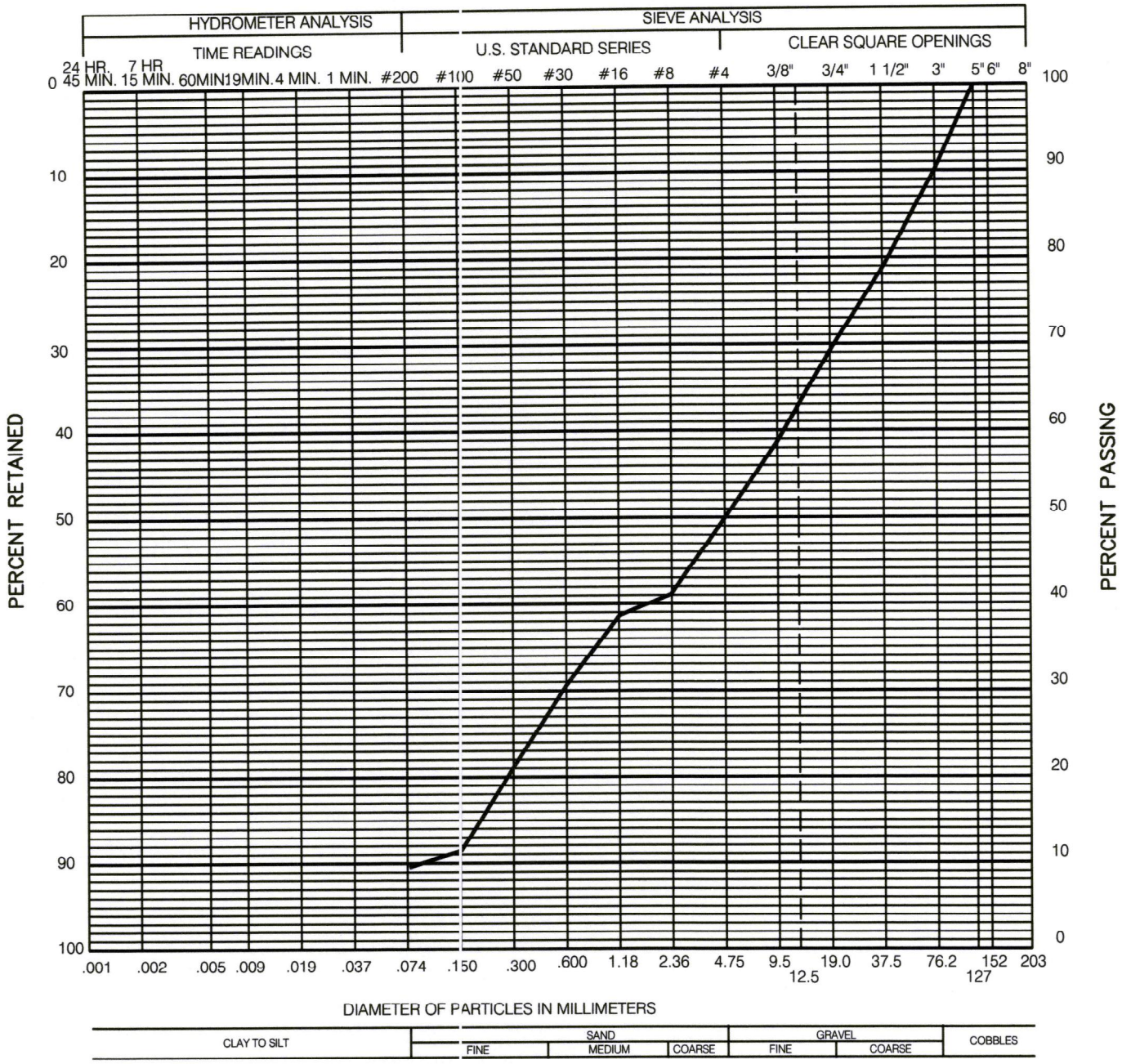
Indicates slotted PVC pipe installed in pit to depth shown.

Practical digging refusal.

NOTES:

1. Exploratory pits were excavated on June 2, 2009 with a Cat 420D backhoe.
2. The exploratory pits were staked by Sopris Engineering in the approximate reservoir site.
3. Elevations of exploratory pits were obtained by interpolation between contours shown on the site plan provided.
4. The exploratory pit locations and elevations should be considered accurate only to the degree implied by the method used.
5. The lines between materials shown on the exploratory pit logs represent the approximate boundaries between material types and transitions may be gradual.
6. Water level readings shown on the logs were made at the time and under the conditions indicated. Fluctuations in water level may occur with time.
7. Laboratory Testing Results:
   WC = Water Content (%)
   DD = Dry Density (pcf)
   -200 = Percent passing No. 200 sieve
   +4 = Percent passing No. 4 sieve

109 158A	HP Geotech Hepworth–Pawlak Geotechnical	LOGS OF EXPLORATORY PITS	Figure 2



GRAVEL 50 % SAND 41 % SILT AND CLAY 9 %

LIQUID LIMIT % PLASTICITY INDEX %

SAMPLE OF: Slightly Silty Sandy Gravel with Cobbles FROM: Pit 1 at 2 to 4 Feet

109 158A	HP Geotech Hepworth–Pawlak Geotechnical	GRADATION TEST RESULTS	Figure 3

HEPWORTH-PAWLAK GEOTECHNICAL, INC.

TABLE 1

SUMMARY OF LABORATORY TEST RESULTS

Job No. 109 158A

SAMPLE LOCATION		NATURAL MOISTURE CONTENT	NATURAL DRY DENSITY	GRADATION		PERCENT PASSING NO. 200 SIEVE	ATTERBERG LIMITS		UNCONFINED COMPRESSIVE STRENGTH		SOIL OR BEDROCK TYPE
PIT	DEPTH (ft)	(%)	(pcf)	GRAVEL (%)	SAND (%)		LIQUID LIMIT (%)	PLASTIC INDEX (%)	(PSF)		
1	2-4			50	41	9					Slightly Silty Sandy Gravel with Cobbles
2	4	28.6	89			37					Slightly Clayey, Silty Sand
3	1 1/2	21.2	98			33					Slightly Clayey, Silty Sand

Attachment 2

ERO Resources Corp.
Environmental Review

ERO Resources Corp.
29844 Stingley Gulch Rd.
Hotchkiss, CO 81419
(970) 872-3020
www.eroresources.com
ero@eroresources.com

August 14, 2009

To: Kerry Sundeen
Grand River Consulting
718 Cooper Ave.
Glenwood Springs, CO 81601

From: Aleta Powers
ERO Resources Corporation

Re: Crystal River Wetland, Riparian and Natural Resource Permitting Memo

On May 19, 2009, Aleta Powers with ERO Resources Corporation reviewed a potential augmentation reservoir location near the confluence of Thompson Creek and the Crystal River for potential environmental issues. Specific review topics were wetlands, riparian areas, floodplains, threatened and endangered species, and migratory bird issues. Thompson Creek is a perennial tributary to the Crystal River, a perennial tributary to the Colorado River, a Traditional Navigable Water.

The review area is located in Pitkin County, Section 28, Township 8 South, Range 88 West; Latitude 39°19'55.02351", Longitude -107°13'04.46896 (see Figure 1).

Methods

Using methods outlined in the 1987 *Corps of Engineers Wetlands Delineation Manual* and the 2006 *Interim Regional Supplement: Arid West Region*, wetlands were determined based on the presence of three wetland indicators: hydrophytic vegetation, hydric soils, and wetland hydrology. Wetland indicator status for plant species was determined by Sabine (1994). The potential jurisdictional nature of the project area wetlands also were reviewed and are summarized in the following sections.

Riparian areas were reviewed to identify potential compliance issues with Pitkin County regulations. Potential riparian areas were identified in the field and mapped on aerial photography. FEMA/FIRM maps were reviewed for the location of the 100-year floodplain in the project area.

The project area was reviewed for habitat and/or potential downstream impacts to species listed as threatened or endangered under the Endangered Species Act that might require consultation with the U.S. Fish and Wildlife Service. Species with habitat in Pitkin County, or whose habitat could be affected by activities in Pitkin County, are listed below.

The U.S. Fish and Wildlife Service (USFWS) has listed the following threatened, endangered, and candidate species as potentially occurring in Garfield County (USFWS 2009). In addition, the bald eagle (*Haliaeetus leucocephalus*) was recently delisted, but is still protected by the Service under the Bald and Golden Eagle Protection Act.

- Canada lynx (*Lynx canadensis*), Threatened
- Colorado River Fish, Endangered
- Mexican Spotted Owl (*Strix occidentalis lucida*), Threatened
- Uncompahgre fritillary butterfly (*Boloria acrocnema*), Endangered
- Ute ladies'-tresses orchid (*Spiranthes diluvialis*), Threatened
- Yellow-billed Cuckoo (*Coccyzus americanus*), Candidate

Potential habitat for Migratory birds—protected under the Migratory Bird Treaty Act (MBTA)—was documented in the project area.

Findings

Wetlands and Waters of the U.S.

One wetland was delineated within the proposed reservoir footprint. Three data sheets (TC-1 to TC-3) were completed, and data sheet locations recorded (see attached data sheets). Wetland edges were marked with consecutively numbered flags, and surveyed the same day. Only one wetland was recorded (see Figure 2). Wetland 1 consists of a wetland area along an irrigation ditch, and an area adjacent to the ditch that also appears to be supported by irrigation water. There is some potential that this wetland is supported by ground water from Thompson Creek or other shallow ground water, but the landscape position of the area is well above the creek. It appears that a stockpond with low dam previously occupied part of the current wetland area, and although the dam is no breached, water spreads out throughout the area rather than flowing in a defined irrigation channel. The delineated portion of the wetland is about 0.44 acres, and as currently planned the reservoir would impact the entire wetland. A narrow wetland fringe continues along the ditch as it traverses east of the proposed reservoir site.

Vegetation is dominated by Baltic rush (*Juncus articus* ssp. *ater*). Other vegetation includes redtop (*Agrostis stolinifera*), Kentucky bluegrass (*Poa pratensis*), and dandelion (*Taraxacum officinale*). A small patch of Canadian thistle (*Breea arvensis*) was also observed. Three soil pits were dug around the wetland to determine the wetland boundary. TC-1 was the only soil pit that had evidence of wetland soils. The top 0.5 inch of soil was organic clay loam with a Munsell matrix color of 10YR3/2. 0.5 to 2 inches deep was clay loam with a Munsell matrix color of 10YR3/2. At 2 to 18 inches, the soil was clay loam with a Munsell matrix color of 7.5YR4/2 with redox features including a depleted matrix of less than five percent with a Munsell matrix color of 7.5YR5/6. Deeper than 18 inches consisted of rock. Soils were sandy loam with a matrix color of 10YR 4/2 and small faint oxidized mottles, and met criteria for stripped matrix hydric soil. The pockets/layers of sand appeared to be from apparent high water events. Hydrology indicators include oxidixed rhizospheres along living roots (only observed along small root, but not throughout) and an FAC-neutral test. The water table was located at a depth of 15 inches. The uplands adjacent to Wetland 1 (TC-2 and TC-3) are dominated by Kentucky bluegrass, timothy (*Phleum pretense*), with minor percentages of cover for Nebraska sedge (*Carex nebrascensis*), and reed canarygrass (*Phalaroides arundinacea*).

Thompson Creek Ordinary High Water Mark and Wetlands

Wetlands also are located along Thompson Creek in the project area, but were not delineated as part of this study. Potential impacts to wetlands and/or along Thompson Creek from a potential augmentation reservoir outlet would likely be minor in nature, but could require a Corps permit depending on the structure location. Because the outlet structure has not been designed, it cannot be determined whether a Corps permit would be required. It is likely permitting can be avoided with careful outlet planning and design.

Jurisdictional Nature of Wetlands

The context and potential jurisdictional nature of this wetland was discussed on site. The wetlands and ditch as currently located are likely jurisdictional because of their eventual connection to the Crystal River via a series of interconnected canals and ditches. However, as part of ongoing operations, Mr. Sewell indicated that the ditch may be relocated upslope of its existing location because it would provide better irrigation efficiencies. If this occurs, it is likely that at least a portion of the wetlands currently supported by the ditch would dry up and no longer support a prevalence of wetland vegetation. If dry-up and vegetation community

shifts to non-wetland species occur, those areas would no longer meet the Corps wetland definition.

Thompson Creek is tributary to the Crystal River and is a jurisdictional water.

Riparian/Floodplain areas

Pitkin County defines Riparian Habitat as "…plant communities contiguous to and affected by surface and subsurface hydrologic features of perennial or intermittent lotic and lentic water bodies (rivers, streams, lakes, or drainage ways). Riparian areas have one (1) or both of the following characteristics: a) distinctly different vegetative species than adjacent areas, and b) species similar to adjacent areas but exhibiting more vigorous or robust growth forms. Riparian areas are often transitional area wetland and upland." For riparian area delineation purposes, those areas with wetland vegetation (classified as Facultative or wetter) but lacking soils and/or hydrology characteristics were mapped as riparian. Areas immediately adjacent to the creek and having a riparian overstory and understory were mapped (see Figure 2). Dominant woody vegetation in the project area includes alder (*Alnus incana* ssp. *tenuifolia*), narrowleaf cottonwood (*Populus angustifolia*), and various willow species (*Salix* sp).

Pitkin County requires 100-foot setbacks from natural riparian areas and wetlands, with opportunities for reducing this to a 50-foot setback if the project proponent can prove that "such reduction shall not result in water quality degradation, stream bank erosion and/or a reduction in the quality of riparian or wetland habitat." The reservoir as currently designed is outside of the 100-foot setback of Thompson Creek. Manmade structures such as ditches and the non-natural wetlands and riparian areas they support are not protected under Pitkin County Land Use Code and do not require setbacks; therefore the wetland fringe along ditches and the limited riparian vegetation supported by the ditches in the project area would not require setbacks. Natural wetlands that are isolated—i.e., lacking a surface connection to interstate waters—are included in the setback protection. As noted previously, Wetland 1 appears to be supported by irrigation ditches but it is unknown if this feature is partially or fully supported by shallow ground water. If this wetland is determined to be not a natural wetland (i.e., is supported solely by irrigation water), it would not be subject to Pitkin County Land Use regulations. However, if it is a natural wetland supported by shallow ground water it would be subject to Pitkin County Land Use regulations. Any outlet structure placed within 100 feet of Thompson Creek also is assumed to require Pitkin County review and permitting.

A portion of the proposed project area is within the FEMA Special Flood Hazard Areas inundated by 100-year Flood (Zone A; no base flood elevations determined; FEMA 1987). It

is likely that a Pitkin County Floodplain Development Permit—which is required for any work within the designated 100-year floodplain (including bank stabilization, bridges, dredging, installation of irrigation equipment, and revegetation) will be required for the project.

Threatened and Endangered Species

ERO compiled the following habitat characteristics and reviewed the project area for potential suitable habitat. In summary, ERO recommends consulting informally with USFWS regarding potential impacts—both beneficial and adverse—to the Endangered Colorado River Fish.

Bald Eagle—Bald eagles are primarily winter residents in Colorado. Most nesting in Colorado occurs near lakes or reservoirs or along rivers. Typical bald eagle nesting habitat consists of forests or wooded areas that contain many tall, aged, dying and dead trees (Martell 1992). A winter roost site for the bald eagle has been identified by the Natural Diversity Information Source (NDIS 2009;COGCC 2009) about 2 miles north of the project area along the Crystal River. The project area could provide roosting and foraging habitat for bald eagles, although there are few dying or dead trees that provide optimal habitat.

Canada Lynx—Lynx habitat generally is described as climax boreal forest with a dense understory of thickets and windfalls (DeStefano 1987). In the southern Rockies, primary lynx habitat is found in the subalpine and upper montane forests between 2,450 and 3,650 meters (8,000 and 12,000 feet) (Lynx Biology Team 2000). Subalpine forest habitat is dominated by subalpine fir and Engelmann spruce (*Picea engelmannii*) while the upper montane forest supports lodgepole pine (*Pinus contorta* ssp. *latifolia*) and aspen (Lynx Biology Team 2000).

The Southern Rockies (Colorado and southern Wyoming) were identified as a Provisional Core Area, because there is a reintroduced lynx population. This lynx population has successfully reproduced in the wild (USDA Forest Service 2008). No lynx critical habitat has been designated in the Southern Rockies.

As described previously, the majority of the project area is upland meadow community and is dominated by Kentucky bluegrass, smooth brome, dandelion, and other introduced pasture grasses and forbs. There is no suitable habitat for lynx foraging, denning, or movement corridors in the study area.

Colorado River Fish—In March 1994, the Department of the Interior designated 1,980 miles of the Colorado River as "critical habitat" for Colorado pikeminnow (*Ptychocheilus*

lucius), razorback sucker (*Xyrauchen texanus*), bonytail (*Gila elegans*), and humpback chub (*Gila cypha*). These fish have similar habitat requirements and historically lived in the same rivers. Critical habitat for the endangered Colorado River Fish on the Colorado River covers the portion of the Colorado River from Rifle, Colorado, to Lake Powell, Utah. Any activities that result in new depletions to the Colorado River—including new surface water evaporation—must be disclosed under the Upper Colorado River Endangered Fish Recovery Program (USFWS 2007).

The December 1999 Biological Opinion for Water Use and Recovery of Colorado River Endangered Fish states that impacts associated with new water depletion projects are offset by Recovery Program accomplishments and by a one-time contribution made by the water project. There is no charge for existing depletions or for new depletions of less than 100 acre-feet of water. The proposed reservoir would increase evaporation, but would also provide augmentation water. ERO recommends consulting with the USFWS regarding the new reservoir, to ensure compliance with the Recovery Program and the ESA.

Mexican Spotted Owl—The Mexican spotted owl (spotted owl) is listed as threatened under the ESA and as a Colorado threatened species. In Colorado, the spotted owl typically inhabits areas with steep exposed cliffs; canyons that are characterized by piñon-juniper; and old-growth forests mixed with Douglas-fir, ponderosa pine, and white fir (Andrews and Righter 1992; USFWS 1995).

No habitat or designated critical habitat for the spotted owl occurs in the study area.

Uncompahgre Fritillary butterfly—The Uncompahgre Fritillary butterfly was listed as endangered on June 24, 1991. A Recovery Plan was completed for the species in 1994 (FWS 1994). No critical habitat has been designated. The Recovery Plan identifies snow willow patches on northeast-facing slopes above 12,500 feet as the only known habitat for the butterfly. Rock willow also provides habitat for the butterfly. Rock willow and snow willow are diminutive species growing less than 10 cm high. Weber describes these as "Depressed, prostrate-creeping, strictly alpine plants less than 10 cm high" (Weber 2001). There is no suitable habitat for the butterfly in the project area.

Ute Ladies'-Tresses Orchid—The Ute Ladies'-Tresses Orchid (ULTO) occurs at elevations below 7,000 feet in moist to wet alluvial meadows, floodplains of perennial streams, and around springs and lakes. Occurrences of ULTO have been documented in

Colorado, Wyoming, Idaho, Nevada, and Utah. Generally, the species occurs where the vegetative cover is relatively open and not overly dense or overgrazed (USFWS 1992).

Recently, the ULTO has been found about 10 miles northeast of the project area along the Roaring Fork River (Condon 2007). There are no known occurrences of ULTO within the project area. The landscape setting, soils, and vegetation communities in the project area are not habitat for the ULTO. The Thompson Creek floodplain is steep and channelized, rather than forming a wide alluvial plain supporting wet meadows. Soils are clay loams that are generally more dense than the alluvial soils typical for ULTO. In addition, the project area is grazed, with introduced pasture grasses, and understory cover that is not supportive of ULTO establishment.

Yellow-billed Cuckoo—The yellow-billed cuckoo (cuckoo) is a neotropical migratory bird. The cuckoo is a summer resident throughout the United States, southern Canada, and northern Mexico; it winters from Colombia and Venezuela south to northern Argentina (Ehrlich et al. 1992; AOU 1998). Cuckoos breed in large blocks of riparian habitat, particularly in cottonwood and willow stands, which they also use extensively for foraging (Ehrlich et al. 1992). Dense understory vegetation seems to be an important factor in site selection (USFWS 2001). The narrow bands of riparian habitat and grazed nature of the project area make it unsuitable habitat for the cuckoo.

Migratory Birds

Habitat for Migratory Birds occurs in the project area, particularly in trees and shrubs along irrigation ditches, Thompson Creek, and scattered throughout the property. To avoid violating the MBTA, ERO recommends all clearing and grubbing for the project occur outside of the nesting season, or between about September 1 and March 31. The Migratory Bird Nesting Season is about April 1 to August 31.

Summary

The table below summarizes the findings of the site review for the potential augmentation reservoir near the Thompson Creek and Crystal River confluence.

Table 1. Summary of Environmental Issues

Issue	Findings/Conclusion
Wetlands and Waters of the U.S.	One wetland (0.44 acres) was identified in the project area and would be completely impacted/filled by the proposed project. If the wetland is supported solely by irrigation water and can be dried up by changing the

Issue	Findings/Conclusion
	ditch alignment, no wetland permitting would be required by either the Corps or Pitkin County. If the wetland is natural and supported by shallow groundwater, permitting by both the Corps and Pitkin County would be required. Permitting may also be required for the outlet structure for the reservoir into Thompson Creek.
Riparian Areas	The project is outside of the 100-foot setback from Thompson Creek. Depending upon the finding for Wetland 1 (i.e., natural or supported solely by irrigation water), a Pitkin County wetland permit may or may not be required. Other riparian areas in the project area are supported by ditches and are not subject to Pitkin County Land Use Regulations.
Floodplains	A portion of the proposed reservoir is within the 100-year floodplain as defined by FIRM. Therefore, it is assumed that a Pitkin County Floodplain permit would be required.
T&E Species	ERO recommends consulting informally with USFWS regarding potential impacts—both beneficial and adverse—to the Endangered Colorado River Fish.
Migratory Birds	ERO recommends all clearing and grubbing for the project occur outside of the nesting season, or between about September 1 and March 31.

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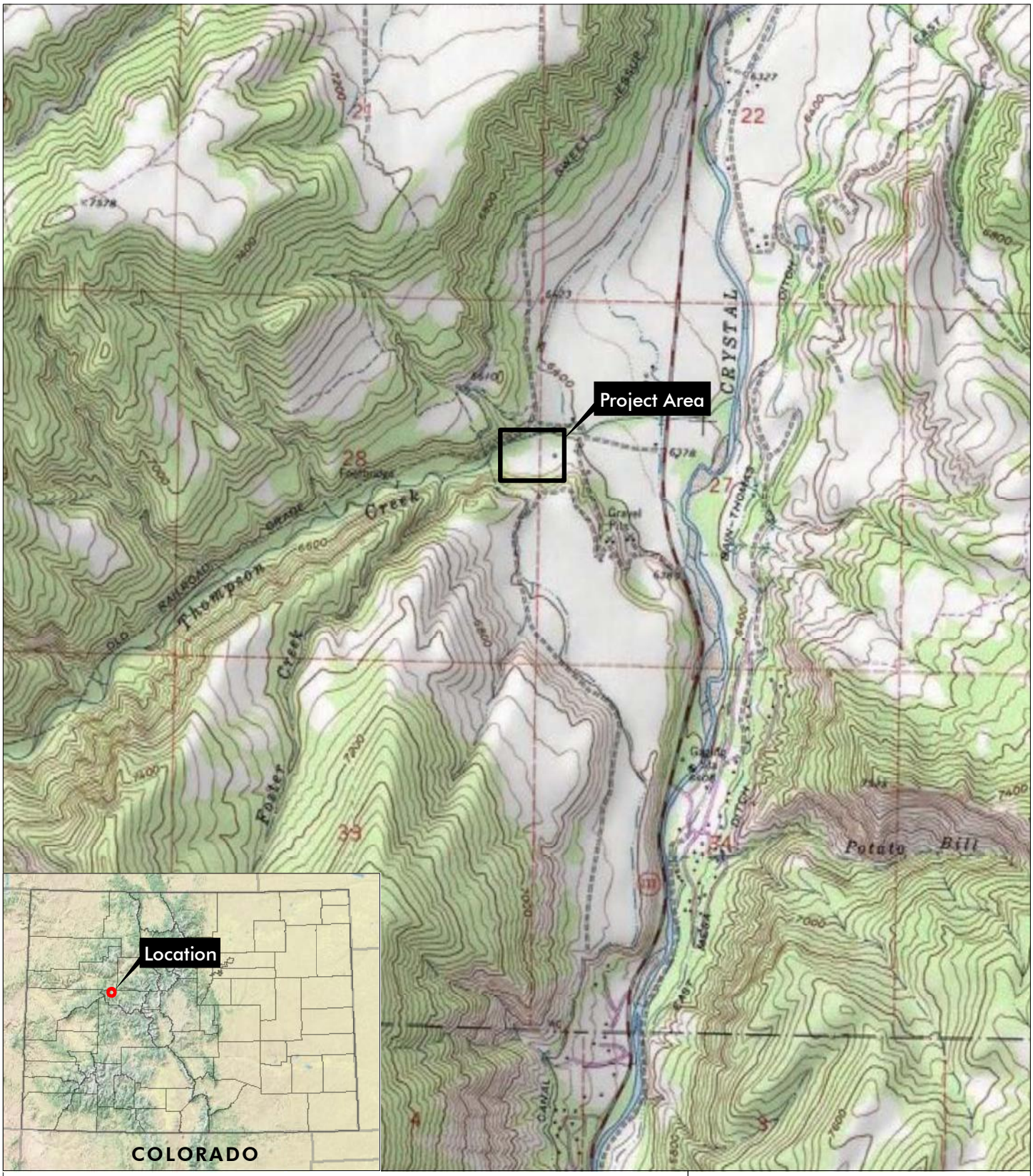
Photos

Photo 1. View northeast from wetland 1 toward proposed dam location.

Photo 2. Thompson Creek northwest of project area.



Sewell Wetland Evaluation

Sections 28 and 27, T8S, R88W, 6th PM

UTM NAD 83: Zone 13N; 308879mE, 4355925mN

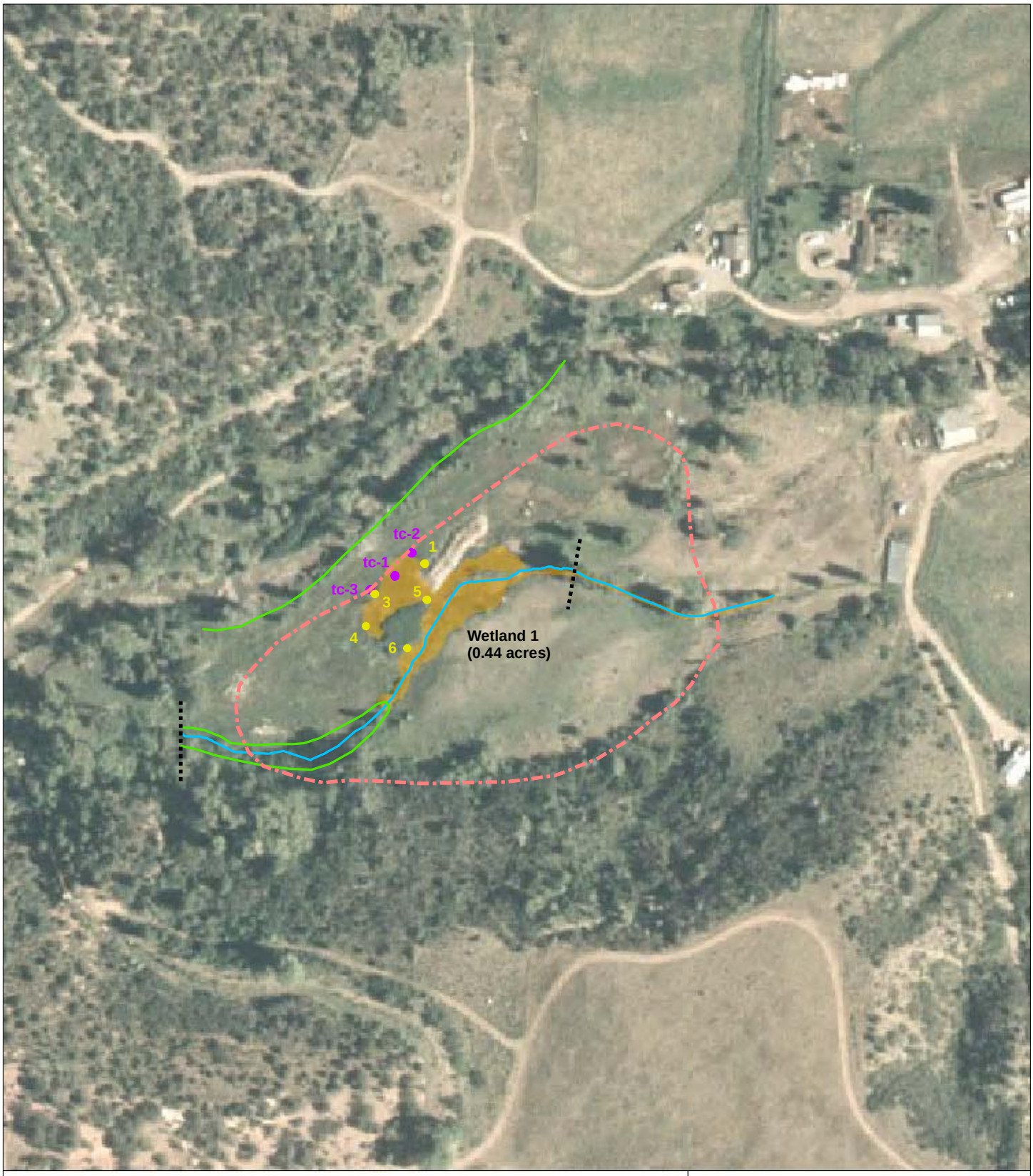
Latitude, Longitude: 39.331646°N, 107.217426°W

USGS Mount Sopris, CO Quad.; Pitkin County, Colorado

Figure 1
Site Location

Prepared for: Hartwig & Associates
File: 4448 figure 1.mxd [WH]
June 2009

ERO Resources Corp.



Sewell Wetland Evaluation

- Soil Pit
- Wetland Flag
- Wetland
- Proposed Reservoir Footprint
- Ditch
- Riparian Boundary
- Limits of Delineation

Image Source: USGS, August 6, 2005

0 100 200 feet

1 inch = 200 feet

N

Figure 2
Wetlands

Prepared for: Grand River Consulting
File: 4438 - Figure 2.mxd (GS)
August 2009

ERO Resources Corp.

107-2180 37.3319
Z13 308831 4355950
Mt. Sopris

WETLAND DETERMINATION DATA FORM – Arid West Region

Project/Site: Sewell (Reservoir) City/County: Pitkin Co Sampling Date: 5-19-09
Applicant/Owner: Grand River Consulting / Sewell State: CO Sampling Point: TC-1
Investigator(s): A Powers Section, Township, Range: S28 T8S R88W
Landform (hillslope, terrace, etc.): terrace Local relief (concave, convex, none): concave Slope (%): 0-1%
Subregion (LRR): D Lat: 39°19'54.7031" Long: 107°13'04.7746" Datum: NAD83
Soil Map Unit Name: Ipson Cobbly loam (56) NWI classification:
Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No ____ (If no, explain in Remarks.)
Are Vegetation N, Soil N, or Hydrology N significantly disturbed? Are "Normal Circumstances" present? Yes X No ____
Are Vegetation N, Soil N, or Hydrology N naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes X No ____	**Is the Sampled Area within a Wetland?** Yes X No ____
Hydric Soil Present?	Yes X No ____	
Wetland Hydrology Present?	Yes X No ____	

Remarks:
Based on ditch diversions, (now unused) the area appears to have been irrigated in past. Wetlands may persist from prior irrigation. No evidence of supportive hydro. except along ditch.

VEGETATION – Use scientific names of plants.

	Absolute % Cover	Dominant Species?	Indicator Status
Tree Stratum (Plot size: ____)			
1.			
2.			
3.			
4.			
	____ = Total Cover		
Sapling/Shrub Stratum (Plot size: ____)			
1.			
2.			
3.			
4.			
5.			
	____ = Total Cover		
Herb Stratum (Plot size: ____)			
1. Juncus arcticus spatha	70	Y	FACW
2. Agrostis stolonifera	10	N	FACW
3. Poa pratensis	10	N	FAC
4. Taraxacum officinale	5	N	FACU+
5. Bromus inermis	5	N	FACU
6.			
7.			
8.			
	100 = Total Cover		
Woody Vine Stratum (Plot size: ____)			
1.			
2.			
	____ = Total Cover		

% Bare Ground in Herb Stratum 0 % Cover of Biotic Crust ____

Dominance Test worksheet:
Number of Dominant Species That Are OBL, FACW, or FAC: 1 (A)
Total Number of Dominant Species Across All Strata: 1 (B)
Percent of Dominant Species That Are OBL, FACW, or FAC: 100 (A/B)

Prevalence Index worksheet:

Total % Cover of:	Multiply by:
OBL species ____	x 1 = ____
FACW species ____	x 2 = ____
FAC species ____	x 3 = ____
FACU species ____	x 4 = ____
UPL species ____	x 5 = ____
Column Totals: ____ (A)	____ (B)

Prevalence Index = B/A = ____

Hydrophytic Vegetation Indicators:
X Dominance Test is >50%
__ Prevalence Index is ≤3.0[1]
__ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
__ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes X No ____

Remarks:

SOIL

Sampling Point: JC-1

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	%	Redox Features Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
0-½"	10YR 3/2	100	—	—	—	—	organic clay loam	
½-2	10YR 3/2	100	—	—	—	—	clay loam	
2-18	7½YR 4/2	≥95	7.5YR 5/6	<5%	C	M	clay loam	
18+	rock							

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5) **(LRR C)**
- ___ 1 cm Muck (A9) **(LRR D)**
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Loamy Mucky Mineral (F1)
- ___ Loamy Gleyed Matrix (F2)
- X Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)
- ___ Vernal Pools (F9)

Indicators for Problematic Hydric Soils[3]:

- ___ 1 cm Muck (A9) **(LRR C)**
- ___ 2 cm Muck (A10) **(LRR B)**
- ___ Reduced Vertic (F18)
- ___ Red Parent Material (TF2)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type: _____

Depth (inches): _____

Hydric Soil Present? Yes X No ___

Remarks:

Pockets / layers of sand from apparent high water events

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1) **(Nonriverine)**
- ___ Sediment Deposits (B2) **(Nonriverine)**
- ___ Drift Deposits (B3) **(Nonriverine)**
- ___ Surface Soil Cracks (B6)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Water-Stained Leaves (B9)
- ___ Salt Crust (B11)
- ___ Biotic Crust (B12)
- ___ Aquatic Invertebrates (B13)
- ___ Hydrogen Sulfide Odor (C1)
- X Oxidized Rhizospheres along Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ___ Water Marks (B1) **(Riverine)**
- ___ Sediment Deposits (B2) **(Riverine)**
- ___ Drift Deposits (B3) **(Riverine)**
- ___ Drainage Patterns (B10)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Shallow Aquitard (D3)
- X FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes ___ No ___ Depth (inches): _____

Water Table Present? Yes X No ___ Depth (inches): 15"

Saturation Present? (includes capillary fringe) Yes ___ No ___ Depth (inches): _____

Wetland Hydrology Present? Yes X No ___

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

Marginal. Some ox root channels along small roots - not throughout

-107.2179
39.3320

Z13
308838
4355960

WETLAND DETERMINATION DATA FORM – Arid West Region

Project/Site: Sewell / Reservoir City/County: Pitkin Co. Sampling Date: 5-19-09
Applicant/Owner: Grand River Consulting / Sewell State: CO Sampling Point: TC-2
Investigator(s): A. Howers Section, Township, Range: S28 T8S R88W
Landform (hillslope, terrace, etc.): bench Local relief (concave, convex, none): Concave Slope (%): 0-1%
Subregion (LRR): D Lat: 39°19'55.02351 Long: 107°13'04.46896 Datum: NAD83
Soil Map Unit Name: Ipson Cobbly loam (5E) NWI classification:
Are climatic / hydrologic conditions on the site typical for this time of year? Yes Y No _____ (If no, explain in Remarks.)
Are Vegetation N, Soil N, or Hydrology N significantly disturbed? Are "Normal Circumstances" present? Yes Y No _____
Are Vegetation N, Soil N, or Hydrology N naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present? Yes _____ No X
Hydric Soil Present? Yes _____ No X
Wetland Hydrology Present? Yes _____ No X

Is the Sampled Area within a Wetland? Yes _____ No Ø

Remarks:
edge formed by large compost piles near ditch

VEGETATION – Use scientific names of plants.

	Absolute % Cover	Dominant Species?	Indicator Status
Tree Stratum (Plot size: _____)			
1.			
2.			
3.			
4.			
	_____ = Total Cover		
Sapling/Shrub Stratum (Plot size: _____)			
1.			
2.			
3.			
4.			
5.			
	_____ = Total Cover		
Herb Stratum (Plot size: _____)			
1. Poa pratensis	35	Y	FACU
2. Phleum pratense	15	N	FACU
3. Carex nebr.	10	N	OBL
4. Taraxacum offic.	10	N	FACU
5. Juncus arcticus ssp atr	10	N	FACW
6.			
7.			
8.			
	80 = Total Cover		
Woody Vine Stratum (Plot size: _____)			
1.			
2.			
	_____ = Total Cover		

% Bare Ground in Herb Stratum 20 % Cover of Biotic Crust _____

Dominance Test worksheet:
Number of Dominant Species That Are OBL, FACW, or FAC: Ø (A)
Total Number of Dominant Species Across All Strata: 1 (B)
Percent of Dominant Species That Are OBL, FACW, or FAC: Ø (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species	10	x 1 =	10
FACW species	10	x 2 =	20
FAC species		x 3 =	
FACU species	60	x 4 =	240
UPL species		x 5 =	
Column Totals:	80 (A)		270 (B)

Prevalence Index = B/A = 3.3

Hydrophytic Vegetation Indicators:
___ Dominance Test is >50%
___ Prevalence Index is ≤3.0[1]
___ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes _____ No X

Remarks:
Site fairly dry; transition in veg from high % baltic rush to poa dominant used as wetland boundary indication

SOIL

Sampling Point: TC-2

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	%	Redox Features Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
0-20	10YR 3/3	>99	10YR 4/4	<1	C	M	clay loam	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5) **(LRR C)**
- ___ 1 cm Muck (A9) **(LRR D)**
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Loamy Mucky Mineral (F1)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)
- ___ Vernal Pools (F9)

Indicators for Problematic Hydric Soils[3]:

- ___ 1 cm Muck (A9) **(LRR C)**
- ___ 2 cm Muck (A10) **(LRR B)**
- ___ Reduced Vertic (F18)
- ___ Red Parent Material (TF2)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type: _____

Depth (inches): _____

Hydric Soil Present? Yes _____ No X

Remarks: no hydric soils

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1) **(Nonriverine)**
- ___ Sediment Deposits (B2) **(Nonriverine)**
- ___ Drift Deposits (B3) **(Nonriverine)**
- ___ Surface Soil Cracks (B6)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Water-Stained Leaves (B9)
- ___ Salt Crust (B11)
- ___ Biotic Crust (B12)
- ___ Aquatic Invertebrates (B13)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres along Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ___ Water Marks (B1) **(Riverine)**
- ___ Sediment Deposits (B2) **(Riverine)**
- ___ Drift Deposits (B3) **(Riverine)**
- ___ Drainage Patterns (B10)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Shallow Aquitard (D3)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes _____ No _____ Depth (inches): _____

Water Table Present? Yes _____ No _____ Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes _____ No _____ Depth (inches): _____

Wetland Hydrology Present? Yes _____ No X

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks: water in pit @ 18"

-107.2181 Z13
39.3318 308820,
4355945

WETLAND DETERMINATION DATA FORM – Arid West Region

Project/Site: Sewell Reservoir City/County: Pitkin CO Sampling Date: 5-19-09
Applicant/Owner: Grand River Consulting / Sewell State: CO Sampling Point: TC-3
Investigator(s): A. Powers Section, Township, Range: T8S R88W S28
Landform (hillslope, terrace, etc.): bench Local relief (concave, convex, none): none Slope (%): 0-1 %
Subregion (LRR): D Lat: 39°19'54.51762" Long: 107°13'05.23304" Datum: NAD83
Soil Map Unit Name: Ipson Cobbly Loam (54) NWI classification:
Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No (If no, explain in Remarks.)
Are Vegetation N, Soil N, or Hydrology N significantly disturbed? Are "Normal Circumstances" present? Yes X No
Are Vegetation N, Soil N, or Hydrology N naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present? Yes X No
Hydric Soil Present? Yes No X
Wetland Hydrology Present? Yes No X
Is the Sampled Area within a Wetland? Yes No X

Remarks:

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size:)	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
	= Total Cover		
Sapling/Shrub Stratum (Plot size:)			
1.			
2.			
3.			
4.			
5.			
	= Total Cover		
Herb Stratum (Plot size:)			
1. Phalaris arundinacea	75	Y	OBL
2. Juncus arcticus ssp atlanticus	10	N	FACW
3. Poa pratensis	10	N	FACU
4.			
5.			
6.			
7.			
8.			
	95 = Total Cover		
Woody Vine Stratum (Plot size:)			
1.			
2.			
	= Total Cover		

% Bare Ground in Herb Stratum 5 % Cover of Biotic Crust

Dominance Test worksheet:
Number of Dominant Species That Are OBL, FACW, or FAC: 1 (A)
Total Number of Dominant Species Across All Strata: 1 (B)
Percent of Dominant Species That Are OBL, FACW, or FAC: 100 (A/B)

Prevalence Index worksheet:

Total % Cover of:	Multiply by:	
OBL species	x 1 =	
FACW species	x 2 =	
FAC species	x 3 =	
FACU species	x 4 =	
UPL species	x 5 =	
Column Totals: (A)		(B)

Prevalence Index = B/A =

Hydrophytic Vegetation Indicators:
X Dominance Test is >50%
__ Prevalence Index is ≤3.0[1]
__ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
__ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes X No

Remarks:
Very small patches (≈ 3' square) occur in meadow.

SOIL

Sampling Point: TC-3

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	%	Redox Features Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
0-20	10YR3/3	100	—	—	—	—	Clay loam	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5) **(LRR C)**
- ___ 1 cm Muck (A9) **(LRR D)**
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Loamy Mucky Mineral (F1)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)
- ___ Vernal Pools (F9)

Indicators for Problematic Hydric Soils[3]:

- ___ 1 cm Muck (A9) (LRR C)
- ___ 2 cm Muck (A10) (**LRR B**)
- ___ Reduced Vertic (F18)
- ___ Red Parent Material (TF2)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type: _____

Depth (inches): _____

Hydric Soil Present? Yes _____ No X

Remarks: No hydric indicators

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1) **(Nonriverine)**
- ___ Sediment Deposits (B2) **(Nonriverine)**
- ___ Drift Deposits (B3) **(Nonriverine)**
- ___ Surface Soil Cracks (B6)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Water-Stained Leaves (B9)
- ___ Salt Crust (B11)
- ___ Biotic Crust (B12)
- ___ Aquatic Invertebrates (B13)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres along Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ___ Water Marks (B1) **(Riverine)**
- ___ Sediment Deposits (B2) **(Riverine)**
- ___ Drift Deposits (B3) **(Riverine)**
- ___ Drainage Patterns (B10)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Shallow Aquitard (D3)
- X FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes _____ No _____ Depth (inches): _____

Water Table Present? Yes _____ No _____ Depth (inches): _____

Saturation Present? (includes capillary fringe) Yes _____ No _____ Depth (inches): _____

Wetland Hydrology Present? Yes _____ No X

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

None; no water in pit
(FAC-neutral; 1-20 indicator only)