DEERE & AULT
CONSULTANTS, INC.

MEMORANDUM

TO: Dave Hornbacher, Director, City of Aspen Utilities
Margaret Medellin, Utilities Portfolio Manager

FROM: Victor G. deWolfe, P.E., P.G.
Don W. Deere, P.E.

DATE: September 29, 2017

RE: Reservoir Pre-Feasibility, Woody Creek Parcel, McLain Flats, Pitkin County, Colorado; D&A Job No. CG-0687.003.00

INTRODUCTION

This memorandum describes Deere & Ault Consultants' (D&A) reservoir pre-feasibility study for a site consisting of two adjacent parcels of land on McLain Flats in Pitkin County, Colorado (**Figure 1**). The McLain Flats site includes a vacant property currently owned by the Woody Creek Development Company (aka, the Woody Creek Parcel, herein referred to as the WCDC parcel), for which the City of Aspen is currently under contract to purchase. The adjacent Vagneur gravel mine, owned by Elam Construction, could provide additional water storage. This site was identified as being a potential site for reservoir construction during an earlier site screening process. The pre-feasibility study included geotechnical investigations, a natural resources assessment (NRA), a site visit of the active Vagneur mine, preliminary geologic and geotechnical analysis, development of in-situ and gravel pit reservoir alternatives, and cost estimating. Four separate alternatives for water storage are presented in this memorandum. The alternatives include options that are built on the WCDC parcel alone to options that encompass both sites. The alternatives range in storage from a low of about 320 acre-feet for in-situ storage to a maximum reservoir of 8,000 acre-feet.

SITE CONDITIONS

The McLain Flats site is located in unincorporated Pitkin County in the Eastern One-Half of Section 16, Township 9 South, Range 85 West of the 6th Principal Meridian (**Figure 1**). The site is situated on a glacial outwash terrace about 150 feet above the Roaring Fork River. Upper River Road runs along the slope of the terrace about 50 feet above the river. The community of Woody Creek occupies a lower terrace northwest of the site. The topography of the terrace is generally flat on the top, exhibiting 1 to 2 percent slopes; and very steep on the sides with slopes up to 50 percent.

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The WCDC parcel considered for reservoir development by the City, occupies an area of about 55.7 acres on top of the terrace. A smaller parcel measuring 1.9 acres located along Upper River Road would also be acquired by the City (**Figure 1**). The WCDC parcel is currently a vacant sage brush meadow. Overhead electric transmission lines run along the edge of the terrace on the west side of the site. Smaller overhead electric lines cross the site as well. A high-pressure gas line runs beneath Raceway Drive along the eastern edge of the parcel. The Rio Grande Trail is a paved bicycle path on Pitkin County land that runs along the terrace about 30 feet below the top. A fiber optic line is buried beneath the bicycle path. A smaller gravel trail runs along the top of the terrace.

The existing Vagneur Gravel Mine is situated on an adjacent parcel of land measuring about 104.4 acres. The mine consists of an open pit in the middle terrace (which has been partially filled in) and a benched quarry in the upper terrace. The mine operates a crusher to supply aggregate for industrial uses.

GEOTECHNICAL CONDITIONS

The geotechnical conditions at the site were investigated by conducting reconnaissance geologic mapping, drilling four borings, digging five test pits, and testing soil and rock in the laboratory. To support the investigation, we acquired 2-foot topographic contours from a LiDAR survey performed in 2016 for Pitkin County. The topography of the site is included along with the geologic map and locations of the geotechnical borings, test pits, and other sample sites on **Figure 2**.

The geotechnical conditions of the site are characterized by deep glaciofluvial gravel, cobble, and boulder deposits overlying fractured Mancos Shale bedrock. A deep buried ancestral valley of the Roaring Fork River (paleochannel) appears to cut northerly through the WCDC property. The glaciofluvial outwash deposits were laid down during glacial melting events by large sustained floods. The resulting morphology is an ancestral valley buried by a series of three terraces, labelled as youngest through oldest, as shown on the map of **Figure 2**, and Profile A on **Figure 3**. The community of Woody Creek occupies the youngest outwash terrace (Qga) and the WCDC parcel occupies is the middle outwash terrace (Qgb). The Vagneur pit is located on the upper two terraces (Qgb and Qgc). The oldest terrace (Qgc) is capped by clayey eolian (windblown) deposits (Qe). The Mancos Shale (Km) is a Cretaceous aged rock that constitutes bedrock at the site and is the base of the buried valley.

Glaciofluvial Outwash Deposits

The glaciofluvial outwash deposits were observed during geologic mapping, geotechnical drilling, and test pit excavation. Summary logs of the geotechnical borings and test pits are included as **Figure 4**. Select samples were tested in a laboratory for index properties. Laboratory test data is shown by depth on the summary logs and tabulated on **Table 1**. The outwash deposits consist of layers of very densely compacted cobbles, gravel and boulders up to 7 feet in one-dimension. The cobbles consist primarily of sub-rounded granite or red sandstone. Due to the size of the particles in the outwash deposit, it is expected to have a very high permeability.

The drilling program encountered 90 feet of outwash and about 11 feet of Mancos Shale in Boring B-102. In B-102, groundwater was observed at 85 feet deep within the outwash deposits. A pair of nested monitoring wells were installed in B-102, with one screened in the shale and one in the outwash deposits. Both wells measure approximately the same pore water pressure, suggesting that the near surface fractured bedrock is in hydraulic connection with the alluvial groundwater in the cobbles. The well completion details are summarized on **Figure 4**. The other three borings encountered only dry glaciofluvial cobbles and boulders to 123 feet deep, the depth limit of the drilling program.

The test pits were excavated up to 15 feet deep into the glaciofluvial outwash terrace Qgb. In general, the top 4 to 5 feet contains a silty deposit of cobbles and boulders, followed by a 3 to 4-foot layer of cobbles with caliche rinds and cement. Below about 9 feet deep, a cleaner gravel deposit was encountered. Gradation tests were performed on TP-8 bulk samples of the 3-inch minus fraction, the results of which are shown on **Table 1** and **Figure 4**. During test pit excavation, we also estimated the maximum and median particle sizes encountered. Using the field observations in conjunction with the gradation data, we constructed gradation curves for the three layers encountered in TP-8. These curves are presented in **Appendix A** along with other laboratory test data. We also performed boulder counts in three test pits to help estimate the relative number of boulders with one-dimension equal to or greater than 2 feet within the volume of soil excavated. This estimate suggests that approximately 10 percent of the deposit is composed of boulders greater than or equal to 2 feet.

Eolian Deposits

The eolian deposits (Qe) are wind-blown deposits consisting of clay, silt and sand. They are located on top of the oldest glaciofluvial outwash terrace (Qgc) in the eastern part of the Elam parcel (**Figure 2**). The eolian soils are dry silty clays with medium stiffness and low plasticity. Based on the Unified Soils Classification System, the soils classify as lean clay (CL). These soils were sampled and tested in the laboratory for index and engineering properties to assess the soil's suitability as dam core material. The samples were collected from a stockpile in the Vagneur Mine and from the in-place deposits at the top of the highwall. The laboratory testing indicates that the soils have more than 80 percent fines (passing the No. 200 sieve) and between 5 and 20 percent sand. A hydrometer test shows that most of the fine material is silt, although there is enough clay to yield Atterberg limits values that classify the soils as lean clay (CL). The Standard Proctor test performed on the eolian clays suggest the optimum moisture content is about 14.5 percent and the maximum dry density is about 113 pounds per cubic foot (pcf). These data indicate that the eolian clays would be suitable to use as core materials in a dam, but there is only a limited volume on-site.

Mancos Shale

The Mancos Shale is a Cretaceous age (± 78 to 112 million years old) rock deposited in a marine environment. In the Woody Creek quadrangle, it is described by Freeman (1972) to be a dark gray silty to sandy shale with frequent zones of concretions and minor bentonite beds. Overall the main body is about 4,750 feet thick and contains interbedded sandstone layers. The shale is known to have a low permeability which provides a satisfactory bottom seal for gravel pit

reservoir construction. The shale is generally moderately strong with unconfined compressive strengths on the order of 7,000 pounds per square inch (psi) reported in the literature.

The Mancos Shale was observed in outcrop and in core samples during the site investigations. The rock is dark grey to black, dense, thinly bedded, slickensided, fractured shale with local calc-silica concretions and interbeds. Boring B-102 was the only boring to encounter the Mancos Shale on the WCDC parcel. The rock was very difficult to core due to the frequent fractures and the calc-silica concretions, and 10 feet of poor quality core was retrieved in B-102. A piece of core tested in the laboratory indicates the rock has a specific gravity of 2.73, which is a dry density of 170 pcf (very dense).

The Mancos outcrops as a steep slope in the road cut along Upper River Road following the southwest edge of the site (**Figure 2**). A package of northward dipping sandstone (Kms) beds was observed on the far south end of the site. However, further north along the road cut, the outcrop transitions to a southward dipping package of fractured shale beds with calc-silica concretions and concretionary beds. This structural orientation is the result of a west-to-east plunging syncline (**Figure 2**). Under the WCDC site, the bedding appears to be fairly uniform striking southwest and dipping 50˚south.

The Mancos Shale was also observed in outcrop along the lower highwall of the Vagneur Mine. In this area, groundwater seeps were observed from the glaciofluvial deposits above the outcrop (**Figure 2**), indicating that the shale has a very low permeability and acts as a groundwater barrier.

Paleo Topography

Because the shale was not encountered in three of the borings drilled 123 feet deep during geotechnical investigations, the depth of the bedrock beneath the site was evaluated using published geologic logs of State permitted wells in the vicinity. A total of 13 well logs were found in the area that provided an estimate to the top of bedrock. These data, in conjunction with our geologic mapping and interpretation, were used to build a contour map of the bedrock surface. This contour map, along with the pertinent data is presented as **Figure 5**. The contour map shows a deep paleochannel, or buried valley, of the ancestral Roaring Fork River beneath the site. The presence of the sandstone outcrop at the south end of the site suggests that this more resistant rock formed a knickpoint where the river sharply veered east and down-cut into the shale. Subsequent erosion through the Qgb terrace resulted in the current position of the Roaring Fork River and a ridge of bedrock between it and the paleochannel. This rendition of the bedrock surface at the site is in large part based on a well that was drilled in 1994 and encountered dry Mancos Shale at a depth of 200 feet. The location of this well is based on the permit documents, as well as inspection of 1991 versus 1999 aerial imagery of the site. Using 3D analytical techniques in GIS, a difference model was created between the topography and the bedrock surfaces to show the depth to bedrock contours at the site. This map is presented as **Figure 6**.

Preliminary Slope Stability

Preliminary slope stability analyses were conducted for the site using the geometry based on the bedrock elevation map and the topography. The primary stability analyses were conducted for the steep slopes leading towards the Roaring Fork River. Examples of these slopes are shown on the western edges of the profiles on **Figure 3**.

The glaciofluvial outwash deposits are very strong soil deposits as they are dense, free draining, and made up of about 50 percent cobbles and boulders. We estimate that they have a frictional strength of the order of 50˚. They stand on natural slopes of 45˚. The Mancos Shale has variable shear strength properties highly dependent on bedding. The steep bedding orientation on-site is generally favorable for the stability of terrace slopes.

Our preliminary analysis indicates that the northern one-half of the site is quite stable with the thick glaciofluvial deposits of the middle terrace (Qgb) fully buttressed by the lower terrace (Qgc). This is the case near the community of Woody Creek where very high factors of safety for stability were calculated.

In the southern parts of the site, bedrock is higher and the overall terrace slope is higher. Additional investigations should be conducted in this area to verify adequate slope stability exists.

ENVIRONMENTAL CONDITIONS

An ecologist with ERO conducted a natural resources assessment (NRA) at the site during a visit in July 2017. The full report is provided as **Appendix B**. The assessment did not identify any wetland areas or potential federally threatened and endangered species habitat. However, if any work is planned to pump water directly out of the Roaring Fork River, a Nationwide 404 Permit will need to be acquired from the U.S. Army Corps of Engineers prior to any construction work in the riparian area. There is a potential for nesting raptors at the site, but initial construction activities can be planned to avoid the nesting season, or a nest survey could be conducted prior to beginning construction.

Another issue that could affect open-water reservoir development at the property is the potential to increase the risk of bird/wildlife aircraft strike hazards because the reservoir could attract wildlife, especially flocks of water fowl. The site is situated within five miles of the Aspen/Pitkin County Airport. According to Section 4 of the Federal Aviation Administration's (FAA) Advisory Circular No. 150/5200-33B, (Appendix C of the Aspen/Pitkin County Airport Wildlife Hazard Management Plan), any proposed land-use practice changes within five miles of an airport (aka the "General Zone") would need to be reviewed by the FAA. As discussed in the NRA, in the context of water storage, mitigation techniques include, but are not limited to, the following:

1. Building an in-situ or underground storage vessel. This would eliminate the hazard by eliminating an open water surface that attracts wildlife.

2. Using a layer of floating bird deterrent balls or other covers. This mitigation is used for open storage vessels, and forms a floating cover on a reservoir that does not attract wildlife. This method also reduces evaporation, but would preclude recreational uses.

3. Implementing a wildlife hazard management plan in coordination with the airport's plan.

4. Employing wildlife deterrent officers and trained dogs to patrol the reservoir and keep wildlife away.

WATER STORAGE ALTERNATIVES

The water storage alternative concepts developed include above grade storage (with small dams), below grade storage (all below site ground level) and in-situ storage (storage in voids of the gravel and cobbles). To realize any of these concepts requires a positive water cutoff within the highly permeable glaciofluvial outwash deposits. The positive cutoff methods we considered include deep cutoff walls (such as slurry walls), dams, slope liners, and geosynthetic liners.

Cutoff walls, dam cores and slope liner cores require a foundation key into the Mancos Shale. The shale would act as a low permeability barrier and form the bottom of these reservoirs. Construction of deep cutoff walls is considered marginally feasible based on depths to bedrock exceeding 200 feet and the number of nested cobbles and very large boulders.

Installation of geosynthetic liners, made of HDPE or PVC, appears to be geotechnically feasible at this site. Geosynthetic liners are versatile. They can form the positive cutoff for a dam slope or a cut slope, and can either be anchored to the shale or installed completely within the outwash where shale is too deep. Once the excavation slope is prepared, a bedding layer of silty sand material is typically placed. The geosynthetic liner is then installed on the bedding and buried by a filter layer of silty sand. The bedding and filter layers act to protect the liner and mitigate seepage in the event the liner is compromised. They also allow riprap to be safely placed on the liner.

For the McLain Flats site, we developed four storage alternatives. These alternatives include both the WCDC and Elam parcels. The four alternatives are:

1. Alternative 1 – Three-Phase Reservoir Storage
2. Alternative 2 – Maximum Reservoir Storage
3. Alternative 3 – Two-Phase Reservoir Storage
4. Alternative 4 – Manufactured In-Situ Reservoir Storage

We prepared a pre-feasibility level engineer's opinion of costs for the four alternatives, and these values are itemized on **Tables 2** through **5**. All alternatives include gravity filling and gravity releasing to the Roaring Fork River. We assumed water delivery could be accomplished using a pipeline from existing ditch structures. We assumed a combined low level outlet pipe and Morning Glory spillway to the Roaring Fork River. Alternative 4 does not require a spillway because it is all in-situ storage, but it would still have the same type of outlet. Additionally, all engineer's opinions of cost include 30 percent contingency.

To use the Vagneur pit for water storage would require a revision to the mine's reclamation plan and cessation of placing inert fill in the pit. The first three alternatives also involve some degree of mining at the WCDC parcel. We therefore assumed all excavation costs would be incurred by a miner. Mining the WCDC parcel would require the property to be permitted as a mine, or added to the existing Vagneur Mine permit.

Alternative 1 – Three-Phase Reservoir Storage

Alternative 1 is a phased project that could realize initial storage at the Vagneur Mine relatively quickly, possibly within a few years. This option also allows time to incorporate the WCDC parcel into the Vagneur mining permit. The layout of this concept is presented on **Figure 7**, and on the geologic profile on **Figure 8**.

Phase 1 of this concept would be to impound water in the Vagneur gravel pit. Low asphalt cored dams would be constructed on the north and south ends of the vessel. HDPE geosynthetic liners would be installed on the cut slopes between the dams and anchored to the shale. The Mancos Shale appears to be more shallow in this area, which suggests it is feasible to use it as a foundation for the positive cutoff methods. Clay cores could also be built in the dams if enough material is available for borrow from the upper terrace stockpile or in-place eolian deposits. This reservoir would total approximately 1,000 acre-feet of storage.

Phases 2 and 3 assume the WCDC parcel can be mined and reclaimed as open water storage. Phase 2 would be on the north end of the site, and include a 20-foot high dam to provide both above grade and below grade storage. The gravel pits would be cut at 3:1 (horizontal to vertical) slopes down to about elevation 7340 feet. The vessels would be completely lined with HDPE geosynthetic liners because the Mancos Shale is so deep. The HDPE liner would be anchored to the dam or to the ground surface at the top of the excavation. Mined material could be stockpiled on the south end of the site so that Phase 2 reservoir construction could continue independent of mining permit approval. The Phase 2 reservoir would realize approximately 700 acre-feet of storage.

Once the mining permit is approved, the material stockpiled on the south end of the WCDC parcel could be processed and sold. With two reservoirs on line, construction of the third phase would begin in conjunction with mining operations. The Phase 3 reservoir would be constructed using HDPE geosynthetic liner as the positive cutoff, resulting in an additional 800 acre-feet of fully below grade storage.

This project would involve mining approximately 3 million cubic yards of material, or about 4.5 million tons. Currently, most of the sand and gravel used for construction in Aspen is trucked from gravel pits in the Carbondale area. Thus, utilization of this local resource would reduce Aspen's carbon footprint. National per-capita consumption of sand and gravel can be as high as 10 tons per year.

Alternative 1 would provide a total of 2,500 acre-feet of storage at a cost of approximately $73 million, or about $29,000 per acre-foot of storage (**Table 2**). The fastest total completion of all three phases would be of the order of a decade. However, the phasing of this alternative provides flexibility for bringing these vessels on line as they are needed.

Alternative 2 – Maximum Reservoir Storage

Alternative 2 represents the maximum storage vessel that could be realized using both parcels. It is also, therefore, the longest-term solution to water storage. The maximum reservoir includes the construction of a 5,000-foot long dam, with a 60-foot maximum section, around the north side of the Vagneur parcel and along the west side of the WCDC parcel (**Figure 9**). The positive cutoff would be provided by an HDPE geosynthetic liner. The outwash would be mined at 2.5:1 (horizontal to vertical) slopes to bedrock. This would result in an excavation of about 11 million cubic yards (16.5 million tons) of gravel and cobbles. A gravity drain would be installed behind the liner on the east side of the reservoir to drain groundwater from behind the liner. The tunneled outlet and spillway would be located on the south end of the reservoir. All utilities, including the high-pressure gas line and multiple overhead electric lines running through each parcel, would have to be relocated. This alternative would provide approximately 8,000 acre-feet of total storage for about $81 million or about $10,000 per acre-foot of storage (**Table 3**).

Alternative 3 – Two-Phase Reservoir Storage

Alternative 3 is a variation of Alternative 1 that involves maximizing open water storage on the WCDC parcel with one reservoir, rather than building two smaller vessels (**Figure 10**). The first phase is the same as for Alternative 1: a 1,000 acre-foot reservoir in the Vagneur pit. The second phase of this alternative would be to build the same low dam as in Phase 2 of Alternative 1, but the excavation would be site-wide instead of leaving material between two cells. The excavation would be cut at 3:1 (horizontal to vertical) slopes down to approximately elevation 7300 feet producing approximately 3.9 million cubic yards (5.9 million tons) of gravel material.

This reservoir would provide approximately 2,000 acre-feet of storage on the WCDC parcel compared to 1,500 acre-feet in Alternative 1. The total storage realized for this alternative would therefore be approximately 3,000 acre-feet and would cost approximately $74 million, or nearly $25,000 per acre-foot of storage (**Table 4**).

Alternative 4 – Manufactured In-Situ Reservoir Storage

Alternative 4 was developed as an alternative to open water storage. This concept involves manufacturing in-situ storage on the south one-half of the WCDC parcel, while the north one-half is used for material stockpiling and processing (**Figure 11**). This option essentially represents converting only the Phase 3 vessel of Alternative 1 to in-situ storage.

Manufacturing in-situ storage would be accomplished by building the fully below grade geosynthetic lined vessel, then backfilling the reservoir with select large cobbles and boulders and storing water in the voids. To fill the vessel, an infiltration gallery consisting of 15,000 linear feet of 36-inch diameter slotted HDPE pipes bedded in gravel would be built near the

surface. The infiltration gallery would be plumbed to the water supply system and buried up to grade. The outlet works would be tunneled to the Roaring Fork River. The outlet would be connected to a 9-foot diameter concrete collection gallery in the bottom of the reservoir. The gallery would run up one slope to a gate house to control releases.

Using select coarse rock as backfill for the vessel would likely allow the manufactured porosity to be of the order of 40 percent. Therefore, such a vessel could provide up to about 320 acre-feet of storage. This alternative would cost approximately $48 million, which would be around $150,000 per acre-foot. This is a very high unit cost for reservoir construction due to the additional handling and processing of the material and the relatively low storage volume it allows.

A variation of Alternative 4 could involve constructing two such in-situ vessels to double the storage. Unit costs would remain high for this variation. A further variation could involve a recharge facility on half of the site. In this case, another infiltration gallery could be constructed and used to recharge water to the Roaring Fork River to replace any out-of-priority depletions in lagged time. Having lagged return flow credits accreting to the river from the recharge facility could allow additional flexibility in operating the storage vessel.

CONCLUSIONS

This reservoir pre-feasibility investigation has resulted in the following conclusions:

1. Open water storage using geosynthetic liners is geotechnically feasible.

2. Slurry wall, or deep cutoff wall construction for in-situ storage, is considered marginally feasible because of the greater than 200-foot bedrock depth and numerous cobbles and boulders.

3. Alternative 1, a three-phase project, could potentially provide 1,000 acre-feet of storage within a few years, and eventually provide up to 2,500 acre feet for about $29,000 per acre-foot.

4. Alternative 2, the maximum storage alternative, could provide 8,000 acre-feet of storage at about $10,000 per acre-foot.

5. Alternative 3, a variation of Alternative 1, would be a two-phase project that could provide about 3,000 acre-feet of storage for roughly $25,000 per acre-foot.

6. Alternative 4, a manufactured in-situ storage vessel, could be constructed to provide approximately 320 acre-feet of storage for a unit cost of up to $150,000 per acre-foot.

RECOMMENDATIONS

Based on this pre-feasibility level investigation and its conclusions, we arrived at the following recommendations:

1. Pursue the potential for using both parcels for water storage.

2. Conduct feasibility level geotechnical analyses for both parcels. Before pursuing reservoir alternatives, the next steps include:

    - Drilling two deep rotosonic borings on the WCDC parcel to confirm depth to bedrock
    - Drilling several borings in the Vagneur gravel pit to assess the foundation conditions
    - Conduct more detailed slope stability analyses

3. Perform a water resources analysis to better understand how the McLain Flats site can be used to optimize the flexibility of the City's water rights.

4. Conduct a risk assessment for potential wildlife hazards.

LIMITATIONS

This pre-feasibility level analysis is considered reasonable, given the data, time and budget available. It was performed using publicly available data and data obtained from field investigations. These data are limited, however, and therefore the results of the analysis must be considered approximate. Should additional data or information become available, D&A can analyze the information and to update the opinions provided in this memorandum.

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TABLES

Table 1
Gravel Pit Reservoir Pre-Feasibility
Summary Of Laboratory Test Results
September-2017

SAMPLE LOCATION				Natural Moisture Content (%)	Gradation*		Hydrometer		Percent Passing No. 200 Sieve	Atterberg Limits		Standard Proctor		Specific Gravity	Unified Soil Classification (Symbol)
Test Hole	Depth (feet)	Unit	Sample Type		Gravel (%)	Sand (%)	Silt (%)	Clay (%)		Liquid Limit (%)	Plasticity Index (%)	Max Dry Density (Pcf)	Optimum Moisture Content (%)		
Upper Terrace	1'	Qe - Eolian	Grab	4.5	0.1	6.3			93.6	34	19				Lean clay (CL)
Upper Terrace Stockpile	0'-1'	Qe - Eolian	Bulk		1.4	18.0	61.2	19.4	80.6	26	11	113.8	14.5		Lean clay with sand (CL)
TP-8	0'-4'	Qgb - Outwash	Bulk	4.6	41.2	32.8			26.0	25	8				NA
	4'-8.5'	Qgb - Outwash	Bulk	2.7	54.8	33.7			11.5						NA
	12'-14'	Qgb - Outwash	Bulk	1.1	54.0	41.7			4.3						NA
B-102	33'	Qgb - Outwash	SPT		50.1	43.5			6.4						NA
	91'	Km - Mancos Shale	SPT	10.6					48.4	23	8				NA
	91'-101'	Km - Mancos Shale	NQ Core						56.8	21	7				NA
	98'	Km - Mancos Shale	NQ Core											2.73	NA
Road Cut	0'	Km - Mancos Shale	Bulk		11.8	28.5			59.7	22	4				NA

* Gradation tests performed on glacial outwash deposits represent the fraction less than 3 inches for bulk samples and less than 1.5 inches for the SPT sample. Bulk samples of outwash had an estimated 50 percent of cobbles and boulders greater than 3 inches.

TABLE 2

ENGINEER'S PRE-FEASIBILITY LEVEL OPINION OF COST
WOODY CREEK GRAVEL PIT RESERVOIR
ALTERNATIVE 1 - THREE PHASED RESERVOIRS
2,500 ACRE-FEET

	Construction Item	Quantity	Unit	Cost	Extension
1	Phase 1 Mobilization (5%)	1	LS	$ 1,235,450	$ 1,235,450
2	Phase 1 Reservoir (1,000 AF)				
	a. Foundation Excavation	130,000	CY	$ 10	$ 1,300,000
	b. Foundation Preparation	1	LS	$ 75,000	$ 75,000
	c. Main Dam Rockfill (Zone 4)	900,000	CY	$ 6	$ 5,400,000
	d. Asphalt Core (Zone 1)	20,000	CY	$ 125	$ 2,500,000
	e. HDPE Liner	648,000	SF	$ 3	$ 1,944,000
	f. Graded Filter Zone & Bedding (Zones 2 & 3)	123,000	CY	$ 25	$ 3,075,000
	g. Riprap/w Bedding	12,000	CY	$ 45	$ 540,000
	h. Concrete HDPE anchor slab	1,000	CY	$ 800	$ 800,000
	i. Grouting	1	LS	$ 500,000	$ 500,000
	j. Instrumentation & Electrical	1	LS	$ 75,000	$ 75,000
				Subtotal	$ 16,209,000
3	Combined Outlet Works & Morning Glory Spillway	1500	LF	$ 3,000	$ 4,500,000
4	Water Delivery Infrastructure	1	LS	$ 4,000,000	$ 4,000,000
5	Phase 2 Mobilization (5%)	1	LS	$ 479,700	$ 479,700
6	Phase 2 Reservoir (700 AF)				
	a. Foundation Preparation	1	LS	$ 75,000	$ 75,000
	b. Main Dam Zone	65,000	CY	$ 6	$ 390,000
	c. HDPE Liner	943,000	SF	$ 3	$ 2,829,000
	d. Graded Filter Zone & Bedding	140,000	CY	$ 25	$ 3,500,000
	e. Riprap	6,000	CY	$ 45	$ 270,000
	f. Interconnect Pipeline	1,250	LF	$ 2,000	$ 2,500,000
	g. Instrumentation & Electrical	1	LS	$ 30,000	$ 30,000
				Subtotal	$ 9,594,000
7	Phase 3 Mobilization (5%)	1	LS	$ 412,650	$ 412,650
8	Phase 3 Reservoir (800 AF)				
	a. Foundation Preparation	1	LS	$ 75,000	$ 75,000
	b. HDPE Liner	991,000	SF	$ 3	$ 2,973,000
	c. Graded Filter Zone & Bedding	147,000	CY	$ 25	$ 3,675,000
	d. Interconnect Pipeline	750	LF	$ 2,000	$ 1,500,000
	e. Instrumentation & Electrical	1	LS	$ 30,000	$ 30,000
				Subtotal	$ 8,253,000
				Miscellaneous Unlisted Items @ 5%	$ 2,234,190
				Total Construction Items	**$ 44,683,800**
				Engineering @ 15%	$ 6,703,000
				Permitting @ 10%	$ 4,468,000
				Subtotal	$ 55,854,800
				Contingency @ 30%	$ 16,756,000
				ESTIMATED TOTAL (rounded to nearest $1,000,000)	**$ 73,000,000**
				Cost per Acre Foot (rounded to nearest $1,000)	*$ 29,000*

Note: These costs do not include land acquisition costs or excavation costs. The latter are assumed to be incured by the miner.

TABLE 3

ENGINEER'S PRE-FEASIBILITY LEVEL OPINION OF COST
WOODY CREEK GRAVEL PIT RESERVOIR
ALTERNATIVE 2 - ULTIMATE RESERVOIR
8,000 ACRE-FEET

	Construction Item	Quantity	Unit	Cost	Extension
1	Mobilization (5%)	1	LS	$ 2,267,250	$ 2,267,250
2	Dam Embankments				
	a. Foundation Preparation	1	LS	$ 75,000	$ 75,000
	b. Main Dam Zone	1,070,000	CY	$ 6	$ 6,420,000
	c. HDPE Liner	4,530,000	SF	$ 3	$ 13,590,000
	d. Graded Filter Zone & Bedding	671,000	CY	$ 25	$ 16,775,000
	e. Riprap	25,000	CY	$ 45	$ 1,125,000
	f. Gravity Drain	2,600	LF	$ 100	$ 260,000
	g. Instrumentation & Electrical	1	LS	$ 100,000	$ 100,000
				Subtotal	$ 38,345,000
3	Combined Outlet Works & Morning Glory Spillway	1000	LF	$ 3,000	$ 3,000,000
4	Water Delivery Infrastructure	1	LS	$ 4,000,000	$ 4,000,000
				Miscellaneous Unlisted Items @ 5%	$ 2,380,613
				Total Construction Items	**$ 49,992,863**
				Engineering @ 15%	$ 7,499,000
				Permitting @ 10%	$ 4,999,000
				Subtotal	$ 62,490,863
				Contingency @ 30%	$ 18,747,000
				ESTIMATED TOTAL (rounded to nearest $1,000,000)	**$ 81,000,000**
				Cost per Acre Foot (rounded to nearest $1,000)	*$ 10,000*

Note: These costs do not include land acquisition costs or excavation costs. The latter are assumed to be incured by the miner.

TABLE 4

ENGINEER'S PRE-FEASIBILITY LEVEL OPINION OF COST
WOODY CREEK GRAVEL PIT RESERVOIR
ALTERNATIVE 3 - TWO PHASED RESERVOIRS
3,000 ACRE-FEET

	Construction Item	Quantity	Unit	Cost	Extension
1	Phase 1 Mobilization (5%)	1	LS	$ 1,235,450	$ 1,235,450
2	Phase 1 Reservoir (1,000 AF)				
	a. Foundation Excavation	130,000	CY	$ 10	$ 1,300,000
	b. Foundation Preparation	1	LS	$ 75,000	$ 75,000
	c. Main Dam Rockfill (Zone 4)	900,000	CY	$ 6	$ 5,400,000
	d. Asphalt Core (Zone 1)	20,000	CY	$ 125	$ 2,500,000
	e. HDPE Liner	648,000	SF	$ 3	$ 1,944,000
	f. Graded Filter Zone & Bedding (Zones 2 & 3)	123,000	CY	$ 25	$ 3,075,000
	g. Riprap/w Bedding	12,000	CY	$ 45	$ 540,000
	h. Concrete HDPE anchor slab	1,000	CY	$ 800	$ 800,000
	i. Grouting	1	LS	$ 500,000	$ 500,000
	j. Instrumentation & Electrical	1	LS	$ 75,000	$ 75,000
				Subtotal	$ 16,209,000
3	Combined Outlet Works & Morning Glory Spillway	1500	LF	$ 3,000	$ 4,500,000
4	Water Delivery Infrastructure	1	LS	$ 4,000,000	$ 4,000,000
5	Phase 2 Mobilization (5%)	1	LS	$ 923,090	$ 923,090
6	Phase 2 Reservoir (2,000 AF)				
	a. Foundation Preparation	1	LS	$ 75,000	$ 75,000
	b. Main Dam Zone	64,800	CY	$ 6	$ 388,800
	c. HDPE Liner	1,962,000	SF	$ 3	$ 5,886,000
	d. Graded Filter Zone & Bedding	290,700	CY	$ 25	$ 7,267,500
	e. Riprap	29,100	CY	$ 45	$ 1,309,500
	f. Gravity Drain	2,600	LF	$ 100	$ 260,000
	g. Interconnect Pipeline	1,600	LF	$ 2,000	$ 3,200,000
	h. Instrumentation & Electrical	1	LS	$ 75,000	$ 75,000
				Subtotal	$ 18,461,800
				Miscellaneous Unlisted Items @ 5%	$ 2,266,467
				Total Construction Items	**$ 45,329,340**
				Engineering @ 15%	$ 6,799,000
				Permitting @ 10%	$ 4,533,000
				Subtotal	$ 56,661,340
				Contingency @ 30%	$ 16,998,000
				ESTIMATED TOTAL (rounded to nearest $1,000,000)	**$ 74,000,000**
				Cost per Acre Foot (rounded to nearest $1,000)	*$ 25,000*

Note: These costs do not include land acquisition costs or excavation costs. The latter are assumed to be incured by the miner.

TABLE 5

ENGINEER'S PRE-FEASIBILITY LEVEL OPINION OF COST
WOODY CREEK GRAVEL PIT RESERVOIR
ALTERNATIVE 4 - MANUFACTURED IN-SITU RESERVOIR
320 ACRE-FEET

	Construction Item	Quantity	Unit	Cost	Extension
1	Mobilization (5%)	1	LS	$ 1,494,580	$ 1,494,580
2	Manufactured In-Situ Reservoir (400 AF)				
	a. Excavation, processing, stockpiling and backfilling	1,290,400	CY	$ 9	$ 11,613,600
	b. Foundation Preparation	1	LS	$ 75,000	$ 75,000
	c. HDPE Liner	991,000	SF	$ 3	$ 2,973,000
	d. Graded Filter Zone & Bedding	146,800	CY	$ 25	$ 3,670,000
	e. Infiltration Piping (36" slotted HDPE)	15,000	LF	$ 180	$ 2,700,000
	f. Gravity Drain	2,600	LF	$ 100	$ 260,000
	g. Concrete Collection Gallery (9' dia.)	750	LF	$ 2,000	$ 1,500,000
	h. Combined Outlet Works & Morning Glory Spillway	1000	LF	$ 3,000	$ 3,000,000
	i. Instrumentation & Electrical	1	LS	$ 100,000	$ 100,000
				Subtotal	$ 25,891,600
3	Water Delivery Infrastructure	1	LS	$ 4,000,000	$ 4,000,000
				Miscellaneous Unlisted Items @ 5%	$ 1,569,309
				Total Construction Items	**$ 31,386,180**
				Engineering @ 15%	$ 4,708,000
				Permitting @ 3%	$ 942,000
				Subtotal	$ 37,036,180
				Contingency @ 30%	$ 11,111,000
				ESTIMATED TOTAL (rounded to nearest $1,000,000)	**$ 48,000,000**
				Cost per Acre Foot (rounded to nearest $1,000)	*$ 150,000*

Note: These costs do not include land acquisition costs.

FIGURES

Legend

- State Highway 82
- Streams
- Salvation Canal
- McLain Flats Reservoir Parcels
- Section Lines

N

0 800 1,600 Feet

Township 9 South, Range 85 West (6th P.M.)
Parcel Data from Pitkin County
Aerial Photo from NAIP (2015)

Glenwood Springs (~35 miles)

Highway 82

Aspen (~6 miles)

WOODY CREEK

Roaring Fork River

Upper River Road

1.9 Acres

Woody Creek Development Co.
(WCDC Parcel)
55.7 Acres

Elam Construction
(Vagneur Gravel Mine)
104.4 Acres

MCLAIN FLATS

21 16
22 15

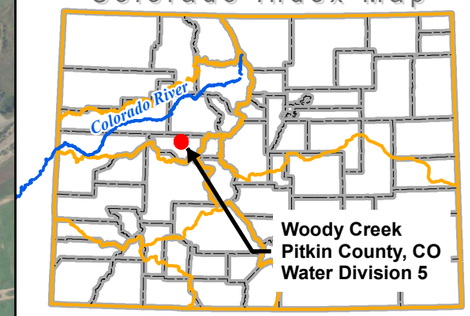
16 9
15 10

Woody Creek

Salvation Canal

Salvation Canal

Colorado Index Map



JOB NO. 0687.003.00

MCLAIN FLATS STORAGE PROJECT

Site Location Map

DEERE & AULT CONSULTANTS, INC.

FIGURE NO. 1

DATE: SEPTEMBER 2017

SCALE: 1 inch=800 feet

U:\0687 City of Aspen\0687.003 Gravel Pit Reservoir Pre-Feasibility\GIS\Figure 1 - Site Location Map.mxd Thursday, September 28, 2017 09:39 AM

N

0 400 800 Feet

Geologic Profiles are shown on Figure 3.
Geology after Freeman, 1972
LiDAR Topography from Pitkin County (2016), C.I. = 2'

Highway 82

Roaring Fork River

Upper River Road

Rio Grande Trail

Woody Creek

WOODY CREEK

MCLAIN FLATS

PROFILE A

PROFILE B

Km Roadcut Sample

B-103 (O)

B-101 (O) TP-1

TP-6 B-104 (O)

TP-8

TP-7

B-102 (O, C, P)

Seeps

Upper Terrace Stockpile Qe Sample

Upper Terrace Qe Sample

Qal

Qga

Qgb

Qgc

Qf

Qe

Km

Kms

58 81

47 51 27

62 65 68 27

Legend

Geotechnical Site Investigations

- Borings (O = Odex, C = Core, P = Piezometer)
- Test Pits
- Other Sample Locations
- Groundwater Seeps

- Strike and Dip of Bedding
- Strike and Dip of Joint
- Approximate Syncline Axis
- Arrow indicates direction of plunge

Geology (Contacts Approximate)

- Qal - Alluvial Deposits
- Qf - Fan Deposits
- Qe - Eolian Deposits
- Qga - Glacial Outwash Terrace A
- Qgb - Glacial Outwash Terrace B
- Qgc - Glacial Outwash Terrace C
- Km - Mancos Shale
- Kms - Mancos Sandstone
- Water

JOB NO. 0687.003.00

MCLAIN FLATS STORAGE PROJECT

Geologic Map

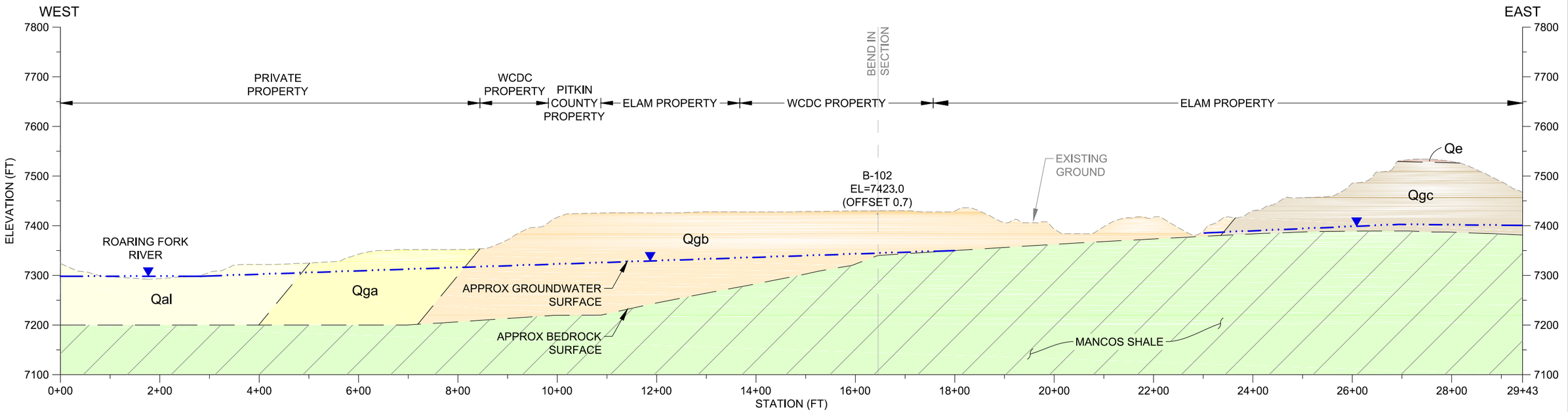
DEERE & AULT CONSULTANTS, INC.

FIGURE NO. 2

DATE: SEPTEMBER 2017

SCALE: 1 inch=400 feet

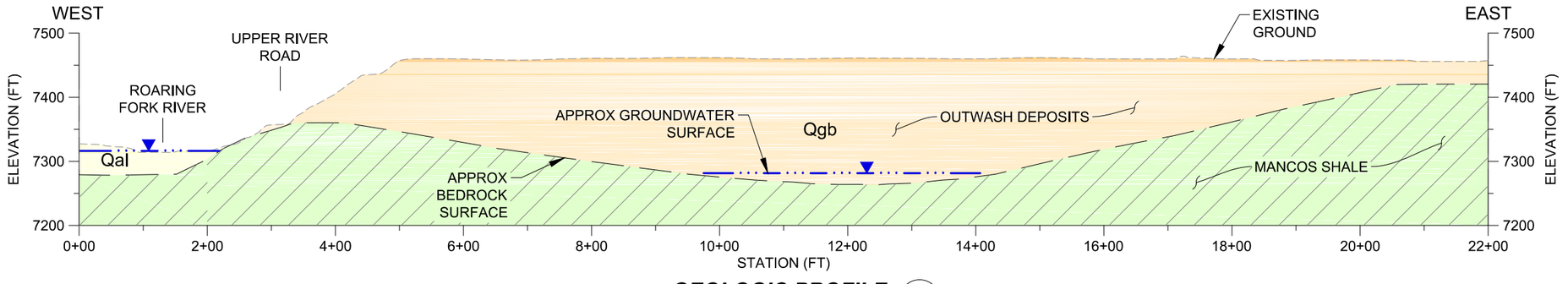
U:\0687 City of Aspen\0687.003 Gravel Pit Reservoir Pre-Feasibility\GIS\Figure 2 - Gelogic Map.mxd Thursday, September 28, 2017 09:37 AM



GEOLOGIC PROFILE A

0 100 200

SCALE IN FEET



GEOLOGIC PROFILE B

0 100 200

SCALE IN FEET

JOB NO. 0687.003.00

MCLAIN FLATS STORAGE PROJECT

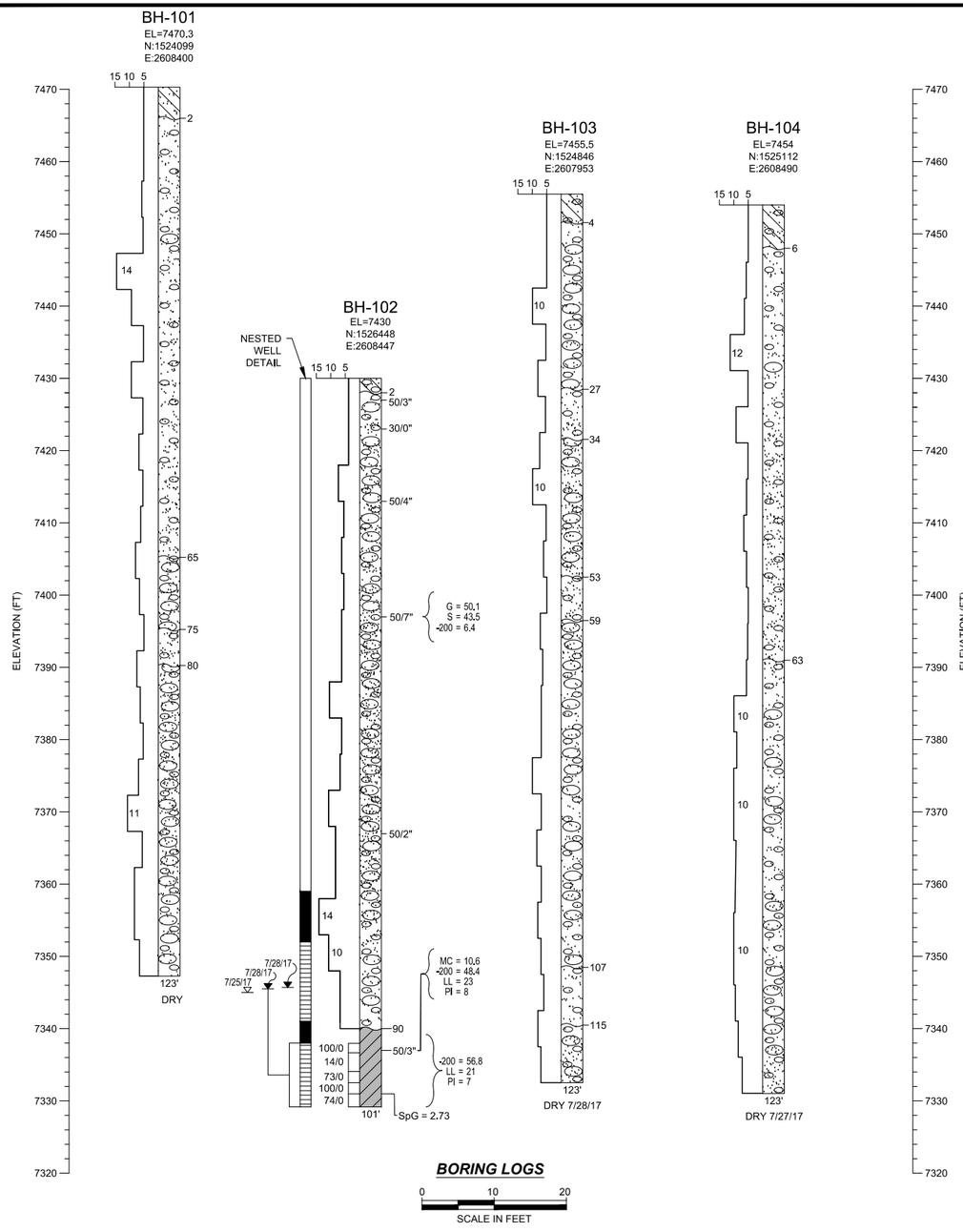
GEOLOGIC PROFILES A AND B

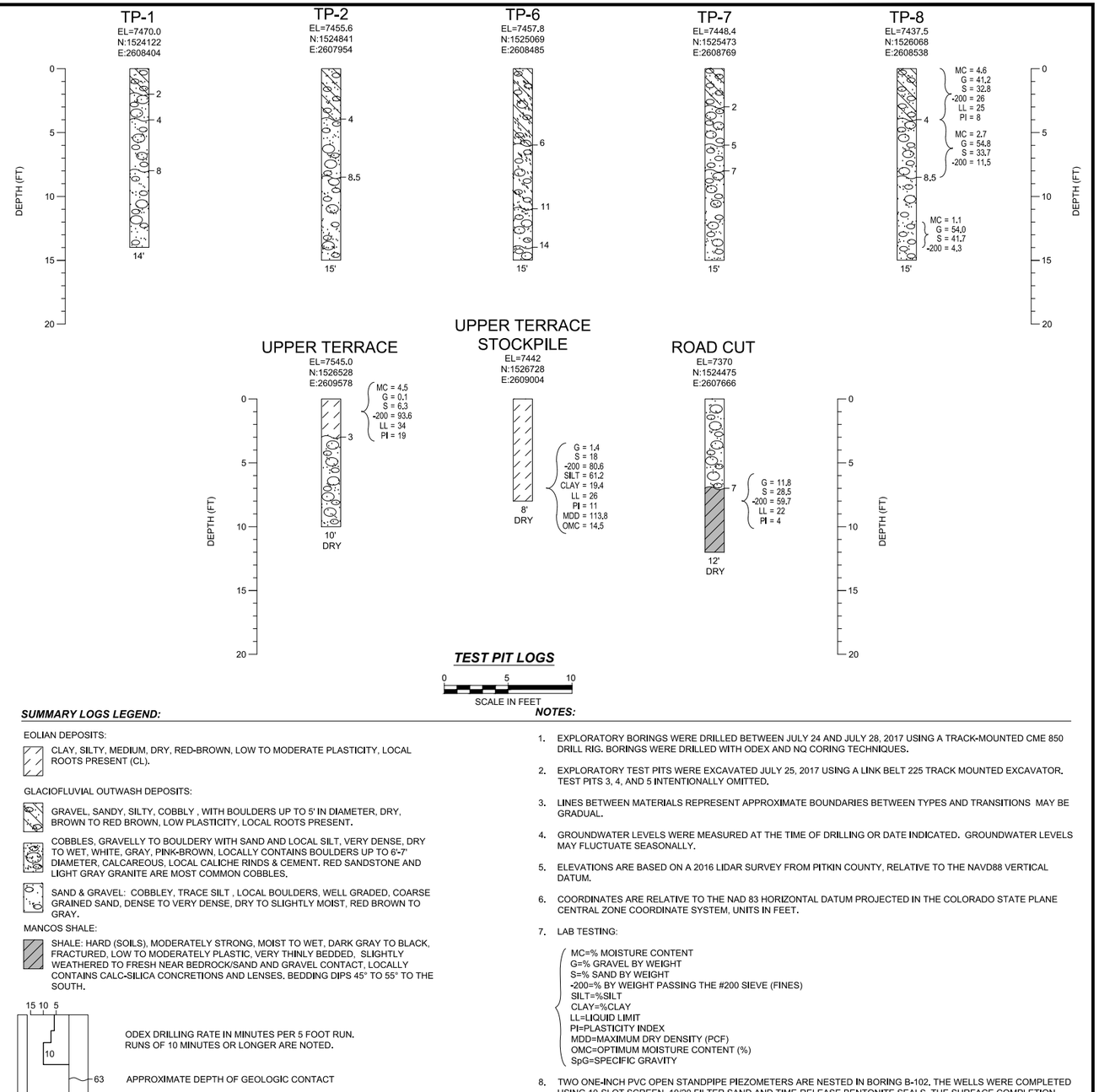
DEERE & AULT CONSULTANTS, INC.

FIGURE NO. 3

DATE: SEPTEMBER 2017

SCALE: AS NOTED





SUMMARY LOGS LEGEND:

EOLIAN DEPOSITS:

CLAY, SILTY, MEDIUM, DRY, RED-BROWN, LOW TO MODERATE PLASTICITY, LOCAL ROOTS PRESENT (CL).

GLACIOFLUVIAL OUTWASH DEPOSITS:

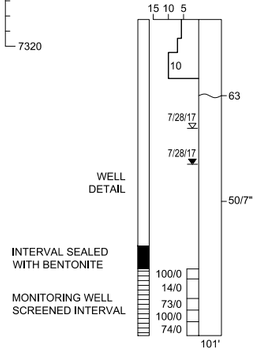
GRAVEL, SANDY, SILTY, COBBLY , WITH BOULDERS UP TO 5' IN DIAMETER, DRY, BROWN TO RED BROWN, LOW PLASTICITY, LOCAL ROOTS PRESENT.

COBBLES, GRAVELLY TO BOULDERY WITH SAND AND LOCAL SILT, VERY DENSE, DRY TO WET, WHITE, GRAY, PINK-BROWN, LOCALLY CONTAINS BOULDERS UP TO 6'-7' DIAMETER, CALCAREOUS, LOCAL CALICHE RINDS & CEMENT. RED SANDSTONE AND LIGHT GRAY GRANITE ARE MOST COMMON COBBLES.

SAND & GRAVEL: COBBLEY, TRACE SILT , LOCAL BOULDERS, WELL GRADED, COARSE GRAINED SAND, DENSE TO VERY DENSE, DRY TO SLIGHTLY MOIST, RED BROWN TO GRAY.

MANCOS SHALE:

SHALE: HARD (SOILS), MODERATELY STRONG, MOIST TO WET, DARK GRAY TO BLACK, FRACTURED, LOW TO MODERATELY PLASTIC, VERY THINLY BEDDED, SLIGHTLY WEATHERED TO FRESH NEAR BEDROCK/SAND AND GRAVEL CONTACT, LOCALLY CONTAINS CALC-SILICA CONCRETIONS AND LENSES. BEDDING DIPS 45° TO 55° TO THE SOUTH.



ODEX DRILLING RATE IN MINUTES PER 5 FOOT RUN. RUNS OF 10 MINUTES OR LONGER ARE NOTED.

APPROXIMATE DEPTH OF GEOLOGIC CONTACT

GROUNDWATER LEVER ENCOUNTERED DURING DRILLING

GROUNDWATER LEVER MEASURED ON DATE INDICATED

STANDARD PENETRATION TEST BLOW COUNT. NUMBER ("N" VALUE) INDICATES THE NUMBER OF BLOWS OF A 140 LB. HAMMER FREE FALLING 30 INCHES REQUIRED TO DRIVE THE SPLIT SPOON SAMPLER 1 FOOT OR THE INDICATED INTERVAL.

CORE INTERVAL SHOWING RECOVERY (%) AND RQD (%) ROCK QUALITY DESIGNATION (RQD) IS THE RATIO (%) OF THE CUMULATIVE LENGTH OF THE SOLID ROCK CORE > = 4 INCHES TO LENGTH OF THE CORE RUN.

DEPTH OF BORING OR TEST PIT (FT)

NOTES:

1. EXPLORATORY BORINGS WERE DRILLED BETWEEN JULY 24 AND JULY 28, 2017 USING A TRACK-MOUNTED CME 850 DRILL RIG. BORINGS WERE DRILLED WITH ODEX AND NQ CORING TECHNIQUES.
2. EXPLORATORY TEST PITS WERE EXCAVATED JULY 25, 2017 USING A LINK BELT 225 TRACK MOUNTED EXCAVATOR. TEST PITS 3, 4, AND 5 INTENTIONALLY OMITTED.
3. LINES BETWEEN MATERIALS REPRESENT APPROXIMATE BOUNDARIES BETWEEN TYPES AND TRANSITIONS MAY BE GRADUAL.
4. GROUNDWATER LEVELS WERE MEASURED AT THE TIME OF DRILLING OR DATE INDICATED. GROUNDWATER LEVELS MAY FLUCTUATE SEASONALLY.
5. ELEVATIONS ARE BASED ON A 2016 LIDAR SURVEY FROM PITKIN COUNTY, RELATIVE TO THE NAVD88 VERTICAL DATUM.
6. COORDINATES ARE RELATIVE TO THE NAD 83 HORIZONTAL DATUM PROJECTED IN THE COLORADO STATE PLANE CENTRAL ZONE COORDINATE SYSTEM, UNITS IN FEET.
7. LAB TESTING:

   MC=% MOISTURE CONTENT
   G=% GRAVEL BY WEIGHT
   S=% SAND BY WEIGHT
   -200=% BY WEIGHT PASSING THE #200 SIEVE (FINES)
   SILT=%SILT
   CLAY=%CLAY
   LL=LIQUID LIMIT
   PI=PLASTICITY INDEX
   MDD=MAXIMUM DRY DENSITY (PCF)
   OMC=OPTIMUM MOISTURE CONTENT (%)
   SpG=SPECIFIC GRAVITY

8. TWO ONE-INCH PVC OPEN STANDPIPE PIEZOMETERS ARE NESTED IN BORING B-102, THE WELLS WERE COMPLETED USING 10-SLOT SCREEN, 10/20 FILTER SAND AND TIME-RELEASE BENTONITE SEALS, THE SURFACE COMPLETION CONSISTS OF A LOCKING 4-INCH STICK-UP STEEL WELL BOX IN A CONCRETE PAD.

JOB NO. 0687.003.00

MCLAIN FLATS STORAGE PROJECT

SUMMARY LOGS OF EXPLORATORY BORINGS & TEST PITS

DEERE & AULT CONSULTANTS, INC.

FIGURE NO. 4

DATE: SEPTEMBER 2017

SCALE: AS NOTED

N

0 400 800

Feet

Aerial Imagery from Pitkin County (2014)
LiDAR Topography from Pitkin County (2016), C.I. = 10'

Highway 82

WOODY CREEK

Roaring Fork River

Upper River Road

Rio Grande Trail

Woody Creek

Roaring Fork Paleochannel

B-101 (O)

B-102 (O, C, P)

B-103 (O)

B-104 (O)

7340 7345 7279 7282 7362 7366 7340 7369 7369 7367 7360 7429 7400 7380 7320 7300 7249 7412 7420 7440 7340 7374 7200 7220 7240 7280 7260 7323 7251 7338 7353

Legend

2017 Geotechnical Borings

- Borings (O = Odex, C = Core, P = Piezometer)
- Bedrock Elevation Data (Approximate)

Bedrock Elevation Contours (C.I. = 20 feet)

- Approximate Outcrop Location
- Inferred Location

Bedrock Elevation

High : 7440

Low : 7200

JOB NO. 0687.003.00

MCLAIN FLATS STORAGE PROJECT

Bedrock Contour Map

DEERE & AULT CONSULTANTS, INC.

FIGURE NO. 5

DATE: SEPTEMBER 2017

SCALE: 1 inch=400 feet

U:\0687 City of Aspen\0687.003 Gravel Pit\ Reservoir Pre-Feasibility\GIS\Figure 5 - Bedrock Contour Map.mxd Thursday, September 28, 2017 09:36 AM

N

0 400 800

Feet

Aerial Imagery from Pitkin County (2014)
LiDAR Topography from Pitkin County (2016), C.I. = 10'

Highway 82

WOODY CREEK

Upper River Road

Rio Grande Trail

Roaring Fork River

Woody Creek

Roaring Fork Paleochannel

B-101 (O)

B-102 (O, C, P)

B-103 (O)

B-104 (O)

Legend

2017 Geotechnical Borings

- Borings (O = Odex, C = Core, P = Piezometer)
- Bedrock Depth Data (Approximate)
- Depth to Bedrock Isopachs (feet)

Bedrock Depth (feet)

High : 224

Low : 0

JOB NO. 0687.003.00

MCLAIN FLATS STORAGE PROJECT

Bedrock Depth Isopach Map

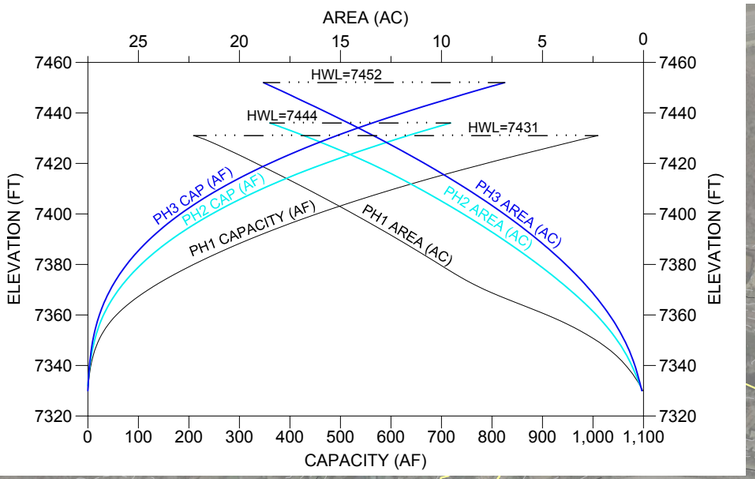
DEERE & AULT CONSULTANTS, INC.

FIGURE NO. 6

DATE: SEPTEMBER 2017

SCALE: 1 inch=400 feet

U:\0687 City of Aspen\0687.003 Gravel Pit Reservoir Pre-Feasibility\GIS\Figure 6 - Bedrock Depth Isopach Map.mxd Thursday, September 28, 2017 09:37 AM



NOTES:

- OHE — OVERHEAD ELECTRIC
- G — HIGH PRESSURE GAS LINE
- FO — FIBER OPTIC CABLE

JOB NO. 0687.003.00

MCLAIN FLATS STORAGE PROJECT

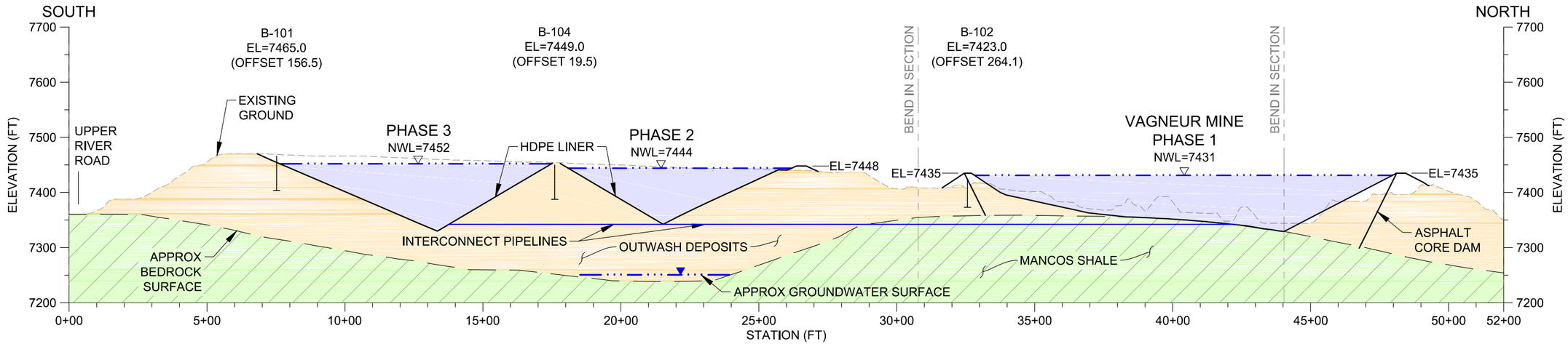
ALTERNATIVE 1 - THREE-PHASE RESERVOIR STORAGE

DEERE & AULT CONSULTANTS, INC.

FIGURE NO. 7

DATE: SEPTEMBER 2017

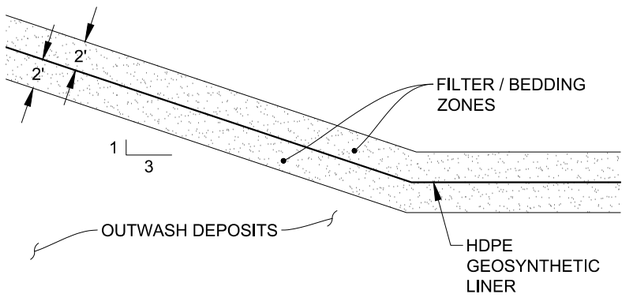
SCALE: AS NOTED



GEOLOGIC PROFILE (C)

Vertical Scale (Feet) 0 100 200

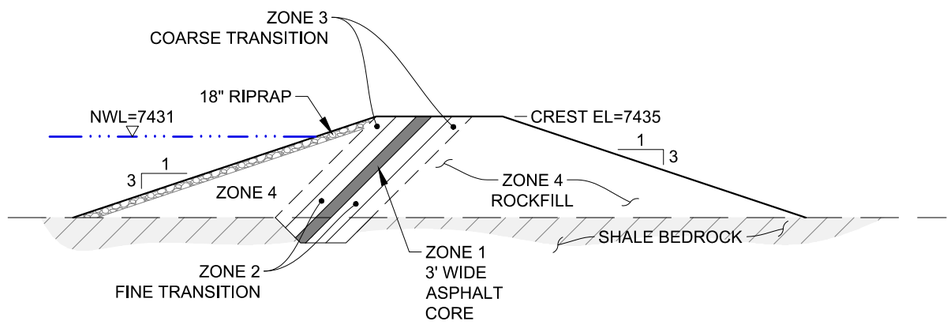
Horizontal Scale (Feet) 0 200 400



GEOSYNTHETIC LINER DETAIL

0 5 10

SCALE IN FEET



PHASE 1 ASPHALT CORE DAM TYPICAL DETAIL

NTS

JOB NO. 0687.003.00

MCLAIN FLATS STORAGE PROJECT

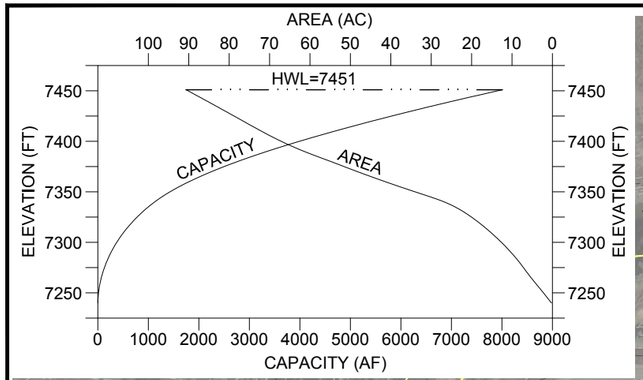
ALTERNATIVE 1 PROFILE & DETAILS

DEERE & AULT CONSULTANTS, INC.

FIGURE NO. 8

DATE: SEPTEMBER 2017

SCALE: AS NOTED



TUNNELED OUTLET & SPILLWAY TO ROARING FORK RIVER

ROARING FORK RIVER

LITTLE TEXAS

UPPER RIVER ROAD

RIO GRANDE TRAIL

WOODY CREEK

DAM

B-103 TP-2

B-101 TP-1

TP-6 B-104

TP-7

TP-8

B-102

MAXIMUM RESERVOIR
8,000 af

NWL=7451

PROPERTY LINES

FILL WITH DIKE

NOTES:

OHE — OVERHEAD ELECTRIC

G — HIGH PRESSURE GAS LINE

FO — FIBER OPTIC CABLE

0 150 300
SCALE IN FEET

JOB NO. 0687.003.00

MCLAIN FLATS STORAGE PROJECT

ALTERNATIVE 2 - MAXIMUM RESERVOIR STORAGE

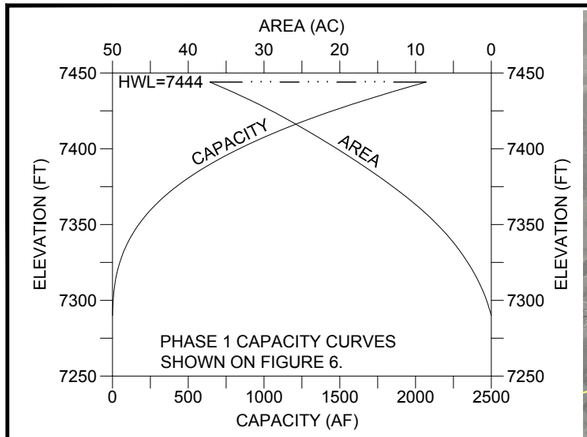
DEERE & AULT CONSULTANTS, INC.

FIGURE NO. **9**

DATE: **SEPTEMBER 2017**

SCALE: **AS NOTED**

Thursday, September 28, 2017 1:53:34 PM DRAWING: U:\0687 city of aspen\0687.003 gravel pit reservoir pre-feasibility\CAD\Working\MFSP-Alt2_Ultimate Reservoir.DWG



ROARING FORK RIVER

LITTLE TEXAS

UPPER RIVER ROAD

WOODY CREEK

RIO GRANDE TRAIL

TUNNELED OUTLET & SPILLWAY TO ROARING FORK RIVER

ASPHALT CORE DAM

DAM

PHASE 2
2,000 af

PHASE 1
1,000 af

B-101
B-103
B-104
B-102
TP-1
TP-2
TP-6
TP-7
TP-8

NWL=7444

NWL=7431

INTERCONNECT PIPILINE

VAGNEUR GRAVEL MINE

PROPERTY LINES

WOODY CREEK

0 150 300
SCALE IN FEET

NOTES:

OHE — OVERHEAD ELECTRIC

G — HIGH PRESSURE GAS LINE

FO — FIBER OPTIC CABLE

JOB NO. 0687.003.00

MCLAIN FLATS STORAGE PROJECT

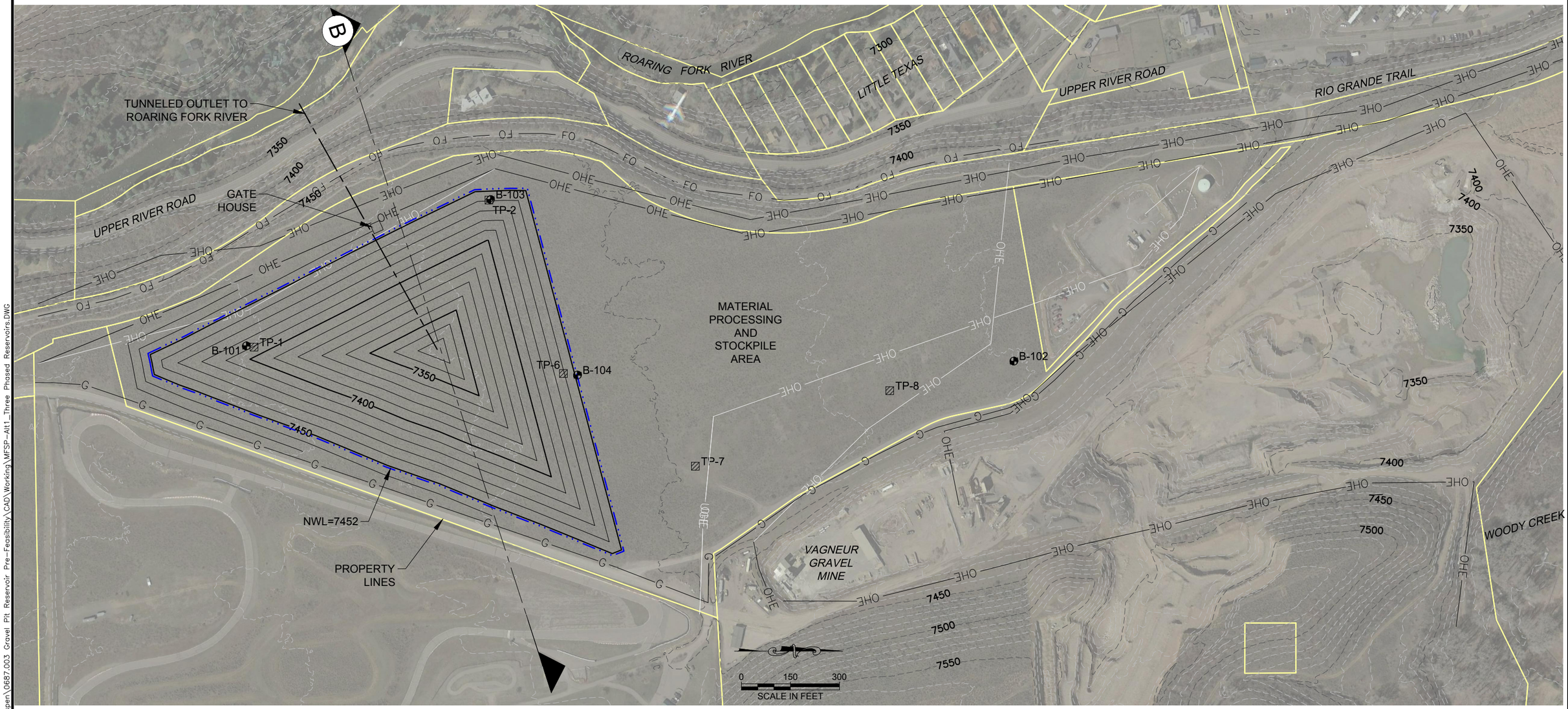
ALTERNATIVE 3 - TWO-PHASE RESERVOIR STORAGE

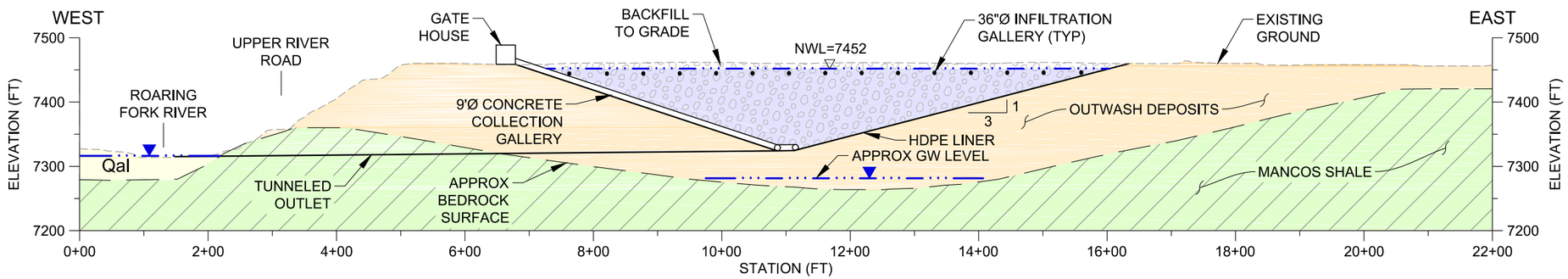
DEERE & AULT CONSULTANTS, INC.

FIGURE NO. **10**

DATE: **SEPTEMBER 2017**

SCALE: **AS NOTED**





GEOLOGIC PROFILE B

0 100 200
SCALE IN FEET

NOTES:

- OHE — OVERHEAD ELECTRIC
- G — HIGH PRESSURE GAS LINE
- FO — FIBER OPTIC CABLE

JOB NO. 0687.003.00

MCLAIN FLATS STORAGE PROJECT
ALTERNATIVE 4
MANUFACTURED IN-SITU RESERVOIR STORAGE

DEERE & AULT CONSULTANTS, INC.

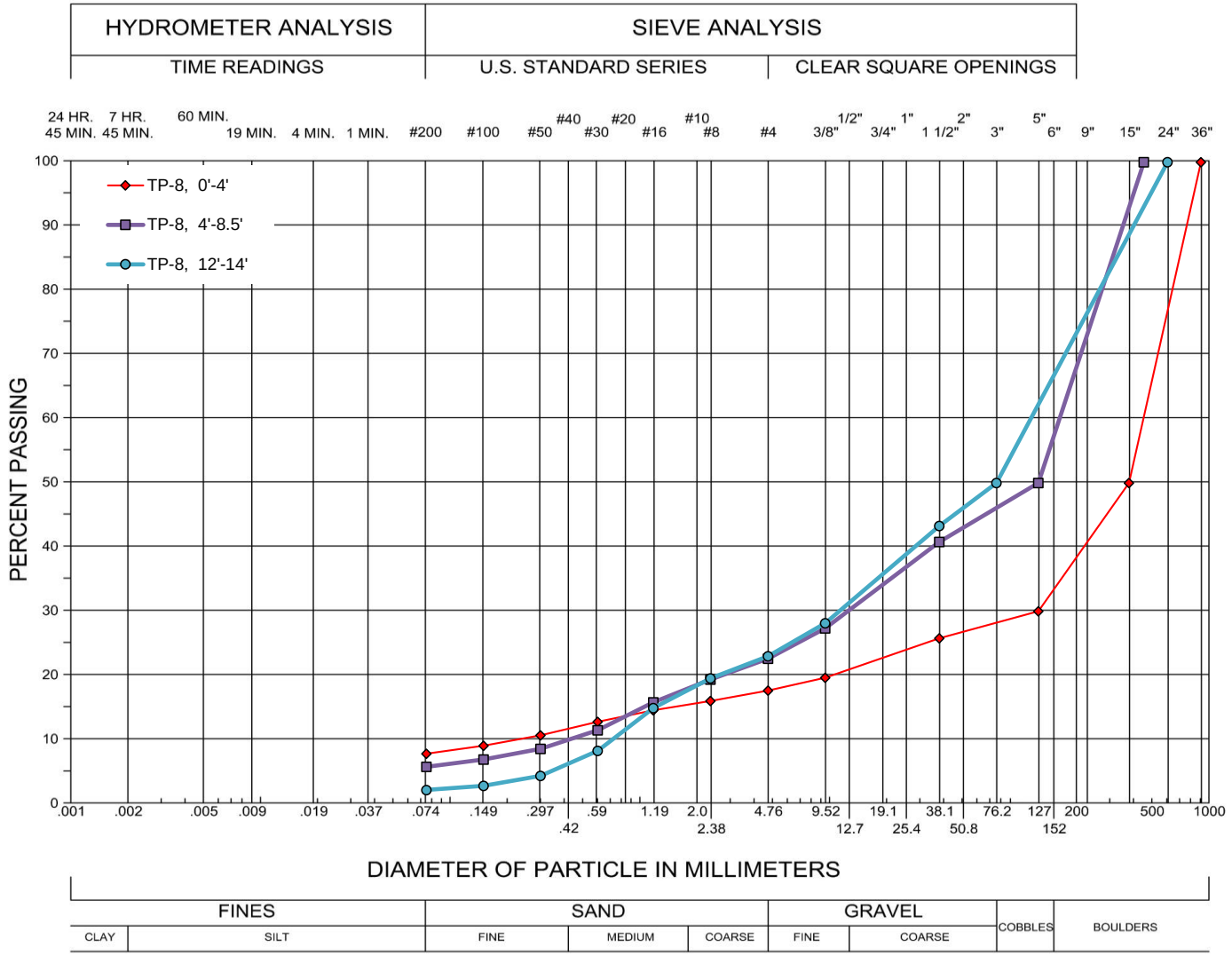
FIGURE NO. 11

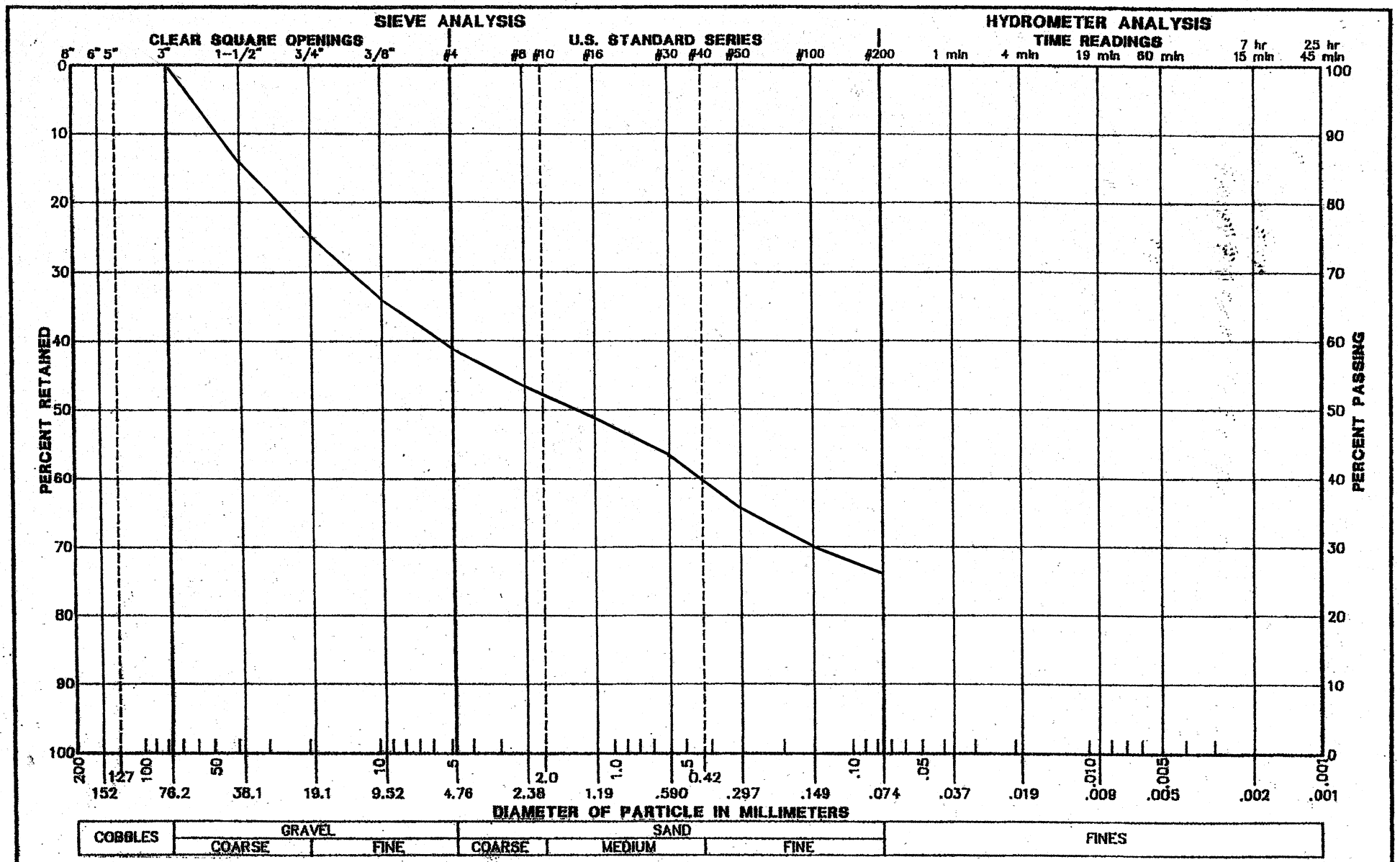
DATE: SEPTEMBER 2017

SCALE: AS NOTED

APPENDIX A
LABORATORY TEST RESULTS

Estimated Gradation for the Glaciofluvial Outwash Deposits





ATTERBERG LIMITS:
LL 25
PL 8

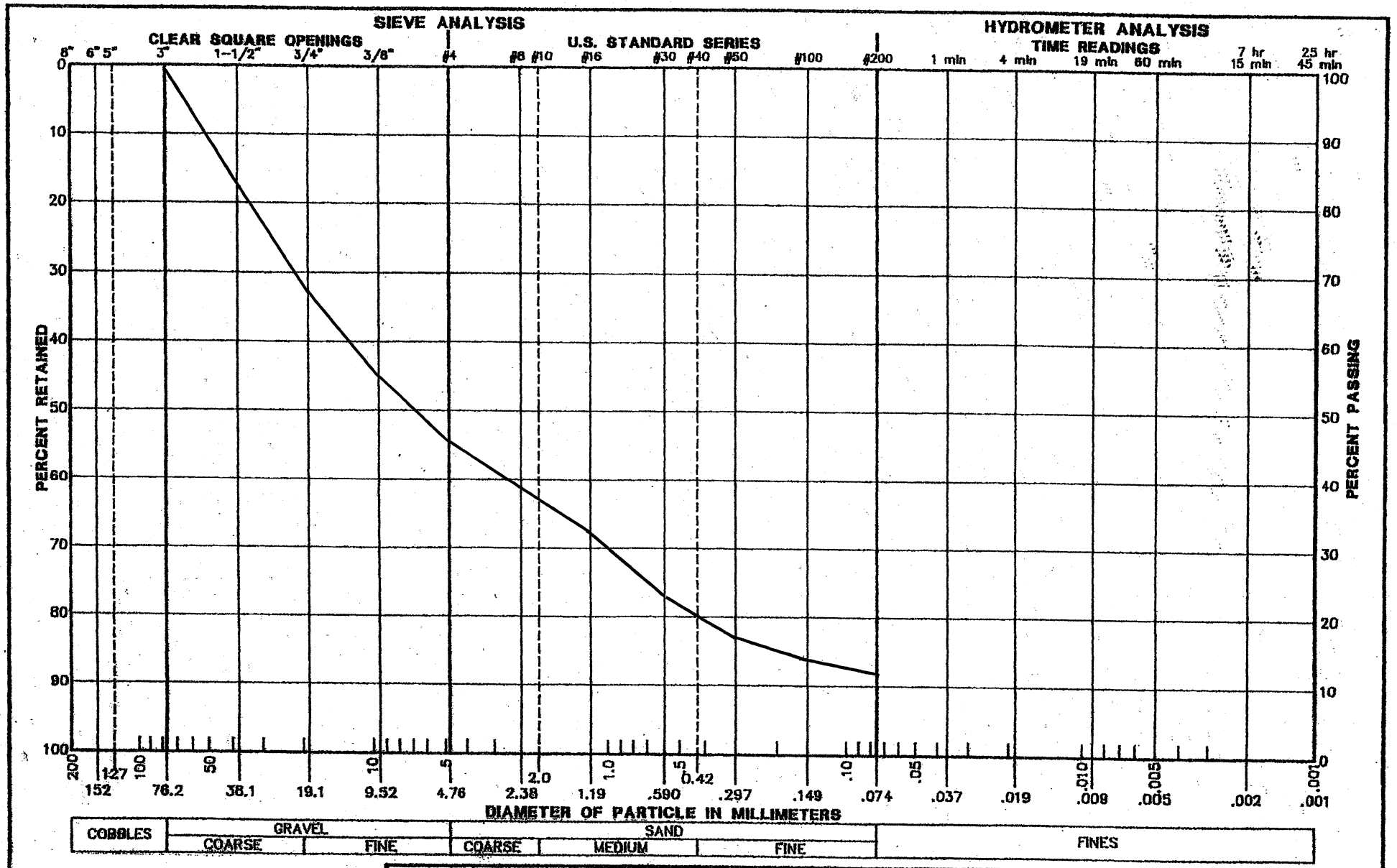
Gravel Pit Reservoir
Pre-Feasibility

TP-8 @ 0.0'-4.0'

J.R. Valentine, Inc.

GRADATION TEST

FIGURE 1



ATTERBERG LIMITS:

LL ---

PL ---

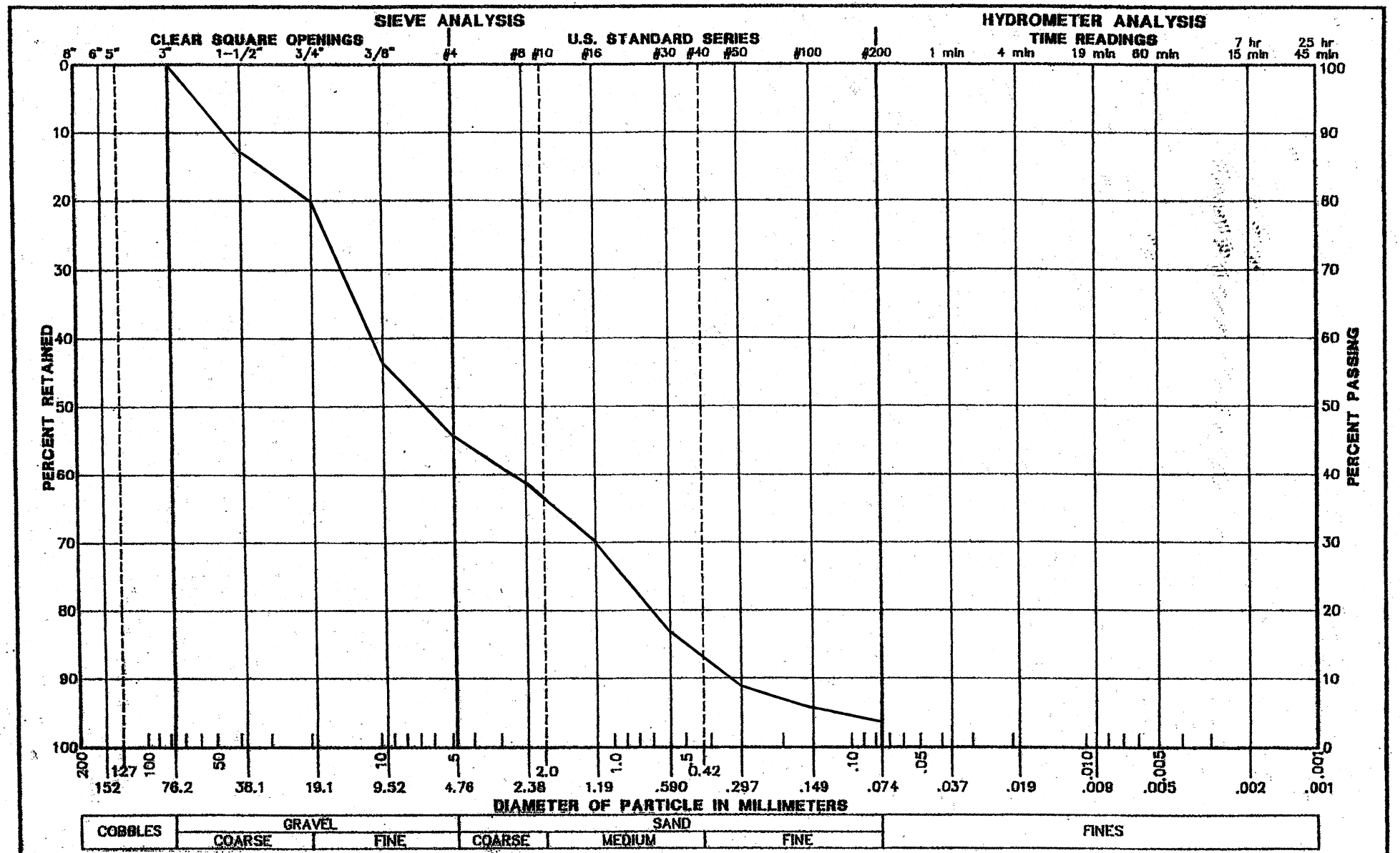
Gravel Pit Reservoir
Pre-Feasibility

TP-8 @ 4.0'-8.5'

J.R. Valentine, Inc.

GRADATION TEST

FIGURE 2



ATTERBERG LIMITS:

LL ---

PL ---

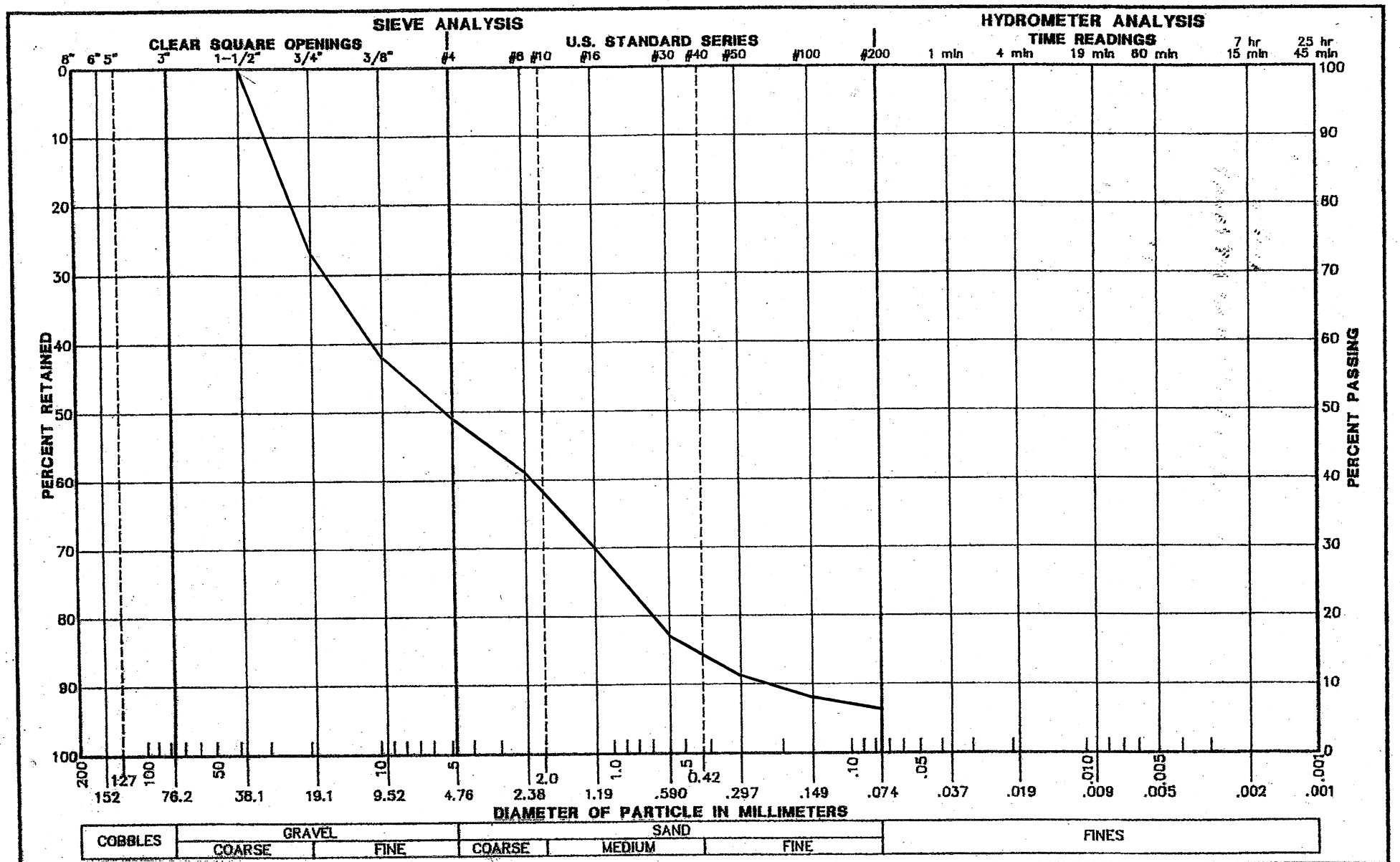
Gravel Pit Reservoir
Pre-Feasibility

TP-8 @ 12.0'-14.0'

J.R. Valentine, Inc.

GRADATION TEST

FIGURE 3



ATTERBERG LIMITS:

LL ---

PL ---

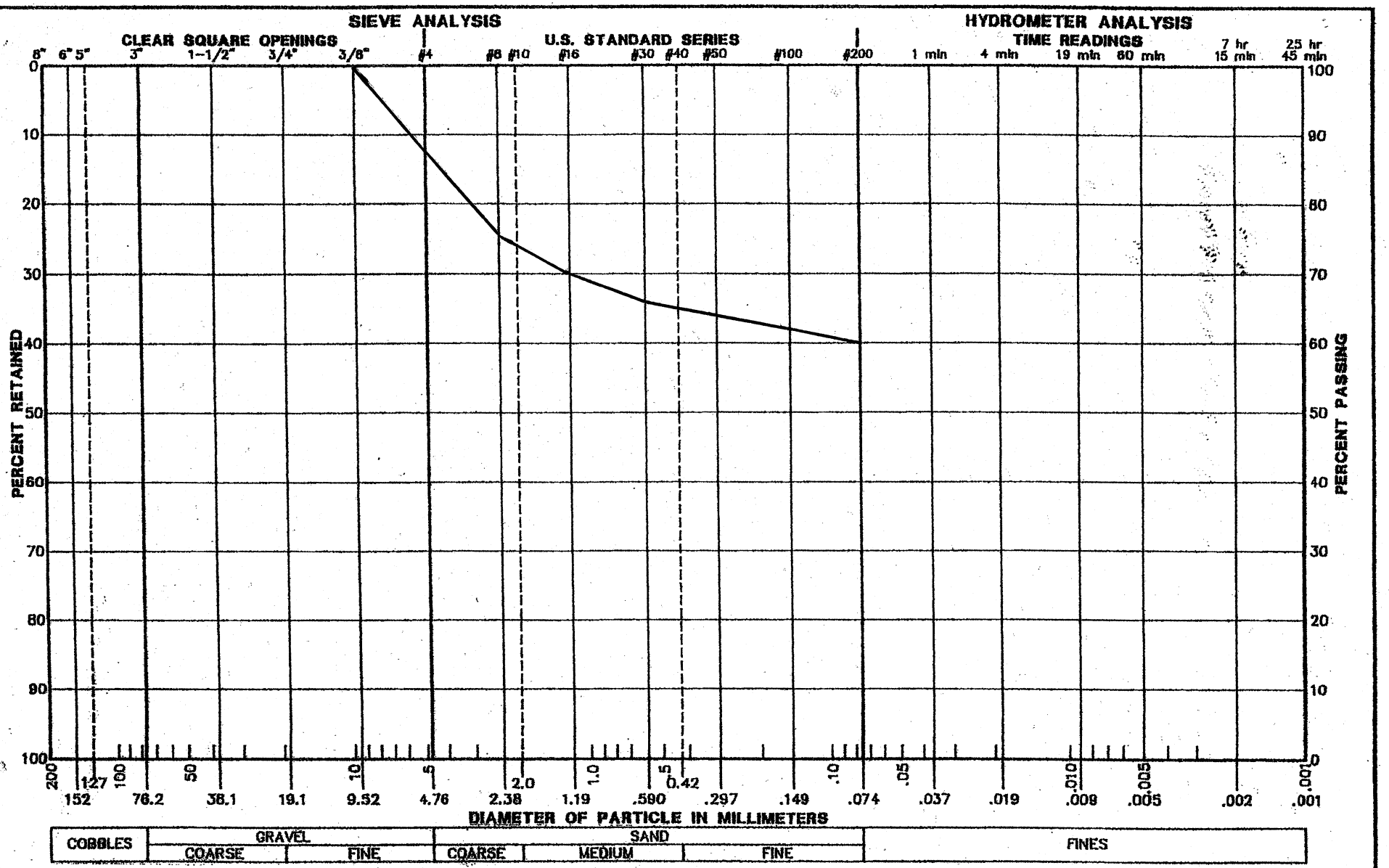
Gravel Pit Reservoir
Pre-Feasibility

BH-102 @ 33.0'

J.R. Valentine, Inc.

GRADATION TEST

FIGURE 4



ATTERBERG LIMITS:
LL 22
PL 4

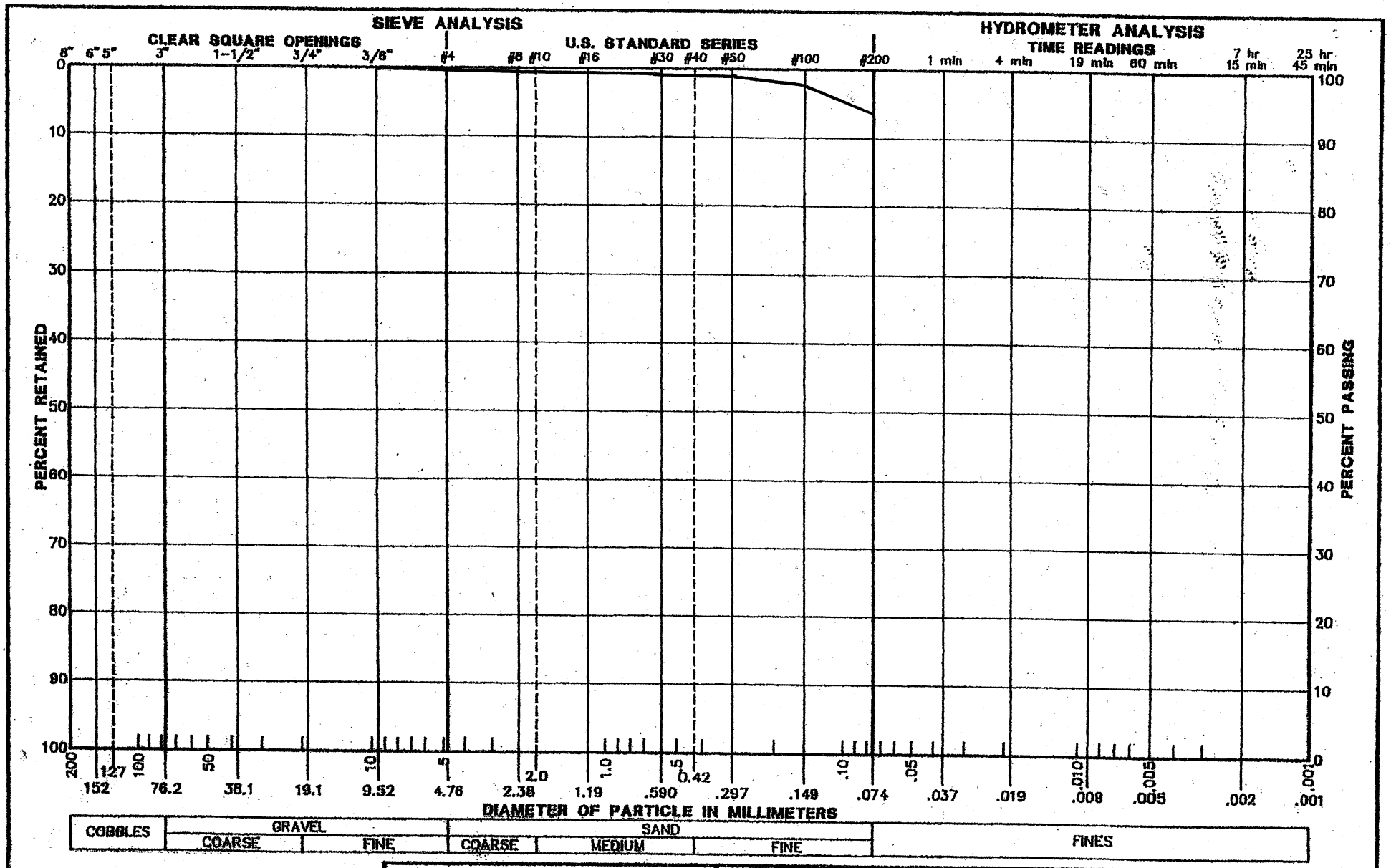
Gravel Pit Reservoir
Pre-Feasibility

Road Cut @ 0.0'

J.R. Valentine, Inc.

GRADATION TEST

FIGURE 5



ATTERBERG LIMITS:
LL 34
PL 19

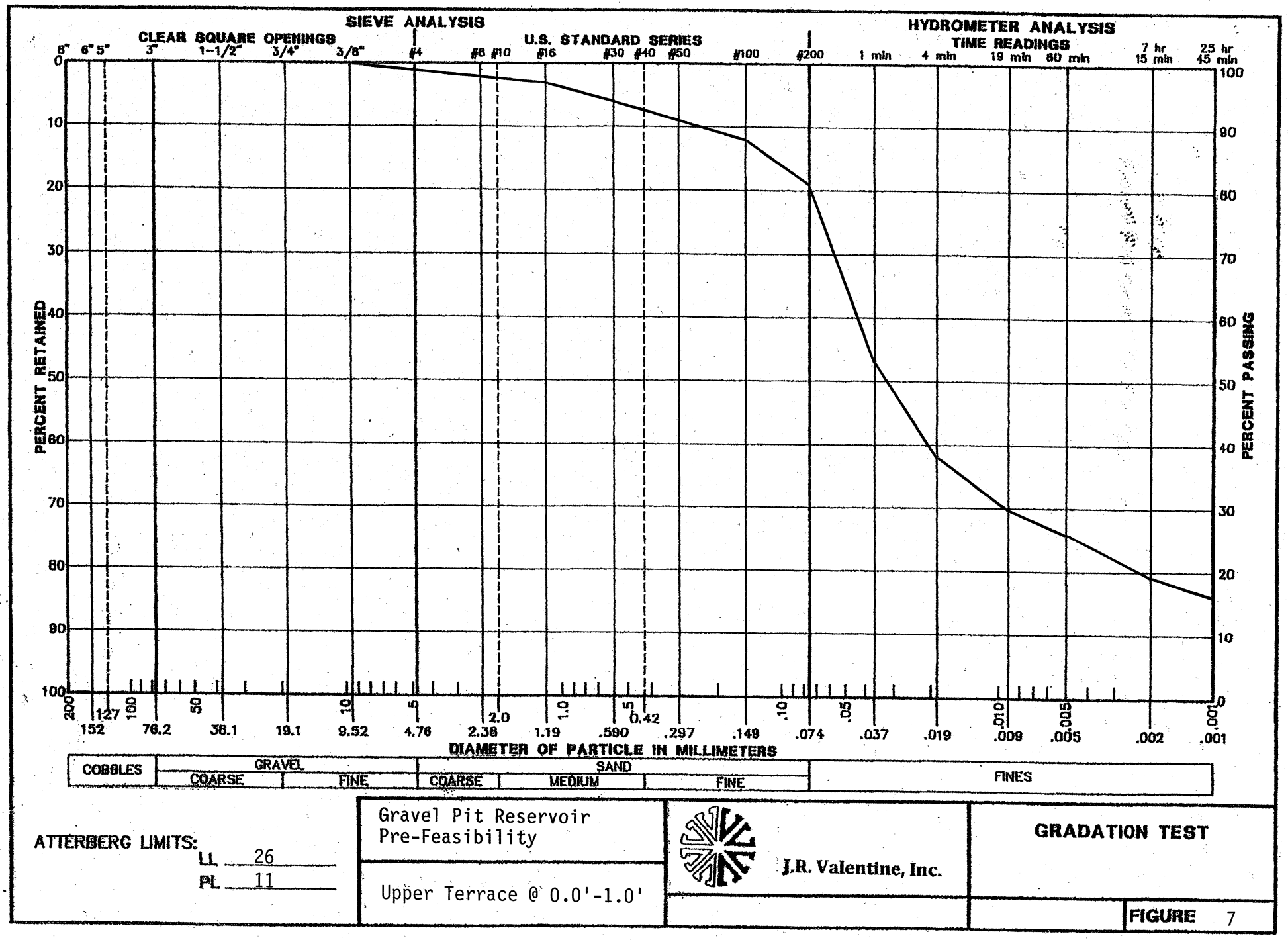
Gravel Pit Reservoir
Pre-Feasibility

Upper Terrace @ 1.0'

J.R. Valentine, Inc.

GRADATION TEST

FIGURE 6



ATTERBERG LIMITS:
LL 26
PL 11

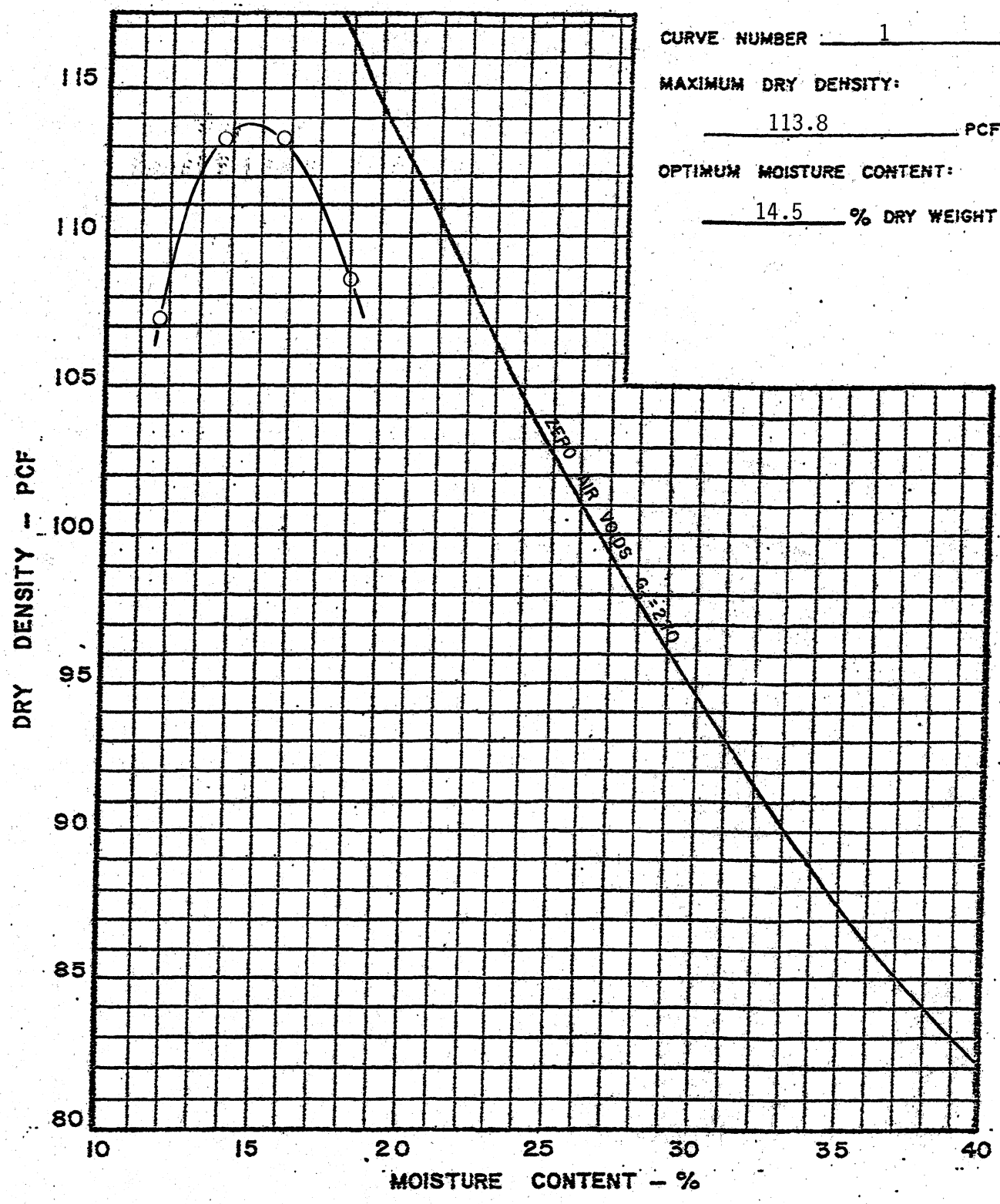
Gravel Pit Reservoir
Pre-Feasibility

Upper Terrace @ 0.0'-1.0'

J.R. Valentine, Inc.

GRADATION TEST

FIGURE 7



CURVE NUMBER 1

MAXIMUM DRY DENSITY:

113.8 PCF

OPTIMUM MOISTURE CONTENT:

14.5 % DRY WEIGHT

SAMPLE DESCRIPTION Sandy Clay

LOCATION Upper Terrace Stockpile

COMPACTION TEST PROCEDURE ASTM D698 Method A

COMPACTION TEST RESULTS

APPENDIX B
NATURAL RESOURCES ASSESSMENT

ERO

Consultants in Natural Resources and the Environment

Natural Resources Assessment
Proposed Reservoir Site
Pitkin County, Colorado

Prepared for—

Deere & Ault Consultants, Inc.
600 South Airport Road, Suite A-205
Longmont, Colorado 80503

Prepared by—

ERO Resources Corporation
1842 Clarkson Street
Denver, Colorado 80218
(303) 830-1188
ERO Project #6941

September 26, 2017

Contents

Tables

Figures

Appendix

Executive Summary

Deere & Ault Consultants, Inc. (D&A) retained ERO Resources Corporation (ERO) to provide a natural resources assessment for the Proposed Reservoir site in Pitkin County, Colorado (project area; Figure 1). The project area is on a terrace above the Roaring Fork River and the small community of Woody Creek. The purpose of this report is to provide an assessment of natural resources that would present a possible fatal flaw that would jeopardize the proposed project. ERO assessed the project area for potential wetlands and waters of the U.S., threatened and endangered species, and general wildlife use. Below is a summary of the resources found at the project area and recommendations or future actions necessary based on the current site conditions and federal, state, and local regulations.

The natural resources and associated regulations described in this report are valid as of the date of this report and may be relied upon for the specific use for which it was prepared by ERO under contract to D&A. Because of their dynamic nature, site conditions and regulations should be reconfirmed by a qualified consultant before relying on this report for a use other than that for which ERO was contracted and if a significant amount of time has passed between the date of this report and project activities.

Wetlands and Other Waters of the U.S. – No wetlands or other waters of the U.S. occur within the project area. If activities are limited to the project area and no other wetlands or waters of the U.S. would be directly affected by the proposed project, no action is necessary to comply with the Clean Water Act.

Threatened and Endangered Species – The project area does not contain habitat for any federally listed threatened or endangered species, although if depletions (changes in the volume and timing of flow) to streams within the Colorado River basin would occur, consultation with the U.S. Fish and Wildlife Service would be required to determine impacts on four Colorado River endangered fish species.

Migratory Birds – The sagebrush shrubland within the project area is nesting habitat for several species of migratory birds. No bird nests were observed during the 2017 site visit; however, an extensive nest survey was not conducted. ERO recommends removing vegetation outside of the active breeding season. If the project schedule does not allow for vegetation to be removed outside of the breeding season, a nest survey should be conducted within one week of activities that would disturb vegetation to ensure that no active nests are destroyed or nesting birds are harmed by project activities.

Bird/Wildlife Aircraft Strike Hazard – The project area is within the General Zone (5-mile buffer) around the Aspen-Pitkin County Airport. Because the proposed reservoir could be an attractant to wildlife, especially water fowl, the Federal Aviation Administration would likely review the project and may have some concerns. Mitigation options may be available. Additional analysis may be needed to model the direct and indirect effects of the proposed reservoir on bird concentrations and to determine possible movements based on other attractants. Because Pitkin County 1041 approval may be needed, coordination with the county is recommended early in the process to determine the airport's concerns and recommendations.

Conclusion – Compliance with the Clean Water Act and the Endangered Species Act would not present a fatal flaw that would jeopardize the project. The proximity of the project area to the Aspen-Pitkin County Airport would present some challenges and would require coordination with Pitkin County and the airport's Wildlife Coordinator to determine the concerns and potential mitigation strategies.

Natural Resources Assessment
Proposed Reservoir Site
Pitkin County, Colorado

September 26, 2017

Introduction

Deere & Ault Consultants, Inc. (D&A) retained ERO Resources Corporation (ERO) to provide a natural resources assessment for the Proposed Reservoir site in Pitkin County, Colorado (project area; Figure 1). The proposed reservoir would be to the east of the Roaring Fork River near the small community of Woody Creek. The purpose of this report is to provide an assessment of natural resource issues that may be considered fatal flaws by regulatory agencies and that would jeopardize the proposed reservoir project.

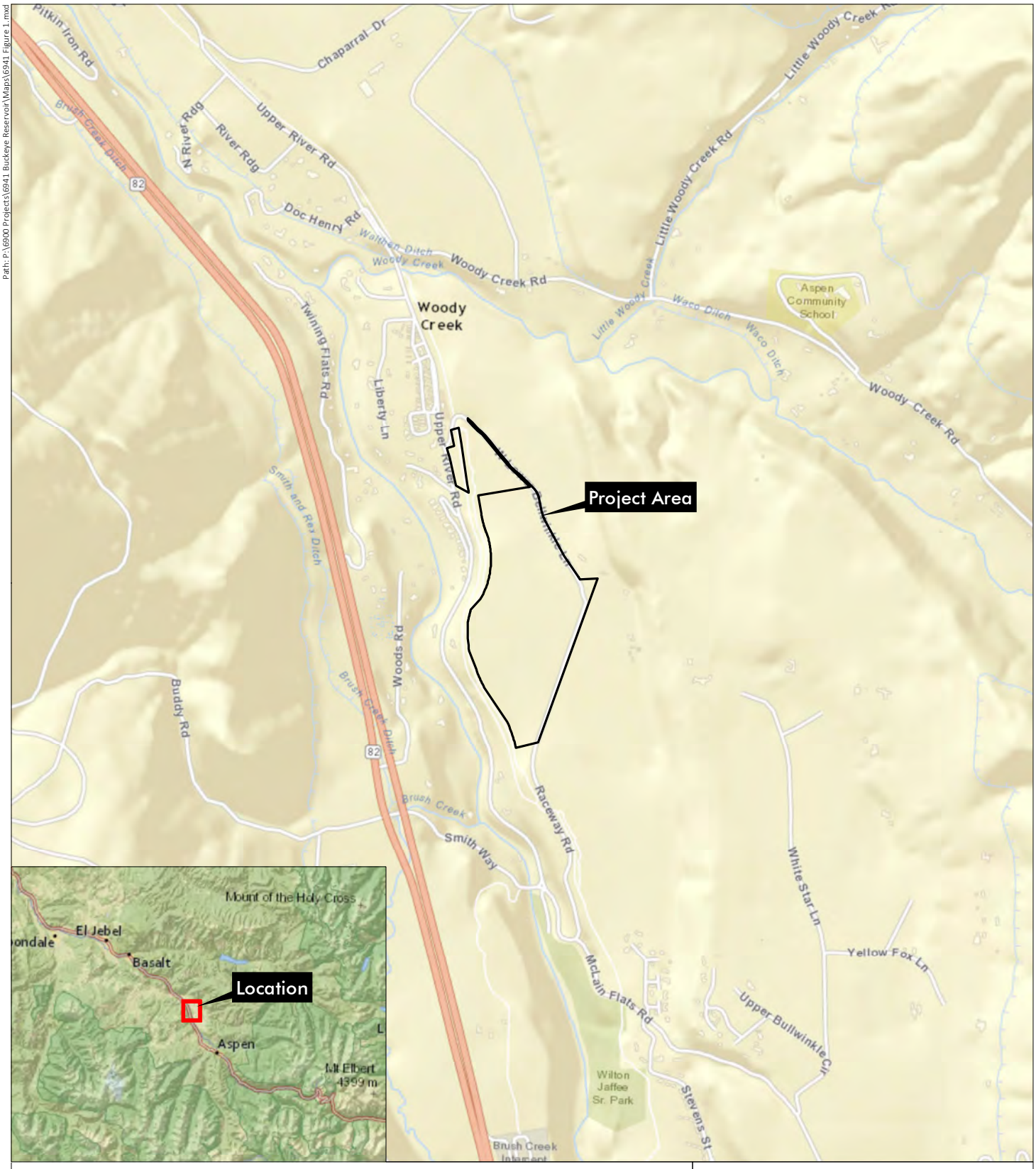
On July 20, 2017, Leigh Rouse, an ecologist with ERO, assessed the project area for natural resources (2017 site visit). During this assessment, activities included a review of potential wetlands and other waters of the U.S. (streams, ponds, lakes, and some ditches); identification of potential federally threatened and endangered species habitat; and identification of other natural resources in the project area. This report provides information on existing site conditions and resources, as well as current regulatory guidelines related to those resources. ERO assumes the landowner would be responsible for obtaining all federal, state, and local permits for construction of the project.

The natural resources and associated regulations described in this report are valid as of the date of this report and may be relied upon for the specific use for which it was prepared by ERO under contract to D&A. Because of their dynamic nature, site conditions and regulations should be reconfirmed by a qualified consultant before relying on this report for a use other than that for which ERO was contracted or if a significant amount of time has passed between the date of this report and project activities.

Project Area Description

The project area is in Section 16, Township 9 South, Range 85 West of the 6th Principal Meridian in Pitkin County, Colorado (Figure 1). The UTM coordinates for the approximate center of the project area are 337539mE, 4348130mN, Zone 13 North. The longitude/latitude of the project area is 106.883213°W/39.267297°N. The elevation of the project area is approximately 7,445 feet above sea level. Photos of the project area are in Appendix A.

The project area is east of Woody Creek, a small community within the Roaring Fork Valley, and sits on a terrace above the Roaring Fork River, a perennial tributary to the Colorado River. State Highway 82 generally parallels the west side of the Roaring Fork River while the Upper River Road occurs between the river and the project area (Figure 2). Raceway Road creates the southeast boundary of the site and



Proposed Reservoir Site

Section 16, T9S, R85W; 6th PM

UTM NAD 83: Zone 13N; 337539mE, 4348130mN

Longitude 106.883213°W, Latitude 39.267297°N

USGS Woody Creek, CO Quadrangle

Pitkin County, Colorado

0 750 1,500 Feet

N

Figure 1
Vicinity Map

Prepared for: Deere & Ault
File: 6941 Figure 1.mxd (GS)
September 26, 2017

ERO Resources Corp.

Proposed Reservoir Site

Project Area Boundary

Image Source: Google Earth©, April 2015

0 250 500 Feet

N

Figure 2
Existing Conditions

Prepared for: Deere & Ault
File: 6941 Figure 2.mxd (GS)
September 26, 2017

ERO Resources Corp.

provides access to a racetrack and shooting range east of the project area. A gravel mine is northeast of the project area. The main 55.7-acre parcel is on the upper terrace (Photo 1) and a secondary 1.9-acre parcel is on a steep bank that slopes toward the Woody Creek community, northwest of the project area (Photo 2). On the west side of the project area, two trails parallel the project area – the Rio Grande Trail is paved and the smaller trail east of the Rio Grande Trail is crusher fines. Powerlines cut through the western part of the project area (Photo 3). Occasionally, large boulders occur in mounds throughout the project area along with other disturbed soil mounds. Along the Roaring Fork River, the riparian corridor is dominated by narrowleaf cottonwood (*Populus angustifolia*) and blue spruce (*Picea pungens*) (Photo 4).

The vegetation within the project area is dominated by sagebrush (*Artemisia tridentata*). Other species present include bitterbrush (*Purshia tridentata*), rabbitbrush (*Chrysothamnus* sp.), serviceberry (*Amelanchier* sp.), snowberry (*Symphoricarpos* sp.), Oregon grape (*Berberis repens*), and juniper (*Juniperus* sp.). Patches of scrub oak (*Quercus gambelii*) occur along the trails and the west property boundary. Forbs and grasses consist of Kentucky bluegrass (*Poa pratensis*), smooth brome (*Bromus inermis*), squirreltail (*Elymus elymoides*), fringed sage (*Artemisia frigida*), wild buckwheat (*Eriogonum* sp.), and pussytoes (*Antennaria* sp.).

Wetlands and Waters of the U.S.

Background

The Clean Water Act (CWA) protects the physical, biological, and chemical quality of waters of the U.S. The U.S. Army Corps of Engineers' (Corps) Regulatory Program administers and enforces Section 404 of the CWA. Under Section 404, a Corps permit is required for the discharge of dredged or fill material into wetlands and other waters of the U.S. In 2007, the Corps issued guidance in response to the Supreme Court ruling in the consolidated cases of *Rapanos v. United States and Carabell v. U.S. Army Corps of Engineers* (Rapanos) stating that the Corps considers traditionally navigable waters (TNWs), wetlands adjacent to a TNW, and tributaries to TNWs that are relatively permanent waters (RPWs) and their abutting wetlands to be jurisdictional waters. Other wetlands and waters that are not TNWs or RPWs will require a significant nexus evaluation to determine their jurisdiction. A significant nexus evaluation assesses the flow characteristics and functions of a tributary and its adjacent wetlands to determine if they significantly affect the chemical, physical, or biological integrity of downstream TNWs.

On May 31, 2016, the U.S. Supreme Court concluded that approved jurisdictional determinations are judicially reviewable under the Administration Procedure Act and, therefore, can be appealed in court. The Corps has recommended that requests for both approved and preliminary jurisdictional determinations be done using guidance outlined in Regulatory Guidance Letter (RGL) 16-01 and that a jurisdictional form request be completed (Corps 2016). The Corps has indicated that jurisdictional determinations associated with a Section 404 CWA Permit request will preside over stand-alone

jurisdictional determination requests. While ERO may provide its opinion on the likely jurisdictional status of wetlands and waters, the Corps makes the final determination.

Site Conditions and Regulations

ERO assessed the project area for potential isolated wetlands, jurisdictional wetlands, and other waters of the U.S. (streams, ponds, lakes, and some ditches). The project area is entirely sagebrush-dominated upland, and no wetlands or other waters subject to Corps' jurisdiction are present. Because no jurisdictional waters of the U.S. are present in the project area that would be directly impacted by project activities, no action is necessary to comply with the CWA. Other actions that may be part of the proposed project (e.g., construction of a diversion structure) and that would affect a jurisdictional water of the U.S. would require coordination with the Corps to determine compliance with the CWA.

Threatened, Endangered, and Candidate Species

ERO assessed the project area for potential habitat for threatened, endangered, and candidate species under the Endangered Species Act (ESA). Federally threatened and endangered species are protected under the ESA of 1973, as amended (16 U.S.C. 1531 et seq.). Significant adverse effects on a federally listed species or its habitat require consultation with the U.S. Fish and Wildlife Service (Service) under Section 7 or 10 of the ESA. The Service lists several threatened and endangered species with potential habitat in Pitkin County, or that would be potentially affected by projects in Pitkin County (Table 1).

Table 1. Federally threatened, endangered, and candidate species potentially found in Pitkin County or potentially affected by projects in Pitkin County.

Common Name	Scientific Name	Status*	Habitat	Habitat Present
Mammals				
Canada lynx	*Lynx canadensis*	T	Climax boreal forest with a dense understory of thickets and windfalls	No
North American wolverine	*Gulo gulo luscus*	PT	Boreal forests and cold areas that receive enough winter precipitation to reliably maintain deep persistent snow	No
Birds				
Mexican spotted owl	*Strix occidentalis*	T	Closed canopy forests in steep canyons	No
Yellow-billed cuckoo	*Coccyzus americanus*	T	Wooded habitat with dense cover and water nearby	No
Fish				
Bonytail chub**	*Gila elegans*	E	Backwaters with rocky or muddy bottoms and flowing pools	No habitat; affected by depletions within the Colorado River basin
Colorado pikeminnow**	*Ptychocheilus lucius*	E	Deep, fast-flowing rivers; prefer large turbid pools found in the main river and its tributaries	No habitat; affected by depletions within the Colorado River basin
Greenback cutthroat trout	*Oncorhynchus clarki stomias*	T	Cold, clear, gravel headwater streams and mountain lakes	No
Humpback chub**	*Gila cypha*	E	Variety of habitats ranging from pools with turbulent to little or no current; substrates of silt, sand, boulder, and bedrock; and depth ranging from 1 to 15 meters	No habitat; affected by depletions within the Colorado River basin
Razorback sucker**	*Xyrauchen texanus*	E	Large rivers, in water 4 to 10 feet deep; adults are associated with areas of strong current and backwaters	No habitat; affected by depletions within the Colorado River basin
Plants				
Ute ladies'-tresses orchid	*Spiranthes diluvialis*	T	Moist to wet alluvial meadows, floodplains of perennial streams, and around springs and lakes below 6,500 feet in elevation	No
Insects				
Uncompahgre fritillary butterfly	*Boloria acrocnema*	E	Associated with large patches of snow willow above 3,780 meters in elevation	No

*T = Federally Threatened Species, E = Federally Endangered Species; PT = Proposed Threatened.
**Water depletions in the Colorado River may affect the species and/or critical habitat in downstream reaches in other counties.
Source: Service 2017.

The proposed project would not directly affect the Canada lynx, North American wolverine, Mexican spotted owl, yellow-billed cuckoo, greenback cutthroat trout, Ute ladies'-tresses orchid, or Uncompahgre fritillary butterfly because of the lack of habitat in the project area. The riparian corridor along the Roaring Fork River is habitat for the yellow-billed cuckoo. Because the proposed project would not directly affect the riparian habitat and the site is on a terrace not directly abutting the river,

there would not be a direct effects on yellow-billed cuckoo habitat. The project would not result in any direct impacts on federally threatened and endangered species.

Colorado River Endangered Fish Species

The Roaring Fork River is a tributary to the Colorado River, which is habitat for four endangered Colorado River fish species – bonytail chub, Colorado pikeminnow, humpback chub, and razorback sucker. An action that causes a change in the volume or timing of flow is considered a depletion. Water diverted from the Roaring Fork River or any other tributary to the Colorado River would cause depletions to the Colorado River that would adversely affect the Colorado River fish species. If a project-related action, such as constructing a diversion structure, would require Section 404 authorization, the action would create a federal nexus and depletions to the Roaring Fork River would require consultation with the Service. Typically, the lead federal agency (i.e., the Corps for 404 authorization) would consult with the Service under Section 7 of the ESA. The Section 7 consultation process typically consists of a biological assessment (BA) provided by the Corps (or other lead federal agency) to the Service describing the effects on listed species and designated critical habitat and proposed mitigation for the impacts. The Service responds to the BA with a biological opinion (BO) providing its opinion on the effects and prescribing the required mitigation to avoid jeopardizing the continued existence of a federally listed species or adverse modification of designated critical habitat (reasonable and prudent alternatives or measures). The BO's reasonable and prudent alternatives are included as special conditions in any permit issued by the Corps.

In 1999, the Service issued a Programmatic BO with specific elements to implement the Recovery Implementation Program for Endangered Fish Species in the Upper Colorado River Basin (Recovery Program) (Service 1999). The Recovery Program is a mechanism to consult with the Service and for the regulated public to benefit from existing mitigation measures. When consulting on projects, the Service would determine if progress toward recovery has been sufficient for the Recovery Program to serve as a reasonable and prudent alternative or measure. The Service also would consider whether the probability of success of the Recovery Program is compromised as a result of the project or the cumulative effect of depletions. The Service would consider Recovery Program and non-Program actions throughout the basin in evaluating the sufficiency of the program to serve as a reasonable and prudent alternative or measure for the project. The Service would assess the sufficiency of Recovery Program actions in proportion to the potential impacts of a proposed federal action. That is, the smaller the impact of a federal action, the lower the level of actions by the Recovery Program or others needed to avoid jeopardy or destruction or adverse modification of critical habitat.

The Service only consults on and tracks depletions associated with a federal action. If the proposed project would not trigger a federal nexus, consultation with the Service on the Colorado River endangered fish species would not be necessary.

Other Species of Concern

Raptors and Migratory Birds

Migratory birds, as well as their eggs and nests, are protected under the Migratory Bird Treaty Act (MBTA). The MBTA does not contain any prohibition that applies to the destruction of a bird nest alone (without birds or eggs), provided that no possession occurs during the destruction. While destruction of a nest by itself is not prohibited under the MBTA, nest destruction that results in the unpermitted take of migratory birds or their eggs is illegal and fully prosecutable under the MBTA (Migratory Bird Permit Memorandum, Service (2003)). The regulatory definition of a take means to pursue, hunt, shoot, wound, kill, trap, capture, or collect; or attempt to pursue, hunt, shoot, wound, kill, trap, capture, or collect.

Under the MBTA, the Service may issue nest depredation permits, which allow a permittee to remove an active nest. The Service, however, issues few permits and only under specific circumstances, usually related to human health and safety. Obtaining a nest depredation permit is unlikely and involves a process that takes from 8 to 12 weeks. The best way to avoid a violation of the MBTA is to remove vegetation outside of the active breeding season, which typically falls between March and August, depending on the species. Most MBTA enforcement actions are the result of a concerned member of the community reporting a violation.

Habitat and Recommendations

Sagebrush shrublands are nesting habitat for several bird species including Brewer's sparrow, vesper sparrow, grasshopper sparrow, western meadowlark, horned lark, and loggerhead shrike. Generally, the nesting season in the Intermountain West is from April through August. No bird nests were observed in the project area during the 2017 site visit; however, a full nest survey was not conducted. The best way to avoid affecting nesting migratory birds is to remove vegetation outside of the active breeding season. If the project schedule does not allow vegetation removal outside of the breeding season, a nest survey should be conducted within a week prior to any vegetation-disturbing activity so that any active nest can be avoided until the birds, including fledglings, have left the nest to avoid a "take" under the MBTA. If active nests are found during surveys, any work that would destroy the nests or cause a bird to abandon eggs or chicks cannot be conducted until the birds have left the nests. There is no process for removing nests during the nonbreeding season; however, nests may not be collected under MBTA regulations.

Although the proposed project would not affect the riparian corridor along the Roaring Fork River, it provides nesting habitat for a variety of birds including raptors. A few raptor species such as bald eagles, great horned owls, and red-tailed hawks can nest as early as December (eagles) or late February (owls and red-tailed hawks). Colorado Parks and Wildlife (CPW) has recommended setbacks from active raptor nests; the distance depends on the species. Prior to any land disturbance activity, a nest survey should be conducted in the riparian corridor adjacent to the project area to determine if any setbacks from an active nest are needed during the breeding season. CPW allows some changes in the setbacks depending on the circumstances, such as if birds are nesting in a highly disturbed area.

Other Wildlife

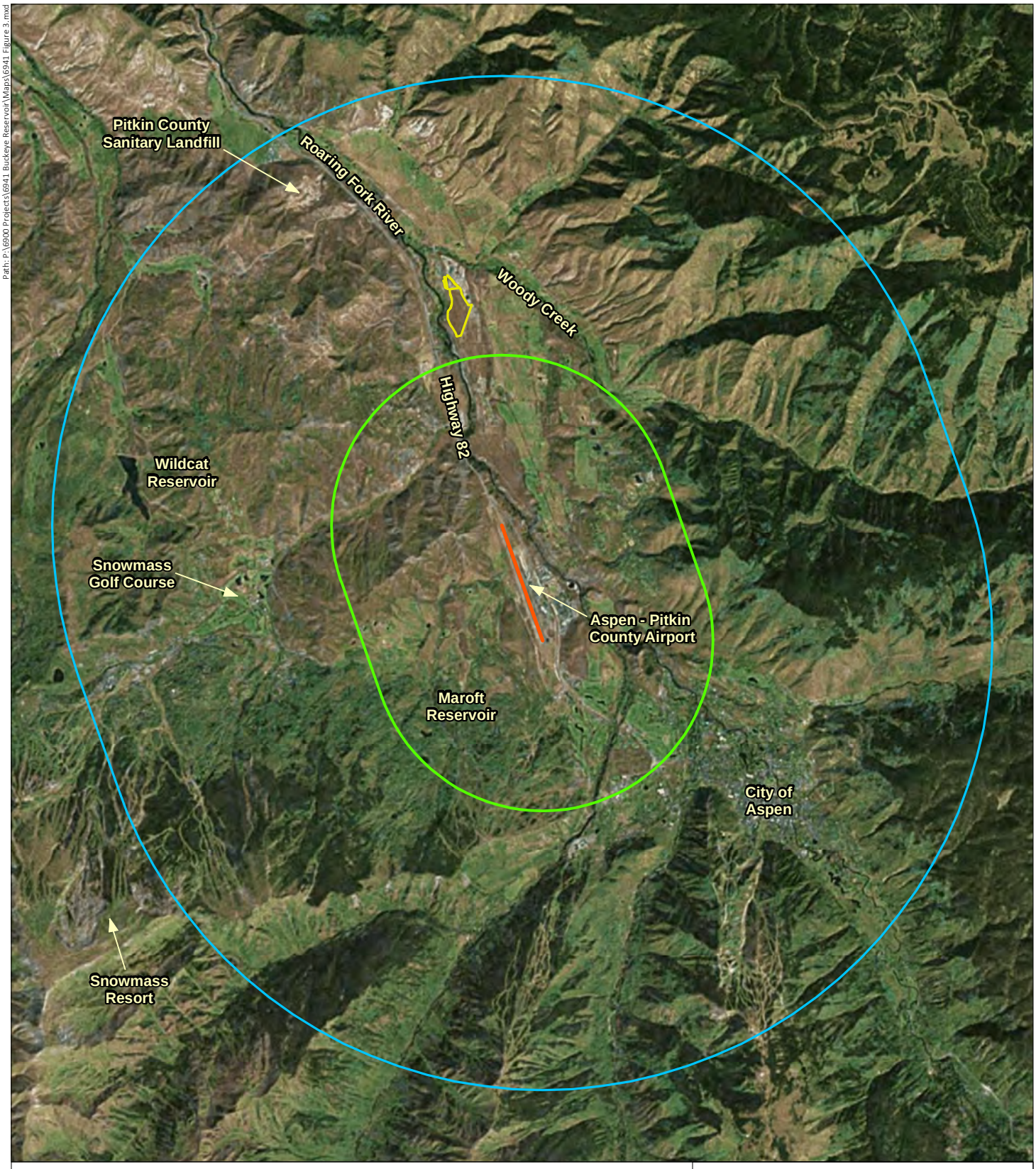
The sagebrush habitat provides habitat for many of Colorado's wildlife species including mule deer; elk; mountain lion; many small mammals (cottontail rabbit, jack rabbit, pocket gopher, striped skunk, red fox, coyote, and deer mouse); and reptiles (gartersnake, smooth green snake, and gopher snake). According to the Natural Diversity Information Source, the project area is within the overall range for elk, mule deer, and mountain lion and in summer range for mule deer (CPW 2017). The proposed project may displace some species but would not likely affect overall populations. The proposed reservoir may benefit some water fowl and other aquatic species.

Bird/wildlife Aircraft Strike Hazard

The proposed reservoir could be an attractant to water fowl, especially in the spring during migration. Birds that could be potentially attracted to open water in the Roaring Fork Valley are: gulls, geese, ducks, herons, and some raptors. Large mammals such as mule deer and elk may also use the proposed reservoir as a water source.

The Aspen-Pitkin County Airport is about 2 miles to the south of the study area (Figure 3). The airport is approximately 7,820 feet in elevation. The mountain setting of the airport and the surrounding grasslands, shrublands, forests, and open water features create different types of habitat for many species of wildlife. The Federal Aviation Administration (FAA) determined that the Aspen-Pitkin County Airport has a high level of risk associated with wildlife collisions with aircraft, which creates a safety hazard for flights into and out of Aspen-Pitkin County Airport. The factors that primarily contribute to wildlife/aircraft strike risk include bird flight heights, aircraft flight patterns and heights, wildlife habitat affinities, and the location of wildlife attractants near aircraft movement areas. The FAA issued regulations (14 CFR 139.337) that require certified airports to conduct a wildlife hazard assessment if wildlife potentially have access to flight patterns and are capable of causing collisions. Because of the high wildlife hazards, the FAA required Aspen-Pitkin County Airport to conduct a Wildlife Hazard Assessment and as a result of determining a high level of risk, required the airport to prepare a Wildlife Hazard Management Plan (Mead & Hunt, Inc. 2012). As part of the airport's wildlife management, a Wildlife Coordinator is appointed and assists with implementing the management protocols.

The FAA developed Advisory Circular 150/5200-33A to provide guidance for land uses on airport property and in the surrounding area that could potentially attract wildlife hazardous to aircraft (U.S. Department of Transportation 2004). The FAA recommends maintaining a separation distance of 5,000 feet between airport ground movement areas and wildlife attractants for piston-powered aircraft, 10,000 feet for turbine-powered aircraft (Critical Zone), and 5 miles between wildlife attractants and approach, departure, or circling airspace (General Zone; Figure 3). Potential land uses that could attract wildlife that pose a risk to aircraft safety include wetlands or open water, landfills, livestock and agriculture fields, golf courses, or landscaped parks (Cleary and Dolbeer 2005).



Proposed Reservoir Site

Aspen-Pitkin County Airport Runway

Critical Zone (Aspen Airport 10,000-Foot Buffer)

General Zone (Aspen Airport 5-Mile Buffer)

Project Area Boundary

0 4,000 8,000 Feet

N

Image Source: USDA FSA, September 2015

Figure 3
Wildlife Zones and Attractions

Prepared for: Deere & Ault
File: 6941 Figure 3.mxd (GS)
September 26, 2017

ERO Resources Corp.

Under Section 4 of Advisory Circular 150/5200-33A, the FAA discourages the development of facilities that would be located within the 5,000/10,000-foot criteria. For projects outside the 5,000/10,000-foot criteria, but within 5 statute miles of the airport's aircraft movement areas, FAA may review proposed land use changes to determine if such changes present potential wildlife hazards to aircraft operations. The FAA may discourage the development if it shows that the area or proposed land use change supports wildlife species that are hazardous to aircraft.

According to FAA (2017), there have been 42 documented bird strikes since August 2007 at the Aspen-Pitkin County Airport. About 28 percent of the strikes were identified as mountain bluebirds. Other birds involved in collisions were identified as magpie, American pipit, blue jay, western sandpiper, American crow, great horned owl, killdeer, horned lark, red-tailed hawk, and sparrow. The proposed reservoir would not be an important part of the preferred habitat of these species; however, water fowl species may be attracted to the proposed reservoir. The proposed reservoir is outside of the Critical Zone but within the General Zone. Some of the other attractants to wildlife within the General Zone include the Roaring Fork River and riparian corridor, Pitkin County Sanitary Landfill, Snowmass Golf Course, Wildcat Reservoir, and the many acres of natural habitat (Figure 3). Movements from the proposed reservoir to some of these features could potentially be through the flightpath.

If the proposed reservoir is determined to be a hazard by the airport's Wildlife Coordinator, options to deter wildlife use of the proposed reservoir could include:

- Steep, unvegetated banks
- Liners
- Netting
- Floating balls
- Floating covers
- Underground storage
- Trained dogs to deter birds and other wildlife from using the reservoir

Often times, using multiple methods can be the most effective. Additionally, the owners of the proposed reservoir would likely be expected to prepare and implement a Wildlife Management Plan to comply with the airport requirements. Birds using the reservoir would still be protected under the MBTA, and a permit from the Colorado Parks and Wildlife would be required for a lethal take.

Potential Regulatory Reviews

Clean Water Act 404 Authorization

If the proposed project would require the placement of dredged or fill material into a water of the U.S. subject to Corps jurisdiction, Section 404 authorization would be required. Depending on the impacts of the project on waters of the U.S. (which are unknown at this time), the project could be authorized under a Nationwide or an Individual permit. Nationwide permits are issued when the impacts are under a specified threshold of impact for the specific activity, and no public review is completed. Individual

Permits are for impacts above a certain threshold but that do not cause significant overall adverse effects on resources. For an Individual permit, typically there is a 30-day public comment period during which the Corps could receive comments from the public, state agencies, and/or federal agencies. The Corps may receive comments on the proximity of the project area to the airport and would allow the applicant to respond. The Corps would likely not deny a permit because of the proximity of the proposed reservoir to the airport but would instead defer to local or county regulations to rule on the increased hazards or may require mitigation measures as a permit condition.

Pitkin County Areas and Activities of State Interest

As part of its Land Use Code, Pitkin County has a review process codified as the Areas and Activities of State Interest Act, or more popularly known as the 1041 Act. Pitkin County may require a review of the proposed reservoir because it involves the site selection and construction of a major facility of a public utility and because it is near the Aspen-Pitkin County Airport. For a project to proceed, the County would issue either a permit or a Finding of No Significant Impact determination. The County would likely defer to FAA recommendations and may require a wildlife management plan and mitigation to offset potential hazards of the proposed reservoir in order to issue a permit. Early coordination with the County is recommended. Additional analysis may be needed to model the direct and indirect effects of the proposed reservoir on bird concentrations and to determine possible movements based on other attractants.

Conclusions

The sagebrush-dominated project area provides habitat for many wildlife, plant, and invertebrate species, but none that are protected under the ESA. No wetlands or other waters of the U.S. would be directly affected by the proposed project. Coordination with regulatory agencies, such as the Corps or Service, may be required if the mechanism for providing water for the project would impact a jurisdictional water of the U.S. Depletions from the Colorado River basin would require consultation with the Service on the Colorado River endangered fish species. The proximity of the proposed reservoir to the Aspen-Pitkin County Airport could attract some birds that may increase the risk of collision with aircraft. Coordination with Pitkin County early in the process would help determine its concerns and possible management recommendations to comply with airport requirements.

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Appendix A Photo Log

Photo 1 - The 55.7-acre parcel on the terrace above the Roaring Fork River.

Photo 2 - The 1.9-acre parcel on a steep bank.

Photo 3 - Powerlines on the west side of the project area paralleling a small trail.

Photo 4 - The riparian corridor along the Roaring Fork River.