DEERE & AULT
CONSULTANTS, INC.

June 27, 2019

Mr. Kent Reinhardt
Terrace Irrigation Company
P.O. Box 109
Monte Vista, Colorado 81144

Re: Terrace Reservoir Outlet Inspection and Outlet Works Pipe Repair Concepts; D&A Job No. CG-0526.002.00

Dear Mr. Reinhardt:

This letter presents our findings of the Terrace Reservoir Outlet Works inspection and preliminary development of repair concepts for the welded 48-inch diameter steel outlet works pipe. The purpose of the outlet works tunnel inspection was to gain familiarity of the tunnel outlet works system and the associated 48-inch diameter steel outlet pipe condition. Information gained from the reservoir inspection was used to help analyze and develop potential concepts to repair the pipe.

We understand that the State Engineer's Office of Dam Safety (SEO) is concerned with the amount of corrosion that has developed along the existing steel outlet works pipe and has requested the pipe condition be reviewed. We reviewed the Ultrasonic Testing (UT) results taken in 2013. We also reviewed past plan sheets, provided to us by Terrace Irrigation Company and the SEO, to assist in our understanding of the Terrace Reservoir outlet works. In addition, during our outlet inspection we observed the west gate valve condition from the outlet tunnel.

GENERAL

Terrace Reservoir and dam is owned and operated by the Terrace Irrigation Company and is located on the eastern edge of the San Juan Mountains, southwestern Colorado. More specifically, it is located in Conejos County, Section 23, Range 6E, Township 36N as shown on **Figure 1**. The main dam is located at an elevation of 8520 feet (NAVD 88) and is constructed across the Alamosa River in a narrow canyon with rock bluffs on either side. A smaller saddle dam is located just east of the main dam. The main dam is a combination earth core and rockfill shell, constructed in 1911. Its core was constructed using "puddle core" construction techniques. It is approximately 166 feet high with a normal water surface elevation of 8,523.4 feet. The approximate storage capacity is 15,182 acre-feet. A concrete labyrinth spillway is constructed on the adjacent saddle dam. The outlet works is tunneled through the welded tuff ash flow of the La Jara canyon member. It is located in the left dam abutment and consists of an ungated, unlined, upstream tunnel connected to an underground concrete outlet gate structure located at the center of the dam. The concrete outlet gate structure houses two 48-inch diameter gate valves that releases water into the downstream tunnel section of the outlet works. The gate valves are reached by a 160-foot tall shaft that extends to the dam crest. The downstream outlet tunnel is unlined and excavated through rock. The total length of the outlet works

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is approximately 900 lineal feet with the downstream tunnel length bring approximately 330 lineal feet.

The two 48-inch diameter gate valves discharge into the downstream tunnel in separate ways. The west gate opens into a short 48-inch diameter steel pipe that discharges directly into the unlined downstream tunnel. The east gate valve connects into a 48-inch diameter welded steel pipe that was constructed and follows inside the downstream outlet tunnel. The pipe is operated under pressure and discharges through a 42-inch diameter Allis-Chalmers Ring Jet Valve. The pipe is supported off the tunnel invert by 13 concrete pipe supports and associated steel strapping. The span length between supports is approximately 20 feet. Typically, reservoir releases through the 48-inch diameter steel pipe and ring jet valve are between 450 cfs to 500 cfs. At higher release flow rates, during spring snowmelt, the west gate valve is opened. The 48-inch pipeline flowrate is reduced, and the ring jet valve is used to regulate outlet flow rates. Reservoir water released from the west gate follows an irregular path down the outlet tunnel, flowing around the concrete pipe supports and steel pipe. This water and water released by the ring jet valve cascade approximately 15 feet to 20 feet into a large plunge pool at the toe of the dam. The water then continues east down the Alamosa River Canyon. The outlet works and other dam features are shown on **Figure 2**.

The 48-inch diameter welded steel pipe and ring jet valve were installed by the Terrace Irrigation Company in the winter of 1979 and 1980. The pipe is constructed from 5/16-inch (0.3125 inches) thick spiral welded steel. There are three expansion joints installed to allow for pipe movement. The pipe appears to have been installed without a coating or lining and has subsequently corroded since installation. Construction equipment access to the tunnel was reportedly made by following the Alamosa River bed and an existing unimproved access road that connects the river bed to Forest Service Road 255.

Field Pipe Wall Measurements

In 2015 the State Engineer's Office (SEO) requested that the Terrace Irrigation Company hire a company to investigate the steel pipe wall thickness in response to the presence of continuing exterior corrosion. Water Works Irrigation, out of Alamosa, completed UT testing from the outside of the pipe in December 2016. The interior of the pipe was not inspected at that time. The pipe was measured at five points along the top of the pipe and seven points along the bottom of the pipe. Eight measurements were taken in the upstream 80 feet of the pipe and the final four readings were taken in the remaining downstream 250 feet of pipe.

The average steel thickness reported was 0.0571 inches, or 18.27% loss of wall thickness for the top of the pipe and 0.0528 inches, or 16.89 percent loss of wall thickness for the bottom of the pipe. The estimated average corrosion rate is approximately 0.015 inches per year or 39.13 micrometers per year. The thinnest steel wall thickness reported was on the pipe invert about 80 feet downstream of the concrete outlet gate structure It was measured at 0.201-inches thick or approximately a 36 percent loss of steel thickness. The corrosion rate at this point equates to approximately 0.003 inches per year or 79.42 micrometers/year. This specific rate is above the anticipated rural and urban corrosion rates as described for carbon steel in atmospheric conditions by the American Galvanizers Association. These anticipated rates are 4 to 60 micrometers/year and 30 to 70 micrometers/year, respectively. The estimated average corrosion rate of 39.13 micrometers per year falls within these limits.

OUTLET WORKS TUNNEL AND 48-INCH DIAMETER PIPE INSPECTION

On December 5, 2018 Deere & Ault Consultants personnel accompanied Terrace Irrigation Company personnel on an inspection of the existing Terrace Reservoir Downstream Outlet Tunnel. Terrace Irrigation Company personnel included Mr. Kent Reinhardt and Mr. Lynn Christianson and Deere and Ault personnel, included Mr. Glen Church and Mr. Rhett Hines.

The inspection took approximately two hours to complete. The outlet works tunnel was reached by walking down the face of the dam. The reservoir gage height was approximately 64.3 feet with a storage capacity just over 2,900-acre feet. There was approximately 2 to 3 cfs of water running down the tunnel invert and is a combination of west gate valve leakage and seepage into the tunnel. Approximately 1 cfs appeared to be coming from the west gate valve. Seepage into the tunnel occurs in several places but primarily appears to be entering through a concrete bulkhead wall on the west side of the outlet tunnel near the concrete thrust block. Approximately 100 gpm to 200 gpm is estimated to be seeping into the tunnel from this location. The steel pipeline was empty at the time of the inspection and the ring jet valve was open. A small amount of water (less than 0.5 gpm) was noticed seeping from the rock trap drain.

The downstream outlet tunnel is generally rectangular in shape, approximately seven feet high by 8 feet wide, though the dimensions vary. The tunnel was constructed by drill and blasting and has little if any interior support. The rock contains horizontal and vertical jointing that intersects the tunnel and seems to have helped form the relatively flat tunnel crown. The tunnel invert is undulating and rough with several deeper holes and stepped sections with cascading water.

The downstream tunnel alignment generally trends north south approximately 250 lineal feet upstream from the tunnel outlet. At this point the tunnel alignment angles towards the north east. This bend in the tunnel orientation appears to coincide with the alignment of an abandoned access adit on the west side of the tunnel and is a source of water leaking into the tunnel as mentioned previously. The access adit alignment appears on some of the original 1911 construction drawings. The adit appears to be sealed from the downstream outlet tunnel with a concrete and timber bulkhead. The bulkhead that extends for approximately 10 to 15 feet (estimated). A plan and profile of the existing outlet tunnel is shown on **Figure 3**.

Photo 1. Concrete and timber bulkhead near abandoned access adit.

The 48-inch diameter outlet pipe generally follows the east side of the tunnel. At the tunnel bend the pipe is encased and enclosed by a post tensioned, cast-in-place, concrete thrust block that extends from the tunnel invert to the tunnel crown. The thrust block is approximately 4-foot long and is reinforced with horizontal tensioned rock anchors. The opening between the concrete thrust block and west tunnel rib is approximately 30-inches. In places the steel pipe is within a few inches of the tunnel crown, particularly near and upstream of the concrete thrust block. Also, in areas along the tunnel, the east side of the pipe is within 12-inches of the east tunnel rib.

Photo 2. 5-inch clearance between pipe crown and tunnel back.

The pipe's exterior shows signs of rusting throughout its length but is notably bad approximately 150 feet upstream of the tunnel outlet. In many areas from this distance to the concrete outlet gate structure the pipe has a notable layer of iron oxide up to 1/8-inch thick. The following photographs show examples of corrosion on the west and under sides of the pipe in these areas.

Photo 3. 48-inch diameter welded steel pipe, showing corrosion and iron oxide layers.

Photo 4. Underside of the 48-inch diameter welded steel pipe showing corrosion and iron oxide layers.

The bolts for the expansion couplings are severely corroded. No signs of leakage from the pipe was apparent at the expansion couplings. Factory coatings are still partially visible on one of the couplers. The threaded steel anchors cast into the concrete supports were severely corroded as well, with two of the straps no longer being connected. This is shown in the following photo.

Photo 5. Expansion Coupling

The existing west gate valve leakage was observed during our tunnel inspection. With approximately 60 feet of head it was estimated 1 cfs was spraying between the seats on the valve. The leaks are located at the ten o’clock and two o’clock position as show in in the following photo.

Photo 6. Downstream view of West Gate Valve Leakage

The as-constructed 1979 drawings show an air vacuum valve located on top of the pipe at station 2+88, however, the air vacuum valve is no longer in place at station 2+88. Interestingly it looks as though the blind flanged manway at station 2+95 has a threaded connection, possibly for an air vacuum valve. The manway appears to be approximately 18-inches in diameter. Both the air vacuum valve flange and manway flange threaded bolts are severely rusted and may no longer be serviceable.

EXISTING STEEL PIPE ANALYSIS

Given how the pipeline is supported in the outlet tunnel, the environment is very conducive to continuous corrosion around the entire pipe exterior. Outlet tunnels are traditionally humid by their nature, and the steel pipe experiences wetting and drying cycles on its interior and exterior during outlet works operation and subsequent stoppages in operation. Situations encourage continuous corrosion. Also, scouring flows could be continually removing loose rusted steel, this exposing underlying steel to additional corrosion.

To help examine the pipe integrity, a simplified structural analysis of the pipeline was conducted using the December 2016 pipe wall thickness field measurements. We have assumed that the UT measurements are accurate and have indicated the true remaining steel thickness. Verification of UT testing is often completed by cutting a small steel coupon out of the material in question. The density of the coupon is weighed to verify steel density with the corresponding measurements.

The American Water Works Association (AWWA) C-200 guidelines for determining pipe wall thickness to resist internal pressure were used in this analysis. The analysis assumed 160 feet (69.3 psi) of reservoir head and a 20-foot long free span for the 48-inch diameter pipe. For a recommended factor of safety of 2 to be achieved to resist internal pressure, a continuous pipe thickness of 0.125 inches is required. This is approximately 0.076 inches less than the thinnest field measurement of 0.201 inches. At a corresponding yearly corrosion rate of 79.42 micrometers per year (0.003 inches/year) this equates to approximately 20 years before the pipe thickness reduces to this point.

AWWA also recommends minimum steel wall thickness required for moving, hauling, or lifting steel pipe into place. This wall thickness of 0.167" is slightly thicker than that required for resisting internal pressure. Following the above corrosion rate procedure suggests approximately 9 years (at the worst UT measurement) that the pipe can be moved while maintaining the recommended AWWA Factor of Safety.

These are very general analysis and given the many localized variables associated with corrosion rates it should only be used as a rudimentary guideline to approximate pipeline service life. It assumes a uniform corrosion rate around the entire pipe circumference, which does not commonly happen in the field. Additionally, there may be thinner pipe wall thicknesses in unmeasured sections of the pipeline that would reduce these times. Typically, pipelines in this type of environment begin failing by the presence of leaks during pressurized operation. Over time, these leaks become more numerous and widespread and require more and more maintenance to repair. If the pipe were to quickly fail or rupture, the rapid changes in pressure could damage the remaining pipe.

WEST GATE VALVE

We understand that the west gate valve leaf was broken while in service. It was removed and a new matching leaf was cast and the brass settings were replaced or repaired by Brimhall Industrial. After the new leaf was attached the valve leaked similar to what was observed during the inspection. Based on our observation it appears the leaks are located most likely between the seals.

OUTLET PIPE OBSERVATION AND REPAIR CONCEPTS

Repair or replacing the existing outlet pipe will not be easy and will require time to plan and permit. The inspection of the outlet pipe exterior and our simplified structural analysis indicates a failure of the outlet pipe does not appear imminent. This, in theory, gives the company time to begin developing repair plans, schedules, and financing while continuing operating and performing detailed inspections of the outlet pipe. Given the time required for engineering, hiring a contractor, permitting, and funding the repair work items should begin relatively soon. The inspections are necessary to document changes that may suggest acceleration of the future pipe repair schedule. For planning purposes, two concepts are presented for repairing or replacing the pipe but no matter what repair alternative is eventually developed, access to the outlet tunnel will be required for equipment and materials.

INSPECTION AND CONTINUING OBSERVATION PLAN

Annual inspection of the outlet works pipe should be continued to assist in identifying potential problems with the outlet pipe. This will help schedule routine maintenance, and potentially help prolong the pipes service life. Items to be added to the pipe inspection are summarized as follows.

- The interior of the pipe should be inspected with a camera, such as a borescope, to further understand the pipe interior corrosion.
- The pipe should be observed when pressurized to identify and document pipe leaks and the performance of the expansion and flanged fittings.
- UT testing should be performed in several pipe sections at consistent measuring points to determine a background pipe thickness and corrosion rate. We suggest testing be done at least 2 years in a row. This would possibly help identify any potential acceleration of corrosion or areas that might need further testing methods and develop a baseline pipe wall thickness. If UT testing doesn’t indicate material changes, and visual inspection of the pipe exterior indicates little change, then testing frequency could be reduced to every 5 years.
- Inspect the west gate valve during the outlet inspection. The leakage should be monitored during outlet inspections and documented if changes do occur, the gate valve should be reevaluated. In our experience the gate valve leaf should be operated in either closed or fully open position. This will minimize the potential for vibrations that may lead to cracks in the leaf.

ACCESS TO THE OUTLET WORKS

Current access to the outlet works tunnel is gained by walking down the downstream dam face. No road is currently available. Any repair options for the outlet works pipe will require heavy machinery, generators, and other equipment and materials to be delivered to the outlet tunnel opening. Additionally, since the outlet tunnel is situated 15 feet to 20 feet above the riverbed, a work pad or staging area would need to be built to provide access to the outlet tunnel invert.

Past Equipment Access

We understand that in 1979 temporary access for construction crews and equipment was gained from the downstream. The river bed of the Alamosa River and the access road to the Alamosa River Station Gage from Forest Road 225 were used. The total length of this route is approximately 3,700 feet from the outlet works to Forest Road 225. Approximately 1,700 linear feet of this route is on BLM property while the remaining is Terrace Irrigation Company property.

In general, based on topography, this appears to be the easiest access to the outlet tunnel. However, permitting requirements to use this route may be onerous and will require extended consultation with the BLM to obtain rights of ways or easements and potentially the Corps of Engineers for working within wetland areas. Scheduling and permit requirements would have to be weighed against potential construction costs. We anticipate that the access road from Forest Road 225 would need to upgraded and possibly widened. A new road across BLM property would need to be constructed from the Alamosa River Gage west to the Company's property.

Potential Permanent Access Roads

We developed a precursory review of potential permanent road alignments on Terrace Reservoir Irrigation property to the outlet works. Construction of a permanent road to the dam downstream toe outlet works on company property would be difficult but valuable in providing future access and reduced construction costs for maintenance and repairs. Additionally, this would alleviate risks of obtaining permits and associated timing with the BLM. Potential routes are are shown on **Figure 4**. Other routes may be identified with further field investigations.

We have initially tried to maintain a 10 percent maximum slope and minimal river crossings. However, steeper grades may be needed given the canyon topography. Our initial estimates of constructing an access road are approximately $400,000 to $800,000 depending on blasting and river crossings. Some permitting may still be required depending on a final alignment. This estimated cost range is based off our experience of road construction at other mountain reservoirs. If desired by the company, to further explore this potential, we suggest meeting on-site with a contractor to determine a plausible route and development of a more accurate construction costs.

Air Lifting

As another option, we discussed with a local helicopter company the potential of air lifting equipment and supplies to the outlet works. Rates are typically set on an hourly basis, with a minimum four hours required to travel to and from Terrace Reservoir from their home base before any work begins. Currently, the helicopter rate alone is around $3,100/day, but for planning purposes overhead and markup would need to be included as well. So, for an hour of on-site work daily pries could approach $20,000/day. Depending on potential repair work and scheduling, the cost for air lifting equipment for a 2-month outlet repair project could be several hundred thousand dollars. Equipment weight would be limited with air lifting, and thus may limit potential pipe repair options.

OUTLET WORKS REPAIR

We considered several outlet works repair concepts including pipe repair, pipe removal, tunnel expansion and concrete encasement. We selected two potential outlet works repair and replacement concepts. These include:

1. Coating and lining the pipe in the field and;
2. Removing the existing pipe and replacing with a new 48-inch diameter pipe.

Estimated construction costs for these two concepts are based on our past experience with mountain reservoir projects and should be used to guide the magnitude of future construction work. These costs will need to be updated with further analysis and discussions on constructability with potential contractors. In general, the following work items would be required for either concept:

- We anticipate the 48-inch diameter outlet pipe work to be completed in the winter months. The upstream coffer dam would have to be re-established to provide a reliable, safe and operable water impoundment structure during the construction work. We understand in the past that icing buildup developed downstream of the dam during coffer dam releases and was a concern with the division engineer and would need to be managed with them prior to construction.
- For any work within the tunnel we suggest that some tunnel support work would need to be planned for as well. Rock scaling, rock bolting and shotcrete work would be needed to properly support the tunnel rock for safe worker access. Some minor rock excavation may be needed to provide workspace.
- A minimum 30-foot by 60-foot work area would be needed by contractors we contracted to properly stage their equipment and supplies at the end of the outlet tunnel. The work area would perform best if built to closely match the tunnel invert elevation.

Coating and Lining Pipe in Place

The pipe could be coated and lined in the field. This would require removal of all rust to bare metal or a near white finish and then either, by manual or mechanical methods, applying a lining on the pipe interior and coating on the pipe exterior. Water and temperature needs to be tightly controlled during lining and coating application. Contractors we talked with were concerned about the limited space between the pipe and rock. This would make it difficult to prepare and coat the outside of the pipe. To address this and properly coat the outside of the pipe, the pipe would need to be possibly cut and temporarily lifted off its pipe supports to provide access to the underside and west sides of the pipe for rust removal and coating. It is estimated this would cost in the range of $2 to $4 million dollars depending on access to the tunnel portal. Obviously, the sooner this is done, the more service life that would be provided to the existing 48-inch diameter pipe. This work could add an additional 25 to 50 years of service to the existing pipe depending on when it is completed.

Replacement of 48-inch Diameter Pipe

Another alternative would be replacing the existing 48-inch outlet pipe. With forward planning this could be scheduled at a point most convenient for the company. This option could entail running the existing pipe with normal maintenance and inspection until it approaches the end of its service life. The pipe could be replaced at that time. This would require complete removal of the existing pipe and demolition and replacement of the thrust block and concrete supports. Potentially the 48-inch diameter pipe could be replaced with steel or high-density polyethylene pipe (HDPE). A temporary or permanent access road would have to be provided for this concept to get pipe and equipment to the outlet tunnel. This concept is estimated to cost in the range of $4 to $6 million dollars and would potentially provide up to 100 years plus of service life.

SUMMARY AND RECOMMENDATIONS

Based on our visual inspection of the 48-inch diameter outlet pipe and simple structural analysis following AWWA guidelines, it appears the existing 48-inch diameter pipe has additional service life. However, it should be anticipated that more involved maintenance may be required as the pipe ages and corrodes. Future repairs could include welding and plugging leaks in the steel pipe and replacement of fittings, etc.

Since, in general, the existing pipe appears to have remaining service life there is time to begin future outlet tunnel access, planning and develop repair plans. The construction costs presented are meant to give an idea of anticipated construction cost magnitude and will need to be adjusted with further study. However, this should give an idea of the potential costs going forward.

Coating and lining the pipe in place would require handling the pipe in the field. This option would need to be done sooner to maximize the service life and allow the pipe to be lifted and moved without damaging the pipe. This could add an additional 20 years to 40 years of service life to the existing pipe depending when it is completed. Replacing the pipe would require removing the existing pipe and concrete thrust block and supports. The pipe could be potentially replaced with coated and lined steel or possibly HDPE. The service life could be 75 years to 100 years with this option.

Our recommendations for the Terrace Reservoir Outlet Works pipe work going forward are as follows:

1. Outlet Works Inspection – Maintain annual inspections of the exterior and interior of pipe. The interior of the pipe should be video inspected. Inspect the outlet pipe exterior and fittings while pressurized.
2. Ultra Sonic Testing – Complete UT Testing for 2 years and document results. The readings should be conducted at the same points. If little difference is noted in pipe wall thickness and there are no adverse changes noted in the visual inspection, then UT Testing could be scheduled back to a 5-year interval.
3. In the next year, begin investigating an access plan to the outlet tunnel. Look at potential permanent road routes with a contractor and develop a construction cost and timetable. Begin looking into permit requirements and time required for the temporary road to compare with the permanent road routes.
4. Depending on results of the continued monitoring of the existing outlet works and its performance, begin developing a preferred outlet works pipe repair plan and schedule and develop more detailed engineering, permitting, and construction cost estimates.
5. Begin looking at potential financing through grants and loans as needed for pipe repairs or replacement.

Please contact me with any questions or comments that you may have regarding this review.

Sincerely,

DEERE & AULT CONSULTANTS, INC.

Glen G. Church, P.E.
Principal

GGC:em

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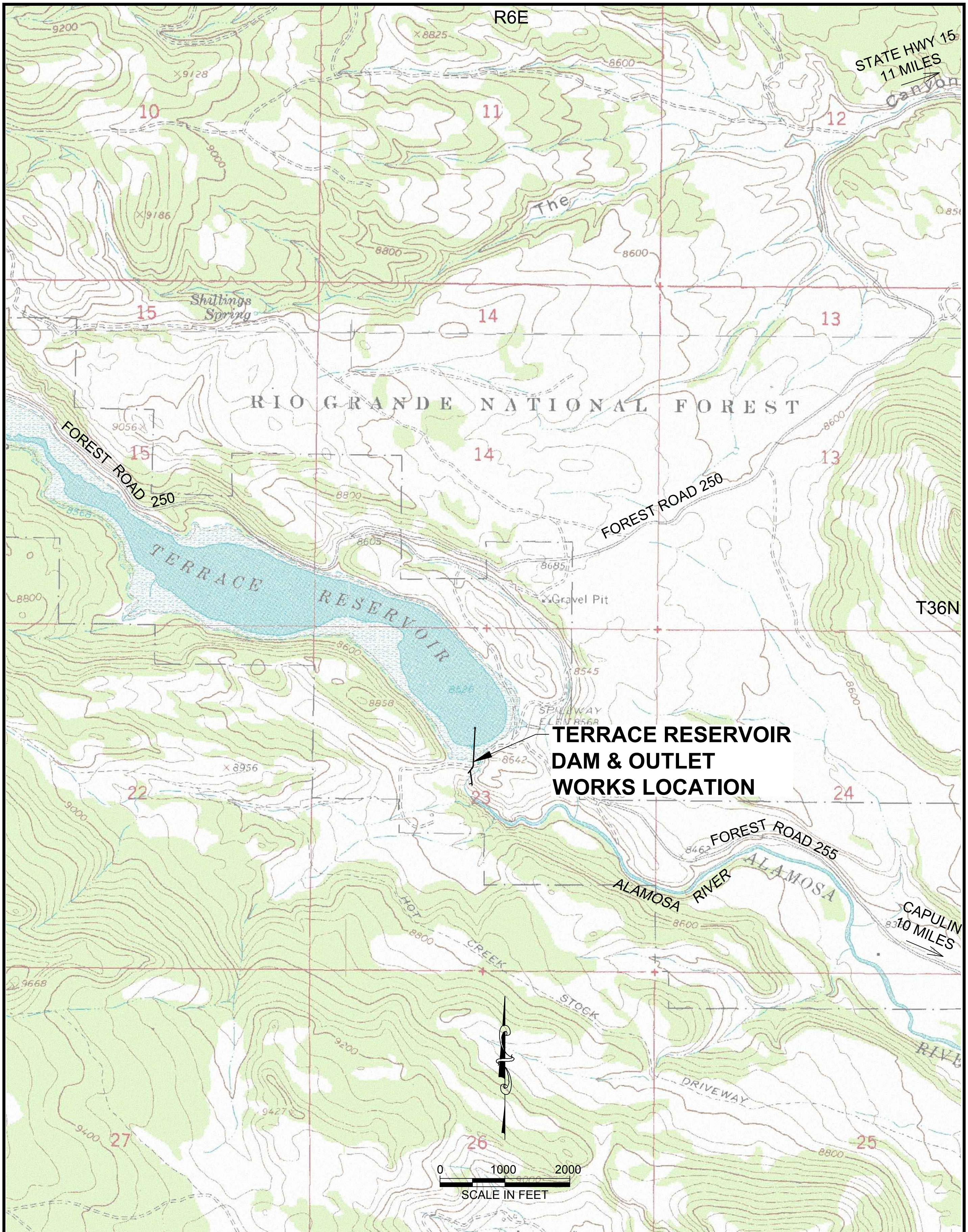

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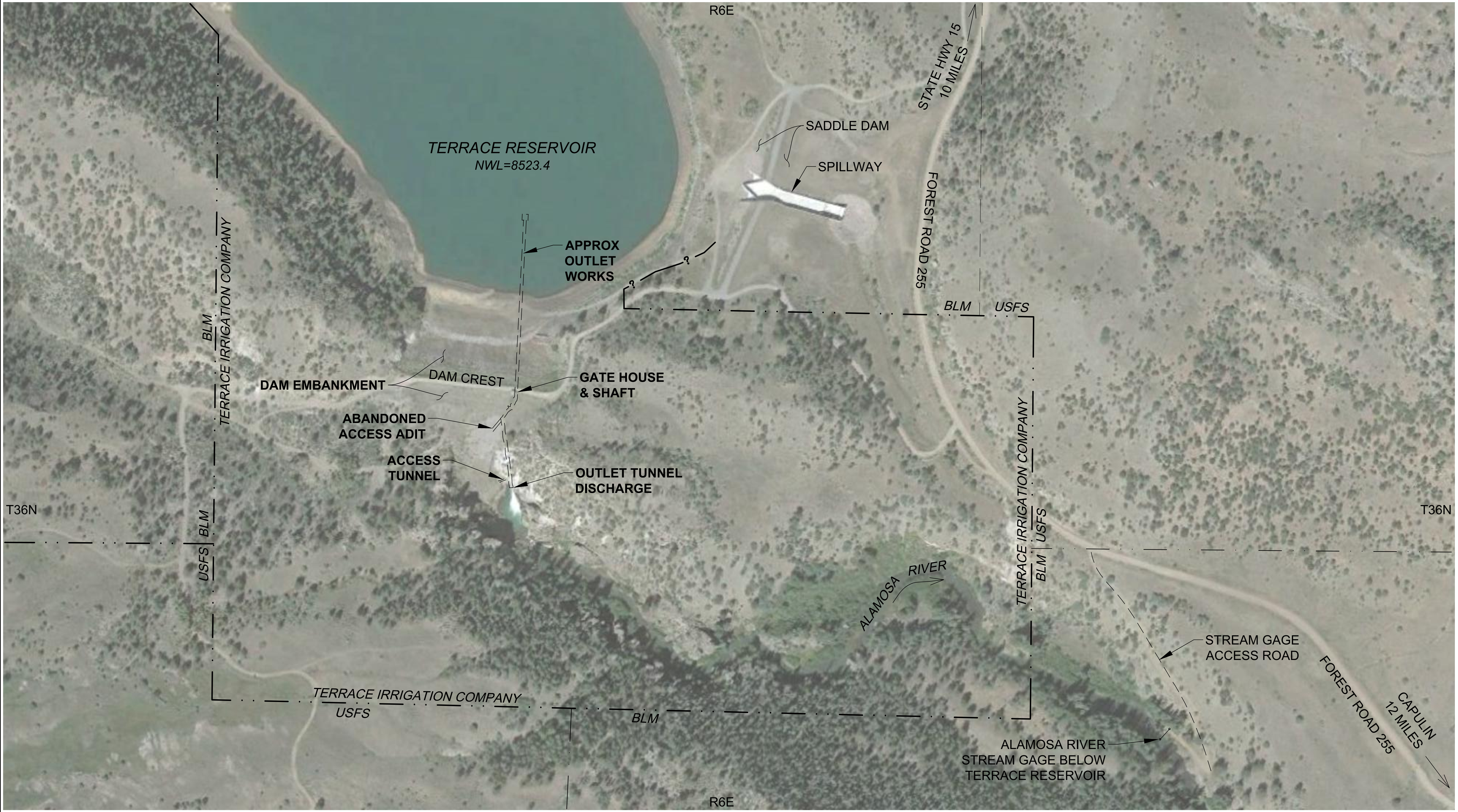
DEERE & AULT CONSULTANTS, INC.	TERRACE IRRIGATION COMPANY VICINITY MAP	FIGURE NO. 1
	JOB NO. 0526.002.00 / SCALE: AS NOTED	



NOTES:

1. AIR PHOTO TAKEN FROM GOOGLE EARTH PRO DATED SEPT 8TH, 2016.
2. PROPERTY BOUNDARIES ARE APPROXIMATE AND TAKEN FROM BUREAU OF LAND MANAGEMENT - COLORADO.
3. OUTLET WORKS LOCATION APPROXIMATED FROM 1911 AND 1979 CONSTRUCTION DRAWINGS FOR TERRACE RESERVOIR

0 150 300
SCALE IN FEET

JOB NO. 0526.002.00

TERRACE IRRIGATION COMPANY

TERRACE RESERVOIR

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FIGURE NO. 2

DATE: JUNE 2019 **SCALE:** AS NOTED

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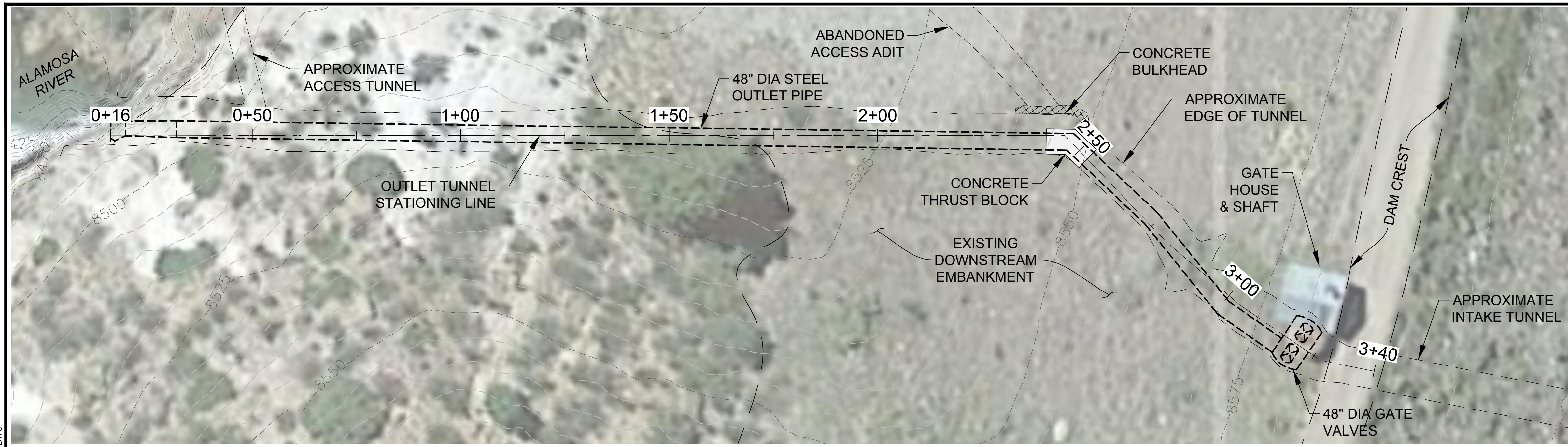

TERRACE RESERVOIR DOWNSTREAM OUTLET TUNNEL PLAN

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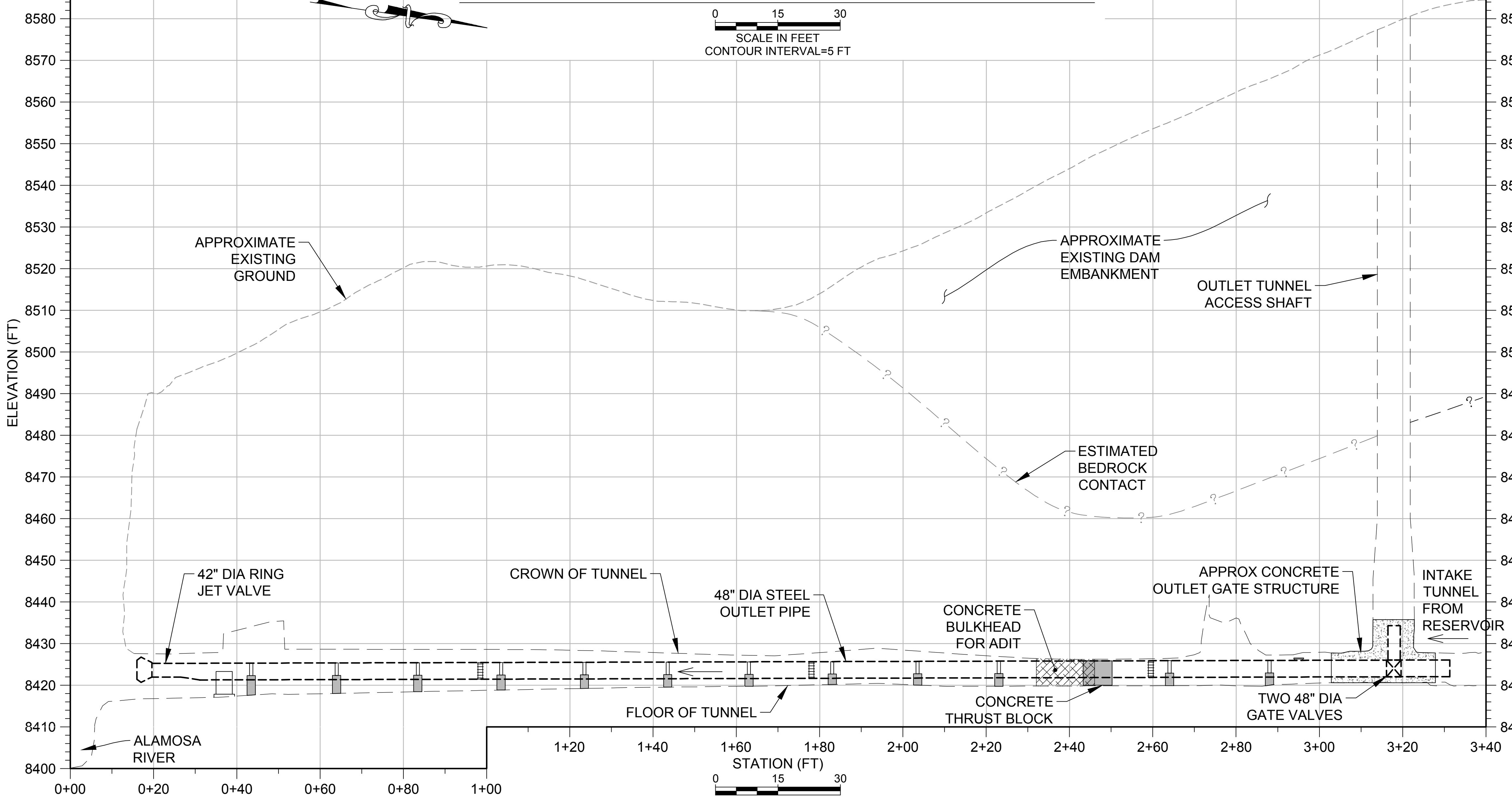
CONTOUR INTERVAL=5 FT



NOTES:

1. AERIAL IMAGERY FROM GOOGLE EARTH PRO, DATED 9-8-16.
2. TOPOGRAPHY APPROXIMATED FROM SAN LUIS VALLEY LIDAR ACQUISITION PROJECT 2011, NAVD88, AS PROVIDED BY THE STATE OF COLORADO.
3. VERTICAL DATUM OF PROFILE ADJUSTED FROM NGVD29 TO NAVD88 (+4.74 FT).
4. OUTLET TUNNEL PIPE PLAN AND PROFILE APPROXIMATED FROM 1979 AS-BUILT CONSTRUCTION DRAWINGS TITLED, "TERRACE RESERVOIR & DAM OUTLET MODIFICATIONS".
5. ABANDONED ACCESS ADIT LOCATION ESTIMATED FROM "PLANS OF TERRACE RESERVOIR DAM", JULY 1ST, 1911.

JOB NO. 0526.002.00

TERRACE IRRIGATION COMPANY

EXISTING OUTLET WORKS PLAN AND PROFILE

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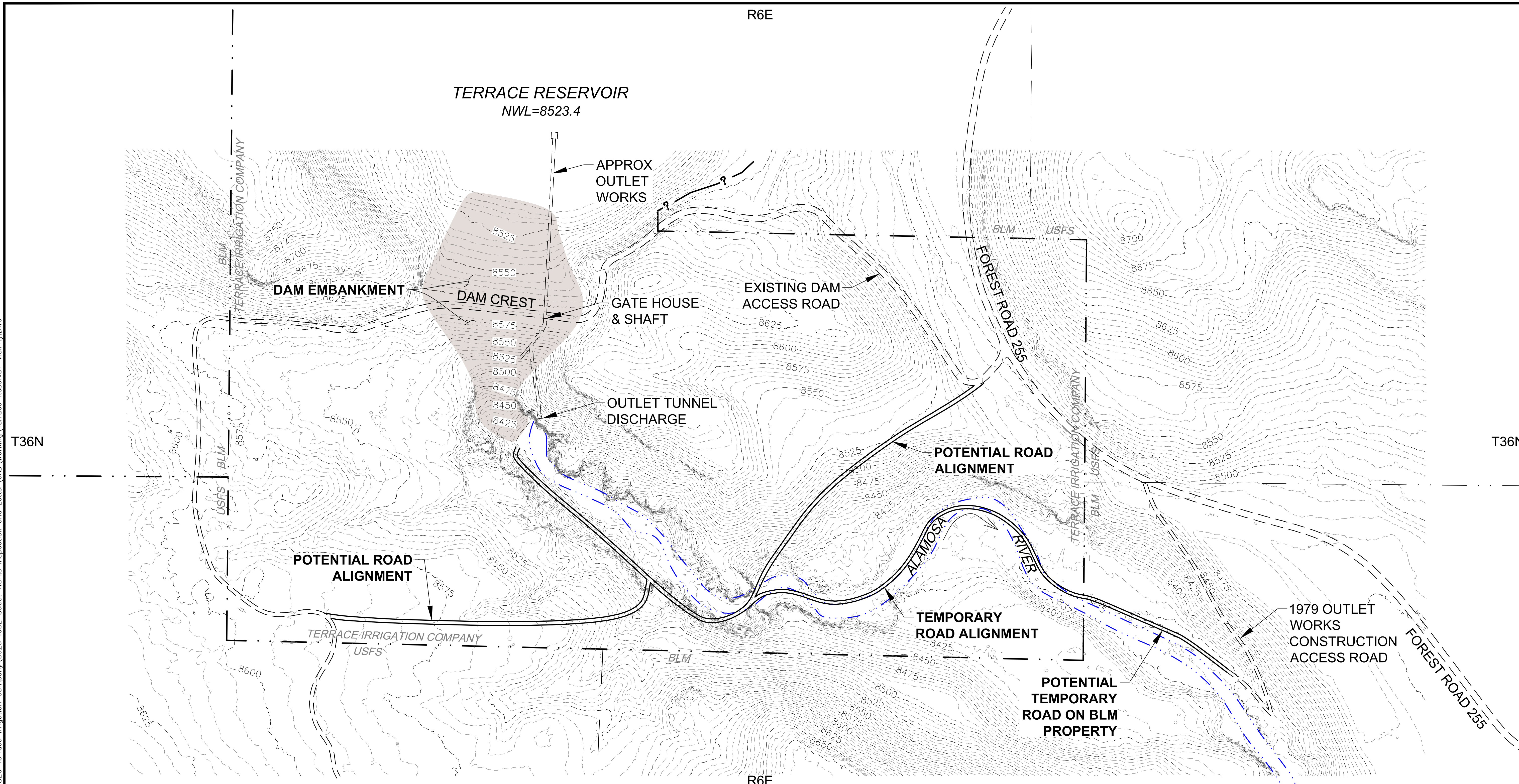
FIGURE NO. 3

DATE: JUNE 2019 SCALE: AS NOTED



NOTES:

1. TOPOGRAPHY APPROXIMATED FROM SAN LUIS VALLEY LIDAR ACQUISITION PROJECT 2011, NAVD88, AS PROVIDED BY THE STATE OF COLORADO.

2. PROPERTY BOUNDARIES ARE APPROXIMATE AND TAKEN FROM BUREAU OF LAND MANAGEMENT - COLORADO.

3. OUTLET WORKS LOCATION APPROXIMATED FROM 1911 AND 1979 CONSTRUCTION DRAWINGS FOR TERRACE RESERVOIR

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OUTLET WORKS ACCESS ROADS

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FIGURE NO. 4

DATE: JUNE 2019 **SCALE:** AS NOTED

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