Denver Water

Gross Reservoir Hydroelectric Project
FERC Project No. 2035

2021 TREE REMOVAL PLAN

June 7, 2021

Prepared by:

DENVER WATER

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ACD	Air Curtain Destructor
BCN	Biochar Now!
BMP	Best Management Practice
CDOT	Colorado Department of Transportation
CDPHE	Colorado Department of Public Health and Environment
CFSY	Nederland Community Forestry Sort Yard
Corps	U.S. Army Corps of Engineers
Commission	Federal Energy Regulatory Commission
CPW	Colorado Parks and Wildlife
CR	County Road
CSFS	Colorado State Forest Service
Denver Water	Board of Water Commissioners for the City and County of Denver
EIS	Environmental Impact Statement
EPA	Environmental Protection Agency
FERC	Federal Energy Regulatory Commission
FS	Forest Service Road
GRE Project	Gross Reservoir Expansion Project
HL	Helicopter Logging
Log Landings	Helicopter Log Landing Locations
Order	License Amendment
SH	State Highway
USFS	U.S. Forest Service

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1. Introduction

The Board of Water Commissioners for the City and County of Denver (Denver Water) is in the process of obtaining the necessary permissions to expand Gross Dam and Reservoir (the Gross Reservoir Expansion Project or GRE Project). The GRE Project involves raising the dam at Gross Reservoir, located on South Boulder Creek in Boulder County, Colorado, by 131 feet. The reservoir storage capacity will be expanded by 77,000 acre-feet increasing the storage capacity from approximately 42,000 acre-feet to approximately 119,000 acre-feet.

Since Gross Reservoir is within a federal hydropower reserve and is subject to an existing Federal Energy Regulatory Commission (FERC) hydropower license – Gross Reservoir Hydroelectric Project No. 2035 – Denver Water had to amend its existing hydropower license to pursue the GRE Project. The FERC order amending this license (FERC Order) was issued on July 16, 2020 and mandates the creation of several plans to address impacts related to the expansion and operation of Gross Dam and Reservoir by Denver Water.

1.1 Scope and Objectives of the Tree Removal Plan

The 2020 FERC Order requires Denver Water to start and complete construction of the raised dam by July 16, 2022, and July 16, 2027, respectively, and to submit a final Tree Removal Plan by July 16, 2021. This Tree Removal Plan has been prepared consistent with the requirements of the FERC Order, including specific tree removal requirements of 4(e) Condition 27 and Article 423 that are addressed in sections 2, 3, and 4, and consultation requirements fulfilled through the activities summarized in Appendix A. The draft plan was developed pursuant to Article 423 of the FERC Order, which requires Denver Water to submit for review by the U.S. Forest Service (USFS), Colorado State Forest Service (CSFS), Boulder County, Jefferson County and Gilpin County. Consistent with the terms of 4(e) Condition 27, this Tree Removal Plan was approved by USFS prior to submittal to FERC (Appendix B).

The first Tree Removal Plan was published in 2008 and referenced in the Draft and Final Environmental Impact Statement (EIS) for the GRE Project[1] in 2009 and 2014, respectively. The 2008 Tree Removal Plan is included as Attachment E-6 of the FERC License Amendment Application. In 2019, a Tree Removal Plan (2019 Tree Removal Plan – Appendix C) was developed to include evaluation of multiple removal and disposal methods and development of four tree removal alternatives. The 2019 Tree Removal Plan was reviewed by several agencies as discussed in section 1.3. Denver Water prepared this 2021 Tree Removal Plan based on the agency comments that were received. This 2021 Tree Removal Plan expands on the selected alternative that was documented in the 2019 Tree Removal Plan.

[1] The EIS for the GRE Project was titled “Moffat Collection System Project Final Environmental Impact Statement” (April 2014).

As required by the FERC Order, this Tree Removal Plan must be submitted to the FERC by July 16, 2021. Appendix D further describes other related plans and permitting processes that Denver Water has completed or is in the process of completing.

The purpose of this Tree Removal Plan is to describe the proposed methods for and implementation of tree removal for the GRE Project. Tree removal is necessary for initial clearing for construction staging to provide adequate room for construction activities, and prior to expanding the reservoir inundation area for water quality, operational, and safety purposes. Denver Water hired timber resource professionals to complete a field reconnaissance and inventory, review market options, and perform a cost analysis of tree removal alternatives. This Tree Removal Plan balances Denver Water's two main objectives. Denver Water wants to be a responsible environmental steward by minimizing land disturbance and reusing or repurposing the biomass removed during tree removal activities where feasible. Denver Water is also committed to minimizing community impacts related to tree removal activities, including tree removal traffic and nuisance factors (i.e., noise, lighting). This Tree Removal Plan provides tree removal and disposal options, haul routes, and measures to minimize impacts. Denver Water has submitted this Tree Removal Plan to agencies for review and has incorporated feedback that supports these objectives. Please see detail regarding agency coordination in section 1.4 of this Tree Removal Plan.

1.2 Project Description

The GRE Project involves raising the water level in Gross Reservoir by 124 feet, from an elevation of 7,282 feet to an elevation of 7,406 feet. The reservoir storage capacity will be expanded by 77,000 acre-feet from 41,811 to 118,811 acre-feet. Of the 77,000 acre-feet, 72,000 acre-feet will be used for Denver Water's storage needs, and 5,000 acre-feet will be used for a dedicated "environmental pool" to store water owned by the cities of Boulder and Lafayette to be used to enhance flows in South Boulder Creek during periods of low flow. The surface area of the reservoir will be expanded, which first requires the clearing of approximately 415 acres of forested land in the inundation area. The removal and disposal of trees and shrubs within the inundation area is the focus of this Tree Removal Plan. However, as also discussed in this plan, 80 to 90 acres of trees will be removed for site and dam preparation.

Implementation of the Tree Removal Plan will occur in two phases — an Initial Phase and an Inundation Area Phase. Denver Water's preliminary GRE Project design shows an Initial Phase that will involve clearing of approximately 80 to 90 acres of land for the quarry, access roads, staging areas, dam abutments and base, and dam access areas for site preparation. The Inundation Area Phase will involve clearing the remainder of forested land surrounding the reservoir within the inundation area. The 415 acres to be cleared includes 145 acres of Denver Water property and 270 acres of National Forest System lands. The land that will be cleared is between the elevations of 7,282 feet and 7,406 feet. All tree removal work areas are located within Boulder County; however, access, including truck haul routes, will affect other jurisdictions in Gilpin and Jefferson counties. Figure 1 provides an overview of the GRE Project features and section 2.1 provides an overview of the construction activities that will be completed during the Initial Phase.

The Initial Phase of the Tree Removal Plan will include the clearing associated with the Osprey Point Quarry (primary quarry on Figure 1) and associated access roads, staging areas, and dam access that will encompass the southeastern portion of the reservoir starting from the Osprey Point Quarry and heading northeast along Gross Dam Road to Gross Dam (refer to Figure 1). Experience and lessons learned from the Initial Phase will be used to inform the planning and implementation of the Inundation Area Phase. The Inundation Area Phase will include the clearing associated with the remainder of the reservoir inundation area.

The Inundation Area Phase will require removal of approximately 140 to 1,170 trees per acre, or an estimated 200,000 trees with approximately 24,000 tons of woody biomass, along an estimated 12.5 miles of shoreline (see section 1.3.2.2). Most are coniferous trees that range in size from 8 to 50 feet tall and vary in diameter at breast height from 2 to 30 inches. Trees that are smaller than these dimensions will be left in place during this work. Tree removal and disposal will require hauling of biomass material to landfills or to commercial markets for use as further described in section 2. Haul routes and potential impacts to area traffic, communities, and roadways are also described in section 2. Preliminary mitigation measures for traffic are provided in section 2.3, as are preliminary mitigation measures and best management practices (BMPs) for erosion control, water quality, and nuisance factors. Final mitigation measures and BMPs will be provided per specific permits and plans in Appendix D that will be submitted prior to start of tree removal activities for the GRE Project.

A GRE Project schedule summary is provided in section 3. Construction activities, expected to begin in the first half of 2022 (prior to the FERC-mandated start date of July 16, 2022), would include the clearing and development for the quarry, staging areas and access roads/areas around Gross Reservoir and Dam associated with the Initial Phase of this Tree Removal Plan. The Inundation Area Phase of this Tree Removal Plan would involve tree removal activities within the inundation area, which would likely take place in phases over two years beginning in 2025.

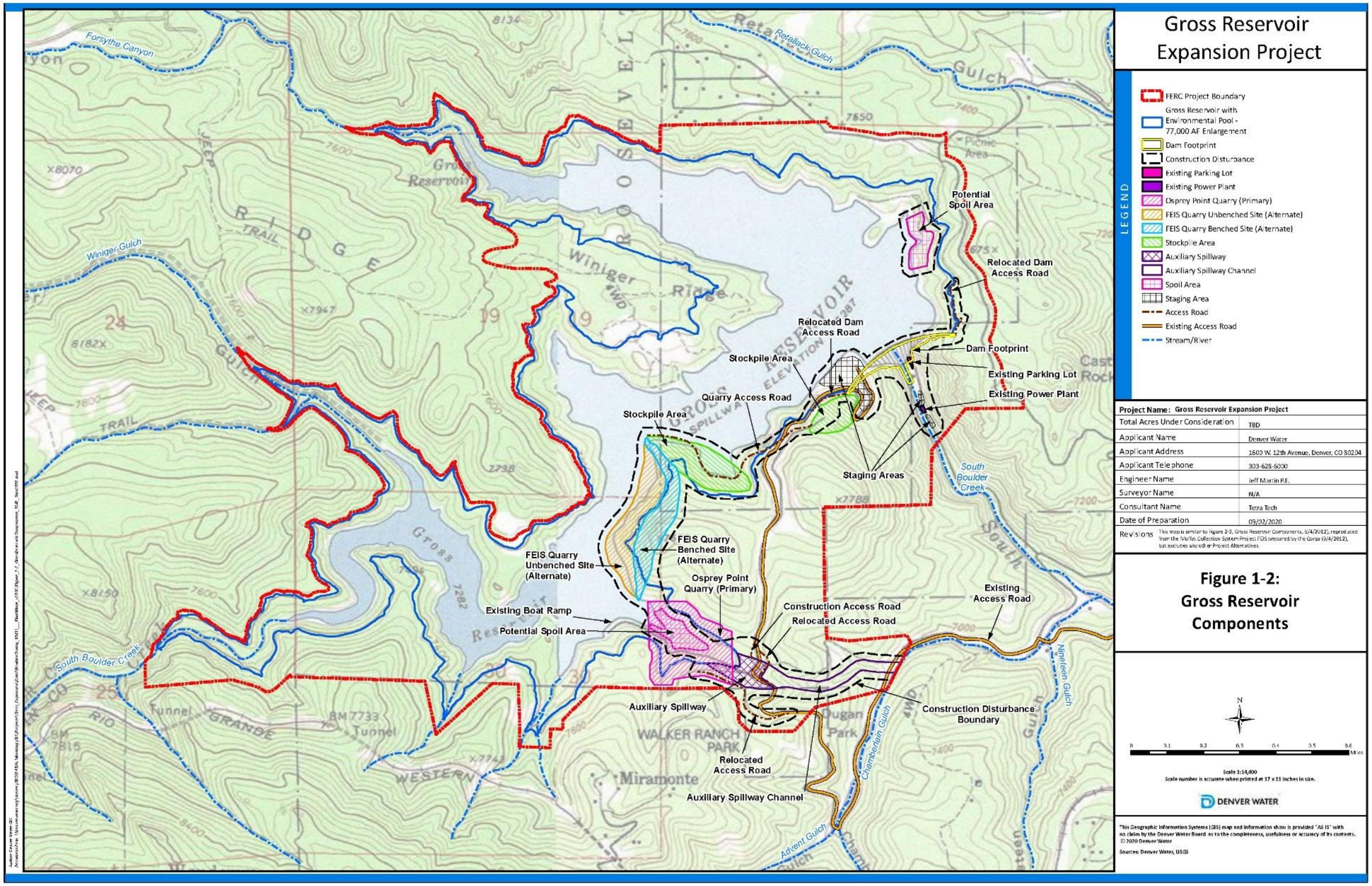

Figure 1: Overall Gross Reservoir Expansion Site Plan

1.3 Project Environmental Permitting and Requirements

The following sections highlight the extensive environmental studies and permitting that have been completed to date in support of the GRE Project. An EIS was initiated in 2003 for the GRE Project in accordance with the National Environmental Policy Act whereby the U.S. Army Corps of Engineers (Corps) served as the lead agency with jurisdiction under the Clean Water Act and FERC served as a cooperating agency. A Final EIS for the GRE Project was completed in 2014 and was followed by the Corps' 2017 Record of Decision and 2017 404 Permit. Because Gross Dam and Reservoir are features of a FERC-licensed hydroelectric project, the FERC has jurisdiction under the Federal Power Act and an amendment to the existing license was required. The license amendment was granted by FERC on July 16, 2020. This Tree Removal Plan incorporates information from the robust environmental studies and permitting completed to date for the GRE Project. Appendix D lists other GRE Project permissions and approvals related to tree removal activities. The following specific FERC Order Article 423 requirements have been addressed in this Tree Removal Plan as summarized in Table 1.

Table 1:
Additional Provisions Required By Article 423

Condition	Section of Tree Removal Plan
1. Measures to limit travel speeds on logging roads	2.4.1
2. Measures to prevent public use of logging roads during logging operations	2.4.1
3. Measures to limit log removal traffic to daylight hours	2.4.1
4. Measures to ensure logging trucks are appropriately equipped with mufflers to minimize noise	2.4.1 2.4.3
5. Measures to minimize fugitive dust	2.4.2
6. Measures to minimize soil erosion and effects to water quality	2.4.2
7. Measures to minimize odors and nighttime lighting	2.4.3

In addition, FERC Order Article 423 requires that the Tree Removal Plan be prepared after consultation with USFS, CSFS, Boulder County, Jefferson County, and Gilpin County as discussed in section 1.3.2.3. and summarized in Appendix A and G.

1.4 Previous Tree Removal Plans

1.4.1 2008 Tree Removal Plan

The Final EIS referenced and FERC License Amendment Application (included as Attachment E-6) for the GRE Project included a Tree Removal Plan developed in 2008. This plan was a high-level review of site conditions and material present. The 2008 Tree Removal Plan described possible access road locations, haul routes, staging areas, and tree removal and disposal options. Removal methods included helicopter and yarding devices for steep areas, and disposal methods included burning materials or hauling them offsite. The 2008 Tree Removal Plan also included an inventory estimate of the amount of material that would require removal. The inventory was further refined and updated in 2019 as discussed in the following section.

1.4.2 2019 Tree Removal Plan

A Tree Removal Plan was developed in 2019 (Appendix C). Two draft plans were submitted to reviewing agencies[2] in 2019 and comments have been incorporated into the 2021 Tree Removal Plan as shown in the September 30, 2019, Comment Response Matrix in Appendix A. Specific objectives of the 2019 Tree Removal Plan were to find the most cost-effective and efficient tree removal and disposal option(s), maximize product utilization, minimize tree removal traffic, and minimize nuisance factors (noise, light, and odor). Field work took place in spring 2019 and included revising estimates of material volume; re-evaluating site conditions for transport of material to staging areas (yarding, helicopters, trucks); and considering disposal options for the material (burning, biochar, pellet plant, landfill). Additionally, estimates of the number of truck trips for the various timber waste and merchantable timber removal were made, and safe haul routes and access roads were identified. Costs were evaluated using LogCost (version 18.1) to evaluate contemporary harvesting technologies and helicopter opportunities including aerial and cable systems, as well as ground-based systems. The advantages/disadvantages and cost of each option were described, and recommendations were made on the proposed methods and the location of staging and disposal areas.

1.4.2.1 Evaluation of Alternatives

The 2019 Tree Removal Plan evaluated a suite of tree removal and disposal options and developed four alternatives. An analysis of these alternatives was conducted using the following criteria:

- The most cost-effective and efficient tree removal and disposal option.
- Maximize biomass utilization.
- Minimize tree removal traffic.
- Minimize nuisance factors such as noise, light and odor.

[2] U.S. Forest Service, Colorado Parks and Wildlife, Colorado State Forest Service, Boulder and Jefferson counties and Jefferson Conservancy District.

Alternatives considered but eliminated from consideration based on agency feedback are described in Appendix E. Alternative Three, 4 Helicopter Log Landing Locations (Log Landings), was the Selected Alternative and is discussed below.

The analysis of the tree removal alternatives in the 2019 Tree Removal Plan was based on experience with logging engineering, harvest systems design, and implementation, guided by Colorado Forestry Best Management Practices (CSFS 2013). The overarching guiding principle was to develop a tree removal plan that would minimize impacts on the community and maximize biomass utilization at the most cost-effective price point. Factors considered for alternative evaluation include cost; tree removal and disposal efficiency; methods to maximize biomass utilization; measures to minimize tree removal traffic; and measures to minimize nuisance factors such as noise, light and odor. The Selected Alternative meets all of the evaluation criteria. The Selected Alternative:

- Minimizes traffic and nuisance factors and provides the least-cost option for tree and debris removal.
- Will reduce west side community haul truck traffic impacts.
- Has the best operational options from unplanned shutdowns or mechanical issues with four landing sites, and the fewest helicopter round trips for yarding biomass.
- Provides a spectrum of biomass disposal opportunities to best take advantage of market conditions and reduce impacts from haul traffic.

The cost analysis was based on the stated objectives, field reconnaissance and inventory, market reviews, timber resource analysis, and cost analysis (using LogCost version 18.1). The largest factor in determining the tree removal costs is the yarding distance needed for helicopters. With four strategically placed landing locations, the helicopter yarding distances for the Selected Alternative were greatly reduced, resulting in removal costs being approximately $322,000 lower than the next lowest cost alternative.

The Selected Alternative uses four possible log landing sites, (1) Winiger Ridge, (2) Winiger Gulch Road, (3) Osprey Point Road, and (4) North Shore Point for primary processing of harvested logs and biomass (refer to Section 2.2). Two of the landings, 3 and 4, use Gross Dam Road for removal of material. Coordination of tree removal activities and dam construction activities will minimize potential conflicts. Table 2 summarizes the merits of the Selected Alternative.

Table 2:
Merits Considered for Selected Alternative: 4 Log Landings

Advantages	Disadvantages
• Lowest stand removal cost • Maximizes opportunities for cable and ground yarding equipment, reducing costs • Reduces west side community haul truck traffic impacts • Four landings areas allow for operational flexibility to respond to unplanned shutdowns or mechanical issues • The fewest helicopter round trips for yarding biomass • Provides a spectrum of biomass disposal opportunities (i.e., cordwood, chips and energy production as discussed in section 2.2) • Provides opportunities to minimize impacts on wildlife • Potential to reduce 1,000 tons of carbon emissions by eliminating disposal truck traffic.	• Most landing construction impacts (four landings) • Most service landing construction impacts (two service locations) • Increases haul truck traffic impacts through communities on the east side of the reservoir

For biomass utilization, the Selected Alternative can make use of a suite of disposal options depending on market conditions. They range from full marketable utilization and removal from the GRE Project, to complete onsite disposal using air curtain destructors (ACDs), to hauling material to a landfill. To minimize tree removal traffic and pursuant to air quality regulations, Denver Water is evaluating the option to treat GRE Project debris onsite using ACDs.

Section 2 of this Tree Removal Plan expands further on the elements associated with the Selected Alternative.

1.4.2.2 Forest Resources Inventory

The first forest inventory was completed by the CSFS in the Gross Reservoir Forest Management Plan (CSFS 2005) and became the basis for the inventory in the 2008 Tree Removal Plan (LSA 2008a, 2008b). The 2019 Tree Removal Plan modeled tree tonnage/acre for each stand based on the 2008 Tree Removal Plan contemporary cruise models and published tree weight data (Lynch 2005). Tree weights were based on tree species, cubic foot volumes, and diameter using the best available science to arrive at total biomass harvest tons. The 2019 Tree Removal Plan revisited the 2008 Tree Removal Plan weight estimates as they were determined to be high for typical Front Range forests. The tree weights in the 2008 Tree Removal Plan were adjusted as described below using local Front Range green forest weights by species and estimated merchantable board foot Scribner volumes (i.e., Scribner Decimal C Rule Measurement for Board Meet), total cubic foot stem volumes, and live weights of stems and branches for each of the 36 stands in the 2008 Tree Removal Plan.

Table 3 shows the revised acreage estimated in the 2019 Tree Removal Plan and the resulting total tons to be removed, including 2,035 tons of surface fuels, which equals 24,398 tons from harvested stands in the inundation area. The 2019 Tree Removal Plan includes the detailed stand inventory in Appendix F. Prior to removal of timber from National Forest System lands, a cruise survey will be completed in consultation with USFS.

Table 3. Stand Inventory Summary for Inundation Area Phase

Species	Total Acres	Total Trees	Tons/Acre	Total Tons
Ponderosa/Doug-Fir*	415	207,970	53.89	22,363
Surface fuels	415			2,035
Total				**24,398**

* Other tree species compose minor amounts of the inventory.

1.4.2.3 Preliminary Agency Coordination and Review

Denver Water provided the draft 2019 Tree Removal Plan to several agencies and held two meetings with agencies to discuss findings and solicit input. The draft 2019 Tree Removal Plan was provided to agencies, and a meeting was held on August 5, 2019. The meeting included representatives from: Boulder County, Colorado Parks and Wildlife (CPW), CSFS, Dahl Environmental Services (consultant), Denver Water, Jefferson County, Jefferson Conservation District, Tetra Tech, Inc. (consultant), and USFS. Denver Water invited comments on the draft 2019 Tree Removal Plan from agencies by August 26, 2019. A second meeting was held on October 1, 2019 with the same participants. Denver Water presented the Selected Alternative and indicated that further refinements would be captured in the Tree Removal Plan required by FERC.

Appendix A includes the meeting notes from each meeting, as well as agency comments and Denver Water's responses. Denver Water shared a matrix of comments and responses at the second agency meeting. Denver Water added conceptual haul road drawings to the 2019 Tree Removal Plan in response to agency feedback.

2. 2021 Tree Removal Plan Required by FERC

This Tree Removal Plan is one of several required plans per the FERC Order (see Appendix D). The FERC Order requires Denver Water to consult with USFS, CSFS, Boulder County, Jefferson County, and Gilpin County for preparation of the Tree Removal Plan. Denver Water has prepared this Tree Removal Plan for review and input by these agencies.

2.1 Agency Coordination and Review

Since the 2019 Tree Removal Plan, Denver Water has continued to engage agencies in discussions related to tree removal. Denver Water met with agencies on February 10, 2021 (see meeting notes in Appendix G). Representatives included Boulder County, Denver Water, Jefferson County, Gilpin County, the Town of Superior, Colorado Department of Transportation

(CDOT) Region 1, CDOT Region 4, Tetra Tech, Inc. (consultant), and Black & Veatch (consultant). The participants provided comments during the meeting on the following issues:

- CDOT suggested Denver Water avoid using the route through U.S. Highway 6 to State Highway (SH) 58 due to emergency services limitations and difficulty responding if there is an incident.
- Denver Water indicated they are exploring a possible staging area for construction activities near the intersection of SH 72 and SH 93.
- CDOT expressed concern regarding the GRE Project schedule and the time needed for Denver Water to acquire the necessary access permits for SH 72 and Gross Dam Road. The property acquisitions will likely take at least 9 months.
- CDOT Region 1, Region 4, and Boulder County will require traffic studies and will review haul routes prior to Denver Water finalizing the truck routes for tree removal.
- Denver Water provided a draft Tree Removal Plan for review and comment on March 15, 2021. All comments that were received on this plan are included in Appendix G. Denver Water reviewed and responded to all received comments and made necessary changes to this final Tree Removal Plan. A matrix of comments and Denver Water responses are provided in Appendix G.

2.2 Initial Phase — Tree Removal and Clearing

Beginning in 2022, the GRE Project will require site preparation to clear and widen roads, clear staging areas, and clear the quarry area. These activities will comprise the Initial Phase. Tree removal activities along the reservoir inundation area (Inundation Area Phase) could begin as early as 2025 as described in section 2.3. The following areas could be disturbed by initial construction activities and require tree and brush removal: Gross Dam Road and SH 72 Intersection, Gross Dam Road from SH 72 to Gross Reservoir, the quarry at Osprey Point, haul/access roads and staging areas, the aggregate crushing plant, the concrete batch plant, the North Shore Peninsula and left dam abutment access, and the raised dam foundation (see Figure 2). The clearing that will be completed during the Initial Phase is about 80 to 90 acres, depending on final design and locations of facilities. The areas to be cleared are a mix of merchantable timber and slash and will be on Denver Water and National Forest System lands. The use of ACDs may be evaluated in a pilot test to assess emissions relative to air quality standards. The use of helicopters and landing sites will not be required during the Initial Phase. Denver Water expects the biomass generated during the Initial Phase will be disposed at the Foothills Landfill, located along SH 93 south of SH 72, based on the expectation that the ACD option may have limited feasibility given air quality restrictions. The initial clearing areas are shown in Figure 2.

Haul routes for the cleared biomass in the Initial Phase will follow Gross Dam Road to Crescent Park Drive[3] to SH 72. Trucks could then use SH 72 to transport biomass material to the Foothills Landfill off SH 93. Preliminary estimates indicate there will be approximately 3,420 tons of biomass to remove during the Initial Phase clearing and that trucks can haul the biomass at a rate of two to three trucks per hour over an 8-hour daylight period for an approximate total of 150 truckloads. Based on these estimates, the tree clearing haul operation for the Initial Phase will require eight to nine days, or approximately two weeks.

Denver Water will coordinate with CDOT, Jefferson County and Boulder County to identify any necessary access permits and improvements at the intersection of SH 72 and Crescent Park Drive.

[3] Denver Water had identified an improved intersection alignment at the SH 72 and Gross Dam Road intersection in 2020. Due to delays in agency reviews, the intersection improvements will not be completed prior to activities beginning on site in late-spring 2022. Thus, Crescent Park Drive will be temporarily used for construction traffic until improvements are made to the SH 72 and Gross Dam Road intersection.

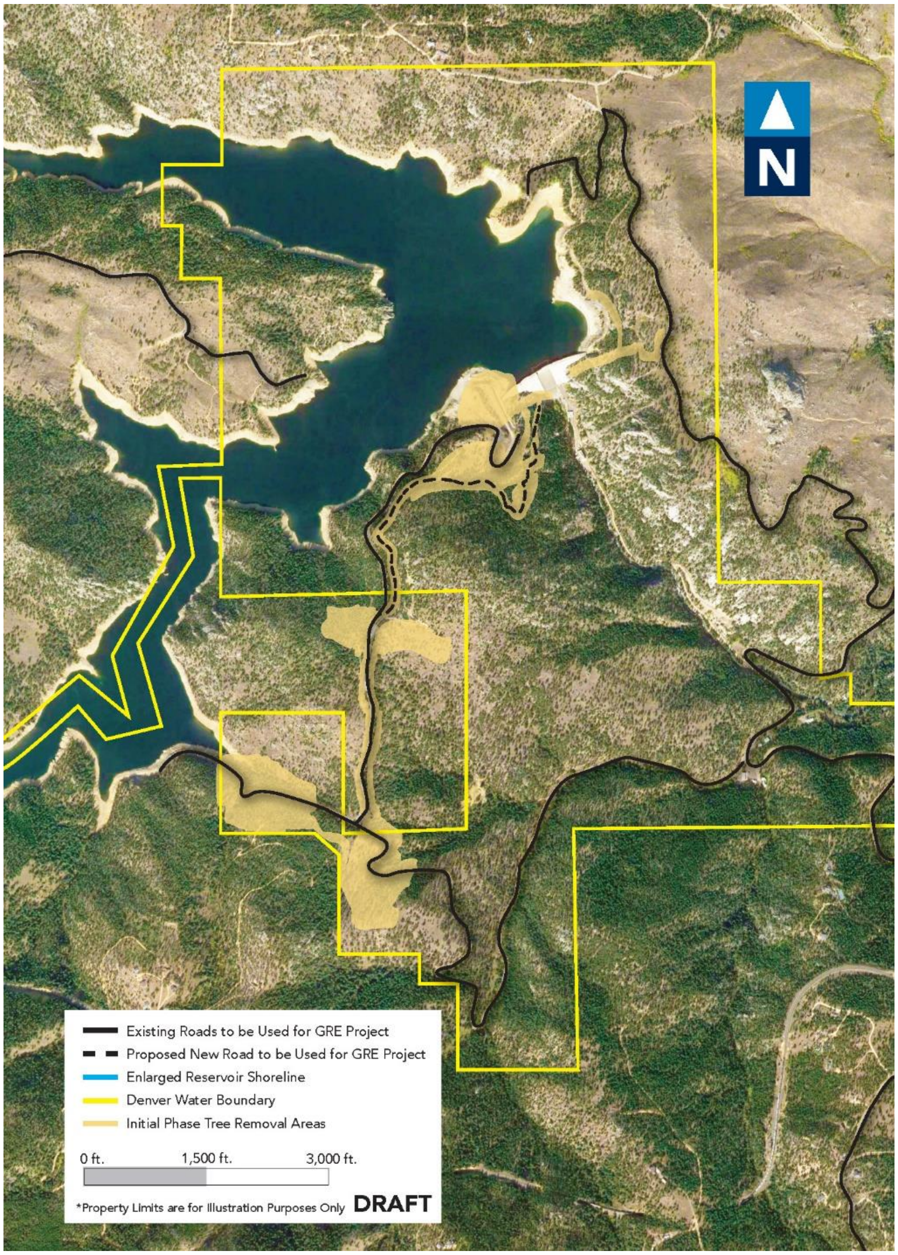

Figure 2: Initial Phase of Tree Clearing Areas

2.3 Inundation Area Phase — Primary Tree Removal

A summary of Denver Water's objectives for tree removal around the reservoir perimeter is described under the Selected Alternative in section 1.4.2.1. Descriptions of the tree removal and disposal methods are included in Appendix H. This section contains detailed information on the implementation of the Inundation Area Phase of the Tree Removal Plan.

Denver Water will likely complete the tree removal after quarry operations have ceased to limit traffic impacts. The GRE Project schedule is summarized in section 3. Denver Water anticipates tree removal in the inundated area to occur during two years, 2025 and 2026. Landing Sites 1 and 2 are expected to be initiated before site preparation activities for tree removal are completed. The initiation of Landing Site 3 will be coordinated with quarry operations. In addition, removal of materials from Landing Sites 3 and 4 will be coordinated with cement and flyash deliveries. Once construction activities have been completed and Denver Water has received permission to start filling the new reservoir space, it will likely take several years to fill Gross Reservoir depending upon hydrological conditions.

Thirty-six unique stands of trees were identified for complete removal along the reservoir shoreline within the inundation area. Vegetation to be removed includes predominately ponderosa pine and Douglas fir and some Colorado blue spruce and Rocky Mountain juniper with inclusions of grass/shrub meadow stand. Figure 3 shows (in purple) terrain too steep for tracked or wheeled equipment and so clearing will be achieved by hand felling and helicopter. For details on equipment to be used for tree clearing refer to Appendix H. Denver Water plans to use four helicopter log landing sites: (1) Winiger Ridge, (2) Winiger Gulch Road, (3) Osprey Point Road, and (4) North Shore Point for primary processing of all harvested logs and biomass (see Figure 3). Two of the landings, 3 and 4, use Gross Dam Road for removal of material to SH 72. Landing sites 1 and 2 will use Forest Service Road (FS) 359 and County Road (CR) 97 to access SH 119.

Denver Water will coordinate tree removal activities and dam construction activities to minimize potential conflicts. Material will be processed and prepared for transportation (e.g., mulched, burned) at the four landing sites. Landing Site 3 is located on Denver Water land adjacent to the Osprey Point and has been used in the past as a timber harvest landing zone for thinning. Landing sites 2 and 4 have been designed to be located within the reservoir expansion inundation area. Landing Site 4, on the North Shore, is not as accessible to larger vehicles as the other landing sites but will serve as a gathering point for the limited quantity of materials planned for that location. Landing Site 4 will require short wheelbase trucks to move material offsite via Gross Dam Road to SH 72. Landing Sites 3 and 4 balance the amount of biomass using access roads east and west of Gross Reservoir and reduce west side community haul truck traffic impacts.

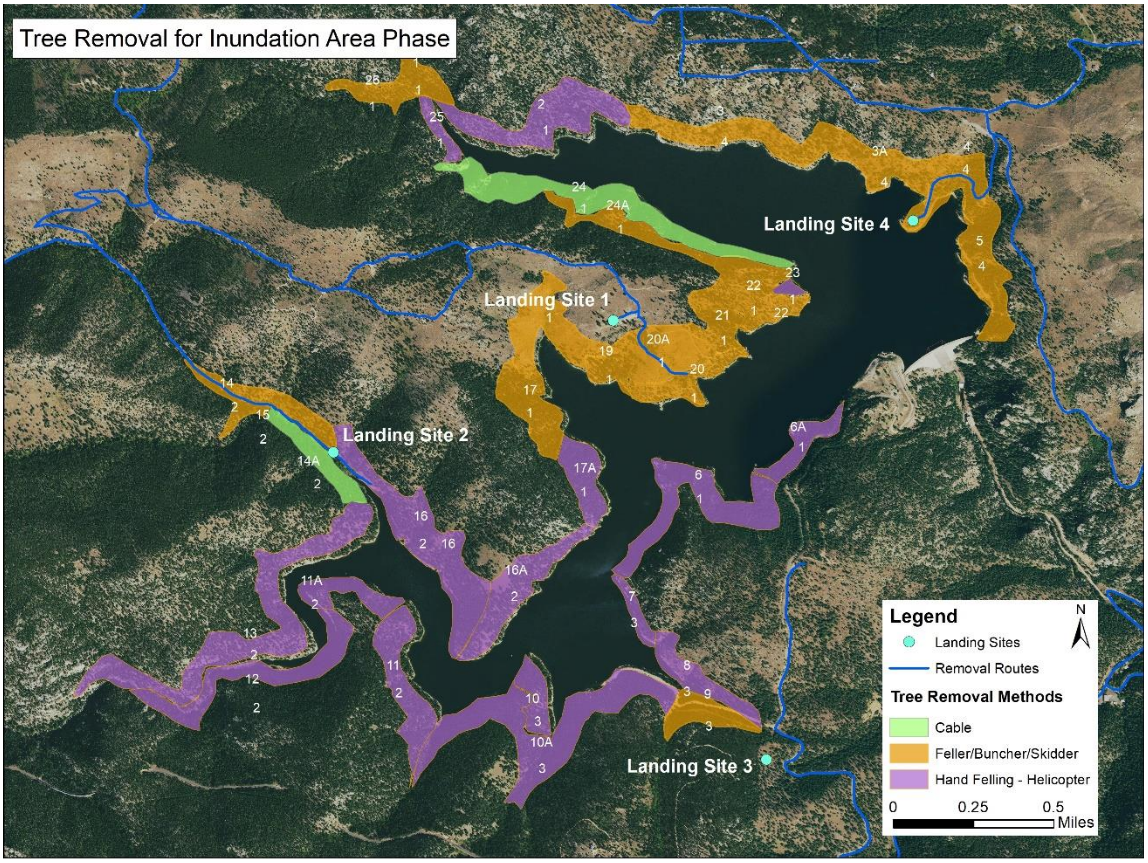

Figure 3: Inundation Area Phase Tree Removal

2.3.1 Tree Removal

Denver Water will remove as much biomass as possible from the inundation area for water quality concerns. Colorado Department of Public Health and Environment's (CDPHE's) 401 Certification acknowledges Denver Water's plan to remove trees from the inundation area to limit mercury methylation. Denver Water will use multiple harvest methods as shown on Figure 3. For stands with slopes 40% or greater (purple and green shading), helicopter and cable systems will be used after hand felling is completed. For stands with slopes less than 40% (orange shading), Denver Water will use mechanical tree processors for felling. Tree removal methods by stand, including acreage, are listed in Appendix F. More than half of the tree removal effort will use helicopter logging because of steep slopes. The use of helicopters was identified as the most effective and efficient way to remove the timber and also reduces the duration of tree removal activities. The exact schedule and number of helicopters onsite at one time will be determined with the contractor prior to activities beginning.

At the time of the 2019 Tree Removal Plan, the value of the sawtimber produced was below the cost of production, so the sawtimber was considered non-merchantable (i.e., biomass). Denver

Water will re-evaluate market conditions during the contracting process and adjust disposal methods as needed. If there is a market for the material, Denver Water will make its best effort to take the material to an end user.

Based on the data in Appendix F, 18,024 tons (81%) of biomass will be removed from the west area, and 4,336 tons of biomass (19%) will be removed from the east area. The remaining 2,035 tons of surface fuels are estimated to be located evenly throughout the site. Approximately 42% of biomass will be hauled from Landing Site 1; 39% from Landing Site 2; 10% from Landing Site 3; and 9% from Landing Site 4. Each landing site has different characteristics and final disposal options will vary for each site based on the landing site location in relation to feasible haul routes and the biomass material properties.

Logs and biomass delivered to landing sites will be handled by grapple loaders to sort material for processing. The main landing for log processing and helicopter service will be on Winiger Ridge. Temporary skid trails will be constructed below the new high watermark (7,406 feet) of the inundation area to facilitate tree removal. Stands will receive final site cleanup by mulching and/or hand removing wood material and biomass inside the inundation areas down to a size of 2 inches in length and diameter. Trees, brush (dead or alive), and biomass will be cut within 6 inches of the ground on uphill side of the slope or obstruction and removed from the inundation areas. Disturbed areas outside the inundation area will be restored to original conditions as required by GRE Project permits and agreements.

2.3.2 Debris Processing and Disposal

Denver Water will select a contractor who will determine the best combination of disposal methods in coordination with Denver Water: chips, ACD (as viable), and cordwood. These methods are discussed in detail in Appendix H. Denver Water intends to select a mix of disposal options to reduce impacts to the environment and provide options to use community resources (such as local lumber yards) or provide cordwood to neighbors. Chip disposal is generally expected to go to local landfills. Disposal options range from full utilization and removal from the GRE Project site to complete onsite disposal using ACDs. Full utilization of biomass debris would require trucking GRE Project debris from the GRE Project site. It is estimated that 15% of all timber removed is merchantable; however, this is dependent on future market conditions which may change. Denver Water will evaluate market conditions and production sources in making final decisions about biomass utilization.

Possible disposal methods associated with landfill destinations or with marketable uses, as viable, are summarized in the following sections. The value of the sawtimber is generally considered non-merchantable, but the value will be revisited at the time of tree removal contracting, approximately 1 year prior to tree removal activities, to account for any changes in market conditions.

Biochar was evaluated for onsite processing, but the long time required for processing limits onsite biochar production. The consideration of using biochar was evaluated and discussed with agencies during the 2019 Tree Removal Plan process. Biochar requires a large up-front investment for processing equipment onsite that substantially increases the biomass disposal cost and is a slow process and would not be practicable to treat all biomass onsite. In addition, off-site disposal would require hauling and a processing site. The biochar process also produces a substantial amount of dust. Denver Water will consider offsite biochar production, if viable, during contracting for tree removal activities.

Air Curtain Destructor

ACDs or burners are widely used in land clearing projects throughout the world. An ACD is a large mobile incinerator. Combustible material is loaded into the large bin and a fan blows a high-pressure curtain of air across the top of the bin. The curtain recirculates combustible gases and smoke until only heat and a minimum of pollutants escape from the bin. ACDs have a 96 to 98% reduction rate, so 2,000 pounds of slash turns into 40 to 80 pounds of ash and a limited amount of biochar. ACDs provide an efficient, environmentally friendly feasible option for debris disposal. Environmental impacts are minimal as near complete combustion is achieved with minimal amounts of escaped particulates, virtually eliminating smoke. Ash and biochar can be stored onsite to be used for site restoration. A USFS San Dimas Technology and Development Center evaluation of ACDs indicated ACDs efficiently disposed of large quantities of fuels while releasing very little emission particulate matter (USFS 2005). Residual ash and biochar have beneficial use and can be applied to disturbed areas during restoration activities.

Results of real-time ambient air testing by Lockheed Martin Technology Service for the U.S. Environmental Protection Agency's (EPA) Environmental Response Team in Puerto Rico showed that "there were no significant emission releases during debris burning." The ambient air monitoring and sampling was conducted at the request of the EPA and the Corps to evaluate air emissions during ongoing burns intended to destroy all burnable woody debris generated by Hurricane Jeanne (Lockheed Martin Technology Services 2005).

Treating biomass onsite using ACDs would greatly reduce product removal traffic from local and state highways. ACD could provide up to 98% reduction in biomass, which would result in a subsequent reduction in truck haul traffic. Beyond reducing local impacts related to truck traffic, Denver Water estimates that eliminating truck traffic associated with debris removal could also reduce carbon emissions by approximately 1,000 tons.

Denver Water may conduct a pilot study of ACD during the Initial Phase to determine whether this option is possible at a large scale or in a more limited extent. The study would evaluate air quality restrictions and seasonal restrictions due to wildfire risk or wildlife impacts. The pilot study also would evaluate the specific rate of processing in tons per hour. The manufacturer asserts that a larger FireBox can eliminate 10 to 12 tons of woody debris per hour, reducing it to approximately 100 tons of wood (or two to four tons of ash and biochar) during a 10-hour day. A single operator can support three ACDs on a single landing. Three ACDs working in combination could eliminate 24,000 tons of debris in 80 burning days. Additional burners would reduce disposal times. During agency meetings to discuss the 2019 Tree Removal Plan, Boulder County representatives shared their experience that the ACD operating capacity was only four tons per hour (not 10 tons per hour as indicated by the manufacturer).

ACDs would require CDHPE permitting and would be subject to Boulder County fire restrictions. Use of ACDs would require coordination with USFS, Boulder County Sheriff, CDPHE, and local fire districts.

Process and Utilize Chips

Grinding whole trees and hauling to biomass utilization facilities is another option for debris disposal. Large grinders are used to convert entire trees into rough chips. Slash is decked in large piles and fed through the grinder with a track hoe or loader, the grinder blows chips into a pile or a truck, and the chips are hauled to a utilization facility. The Morbark 4600XL Wood Hog can process debris at the rate of 100 tons per hour. Given the production capacity of this grinder, 1,000 tons of debris could be processed during a 10-hour day. At this rate, grinding the slash and debris generated by tree removal would take approximately 24 days. Chip vans,[4] capable of holding approximately 100 cubic yards of chips, would carry approximately 23 to 27 tons per load. Given the estimated 24,000 tons of debris for the GRE Project inundation area, grinding and removal from the site would generate approximately 1,000 truckloads of chips across the entire site.

Chips can be used as fuel for steam generation or compost or they can be taken to a landfill. Several utilization facilities operate in Colorado. Eagle Valley Green Energy in Gypsum and Confluence Energy in Kremmling are potential purchasers of biomass for energy production. A1 Organics in Commerce City and Renewable Fiber Inc. in Fort Lupton are other disposal locations.

Cordwood

Cordwood production may be possible if market conditions are favorable and a producer is willing to contract removal of the woody material for the GRE Project. A producer would convert the woody material to cordwood and chips at the landing sites. To date, one producer has expressed interest in discussing this option with Denver Water. Denver Water has considered a sawmill in Longmont and a log processor in Henderson, Colorado.

[4] Chip vans require low clearance roads and may not be feasible for some access routes to Gross Reservoir. An evaluation of roads would be needed to verify accessibility prior to using chip vans.

Nederland, Colorado is a firewood-dependent community for home heating. There may be an opportunity for Denver Water to provide cordwood through local vendors. It will be important to balance “free use” firewood with the existing commercial market in the area.

Local Log Yard

Nederland Community Forestry Sort Yard (CFSY), operated by Boulder County, provides another utilization and disposal option for a portion of the woody material. Operationally, the Nederland CFSY could receive both logs and chips. Its tipping fee is approximately $4.00 per cubic yard but could be higher depending on other factors. The tree removal would produce approximately 24,000 cubic yards. The Nederland CFSY provides the closest offsite disposal location. Disposing saw logs at the sort yard would provide opportunities for local firewood cutters and reduce the trip distance for trucks. This yard is not designed for and does not have the capacity to accept all the material generated from tree removal activities at Gross Reservoir. In consultation with CFSY, Denver Water may deliver an amount of material capable of being processed at the facility.

Foothills Landfill

Denver Water would prefer to minimize the amount of biomass disposed in landfills. Based on the lack of viable markets for biomass/log materials, however, it is likely that a portion of the biomass will be disposed of as chips in local landfills.

Loading and hauling chips to a landfill is the most expensive disposal option considering haul costs and tipping fees. Denver Water determined haul costs based on the landing sites as starting areas for chip trucks. Foothills Landfill is located at 8900 Highway 93 near Golden and is the closest landfill to the GRE Project area. Quoted tipping fees at Foothills Landfill are $22.80 per ton.

2.3.3 Transportation Options Considered

Denver Water considered multiple modes of transportation to complete tree removal under the Inundation Area Phase.

Denver Water explored using boats or barges on Gross Reservoir for biomass transport and determined that option is not feasible due to the short haul distance and because helicopters will already be heavily used for removing material from the steep terrain surrounding Gross Reservoir. Boats or barges, however, will be considered to transport personnel and equipment involved in tree removal activities along the shoreline. Denver Water will rely on helicopters and ground-based vehicles to transport biomass to landing sites. From the landing sites, Denver Water anticipates using ground-based vehicles to remove biomass to final disposal locations.

Denver Water considered using the Union Pacific Railroad line that crosses Gross Dam Road to transport some materials and reduce truck traffic. Denver Water met with Union Pacific Railroad representatives in 2017 to discuss using the railway siding for the GRE Project transportation needs (see documentation in Appendix A). The railway siding is difficult to use for several reasons, including the challenge of coordinating use with Amtrak and other rail users, the high level of existing rail traffic, and the requirement that Denver Water use active rail engines to hold cars in place due to the steep grade. In addition, because of the narrow width in this area, rules related to clearing and maintaining clearance from the main line would complicate the use of the railway siding for the GRE Project activities. Lastly, the area to the north of the siding is part of Eldorado State Park and would need to be cleared and graded for a rail staging area.

2.3.4 Traffic Management

Denver Water is developing a Traffic Management Plan (see Appendix D) as required by the FERC Order. A draft Traffic Management Plan was made available in May 2021 for agency stakeholder review. The Traffic Management Plan includes detailed traffic studies, access road locations, vehicle information, haul routes, and measures to mitigate and minimize traffic and transportation impacts to local residents. This Tree Removal Plan addresses traffic and transportation management for tree removal activities at a conceptual level and more detailed information is included in the Traffic Management Plan.

In addition, Denver Water intends to contract the tree removal work in 2024 and will require the contractor to refine the Traffic Management Plan to finalize details related to: (1) roads to be improved, constructed, and used for tree removal activities; (2) restoring roads to pre-project conditions; (3) travel management considerations such as prevention of public use of temporary roads created for tree removal; (4) transportation management during tree removal activities; and (5) how GRE Project-related traffic would be managed to minimize disruption on USFS roads and provide for visitor safety.

2.3.4.1 Access Roads and Haul Routes

Denver Water evaluated the most efficient transportation system to remove and dispose of GRE Project biomass and woody debris based on a systems feasibility assessment. The system balances efficiency and minimizing impacts on the local community and protecting resources like wildlife and archaeology.

Haul routes are shown in Figure 4 and on the maps provided in Appendix I. This appendix also includes conceptual design information on haul route improvements. Denver Water identified these routes based on substantial input from agencies in 2019 and 2021 as described in section 1.3.2.3. The level of use on specific haul routes will depend on the final destinations for biomass materials. Denver Water will minimize impacts to the local community to the extent practicable and will continue coordinating with CDOT, Boulder County, and other local jurisdictions.

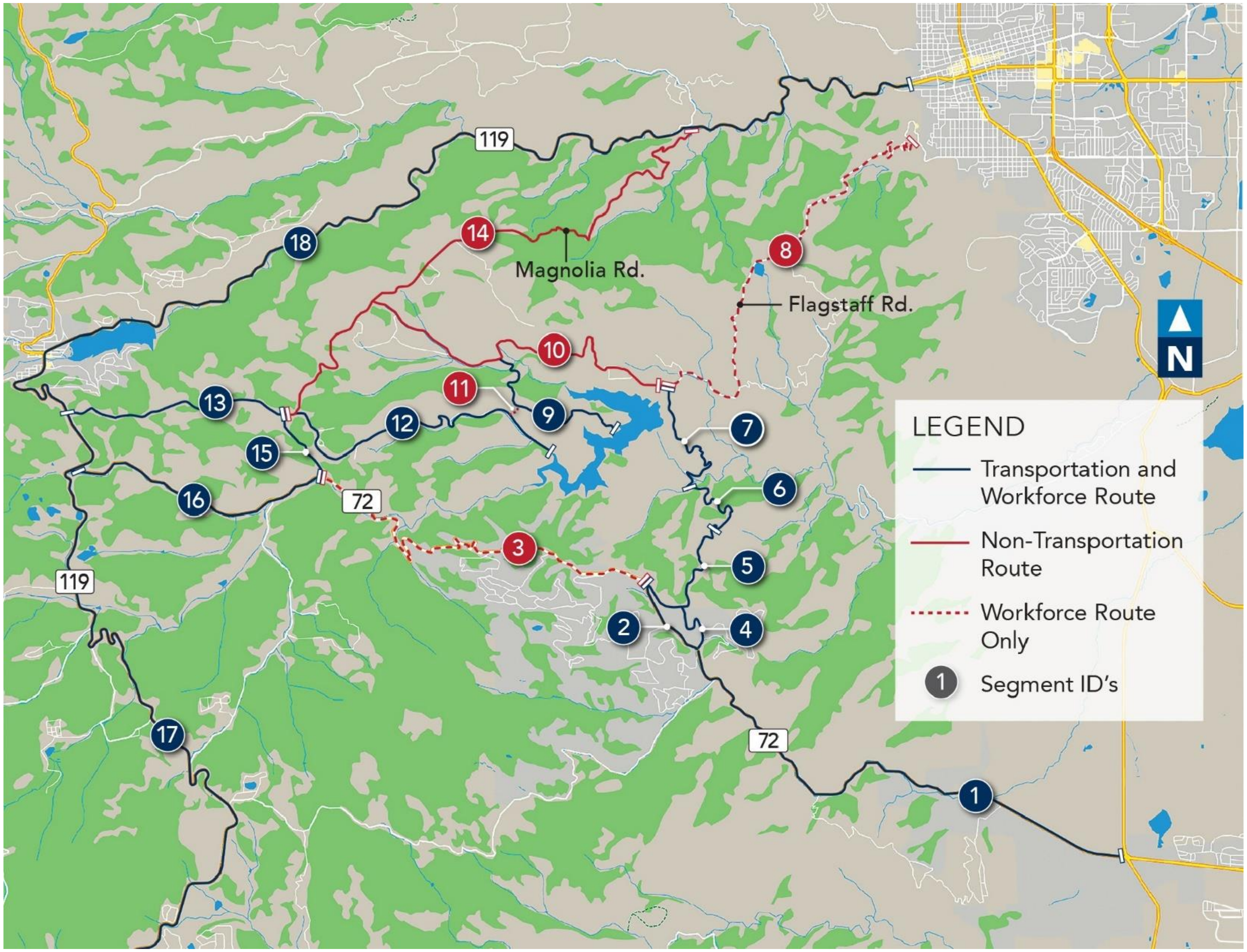

Figure 4: Haul Routes for Tree Removal Activities

The primary access road to the east side of the GRE Project is Gross Dam Road (see Appendix I). Gross Dam Road (CR 77S) will be used for site access to Landing Sites 3 and 4. Gross Dam Road is a gravel road in good condition and currently wide enough for two-way passenger vehicle traffic. Improvements needed for construction activities (delivery of cement and flyash) will require widening of the road to allow for two-way truck traffic. Any tree removal work along the east side that uses Gross Dam Road will be coordinated with dam construction activities to avoid conflicts. Tree removal haul traffic on this side of the GRE Project will originate from either Landing Site 3 or Landing Site 4, travel along Gross Dam Road to SH 72, then travel east towards a designated biomass disposal facility.

The primary access to the west side of the GRE Project will be via FS 359 (Winiger Ridge Road) for Landing Site 1 and CR 97 (Lazy Z Road or Haul Road) for Landing Site 2 (see Appendix I). Haul routes will follow Lazy Z Road (CR 97E) to CR 97 to either SH 72 or SH 119 depending on the final destination. Except for the state highways, these roads are primarily two-track gravel or dirt roads. Prior to utilization, Denver Water will complete an evaluation of these roads to determine what improvements are needed. Since Lazy Z Road (CR 97 and FS 97.1) was used during the original construction of the dam to haul aggregate to the dam, Denver Water is assuming only minor improvements will be needed. Any improvements to roads will be approved by the necessary agencies.

Winiger Ridge is accessed from FS 359 and its subsidiary branches and Winiger Gulch from CR 97. Denver Water will improve the short and steep existing jeep trail that connects these two roads approximately 0.85 mile from the east end of CR 97. To avoid an archaeological site near the start of FS 359 and to shorten the route to the west, Denver Water will improve a connecting road for tree removal traffic for FS 359 and FS 97. FS 97 becomes Boulder County CR 97E (Lazy Z Road) to the west and connects to CR 132 (Magnolia Drive) before eventually connecting to SH 72 via CR 97. Another option is for traffic to continue on CR 132 (Magnolia Drive) to SH 119. Logging roads will need to be developed on the west side of the reservoir to access certain areas. Neither low-clearance nor high-capacity trailers will be used on these logging roads. The connecting road between FS 359 and FS 97 will be located based upon an engineering evaluation of the existing closed road and other possible interconnects in the area.

No haul traffic will be permitted to travel on SH 72 between Pinecliffe and Wondervu and will travel west to SH 119. In addition, Denver Water has committed to avoid Flagstaff Road, Crescent Park Drive (once the SH 72 and Gross Dam Road intersection improvements are complete), CR 68J (accessed from Magnolia Drive and Lakeshore Drive) for hauling materials. State Highway 72 from Pinecliffe to Wondervu is not passable for tractor trailers, which precludes using an eastern route on SH 72 to remove timber from Winiger Ridge. Also, FS 359 must be closed seasonally per the FERC Hydropower License and Denver Water accesses property through a private gate on CR 97E via an access easement. The preferred route is CR 97 to SH 72. Alternatively, if CR 97 proves too steep for use, haul traffic may be diverted further west on Magnolia Drive (CR 132) to SH 119. The Traffic Management Plan evaluates this possibility. Denver Water is also considering potential routes to a sawmill located in Longmont in the case this disposal option is viable.

Permits for overweight and oversized vehicles will be acquired from both Boulder County and CDOT. The Union Pacific Railroad bridge on SH 72 has a clearance of 14 feet, 6 inches, which may limit the transport of large equipment. Denver Water will identify routes to transport the necessary equipment to the GRE Project site given the restrictions in place along the route. Denver Water will provide information on the truck and trailer weights to be used in the Traffic Management Plan. Although a conventional WB-50 style truck could be used for improvements on the east area roads, Denver Water will consider transport vehicle configurations as development of the west side access roads are evaluated. Trucks will be under weight limits and within height restrictions for designated haul routes. Denver Water will assume a maximum weight of 20 tons per truck and maximum height of 14 feet 6 inches.

Onsite haul roads will be matched with specific transport equipment, and erosion controls will be provided for grading associated with haul roads. Access road management will include road maintenance during tree removal activities and erosion control that could include side drainage ditches, as appropriate. Upon the completion of tree removal activities, access roadways will be restored to their original condition or eliminated depending on USFS or Denver Water requirements. If required by USFS, improved National Forest System roads will be returned to the original state and vegetation restored upon completion of tree removal activities. Plans for restoration will be conducted in consultation with USFS.

2.3.4.2 Road and Intersection Improvements

Denver Water will continue coordinating with CDOT, Boulder County, Gilpin County, Jefferson County, and USFS regarding required road and intersection improvements.

Portions of FS 359 and CR 97E will need some improvement to bring in harvesting and support equipment and to transport biomass. The existing FS 359 averages from 10 to 12 feet in width and has grades up to 21%. CR 97E is generally wider and does not exceed 15% in grade. Planned improvements to these access roads include an average width of 12 to 14 feet but will depend on site conditions. The surfaces of these roads will be graded for drainage and compacted and additional gravel base will be added, as necessary. Horizontal curves on these roads will be improved to allow haul truck access. Approximately every half-mile of the roadway will be widened for a short section to 24 feet in width to allow two-way traffic to pass. Denver Water will ensure that line-of-sight associated with pull-outs is evaluated to meet safety requirements. Denver Water also plans to improve the short jeep trail shown as Winiger Spur — FS Road 359.1C on the haul route map in Appendix I. Conceptual plans are also included in Appendix I. Denver Water will evaluate intersections and roadways to ensure safe passage of vehicles associated with tree removal activities.

Denver Water will relocate portions of the existing Gross Dam Road in two locations near the planned saddle dam approximately 1 mile south of Gross Dam to support access to the relocated Osprey Point Quarry and Haul Road Recreation Area post-GRE Project. The relocated road will be composed of the same material and size as the existing road — a gravel surface and a disturbance area of approximately 30 to 50 feet wide by 500 feet long.

Access to the dam will be available using the existing Gross Dam access roads. However, minor road relocations will be necessary at the north and south dam (left and right) abutments because of future inundation. These two road segments will be abandoned and relocated: approximately 1,500 feet of the north (left) abutment access road will be relocated to the east at an elevation 100 feet higher than the existing access road, and approximately 1,500 feet of the south (right) abutment access road will be relocated south of the existing Gross Dam access roads. Both relocated road segments will be gravel surfaced and approximately 25 feet wide.

Denver Water will design Gross Dam Road for two-way tractor trailer hauling (which will require a 25 mile-per-hour speed limit and a turning radius adequate for semi-trailer trucks). Denver Water also will widen a few curves along Gross Dam Road. Denver Water does not plan to pave Gross Dam Road and plans to maintain Gross Dam Road during construction activities and restore the road base to preconstruction conditions. The Traffic Management Plan includes detailed drawings on planned road improvements.

In addition, Denver Water is planning for intersection improvements at SH 72 and Gross Dam Road. An Access Permit for SH 72 and Gross Dam Road for an improved intersection to increase sight distances will be needed. Boulder County must designate Denver Water as the County’s agent for the CDOT access permit application, and Denver Water has asked the Boulder County Transportation Department to make that designation as soon as possible so that Denver Water can move forward with intersection design and permitting.

Denver Water has met with CDOT and Boulder County to discuss the proposed intersection improvements. A preliminary assessment of the interchange has provided three alternatives. Of the alternatives, CDOT indicated a preference for a new intersection, and this improvement will be further evaluated through the design process with CDOT. Denver Water will acquire the necessary property once the design is finalized and the access permit has been submitted to CDOT.

Denver Water plans to transfer the non-CDOT roadway right-of-way at this intersection to Boulder County after the improvements have been made. Denver Water plans to transfer CDOT roadway right-of-way at this intersection to CDOT after improvements have been made. The target completion for the improvement is the fourth quarter of 2022.

2.3.4.3 Additional Improvements

Traffic studies are underway to determine whether additional improvements are needed. Intersections affected by tree removal activities will be studied including SH 72, CR 97, Magnolia Drive (CR 132), and SH 119. Any required environmental studies will be completed as needed. Logging roads in the National Forest System lands require USFS approval for construction and reclamation. Chip vans require suitable grades and curves between processing yards and connections to local access routes.

2.3.4.4 Truck Traffic

Transporting approximately 24,000 tons of chipped processed GRE Project debris from the inundation area will require approximately 1,200 semitrucks (20 tons each). Approximately 75 to 80% would be hauled west using CR 97E and approximately 20 to 25% would be hauled via Gross Dam Road. The exact percentage will not be available until Denver Water contracts the tree removal work in 2024 and the number of trucks could be reduced by onsite activities such as cord wood and the use of ACD. The hauling schedule will include the time required for removal and disposition to the landing sites. In addition, activities will take into account wildlife and wildfire seasonal constraints. Based on two to three trips per hour and 8-hour days, the hauling portion of the tree removal process is estimated to require approximately 50 to 75 work days spread over portions of two years. The actual duration of hauling will be determined after the contractor is selected.

As previously discussed, if Denver Water determines that ACD is viable, truck traffic associated with biomass disposal will be substantially reduced.

2.4 Minimizing Impacts

Denver Water has developed the following mitigations related to tree removal below.

2.4.1 Traffic

The contractor's Traffic Management Plan will be developed prior to construction activities and will include specific plans to manage truck traffic and detailed traffic control plans. Truck traffic associated with tree removal activities will likely follow the same guidelines as trucks for construction activities and is estimated to be two to three trucks per hour during an 8-hour work day. Traffic control plans will be consistent with available roadways and estimated traffic.

The contractor hired for tree removal will be required to limit haul truck traffic during school bus pick-up and drop-off times which may coincide with commuting hours. School bus schedules will be obtained from the school district(s) prior to tree removal activities. Denver Water and the contractor will develop a site security and safety plan for tree removal activities that will include limiting road and public access as needed and will limit travel speeds on logging roads during logging operations. These limitations may temporarily close portions of Gross Reservoir for camping and hiking access and could include the areas adjacent to tree removal activities. For example, Forsythe Canyon would likely need to be closed during tree removal activities as well as most of Winiger Ridge. For safety reasons, helicopters transporting material overhead of hikers will be avoided to the best possible extent. To the greatest extent possible, Denver Water will schedule closures to coincide with periods of low recreation use. Signage and perimeter controls will be used to prevent the public from entering work zones. Log removal traffic will be limited to daylight hours. Other periods of high use such as planned events and activities can also be incorporated into truck traffic associated with tree removal activities on a case-by-case basis. Denver Water will consider all request to limit traffic for planned events. The contractor's Traffic Management Plan will provide specific measures to ensure logging trucks are appropriately equipped with mufflers to minimize noise. Additionally, any locked gates will be controlled by on the ground personnel or through the use of keys for contractors working in the area. The contractor's Traffic Management Plan will require drivers to limit idling vehicles to the greatest extent possible.

2.4.2 Erosion and Effects to Water Quality

Denver Water's contractor will implement measures to control erosion, sedimentation, and fugitive dust during tree removal and disposal activities based on the Grading, Stormwater Permits, Access Permits, Section 404 Permit for the GRE Project, and the Fugitive Dust Control Plan required by Boulder County, CDPHE, and CDOT prior to tree removal activities. Denver Water or its contractor will acquire a State General Permit for Stormwater Discharges Associated with construction activities. As required under this permit, Denver Water will prepare a Stormwater Management Plan that will specify BMPs and inspection requirements to reduce pollutants in stormwater runoff from the construction sites. BMPs will be used to address erosion control, stockpiling of materials, dust control, revegetation, materials handling, and fuel containment. Prior to construction, Denver Water or its contractor will obtain and comply with the necessary CDPHE air quality permits, including developing a Fugitive Dust Control Plan. Denver Water anticipates that tree removal will also be incorporated into grading plan development and permit approval. Denver Water will follow USFS requirements on National Forest System lands and CDOT requirements on state highways.

Measures will be employed to minimize soil erosion and effects to water quality during tree removal and disposal activities. Dust suppression on gravel roads during hauling operations will include speed restrictions and application of water during high wind conditions. Denver Water will implement BMPs to prevent offsite sediment transport.

After tree removal, per Condition 10 (Use of Roads on National Forest System lands) and Condition 28 (Reclamation and Revegetation Seed Mixes and Mulch Materials) in the FERC Order, Denver Water will minimize impacts to roads on National Forest System lands through implementation of a new Road Management Plan. Denver Water will repurpose or revegetate and reclaim National Forest System lands outside the inundation area with seed mixtures and mulch materials approved by USFS according to Condition 28. Repurposed areas will be converted to parking areas or recreation facilities.

2.4.3 Lighting, Noise, and Odors

For safety, tree removal activities will cease during non-daylight hours. For this reason, nuisance nighttime lighting will not be produced related to tree removal activities. Logging trucks will be appropriately equipped with mufflers to minimize noise and speed limits will be enforced. In addition, obnoxious odors will be minimized to meet local requirements.

2.4.4 Hazardous Materials

Contractors will be required to provide a spill prevention plan and provide the necessary equipment for spills and containment onsite as a precautionary measure. Required monitoring of fueling and maintenance operations for safety and spill prevention will be documented in the spill prevention plan. If hazardous materials are to be stored on National Forest System lands, Denver Water will complete a Spill Prevention and Cleanup Plan for USFS approval prior to filing with FERC consistent with Condition 11.

2.4.5 Wildlife

Denver Water will follow requirements for protection of wildlife including avoidance of nesting sites and consideration of winter elk habitat. In addition, the duration of tree removal activities will be minimized to the extent practicable.

The 2019 Tree Removal Plan included consultation with USFS resource specialists to understand the wildlife considerations documented in the various environmental permitting documents and how they apply to tree removal. At the recommendation of USFS staff, wildlife timing restrictions for the adjacent Forsythe Fuels Reduction Project were reviewed (USFS 2016) and the Terrestrial Wildlife Specialist Report including the Biological Assessment and Evaluation for Forsythe II Project (Baker 2016). The wildlife report is relevant to the GRE Project and this Tree Removal Plan specifically because of overlapping species and habitats. A chart of the federally listed, USFS management indicator species, and sensitive species was compiled by USFS and this chart provides an overview of the wildlife species that may be affected by the implementation of the Tree Removal Plan in the tree removal area. Terrestrial species were evaluated by USFS staff biologists to determine whether the species or their habitat are present within the tree removal area. This evaluation identified 12 USFS sensitive species and eight USFS Management Indicator Species.

USFS Management Indicator Species and Sensitive Species that may be affected by implementation of the Tree Removal Plan are listed in Table 4. All sensitive plant areas potentially impacted by the Tree Removal Plan would be surveyed prior to GRE Project implementation as required by 4(e) Condition 22 — Special Status Plants Relocation Plan.

Table 4:
USFS Management Indicator and Sensitive Species

Management Indicator Species	Sensitive Species			
	Mammals	Birds	Amphibians	Insects
Elk, mule deer, golden-crowned kinglet, hairy woodpecker, mountain bluebird, pygmy nuthatch, warbling vireo, Wilson’s warbler, boreal toad	American marten, fringed myotis, hoary bat, Townsend’s big-eared bat	Bald eagle, flammulated owl, Lewis’ woodpecker, northern goshawk, olive-sided flycatcher	Boreal toad, northern leopard frog, wood frog	N/A

Source: USFS (2016)

The Final EIS prepared by the Corps indicated that the federally-designated threatened Preble’s meadow jumping mouse is not known or expected to be present at Gross Reservoir and would not be likely to be adversely affected by the proposed construction and reservoir expansion activities. In addition, the U.S. Fish and Wildlife Service reviewed potential effects to the Preble’s meadow jumping mouse and issued a Biological Opinion on December 6, 2013 that the GRE Project is “not likely to affect” the Preble’s meadow jumping mouse.

Timing restrictions for tree removal activities were based on this information, from wildlife reports by USFS staff specialists, and guidelines developed by biologists from CPW. Key periods for wildlife protection during tree removal activities are as follows:

- Flammulated owl nest sites: April 1 through August 30.
- Elk severe winter range: December 1 through March 30.
- All raptor nest buffers: March 1 through September 15.
- Migratory Bird Treaty Act: March 1 through July 31.

These restrictions, although limited in duration, potentially restrict tree removal activities. Denver Water will continue consultation with CPW and USFS to minimize impacts to raptors and identify appropriate tree removal timeframes.

During implementation of the Tree Removal Plan, Denver Water will work with USFS and CPW to develop measures to minimize potential impacts to raptors and songbirds during helicopter yarding operations that occur during the raptor- and bird-related wildlife protection seasons. Further, Denver Water will work with these agencies to minimize potential impacts to elk during the winter.

2.5 Managing Waterborne Wood Debris

Naturally occurring woody debris that cannot be removed during the tree removal activities will remain in Gross Reservoir as the reservoir fills. Most of this material will be existing, naturally occurring, litter and woody material smaller than 2 inches in diameter. This material will eventually float down the reservoir to the dam site. At other dam sites, this material is prevented from entering the dam by using booms to capture the floating material. Once the reservoir is operational, Denver Water will incorporate debris management as an element of reservoir operations.

2.6 Restoration and Rehabilitation

Most of the area disturbed for tree removal activities will be inundated. Any roads below the new reservoir high water level will be stabilized for bank stability and any new roads or staging areas above the high-water level will be reclaimed. Tree removal, skidding, biomass grinding, chipping, and/or biochar operations will take place on Denver Water-owned and National Forest System lands. When these operations take place above the new pool elevation of 7,406 feet, Denver Water will rehabilitate roads and other operational areas not desirable for future management. Denver Water-owned lands around the reservoir are managed in accordance with the 2016 Forest Management Plan (CSFS 2016). National Forest System lands around Gross Reservoir are managed in accordance with the USFS Arapaho-Roosevelt National Forests Land and Resource Management Plan.

Post-construction restoration of the cleared area above the inundation line will include revegetation with a mix of native grasses, forbs, and shrub species with the exception of new roads and parking areas. Denver Water will work closely with USFS to ensure forest clearing and revegetation is consistent with USFS standards as described in FERC Order 4e condition 28. Per the FERC Order 4e condition 22, Denver Water will develop a Special Status Plants Relocation Plan for addressing impacts to special status plants on National Forest System lands. The plan will detail how USFS special status plant species found on National Forest System lands within the new inundation area and new areas to be disturbed for the relocated recreation facilities will be collected and transplanted.

The cleared area above the inundation area will be revegetated in the first appropriate season following timber removal, while revegetation of other construction areas will mostly occur at the end of construction. New roads and parking areas will not require revegetation. Within the inundation area there could be a gap of several years between timber removal and inundation. Initially, plant communities resulting from revegetation efforts will be relatively sparse, primarily consisting of grasses, forbs, and shrubs, similar to what is found in an early successional plant community. As the revegetated sites mature, they will begin to look more similar to adjacent plant communities.

3. Tree Removal Schedule

GRE Project construction will include the following activities: mobilization, site development (access roads, staging areas, quarry development, and clearing and grubbing), onsite quarry, onsite aggregate production, dam foundation excavation, grouting (curtain/blanket), dam foundation treatment, roller compacted concrete mixing, dam concrete placement (main dam, thrust blocks, and saddle dam), drain holes (dam/foundation), saddle dam completion, slope protection, reservoir clearing (tree removal), site restoration, and demobilization. Construction, including offsite and ancillary improvements to support the dam construction, will be completed over a 6-year period that includes safety improvements to area access roads and the intersection at SH 72 and Gross Dam Road. A preliminary construction schedule is provided in Table 5. The final schedule for tree removal will consider, among other items, key winter range timing for elk (December 1 through March 30) and raptor nesting season (April 1 through July 31).

As discussed above, tree clearing and removal activities will occur in two phases, an Initial Phase, when the site is being prepared for mobilization and the trees are cleared, and an Inundation Area Phase, when the trees are removed toward the end of construction activities. The Initial Phase is planned for 2022 and 2023, Years 1 and 2 in Table 5, and will involve removing trees near the quarry office and maintenance facilities, crane pads, batch plant, roads, and other areas needed for construction activities. Denver Water will contract the work for the reservoir tree clearing in 2024, Year 3 in Table 5. The majority of the trees will be removed in the Inundation Area Phase, which is planned for 2025 to 2026, Years 4 and 5 in Table 5. During the Inundation Area Phase, tree clearing on the west side of the reservoir is planned for 2025, whereby approximately 75% of the project's timber will be removed. Tree clearing on the east side of the reservoir is planned for 2026, whereby approximately 25% of the project's timber will be removed.

Table 5:
Anticipated GRE Project Timeline

Activity/Year	2022	2023	2024	2025	2026	2027	2028
Site Mobilization							
Dam surface preparation, Materials Lab, early site grading for temporary facilities							
Public access to South Shore closed (North Shore open throughout construction)							
Install temporary recreation facilities, public road improvements, site development							
Quarrying operations							
Dam foundation excavation, grouting, plant setup							
Dam raise activities — materials trucking							
Initial Phase (tree removal and clearing)							
Inundation Area Phase (forestry activities/tree clearing)							
First fill							

Note: Presently, Denver Water anticipates Year 1 to begin in 2022.

The following sequential steps are anticipated during tree removal:

1. Site preparation occurs prior to tree removal activities and involves establishing infrastructure for roads, landings, and skid trails. Site preparation is anticipated to be completed 3 months in advance of tree removal operations.
2. Tree removal starts by bringing wood and biomass to the ground with timber felling or feller bunchers. This step is completed to start the drying process ahead of skidding and yarding and to reduce weights for the benefit of helicopter yarding. Tree felling is anticipated to take approximately 3 months. Skidding, yarding, and helicopter yarding is anticipated to take approximately 5 months and can be performed simultaneously on all four landings.
3. Timber processing will be scheduled to complement the yarding process. As logs and biomass are delivered to the landing sites, they will be processed by chipping or grinding or placed into an ACD unit. Depending on utilization decisions, material also could be processed into biochar or used for local firewood consumption. Timber processing is anticipated to take approximately 5 months.
4. Transportation removes GRE Project biomass by chip truck and trailers and dump trucks over the GRE Project road systems and could be conducted simultaneously on all four

landings. Onsite disposal with ACD, if feasible, would reduce vehicle traffic. Transportation is anticipated to occur simultaneously with timber processing during the same 5-month period.

5. Restoration of temporary roads and disturbed sites above elevation 7,406 feet will occur following timber removal operations, lasting approximately 5 months.

4. Conclusion

This Tree Removal Plan describes Denver Water's plan for conducting tree removal activities for the GRE Project and meets the associated FERC Order requirements. As is typical with tree removal work, the specific tree removal and disposal methods will be finalized following selection of the construction contractor and based on market conditions. In addition, Denver Water will follow requirements in the Corps 404 Permit, the FERC-approved Traffic Management Plan, and other appropriate authorities.

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Appendix A:
Stakeholder Coordination and Review

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Agency Coordination and Review

August 5, 2019, Tree Removal Plan Stakeholder Meeting #1 Meeting Minutes

September 30, 2019, Comment Response Matrix on 2019 Tree Removal Plan

October 1, 2019, PowerPoint presentation—Tree Removal Plan

October 1, 2019, Tree Removal Plan Stakeholder Meeting #2 Meeting Minutes

February 10, 2021, PowerPoint presentation—Tree Removal

February 10, 2021, Tree Removal Plan Stakeholder Meeting Agenda and Meeting Minutes

Union Pacific Railroad Coordination

November 2017 PowerPoint Presentation—Commodities by Rail Study

November 1, 2017, UPRR Commodity Delivery Meeting Minutes

April 26, 2018, Concept Rail To Truck Terminal System for Cementitious Materials Located At Union Pacific Railroad's Crescent Siding; Report prepared by Penta Engineering for Denver Water and Boulder County

September 19, 2018, UPRR Crescent Siding Field Meeting Minutes

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August 5, 2019, Tree Removal Plan Stakeholder Meeting #1 Meeting Minutes

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Meeting Notes - Final

Date:	August 5, 2019
Start Time:	1:00 pm / MST
End Time:	4:00 pm / MST
Project:	Gross Reservoir Expansion Project – Tree Removal Plan Stakeholder Meeting #1
Location:	USFS Boulder Ranger District Office, 2140 Yarmouth Ave, Boulder CO 80301
Conf. Call-In Number:	(888) 844-9904, access code: 9066578#
Participants Expected:	Boulder County – Scott Golden, Stefan Reinold Colorado Parks and Wildlife – Kristin Cannon Colorado State Forest Service – Allen Owen Dahl Environmental Services – Bjorn Dahl, Lyle Laverty Denver Water – Paula Daukas, Douglas Raitt, Jessica Alexander, Travis Bray Jefferson County – Steve Durian (by phone) Jefferson Conservation District – Garrett Stephens Tetra Tech – Mike Koester, Perry Patton, Stephanie Phippen, Cheryl Simpson U.S. Forest Service – Kevin Zimlinghaus, Angela Gee, Mike Johnson, Greg Smith

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I. Introduction and Meeting Purpose – Denver Water

Introductions were made from each member of the group.

II. Tree Removal Plan Presentation – Dahl Environmental Services/Tetra Tech - Bjorn Dahl and Lyle Laverty

a. *Background & Project Objectives*

- Started work in January 2019.
- Inventory assessment - Built on history of what was done from the previous study in 2005/2008. Current estimate is 415 acres of inundation area (approximately 208,000 trees), which is the scope of this draft plan.
- Objective was to evaluate, develop, identify and recommend a path forward.

b. *Planning Approach / Outreach*

- Dahl Environmental Services (DES) reached out to a wide range of business, logging and other industry and agency professionals to obtain and review information on existing recycling technologies (chips, pellets, biochar), applications and constraints, as well as information from helicopter companies from the pacific northwest.
- Reviewed *LogCost* model from history of inventory/stand analyses and validated cruise data.
- Analyzed cultural and wildlife constraints.

c. *Biomass Inventory / Biomass Volume / Slope Analysis*

- Built on available data, in some cases only 1 plot per stand, extrapolated to volume estimates for tonnage to be removed.

- 415 acres inundation area; 24,000 tons of biomass (reduced from 50,000 tons from previous LSA report (2008)).
- The previous estimate of 50,000 tons of biomass was high. A more representative weight of 65 lbs/ cubic foot was used to calculate the new biomass estimate of 24,000 tons. Slope analysis: harvesting recommendations were developed based on delineating slopes less than 40% (conventional) vs. slopes greater than 40% (helicopter). High-lead cable, skyline logging technology and helicopter yarding systems were all considered as harvest alternatives.

d. *Harvesting Analysis (Alternatives 1 – 4)*

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- See attached PowerPoint for a description of the alternatives considered.

e. *Access and Transportation Assessment –* Perry Patton, Tetra Tech

- Objective for the road improvements was to decrease the grades, follow existing path, limit road grades to 15% maximum, and avoid pre-historic archeological site.
- For Alternatives 1 and 2, access is from west side of site via FS 359 and Lazy Z Road/ FS 97. Alternative 3 included access from Gross Dam Road (east side) which splits traffic with the west side.
- Alternative 3 has the advantage that it splits traffic in both directions to reduce the impact to residents on the west side.
- Traffic from the east or west side would end up on CO 72. However, no truck traffic can go through Pinecliffe due to switchbacks on CO 72 near Pinecliffe.
- Draft plan proposes improvements to a connector road between Winiger Ridge (FS 359) and Lazy Z/FS 97. Improvements would decrease grade to 15% max to reduce steepness. Connector road would avoid the pre-historic archeological site near the intersection of Winiger Ridge (359) and Magnolia Drive (CR 132).
- Note that using the existing FS 359 (beyond the location of the proposed connector road) would require significant road reconstruction and would impact the archeological site.

f. *Wildlife Constraints*

- This is the elk winter range, as well as the Flammulated owl habitat.
- There is potential for limited operating period on Winiger Ridge Road due to wildlife constraints – at this point unknown. Area would be regulated by the Migratory Bird Treaty Act (MBTA).

g. *Disposal Methods and Options*

- Forsythe II project was discussed. The U.S. Forest Service has made adjustments to its project based on the anticipated tree removal associated with the Gross Reservoir Expansion.

h. Recommended Alternative for Biomass Removal and Disposal – Alternative 3

- Chips (gypsum and Kremmling payments for biomass will offset haul costs), air curtain (reduces biomass to be transported off site), wood chip disposal at Foothills Landfill for $23/ton (Highway 93/72).
- Mastication was not reviewed because that method keeps the material in the reservoir (will not remove it).
- Price does not include removal of material in reservoir.
- Biochar option – there is a large up-front investment that substantial increases biomass disposal cost. Biochar requires significant investment in infrastructure and is not mobile. Requires a large capital investment for processing equipment and is not economically feasible. Dusty and slow process. Would require an off-site production location (Nederland?). Biochar production would require an extra $3.5M in disposal cost.
- Air curtain destructor - $4.2 – $4.3M – could eliminate 900 truckloads of chip and traffic. Good flexibility and operating schedule.
- Due to wildlife, the windows for operation would be fall/winter/spring and then the following fall from staging through restoration. Pilot study planned to confirm production rate.
- Chips - $4.2M.
- Could do both air curtain and chips as option.

i. Decision Criteria and Selection of Alternative 3

- Potential to reduce environmental impacts, social impacts, reduce noise (less helicopter transport), split traffic between the east and west side, reduce emissions and wildlife.
- Environmentally responsible.
- Most helicopter landing options which increases flexibility during operations if something happens at one of the landing areas.
- Least impact to roads.
- Cost effective tree removal options – *LogCost* analysis (cheapest option as it reduces the amount of helicopter trips).
- Haul product off site as the recommended preferred method of tree removal.
- Alternative energy option for disposal at all landing areas – biofuels, chipping, firewood.
- Avoids the archaeological site.
- Minimizes traffic on west site (20% reduction).
- Greatest operating flexibility.
- Greatest disposal flexibility.
- Greatest wildlife limited operating period flexibility.
- Least expensive - most cost effective.

j. *Project Comparison between the 2008 tree removal plan vs. 2019 preferred alternative #3 -* Jessica Alexander, Denver Water

- Original plan showed 50,000 biomass to be removed; currently only 24,000 tons to be removed.
- Proposed Alternative 3 is smaller in scope (less acreage) than the 2008 plan; current estimates include a lesser density of trees onsite (less biomass).
- Schedule is approx. the same time (8 months from start to finish for staging, loading, and 5-month operating season) - may be interrupted with wildlife, weather, equipment
- Unknown factor in schedule – Flammulated owl.
- 1 helicopter landing included in 2008 plan vs. 4 helicopter landings included in 2019 plan.
- 2008 LSA traffic study detailed 27,000 tons of material would need to be hauled offsite (25,000 tons of biomass; 2,000 tons of ash from the air curtain destructors). Presently, this has been reduced to 24,000 tons total, including various options to remove biomass from site to reduce the number of truck trips.
- In summary - the overall gross tonnage of biomass has been refined from the 2008 plan to this 2019 draft plan. The scope of impacts anticipated for Alternative 3 of the 2019 draft plan are less than those impacts analyzed for tree removal under the 2008 plan and NEPA analysis presented in the Final Environmental Impact Statement for the project.

III. Use of Forest Service Roads during Tree Removal – Denver Water, Tetra Tech

a. *Roads Affected*

- Project will involve Forest Service 359, Winiger Ridge, and County Road 97 improvements.
- Improvements to the road will maintain a 12-foot minimum lane, restrict grades. Improvements will involve a minor amount of grading and addition of gravel surface for truck use. May include widening some curves.
- Will estimate how much clearing will need to be done on the side of the road to accommodate a 12-foot lane.
- Keep grades 12% or less, as possible.
- Improvements to roads could be left in place to allow better access for law enforcement, emergency personnel, and USFS while excluding the public by installing gates.
- Final plan from Tetra Tech will include more detail to proposed road improvements, which roads will be improved, de-improved (post project), road details required. The estimate does not include any road costs (same as the 2008 plan). Tetra Tech will issue final plan with specifics, stakeholder outreach feedback, use of closures, all depending on which Alternative is selected.

IV. Coordination with Forsythe II Project – Dahl Environmental Services/Tetra Tech

Forest Services made some adjustments based on comments above.

V. Project Schedule – Denver Water

a. Draft Tree Removal Plan distributed to Stakeholders 8/5/2019.

b. Stakeholders comments are due to Denver Water by 8/26/2019. Please provide comments in letter format and submit to Travis Bray via email (travis.bray@denverwater.org).

c. Stakeholder Meeting #2 & Final Tree Removal Plan - Follow-up meeting to occur October 1, 2019

VI. Conclusion and Questions – Denver Water

Discussion Topics After Tree Removal Presentation –

Update: It was noted by Boulder County representatives that the air curtain destructor/burner operating capacity was only 4 tons /hour from local experience; not 10 tons/hour per vendor information. Denver Water plans to verify the operating capacity on site prior to full scale production.

Q. **Did Dahl look at 2016 Forest Management Plan for Gross Reservoir that was reviewed by CSFS?**

A. DES did use both the 2005 and 2016 reports for the revised TRP. The 2005 was used as the basis of the check cruise plots. Some of the 2016 CSFS plots were used by Drs Sheppard and Mackes to evaluate the inventory analysis. DES utilized the 2016 plots that fell near or within the inundation pool.

DES did not use any of the Forsythe II information. The Forsythe did not have specific cruise information. Dahl used the Colorado Wildfire Risk Assessment to analyze what is already dead on the ground in TRP identifying the two general stand types - ponderosa and mixed conifer stands.

Q. **Do the helicopter contractors complete job without interruption from firefighting?**

A. Contractors that DES contracted are not interested in wildfire contracting; however, moving forward Denver Water must stipulate in the future tree removal contract that they cannot be interrupted for that service. There is a helicopter contractor in Jefferson County who will do the entire job.

Q**. If Alternative #3 is chosen path, how did Dahl identify landing area 3 on the map?**

A. DES went out to the site to investigate – it is located on Denver Water land adjacent to Miramonte. It had been used in past as a timber harvest landing zone for thinning.

Q. **Won’t tree removal happen after the quarrying?**

A. Tree removal will happen after quarrying. Estimated end date of project construction is December 31, 2025.

Denver Water would like the tree removal to be completed prior to that date, and so will likely start one season prior. This would help so that we do not cross paths with traffic from quarrying operations. Time line to fill the reservoir - will not fill in one season, would likely take multiple years. Diversions into the reservoir won’t fill to the capacity immediately.

Q. **How much will the reservoir be drawn down?**
A. Elevation 7,282 down to approximately 7,250 feet during dam construction, which is within the normal operating range. Denver Water will likely not fill reservoir to elevation 7282 in 2021 based on the current construction schedule.

Q. **Would a better alternative to be to use Coal Creek Canyon? Commissioners, impacts to school buses, hours of operations to avoid peak hours for population who lives there?**
A. Denver Water plans to manage truck traffic to miss school bus windows during school and major commuter times. Denver Water is currently exploring a possible staging area by the intersection of CO 72 and Highway 93.

Q. **Wouldn't some of this road cost improvement occur prior to the construction of the dam?**
A. Yes –east side road improvements will be happening as a result of the dam expansion, in advance of the tree removal. Alternative #4 is the only alternative with the east side only exit. Alternative #3 has some of the material being removed via the east side.

Draft plan would develop existing access routes to the Winiger Road area, including restoration of any road widenings per Forest Service standards post-project. Law enforcement has indicated that they would like better access. Denver Water asked Forest Service to consider whether they would like to see options for improving access for Forest Service/law enforcement in the future post-project. This will affect the un-improvement part at the end of the project. USFS stated that the roads would need to be "de-improved" post project.

Q. **Does plan include rocking some of the road to help the chip van's egress**?
A. Yes, some sections of road would need rock in some areas.

Q. **Schedule – final FERC?**
A. FERC order still pending and the Final Tree Removal Plan may not be completed until 2021.

Q. **Are flammulated owls still a concern?**
A. Yes, the Forest Service is still finding call backs (no nests located). On Lazy Z there have been some reports of nests (this area is considered a territory) but it is difficult to identify the actual nest sites.

Q. **What would that mean for LOP (Limited Operating Period)?**
A. Forest Service would designate LOP's in place for the Lazy Z area . The Forest Service is now implementing Forsythe II in that area. Forest Service will continue doing owl surveys in that vicinity. LOP's could significantly impact tree removal activities.

The following action items were discussed.

Action Items

Item	Responsible Person	Completion Date
Comments back from attendees – focus on Alternative #3 but review all alternatives, include: – Give suggestions for removal (biochar cost, burn, removal, landfill) – Project schedule comments – Submit in bulleted letter format to Travis Bray at travis.bray@denverwater.org – Call Travis/Jessica with questions to help with review	All	8/26/19
Set up next stakeholder meeting- end of Sept./early Oct. – Date: Tuesday October 1, 2019 – at 1:00 pm – Location: USFS Boulder Ranger District Office,2140 Yarmouth Avenue, Boulder, CO 80301 – Agency Meeting Invite to all attendees	Jessica	10/1/2019

September 30, 2019, Comment Response Matrix on 2019 Tree Removal Plan

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Comment Number	Entity Commenting	Comment	Tetra Tech	Location in Final Tree Removal Plan
1	Jefferson County Kate Newman	We encourage truck traffic restrictions that would prohibit truck traffic during commute times and school bus pick up/drop off times.	This will be incorporated into the Final Tree Removal Plan as a restriction for trucking traffic.	Section 2.6. Page 2-32
2	Jefferson County Kate Newman	Additionally, we encourage Denver Water to work with the US Forest Services and Colorado Parks and Wildlife to develop specific measures to avoid, minimize, or mitigate potential impacts to (a) raptors and songbirds given that helicopter yarding will occur throughout the wildlife protection season, and (b) elk given that the project falls within severe winter range that work will occur during the winter.	During the operating plan timeframe Denver Water will work with the US Forest Services and Colorado Parks and Wildlife to develop specific measures to avoid, minimize, or mitigate potential impacts to raptors and songbirds during helicopter yarding operations that will occur throughout the wildlife protection season. Further, will mitigate and manage to protect elk within severe winter range that may occur during the winter.	Section 1.3.4. Page 1-5
3	Colorado State Forest Service Allen Owen	1. Landing #2, off of FS97, according to the topo map, appears to be located in a narrow draw. Appears to be very difficult topography to operate in. Was this landing zone ground truthed for helicopter operational feasibility?	Landing 2 was ground verified and selected to utilize a location which is about 2.0 Acres in a flat valley bottom at the end of Winger Gulch on FS 97. See attached topo map. This Heli-landing site will be within the inundation area. The landing site be pre-logged using tractor-cable yarding and site graded to prepare the landing site for helicopter activity.	Section 2.5.2. Page 2-20
4	Colorado State Forest Service Allen Owen	3. I would suggest including an additional map to the plan, showing property ownership boundaries, particularly as it applies to #2 above.	Acknowledged, this map will be incorporated into the Final TRP.	Section 8.1. Page 8-12
5	Colorado State Forest Service Allen Owen	4. Project cost are documented, however one must assume these are 2019 cost. By the time contracts are awarded, these costs will certainly increase in all phases of the operation. I was surprised that a “range” of cost were not provided, i.e., +/- 10, 20%?	All costs in the TRP are based on 2019 with no economic projections for future price increases. Projections of future economic events and inflation will have to be determined at the time of RFP implementation adjusted and based on inflation experience.	Section 2.5.5. Page 2-29
6	Colorado State Forest Service Allen Owen	1. Air Curtain Destructor burn rates seemed overly optimistic (10-12 tons per hour). The cost of the destructors (if purchased or rented/leased by DWB) were either not included (separately) or built into the overall cost of operation. $216,000 just include the operations/ personnel and maintenance, associated equipment to move and feed burners?	Personal communication with Air Burners North American Sale representative confirmed the S-330 Air Burner production rates of 10 to 12 tons per hour are appropriate (m.schmitt 9.11.19). Boulder County has an S-220 what has a production capacity of 7 ton per hour, a production rate approximately 30 percent less than the S-330. Cost estimates in Table 16	No text change made.

Comment Number	Entity Commenting	Comment	Tetra Tech	Location in Final Tree Removal Plan
			include equipment rental rates and operating costs.	
7	Jefferson Conservation DistrictGarrett Stephens	This will probably be explored for all routes, but does CDOT, BoCo or JeffCo have any big road construction plans during this tree removal project? I would have thought 2013 flood response road construction would be done by now, but this summer, they started new projects on 72 where they closed one lane. Obviously a lot of traffic delays.	Denver Water will continue to coordinate with CDOT, Boulder County, and Jefferson County through planning and implementation of the TRP. As Denver Water develops the more detailed Transportation Plan, other road-related projects will be identified and potential overlap with this project will be considered. Note that CDOT plans several road projects in Boulder and Jefferson counties over the next several years. Repairs to CO-72 Coal Creek Canyon and CO-119 Boulder Canyon are forecast to be completed by the end of 2020. DRCOG's 2040 Fiscally Constrained Regional Transportation Plan addresses growth and other challenges in the region, and implementation of projects to address these concerns are likely to occur beyond the implementation schedule of the TRP. Jeffco's Countywide Transportation Plan 2014 Addendum identifies ongoing work along I-70 and CO-93, and traffic is expected to continue on both highways. Boulder County's Transportation Master Plan 2019 Draft Update also identifies improvements to CO-93, and minimal traffic disruptions are anticipated.	No text change made.
8	Jefferson Conservation District Garrett Stephens	If material goes down 72, would it also wind up heading up i70 for Gypsum or Walden? That adds a lot of miles. Would it be more efficient to do without landing 3 in the interest of saving hauling distances? (I haven't done the math, so I could be wrong)	Eliminating landing 3 would increase total harvesting and removal costs by approximately $212,000. Alternative three, utilizing 4 landings, removes project debris utilizing both FSR 97 and the Gross Dam Road. Approximately 20 percent of the volume would be removed vis the Gross Dam Road, Highways 72, 93 and I-70. The remaining 80 percent of the volume would be removed on the west side utilizing FSR 97. The transportation costs to remove debris for Alternative 3 are $253,750, displayed in Table 16. Combined harvesting costs and transportation for Alternative 3 total $4,300,618. Eliminating landing 3 is essentially the harvest plan analyzed in Alternative 2. The debris transportation costs for Alternative 2 are	No text change made.

Comment Number	Entity Commenting	Comment	Tetra Tech	Location in Final Tree Removal Plan
			$144,000. Combined harvesting costs and debris transportation costs for Alternative 2 total $4,512,993. The increased harvesting costs for Alternative2, displayed in Table 16, are attributed to the increased helicopter yarding distances. Alternative 3 with landing 3 reduces helicopter yarding distances, resulting in a net savings of $212,375, offsetting the increased transportation costs.	
9	Jefferson Conservation District Garrett Stephens	Sweetman Enterprises - They are JCK Corporation, that has King Soopers/Loaf n Jug retail firewood bundle contract. Maybe other contracts too. Basically, they use a lot of firewood, and could be a good source of whole log disposal. - Possible cost recovery? They do pay for logs, but not sure how much. Seems like at a minimum they could pay for the cost of hauling.	In recent conversations with JCK Corporation their main interest is procuring dead dry wood for cordwood production. They will not pay for dead or green wood. JCK maybe be interested in receiving green wood to a storage area on Denver Water lands for year-long processing to cure green wood.	Section 3.1.5. Page 3.2
10	Jefferson Conservation DistrictGarrett Stephens	JCK Located in Henderson, CO (Denver metro area), so short hauls relative to taking material to Gypsum	Since 90% of the wood from the TRP is not dry cured wood, JCK will not procure green wood to their Henderson facility; therefore, this is not a viable alternative.	Section 3.1.5. Page 3.2
11	Jefferson Conservation District Garrett Stephens	Air Curtain Destructor (ACD) Adds cost and adds time for disposal.	See Table 16. Estimated costs in Alternative 3 indicate ACD costs to dispose of project debris are approximately $38,000 less than grinding and trucking chips (Table 16). Based on production capacity of 100 tons per day, disposing of debris utilizing ACDs would require approximately 240 burners days. Utilizing three burners, disposal with take approximately 80 days.	No text change made.
12	Jefferson Conservation District Garrett Stephens	ACD Possibly expands landing footprint and adds equipment requirements, if you want to burn simultaneously while other processing and grinding operations are under way.	Use of ACDs could add some additional equipment on the landing, however if the decision is to utilize ACDs, the grinder would not be in the landing footprint. The landings appear to be of adequate size to support ACD operations.	No text change made.
13	Jefferson Conservation District Garrett Stephens	Sorting out logs for hauling, instead of just whole grinding trees, requires more time and equipment. That said, is landing 4 really necessary if all it can handle is short logs? I may	Landing 4 would use an existing 14-foot-wide Denver Water gravel road that is fully serviceable for large equipment, i.e., ACD. Other than firewood, the tree material will be	No text change made.

Comment Number	Entity Commenting	Comment	Tetra Tech	Location in Final Tree Removal Plan
		be mistaken, but I recall that chip vans cannot make it to landing 4, and all you could haul out of there short trucks with firewood. How would slash be disposed of at landing 4, if only short logs can go out? Smaller roll-off trucks could take chips, but guessing it might also be tough to get a grinder/loader or curtain burner in there too.	ground and disposed of on-site (ACD) or hauled to an off-site disposal facility.	
14	Boulder County Conrad Lattes	- the Plan shows that CR 97 and 97E are under USFS jurisdiction but they are Boulder County roads – no improvements can be made to these roads without the county's consent	Acknowledged, this requirement to seek Boulder County approval will be placed in the RFP, as appropriate, for the future Contractor's directions.	Section 2.6. Page 2-31
15	Boulder County Conrad Lattes	- our experience has been that twice the estimated time will be required to burn recently cut wood in air curtain burners	See question 6 response. ACDs are currently being shipped for use by USACE to dispose of river debris. Additionally, ACDs have been used by BC Hydro to dispose of river debris. If planned harvesting operations proceed as outlined in the project schedule (Figure 9), there could be some reduction in moisture content before material is yarded to the landing for disposal. The planned demonstration project to dispose of quarry debris will provide an indicator of ACD production capability with Gross material and debris.	No text change made.
16	Boulder County Conrad Lattes	- there is insufficient discussion of the need for additional access roads for cable yarding and insufficient discussion of the volumes of anticipated traffic on each potential haul road	Approximately 20 percent of the volume will be removed utilizing the Gross Dam Road and Highway 72. The remaining 80 percent of the volume would be removed via FSR 97. Any temporary access roads to support harvesting activities would be constructed in the inundation area. The volume of traffic will be dependent on the future Contractor's method chosen for tree removal and will be described in his Transportation Management Plan to be submitted with his proposal or prior to the start of work.	No text change made.
17	USFS	In section 2.6 Access and Road Management, the plan is to come out from landings in part through Lazy Z to Magnolia Road. The plan should include that haul traffic would follow	Acknowledged, Section 2.6 will be revised to include this language for traffic and designated haul routes on the west side of the site. The impacts would be different depending on the	Section 2.6. Page 2-31

Comment Number	Entity Commenting	Comment	Tetra Tech	Location in Final Tree Removal Plan
		County Road 97 down to Highway 72. We are concerned about whether or not County Road 97 can handle the truck traffic down to Highway 72. If not the haul would continue down Magnolia Road to Highway 119, Peak to Peak. This will have different impacts to county roads as compared to state roads. This should be further considered in developing the final tree removal plan.	route taken with the preferred route being Lazy Z/County Road 97/Highway 72 west as indicated on Figure 8. Impacts to these roads will also depend on the method of tree removal/disposal option chosen by the future Contractor.	
18	USFS	In Figure 8, where the new access road is proposed is not well represented because as it is currently depicted. It follows an old existing, steep road that has been closed. The actual proposed location should match the appropriate maps in Section 8, Maps and Supplemental Data and Information.	Figure 8, in Section 2.6, will be updated to indicate the new access road which will replace the existing one. In addition, conceptual roadway drawings will be provided in the Final TRP to indicate the plan and profile of this new connector road.	Section 2.6., Figure 8, Page 2-32; Section 8.1. Page 8-11; and Attachment 1

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October 1, 2019, PowerPoint presentation—Tree Removal Plan

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Denver Water

October 1, 2019

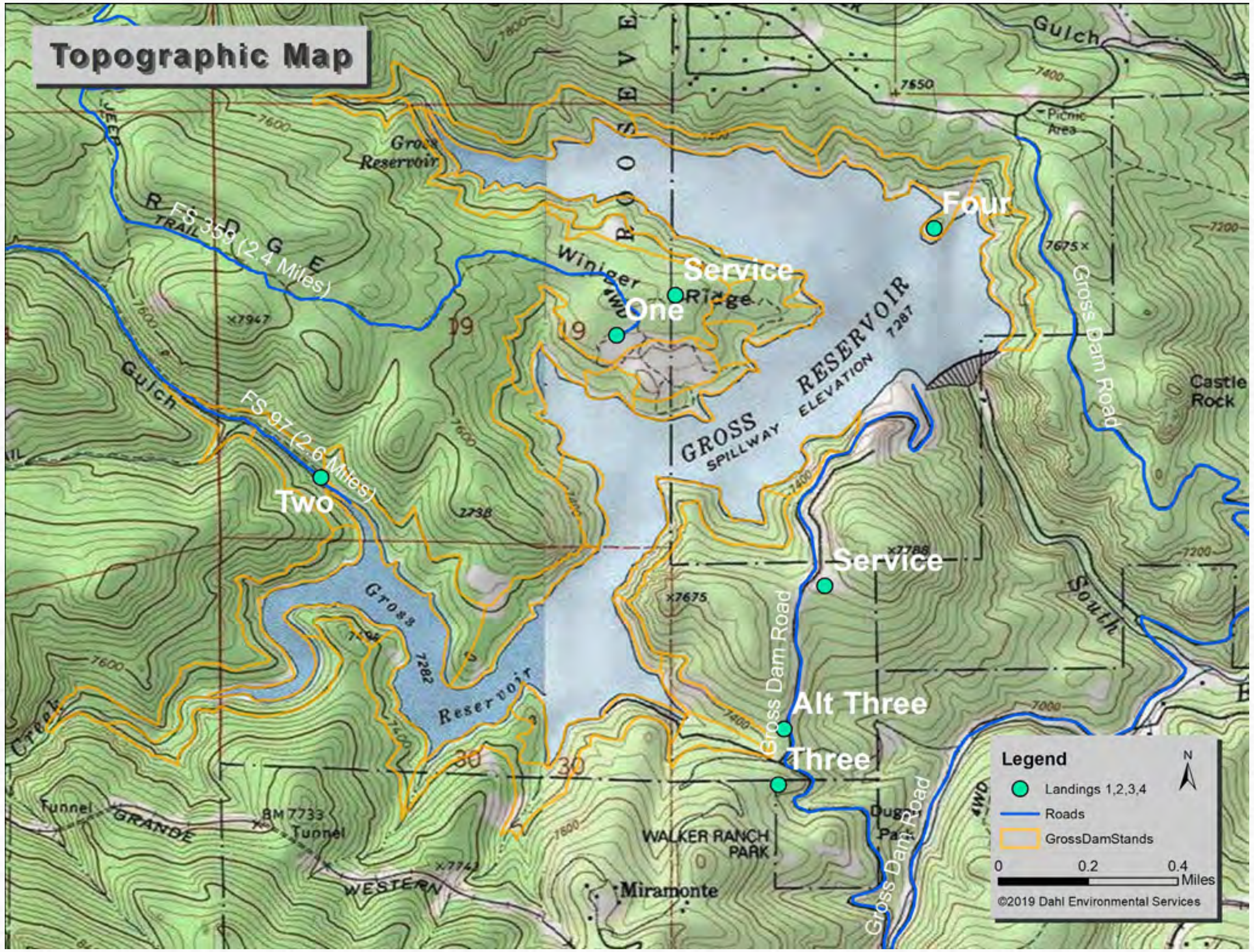
Gross Reservoir Expansion – Tree Removal Plan

Tree Removal Plan Highlights

- Acres to be treated: **415**
- Approximately **640,000 cubic feet** of woody debris
- Approximately **24,000 tons** of debris
- Approximately **208,000 trees**

General Disposal Methods

- Chips
- Air Curtain Destructor
- Biochar
- Foothills Landfill



Harvesting Alternatives

Alternative One

- One Landing – Winiger Ridge

Alternative Two

- Two Landings – Winiger Ridge, Winiger Gulch

Alternative Three

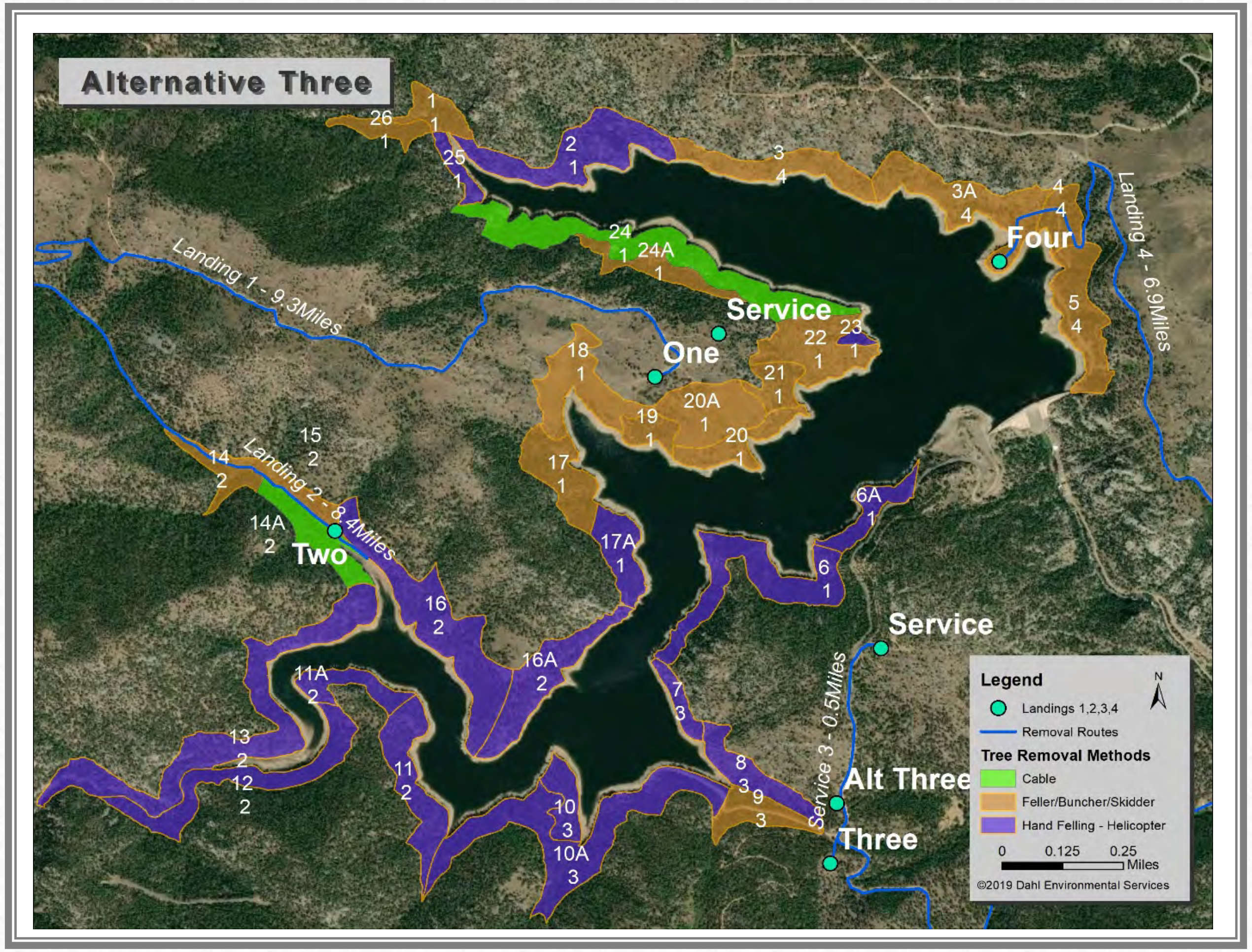
- Four Landings – Winiger Ridge, Winiger Gulch, North Shore and Osprey Point
- Alt Three – Overflow Landing Site

Alternative Four

- One Landing – Osprey Point

Service Landing

- Helicopter fueling and maintenance site



Alternative Three

Four Landings:

- Utilizes helicopter, cable, and skidder operations
- Lowest harvest costs
- Places disposal traffic on Gross Dam Road and west side
- Maximum disposal opportunities
- Reduces helicopter harvesting trip lengths
- Alt Three Landing – overflow landing

Service Landing:

- Helicopter fueling and maintenance site

Alternative Three

Maximize utilization

Minimize project disposal traffic (west side)

Most cost-effective harvesting option

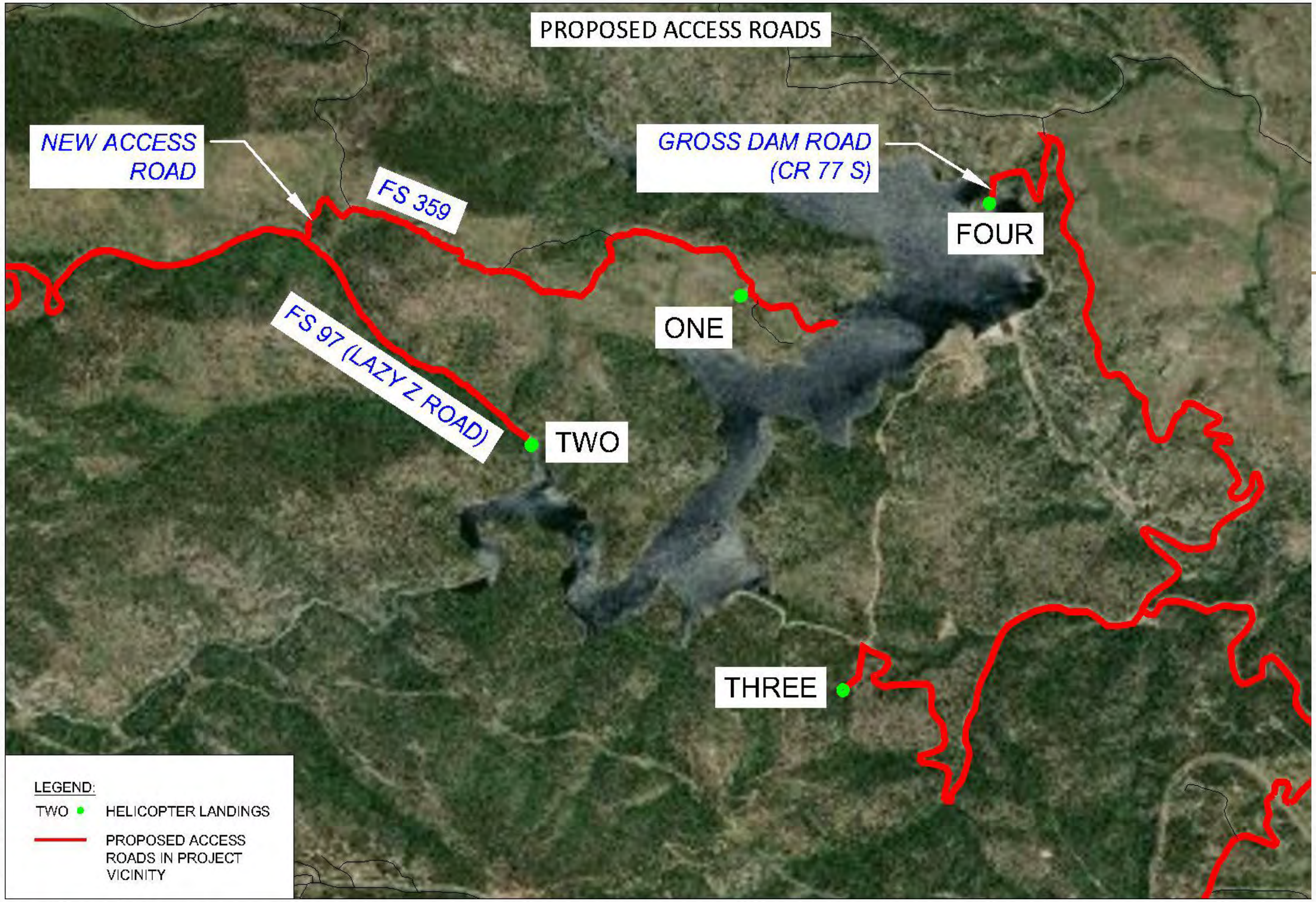
Provides blend of disposal options

Facilitates wildlife mitigation options

Environmentally responsible

What's Next ?

- Denver Water Implementation
- FERC Requirements Condition 27

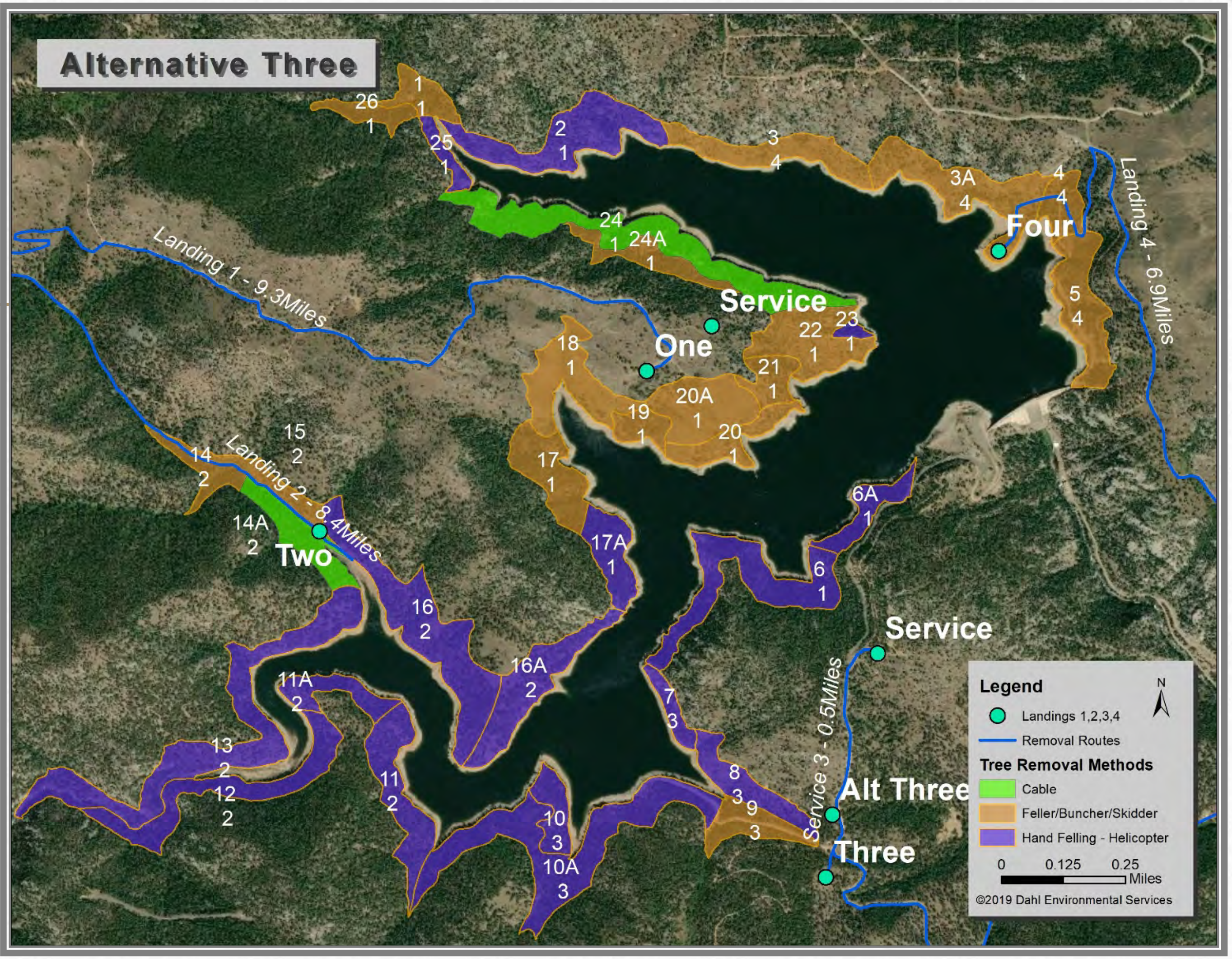


Access and Transportation Assessment

- Principal Routes
  - Forest Service Road 359 (Winiger Ridge)
  - Forest Service Road 97 (Winiger Gulch)
  - Dam Road
- Winiger Connector
  - Avoid FSR 359 Pre-historic Archaeological Site
  - Potential NEPA assessment
  - Flammulated Owl

Alternative Three

- Most cost-effective harvesting option
- Minimizes traffic by an estimated 40% in west-side communities
- Greatest operating flexibility
- Greatest disposal flexibility
- Potential to maximize environmental benefits, social, noise, traffic, emissions and wildlife
- Greater wildlife limited operating period flexibility



Alternative Three Selection Rational

"Minimizing impacts on community and maximize biomass utilization at the most cost-effective price point"

- Multiple landing sites (four) minimize helicopter distances and maximize daily payloads.
- **The least cost option for utilization of debris using multiple disposal methods at all four landing locations.**
- Minimize harvest operating period
- Maximize disposal options
- **Potential to significantly reduce debris disposal traffic**
- Maximum flexibility to manage wildlife constraints
- Most efficient harvesting option
- Potential to minimize environmental impacts, no haul traffic
- **Potential to maximize environmental benefits, eliminate thousand tons of carbon**

Conclusion for Alternative Three Selection

Four tree removal alternatives for the GRE along with recommended disposal methods for each alternative were analyzed (**see Tables 16 and 17**).

Our analysis of each alternative was guided by the following criteria:

1. The most cost-effective and efficient tree removal and disposal option
2. Maximize biomass utilization
3. Minimize tree removal traffic
4. Minimize nuisance factors such as noise, light, and odor

- Based on these criteria, the preferred Alternative Three best meets Denver Water's objectives
- This alternative provides the least cost option for tree and debris removal, while minimizing traffic and nuisance factors
- Four strategically placed landing locations the helicopter yarding distances are greatly reduced, having a approximately $322,000 lower than the next lowest cost alternative
- For biomass utilization, there is a suite of disposal options including full utilization and removal from the project area as well as complete onsite disposal utilizing air curtain destructors (ACDs)
- Eliminating truck traffic associated with debris removal could reduce approximately 1,000 tons of carbon emissions with ACD's
- The overarching guiding principle was to develop a TRP that would minimize impacts on the community and maximize biomass utilization at the most cost-effective price point

Tree Removal and Disposal Options

Table 16:
Tree Removal and Disposal Options

Alternatives	Tree Removal Costs	Debris Disposal: Air Curtain Destructor	Debris Disposal: Chip Utilization (Eagle Valley Green Energy)	Debris Disposal: Biochar NOW	Total Removal and Disposal Cost
1	$5,119,177	$216,000			$5,335,117
	$5,119,177		$144,000		$5,215,177
	$5,119,177			$3,500,000	$8,619,177
2	$4,820,913	$216,000			$5,036,913
	$4,820,913		$144,000		$4,916,913
3	$4,498,788	$216,000			$4,714,788
	$4,498,788		$253,750		$4,752,538
4	$5,858,210	$216,000			$6,074,210
	$5,858,210		$253,750		$6,111,960
	$5,858,210			$3,500,000	$9,358,210

Summary Decision Table

Table 17:
Summary Decision Table

GRE Alternative Summary	Alternative One			Alternative Two		Alternative Three			Alternative Four		
	Chips	AC Burner	BioChar	Chips	AC Burner	Chips	AC Burner	Cordwood	Chips	AC Burner	BioChar
Tree Removal and Biomass Disposal Costs	$5,215,177	$5,335,177	$8,619,177	$4,916,913	$5,036,913	$4,752,538	$4,714,788	$34,000*	$6,111,960	$6,074,210	$9,358,210
Haul Truck/Dump Truck Traffic	900 Haul	None	180 Dump	900 Haul	None	827 Haul	None	80 Haul	900 Haul	None	180 Dump
Permit: Colorado Parks and Wildlife, Forest Service, Boulder County, CDPHE	N/A	CDPHE	N/A	N/A	CDPHE	N/A	CDPHE	N/A	N/A	CDPHE	N/A
Air Emissions	Moderate	Low	None	Moderate	Low	Moderate	Low	Moderate	Moderate	Low	None
Noise Levels	High	Low	Low	High	Low	High	Low	Low	High	Low	Low
Wildlife Conflicts	High	Moderate	Low	High	Moderate	High	Moderate	Low	High	Moderate	Low
Product Utilization	High	Low	Moderate	High	Low	High	Low	416 Cords	High	Low	Moderate
Biochar Percent/Ton	0%	3%	20%	0%	3%	0%	3%	0%	0%	3%	20%
Most cost-effective and efficient method	No	Yes	Yes	No	Yes	No	Yes	No	No	Yes	Yes
Maximizes product utilization	Yes	No	Yes	Yes	No	Yes	No	Yes	Yes	No	Yes
Minimizes hauling traffic	No	Yes	Yes	No	Yes	No	Yes	Yes	No	Yes	Yes
Minimizes nuisance factors such as noise, light, and odor.	No	Yes	Yes	No	Yes	No	Yes	No	No	Yes	Yes

Wildlife Constraints

- Severe Winter Range (Elk)

  December 1 – March 30

- Flammulated owl

  May 1 – August 10

- Migratory Bird Treaty Act

  April 1 – July 31

Implementation Schedule

Figure 9: Project Schedule

Task	Start	End	Duration	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	April	May	June	Jul	Aug	Sept	Oct	Nov	Dec
Project	8/1/2024	12/31/2025	517																	
Site Preparation																				
Road Construction	8/1/2024	10/31/2024	91																	
Developing Landing Locations	8/1/2024	10/31/2024	91																	
Developing Skid Trails	9/1/2024	10/31/2024	60																	
Tree Removal																				
Timber Felling	12/1/2024	2/28/2025	89																	
Feller Buncher	12/1/2024	2/28/2025	89																	
Hand Felling	12/1/2024	2/28/2025	89																	
Skidding and Yarding	3/1/2025	7/31/2025	152																	
Helicopter Yarding	3/1/2025	7/31/2025	152																	
Timber Processing																				
Log Processing	3/1/2025	7/31/2025	152																	
Chipping	3/1/2025	7/31/2025	152																	
Grinding	3/1/2025	7/31/2025	152																	
Biochar	3/1/2025	12/31/2025	305																	
Log Product Processing	3/1/2025	7/31/2025	152																	
Transportation																				
A1 Fiber	3/1/2025	7/31/2025	152																	
Gypsum, CO	3/1/2025	7/31/2025	152																	
Biochar	3/1/2025	7/31/2025	152																	
Cordwood	3/1/2025	7/31/2025	152																	
Boulder Wood Processing	3/1/2025	7/31/2025	152																	
Restoration																				
	8/1/2025	12/31/2025	152																	
Restrictions																				
Raptor Protection Measures	3/1/2025	7/31/2025	152																	
Owl Nests	5/1/2025	8/10/2025	101																	
Goshawk	3/1/2025	9/30/2025	213																	
Raptor Nest Breeding	3/1/2025	9/15/2025	198																	
Elk Winter Range	12/1/2024	3/30/2025	119																	

October 1, 2019, Tree Removal Plan Stakeholder Meeting #2 Meeting Minutes

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Meeting Notes - DRAFT

Date:	October 1, 2019
Start Time:	1:00 pm / MST
End Time:	3:00 pm / MST
Project:	Gross Reservoir Expansion Project – Tree Removal Plan Stakeholder Meeting #2
Location:	USFS Boulder Ranger District Office, 2140 Yarmouth Ave, Boulder CO 80301
Conf. Call-In Number:	(888) 844-9904, access code: 9066578#
Participants Expected:	Boulder County – Scott Golden Colorado Parks and Wildlife – Not present Colorado State Forest Service – Allen Owen Dahl Environmental Services – Bjorn Dahl, Lyle Laverty Denver Water – Douglas Raitt, Jessica Alexander, Travis Bray, Rachel Badger Jefferson County – Steve Durian (by phone) Jefferson Conservation District – Not present Tetra Tech – Mike Koester, Perry Patton, Stephanie Phippen, Cheryl Simpson U.S. Forest Service – Kevin Zimlinghaus, Angela Gee, Greg Smith

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I. *Introduction and Meeting Purpose – Travis Bray, Denver Water (DW)*

Introductions were made from each member of the group.
An overview of the purpose Tree Removal Plan (TRP) and future work was discussed. Additionally, a quick overview of the alternatives evaluated (on-site logistics and disposal off-site) and the preferred alternative was made.

II. Tree Removal Plan Presentation – Overview of Alternative 3 – *Bjorn Dahl and Lyle Laverty – Dahl Environmental Services (DES)*

a. *Decision Criteria and Selection of Alternative 3*

- Gave overview of 2008 plan and alternatives. Used 2016 inventory of 24,000 tons of debris to develop the various alternatives. Alternative 3 Summary:
  - Potential to reduce environmental impacts, social impacts, reduce noise (less helicopter transport), split traffic between the east and west side.
  - Most helicopter landing options (4 sites – Winiger Ridge, Winiger Gulch, North Shore, Osprey Point, plus one overflow landing) which increases flexibility during operations.
  - Least impact to local roads. Places disposal traffic on Gross Dam Road (east side) and the west side. Reduces traffic on west site compared to other alternatives (Alternative 1 and 2).
  - Cost effective tree removal options – *LogCost* analysis (lowest harvest cost option as it reduces the amount of helicopter trips and the trip length).
  - Greatest operating and disposal flexibility.

- Greatest wildlife limited operating period flexibility.
- Least expensive / most cost effective.

b. Road Access – Perry Patton, Tetra Tech

- The principle routes will be FS Road 359 and CR/Lazy Z Road to the west to SH-72, and the Gross Dam Road to SH-72 on the east side.
- Will use new Winiger connector road to shorten haul distance to SH-72 and avoid additional upgrades to FSR 359.

III. Agency Comments – *Dahl Environmental Services/Tetra Tech*

a. Comment Matrix

Tetra Tech/Dahl prepared responses on a comment matrix created for each individual comment received by the agencies on the Draft TRP distributed on August 5, 2019 at Stakeholder Meeting #1. A hard copy of this matrix was provided at the meeting today. The matrix showed which agencies made the comment, the comment, how the comment was being addressed, and where (if any) changes were made in the revised TRP document. There was a uniform acceptance of Alternative 3 based on the comments received.

Denver Water to provide an electronic version of the comment matrix and revised TRP after this meeting. Hard copies were provided at the meeting. Denver Water asked if there were any other questions on the comment matrix? None were raised.

b. Changes made to the TRP

- Changes were made to the TRP in sections outlined in the comment matrix based on the responses.
- Attachment 1 – *Conceptual Haul Road Drawings* to the TRP is new.

IV. Next Steps – Post FERC order (Condition 27) – *Denver Water*

Alternative 3 will be used moving forward to develop a more detailed plan to satisfy Condition 27. This detailed plan will be submitted to FERC 90 days prior to tree removal in the inundation area. Denver Water will continue to engage stakeholders throughout development of the detailed plan prior to submitting the final plan to FERC. DW is on schedule for 2024 and 2025 for tree removal activities.

a. To satisfy Condition 27, will need more details on:

- Travel/Traffic management
- Hazard substances
- Invasive species
- Revegetation
- Raptors
- Reclamation requirements

Denver Water is now able to address those details because we have the recommended Alternative 3 identified. Denver Water will keep options flexible at this point because we need contractor input on the exact methods used and the overall construction timeline.

b. Pilot Test

- Denver Water will perform a pilot test with Air Curtain Destructor (ACD) in 2020 or 2021 as material becomes available as site development gets underway. Will test 20+ acre initial site.

V. Conclusion and Questions – *Denver Water*

Would like to keep plan flexible at this point but will become more detailed prior to Denver Water's final plan submittal to FERC. The Dam Contractor (Kiewit/ Barnard JV – team) was awarded in August and is working on planning efforts to execute Gross Reservoir Expansion Project with design team (AECOM and Stantec) who are currently working on detailed dam design. Follow up questions are mentioned below.

Discussion Topics –

Q. Are there any updates on the FERC license?
A. Denver Water: No – hoping to hear back before the holidays. Letter was sent and they have 45 days to respond which is next week. If there is no response, follow up letters will be sent.

Q. Do you have a timeframe for putting the next draft together on the inundation area?
A. Denver Water: Should be ready to re-engage with stakeholders approximately by the second quarter of 2020. DW needs to complete the pilot project with the ACD to get a better handle on the burn rate before creating a final TRP. Denver Water's goal is to put plans in place prior to the start of quarry clearing on Denver Water property. Quarry work is scheduled to start the second quarter of 2021.

Q. Do you have an idea of how wide you'll go for the test (tree removal) on Denver Water land?
A. Denver Water: Approximately 60-100 feet. It should not require National Forest Service lands. Will not provide USFS with TRP to use haul road as it will fall under Transportation and not the Tree Removal condition.

Q. How far out are we on the tree removal plan/Condition 27?
A. Denver Water: That will be answered after we obtain the pilot study results. For instance, is it too aggressive to try to burn 2/3 of the trees based on weather restrictions from the recent dry summer. We need flexibility built into the plan to adapt to the conditions determined during the pilot test. We also need to work with the Forest Service to expand the plan based on discoveries from the pilot test.

USFS response -- We have recently done treatment on Winiger Ridge and have piles to burn near the dam. We will not burn the piles this year. It will possibly take three years to do a prescribed burn (300 acres/year, 960 acres total over a three-year period).

Q. Where would you find the cable logging system contractor?

A. Tetra Tech/Dahl: There are cable loggers in Colorado – one operator in Fort Collins (Mark Morgan) and one in Colorado Springs (Markit).

Q. What is the buffer distance for the Flammulated Owl call points? This will affect Lazy Z Road.
A. USFS: Can't recall. Forsythe I and II has three years of data on the owl. We will continue to survey during the pile burning. We do know that the goshawk has also been around in the vicinity which will affect burning. We will survey every year. Raptors are more of a concern (eagles). This is a critical winter range for elk. We do not have lynx, but there may be evidence of Preble's mouse which will also affect the design criteria.

The following action items were discussed.

Action Items

Item	Responsible Person	Completion Date
Denver Water to provide an electronic version of the comment matrix and revised TRP after this meeting.	Travis	10/2/19

February 10, 2021, PowerPoint presentation—Tree Removal

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Gross Reservoir Expansion Project – Tree Removal

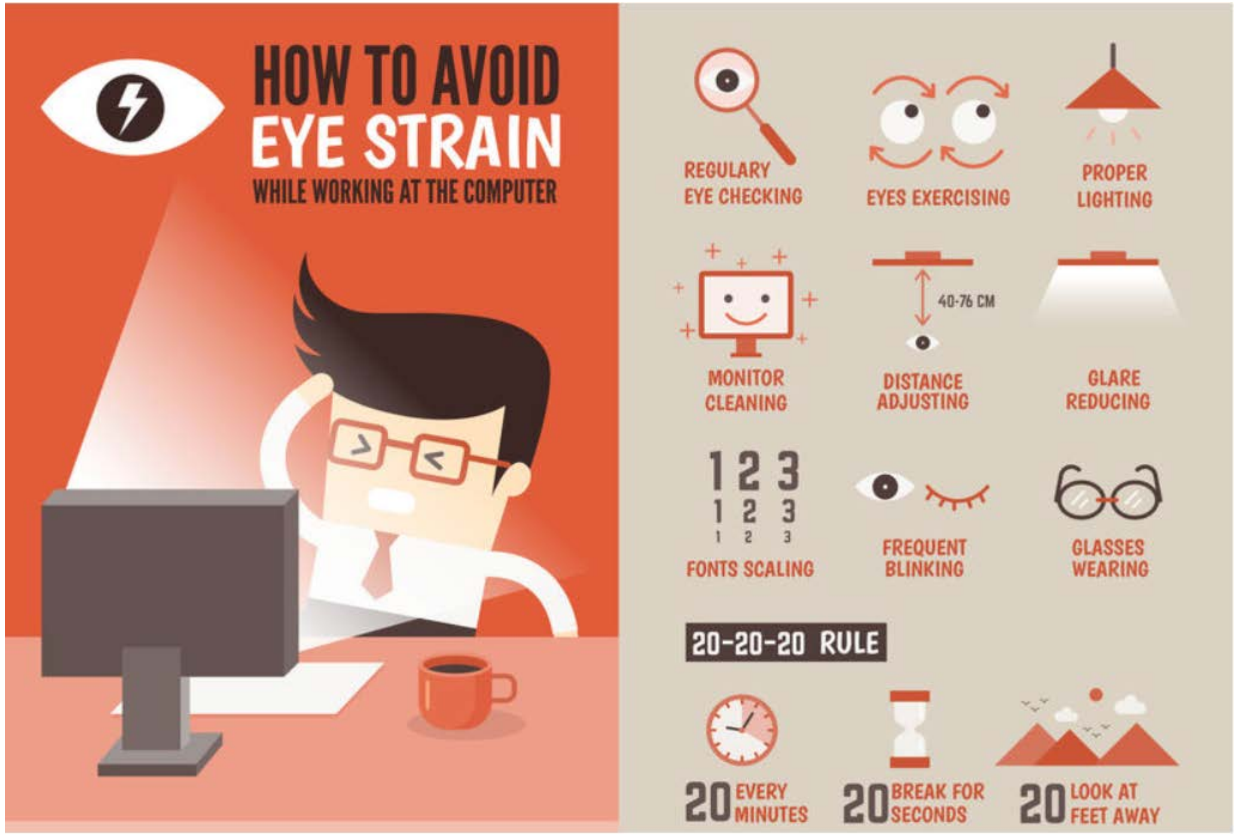
Feb. 10, 2021

DENVER WATER

Introductions

Safety Moment – The 20/20/20 Rule For Eye Strain

- The 20/20/20 rule, if followed, helps reduce fatigue and eye strain.
- It is pretty simple and states: Every 20 minutes, take at least 20 seconds and look away from your work/screen and focus on something else that is at least 20 feet away from you.
- Get up out of your chair.
- Blink your eyes rapidly to propagate tear production.
- Stretch your legs and arms.
- Walk around if you are able.
- Turn your neck and move your shoulders around.



Purpose of the Meeting

To facilitate a common understanding across stakeholders of timelines and expectations relating to vegetation clearing, reservoir perimeter tree clearing, timber harvesting and disposition, tree removal waste hauling and planned timelines for operations

What we have heard:

- All stakeholders are concerned about the route of trucks hauling tree removal biomass
- All stakeholders want the least disruptive approach to the tree removal activity

Agenda

- Timeline overview
- Topics:
  - Project and Site Plan Overview
  - Agency Involvement
  - Areas Requiring Tree Removal
  - Tree Removal Methods
  - Processing Alternatives
  - Transportation of Tree Removal Byproducts
  - Schedule
- Discussion

Housekeeping

- Please turn on your cameras.
- We will go topic by topic with time for larger discussion between each…
- But let us know if you have a question:
  - Drop them in the chat.
  - Use the “Raise Hand” function.
  - Jump in!
- Copies of slides will be provided after the meeting.

Scope of Gross Reservoir Expansion

- Initial phase completed in 1954.
- Designed with expansion in mind.
- Increase storage by 77,000 AF.
- Raise height 131 feet.
- Doubling surface area.
- 7,406 spillway elevation at completion.

Boulder County 1041 Permit

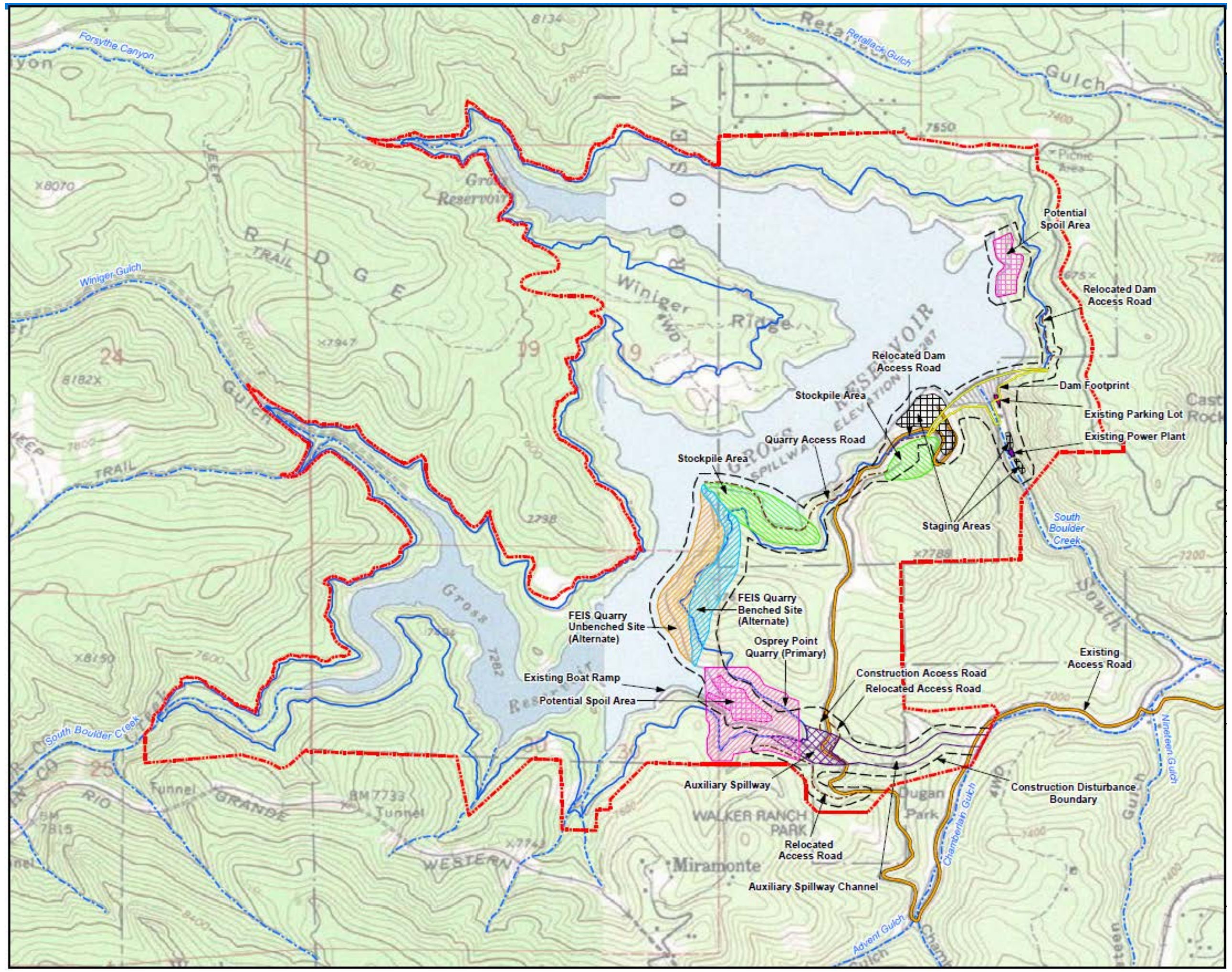
Sept. | Oct. | Nov. | Dec. | Jan. | Feb. | March | April | May | June | July | Aug.

- Sept.: Denver Water submitted 1041 Application to Boulder County
- Oct.–Dec.: Boulder County referral period – extended to Dec. 17
- Dec.: Denver Water receives comments and begins analysis
- Jan.: Denver Water requests extension until Feb. 19
- Feb.: (Expected) Boulder County received Denver Water responses
- March: (Expected) Denver Water to share Tree Removal Plan for review, comment
- June: (Expected) Planning Commissioner Hearing
- Aug.: (Expected) County Commissioner Hearing

Gross Reservoir Expansion Site

Areas Disturbed by Construction

- Gross Dam Road & SH 72 Intersection
- Quarry at Osprey Point
- Haul Roads and Staging Areas
- Aggregate Crushing Plant
- Concrete Batch Plant
- Raised Dam Foundation
- Reservoir Perimeter Below Elev. 7406
- Relocated Recreation Areas



Overall Gross Reservoir Expansion Site Plan

Agency Stakeholders

FOREST SERVICE U S DEPARTMENT OF AGRICULTURE

US Army Corps of Engineers®

DEPARTMENT OF ENERGY FEDERAL ENERGY REGULATORY COMMISSION

COLORADO Division of Water Resources Department of Natural Resources

COLORADO STATE FOREST SERVICE COLORADO STATE UNIVERSITY

COLORADO Department of Transportation

COLORADO Department of Public Health & Environment

Boulder County

CITY OF ARVADA

JEFFERSON COUNTY COLORADO

GILPIN COUNTY COLORADO EST. 1861

Federal Energy Regulatory Commission Order 2035-099

FERC Order issued July 16, 2020

Major Plans Required by the FERC in 2021:

- Tree Removal Plan
- Aquatic Invasive Species/Noxious Weed Plan
- Recreation Management and Monitoring Plan
- Traffic Management Plan
- Quarry Development and Reclamation Plan
- Archaeological Plan and Historic American Engineering Record (HAER) documentation

Plan submission to the FERC required by July 16, 2021 with jurisdiction comments and responses

Construction start required by July 16, 2022

Dam Completion required by July 16, 2027

172 FERC ¶ 61,063
UNITED STATES OF AMERICA
FEDERAL ENERGY REGULATORY COMMISSION

Before Commissioners: Neil Chatterjee, Chairman;
Richard Glick, Bernard L. McNamee,
and James P. Danly.

City and County of Denver, Colorado | Project No. 2035-099

ORDER AMENDING LICENSE AND EXTENDING LICENSE TERM

(Issued July 16, 2020)

1. On November 25, 2016, as supplemented on March 24, 2017, the City and County of Denver, Colorado, acting by and through its Board of Water Commissioners (Denver Water or licensee),[1] filed an application to amend its license for the Gross Reservoir Hydroelectric Project No. 2035 (Gross Reservoir Project or project) to raise the project's dam and enlarge the project's reservoir. Denver Water also proposes to delete and amend certain license articles and to extend the license term by 10 years. The project is located on South Boulder Creek in Boulder County, Colorado and occupies land within the Roosevelt National Forest administered by the U.S. Forest Service (Forest Service). As discussed below, this order approves the proposed amendment with certain revisions and extends the license term as requested by Denver Water.

I. <u>Background</u>

2. On March 16, 2001, the Commission issued a new license to Denver Water to operate and maintain the Gross Reservoir Project for a period of 40 years, and to construct a powerhouse with an installed capacity of five megawatts (MW).[2] On October 1, 2004, the Commission issued an order amending license to authorize an increase in installed capacity to 7.598 MW and a new powerhouse design.[3]

[1] Denver Water is a municipal corporation that provides water to the City and County of Denver, Colorado, and surrounding suburbs.

[2] *City and County of Denver, Colorado*, 94 FERC ¶ 61,313, *on reh'g*, 95 FERC ¶ 61,222 (2001) (2001 License Order).

[3] *City and County of Denver, Colorado*, 109 FERC ¶ 62,002 (2004).

Tree Removal Planning – General

Detailed Tree Removal Plan being developed and will be shared with jurisdictions in March 2021

- Tree removal will occur in 2 phases
  - Initial clearing of the quarry, haul roads, staging areas, plant locations and the dam footprint
  - Reservoir perimeter clearing as dam completion nears

The Tree Removal Plan will address:

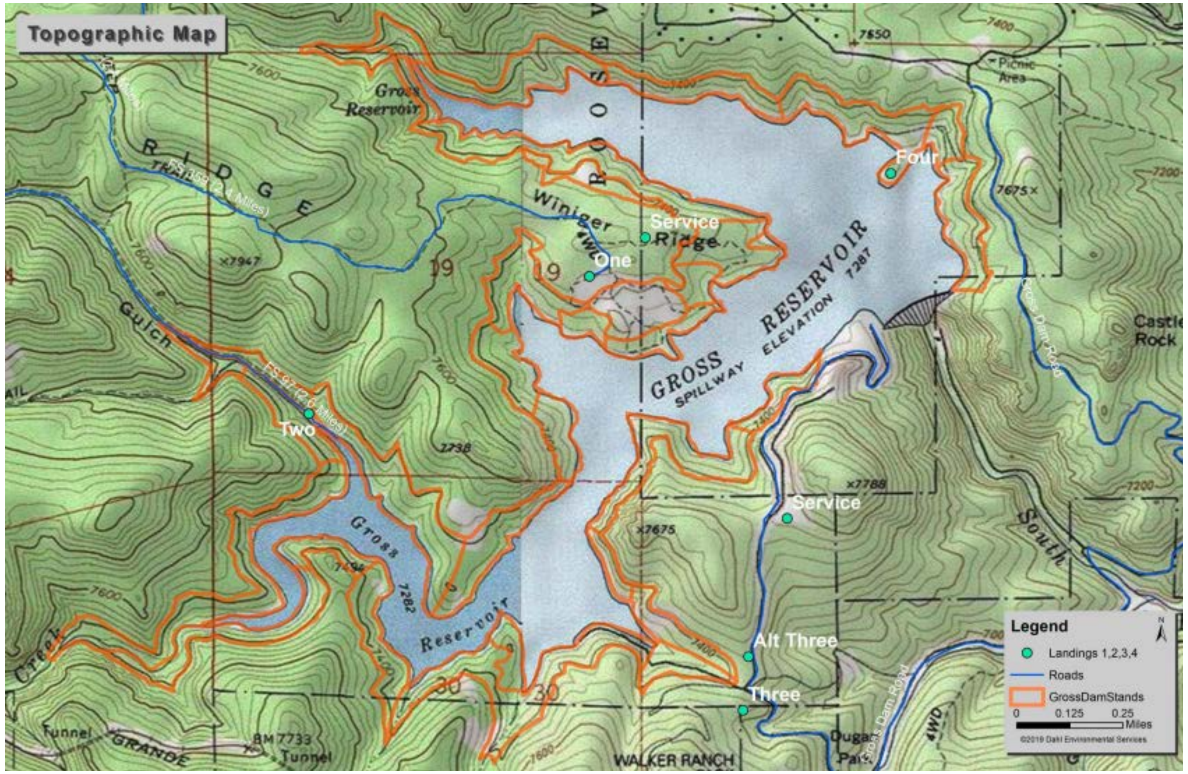
- Transportation management during tree removal activities
- Environmental protections to be followed during tree removal process
- End use of all tree removal material

Forest Resources and Inventory

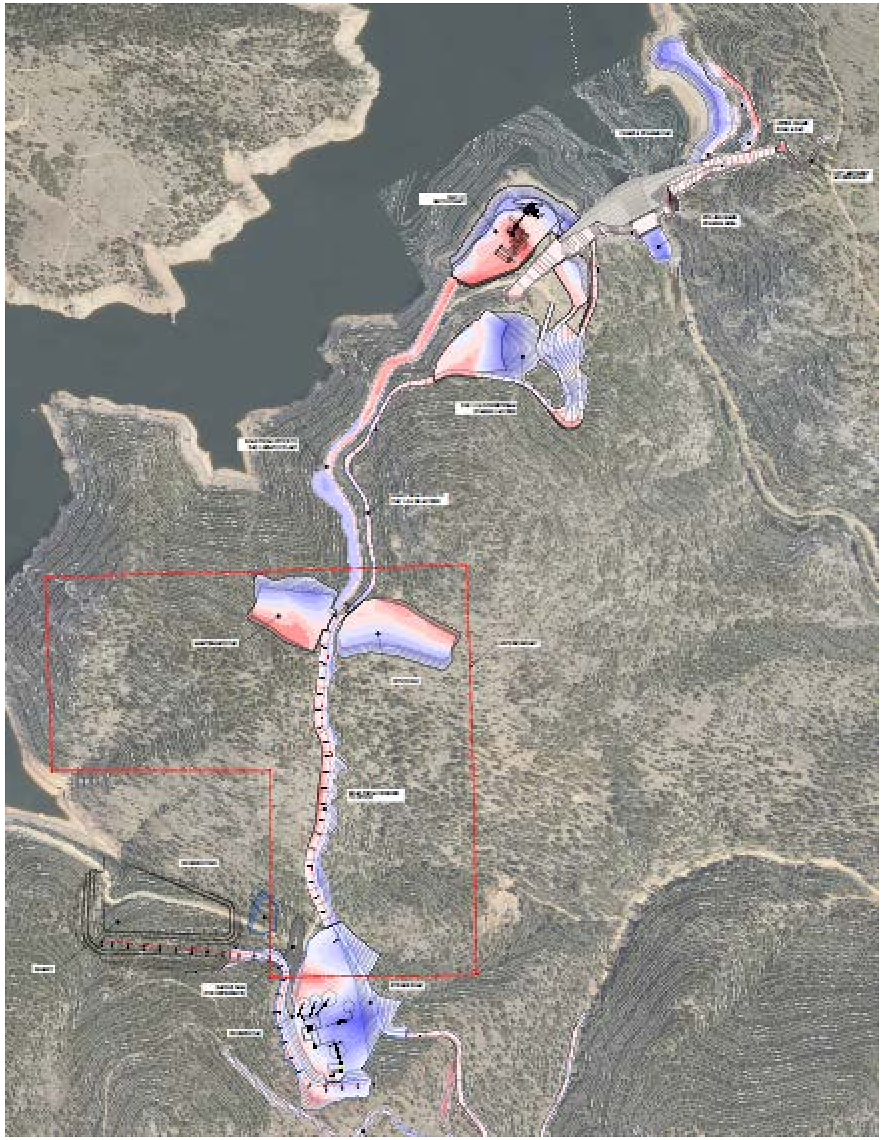
- Updated plan in 2019 using 2005 and 2008 reports as a base. Identified four removal options and moving forward with one option in 2021 update.
- Tree Removal Plan identifies 36 unique stands of trees for removal. Vegetation predominately ponderosa pine and Douglas fir, with some Colorado blue spruce and Rocky Mountain juniper.
- An estimated 24,000 tons of forest biomass to be generated during reservoir clearing operations.
- The value of the sawtimber is considered non-merchantable (i.e., biomass) but this will be revisited at the time of tree removal contracting.
- The Tree Removal Plan requires all quantities of biomass are completely removed down to a minimum material length and diameter of 2 inches within the inundation area.

Where is tree removal required?

- Aggregate quarry, haul roads, staging areas, dam footprint
- Reservoir perimeter below Elev. 7406



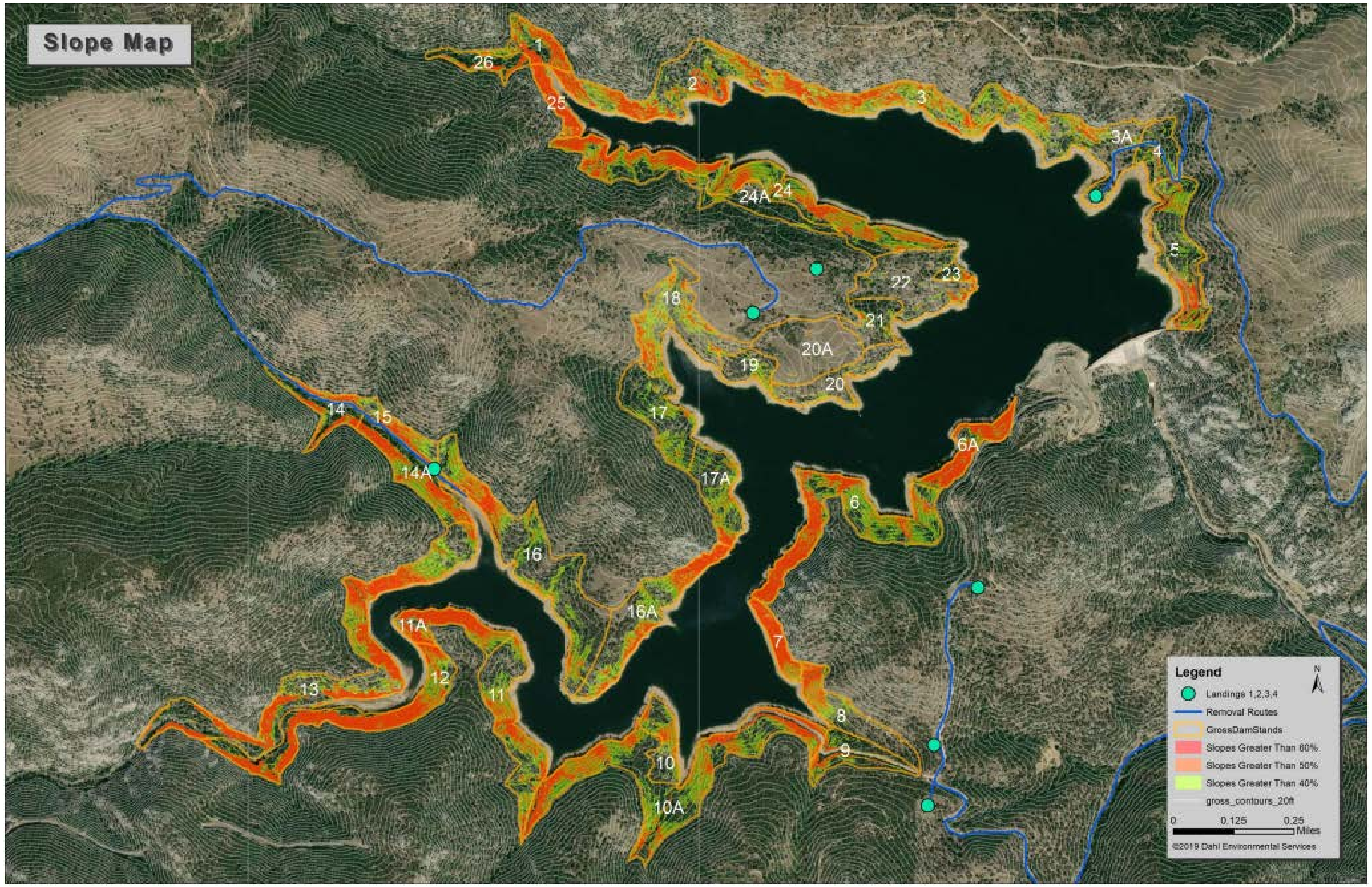
Reservoir perimeter



Early clearing for quarry, dam and staging areas

Terrain Where Tree Removal is Required is Steep

- Orange areas indicated terrain too steep for tracked or wheeled equipment.
- Different tree removal methods are required throughout the area to be cleared.



Tree Removal Equipment

Feller Buncher

Cable

Skidder

Mulchers
Masticators

Helicopter Logging

- Method of logging that can be used where stands are inaccessible.
- Cables are dropped from the helicopter and used to remove cut trees and woody biomass.
- The use of helicopters reduces the infrastructure required to log a specific stand and greatly reduces the schedule and timing of operations.

Helicopter Logging Landing Site

- Helicopter landing sites stage trees and biomass collected from around the reservoir.
- Trucks hauling biomass offsite are loaded at the landing sites.

Disposal Options

- Landfill disposal of biomass is the status quo disposal option from the 2019 TRP study.
- Air Curtain Destructor: Reduction in biomass can be achieved but air quality considerations and seasonal restrictions due to fire restrictions may limit the effectiveness.
- Grinding: Large grinders are used to convert entire trees into rough chips then hauled to biomass facilities is an option for debris disposal.
  - Chips can be used as fuel for steam generation, compost or transported to a landfill.
  - Several facilities operate in the greater project working area:
    - Eagle Valley Green Energy in Gypsum.
    - Confluence Energy in Kremmling.
- Cordwood production may be possible for disposal/use by local vendors. The Nederland Community Forestry Sort Yard may be used at the time of tree clearing.
- Biochar: Evaluated for on-site use but has limitations. Still an option for offsite disposal.

Air Curtain Burning of Biomass

- Air curtain destructors (ACDs) are designed and constructed to optimize the air curtain concept.
- High velocity air is blown across and down at an optimum angle into the box creating the air curtain on top and a rotational turbulence within the firebox.
- The combustion process reduces the wood waste to usable biochar and carbon ash by approximately 98 percent, leaving about **2 percent** in volume (100 tons of wood, or 2 to 4 tons of ash and biochar)

Biomass Grinding and Transport

- Non-merchantable tree biomass requires grinding and transport offsite.
- Logging roads in National Forest require USFS approval for construction and reclamation.
- Chip vans require suitable grades and curves between processing yards and connections to local access routes.

Wood chip grinding equipment (typical)

Possum belly trailers allow the purchaser to haul more chips per load but limit the ability to get into sites due to low ground clearance.

Regular box vans likely required to haul chips

Environmental Considerations for Tree Removal

The schedule for tree removal would consider, among other items:

- Key winter range timing for elk (December 1 through March 30).
- Raptor nesting season (April 1 through July 31).

Noise mitigation through equipment selection and haul route selection.

Installation of erosion control features and BMP's prior to tree removal operations.

Follow USFS requirements on National Forest lands.

Dust suppression on gravel roads during hauling operations.

Having spill response equipment and containment equipment on site as a precautionary measure. Monitoring fueling operations for safety and spill prevention.

DENVER WATER

Stand and Biomass Removal Methods

Selection criteria for the approach to tree removal considers:

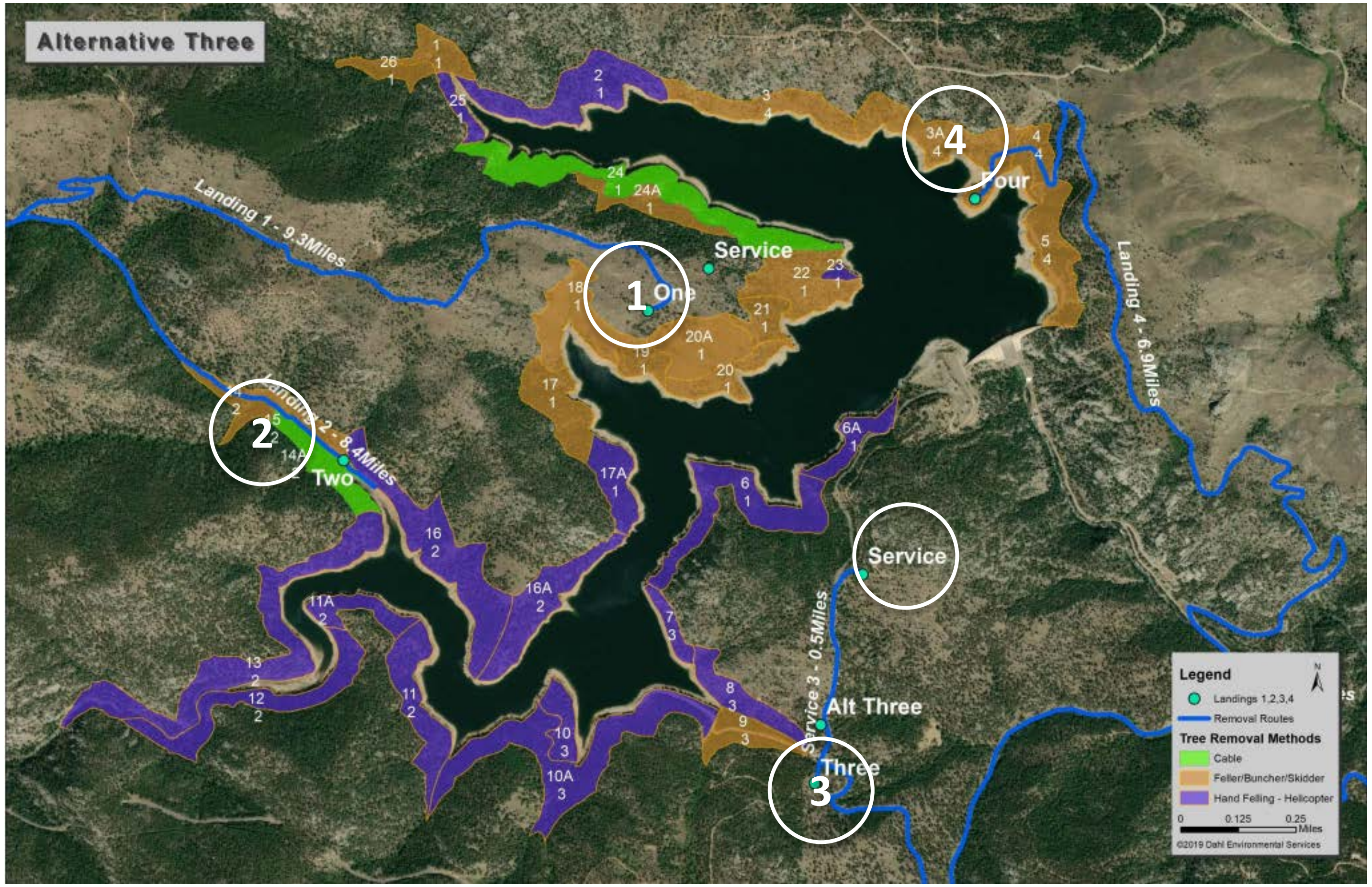
- The most cost-effective and efficient tree removal and disposal option.
- Maximize biomass utilization.
- Minimize tree removal traffic.
- Minimize nuisance factors such as noise, light, and odor.

Stand Removal Method	Biomass Removal Method
Hand Felling – Helicopter	Hand work, Heli-bucket
Feller/Buncher/Skidder	Mulcher
Cable	Cable Cleanup

Preferred Tree Removal Approach – 4-Log Landings

4 Landing and Staging Sites

1. NW landing on Winiger Ridge
2. SW landing near end of Lazy Z Road (CR 97E)
3. SE landing near Osprey Point
4. NE landing near North Shore peninsula



Preferred Tree Removal Approach – 4-Log Landings

- This alternative would make use of four log landing sites: (1) Winiger Ridge, (2) Winiger Gulch Road, (3) Osprey Point Road, and (4) North Shore Point for primary processing of all harvested logs and biomass.
- Reduces west side community haul truck traffic impacts.
- Best operational options from unplanned shutdowns or mechanical issues with four landing areas.
- The least helicopter round trips for yarding biomass.
- Provides a spectrum of biomass disposal opportunities i.e., cordwood, chips and energy.
- Provide opportunities to minimize impacts on wildlife.

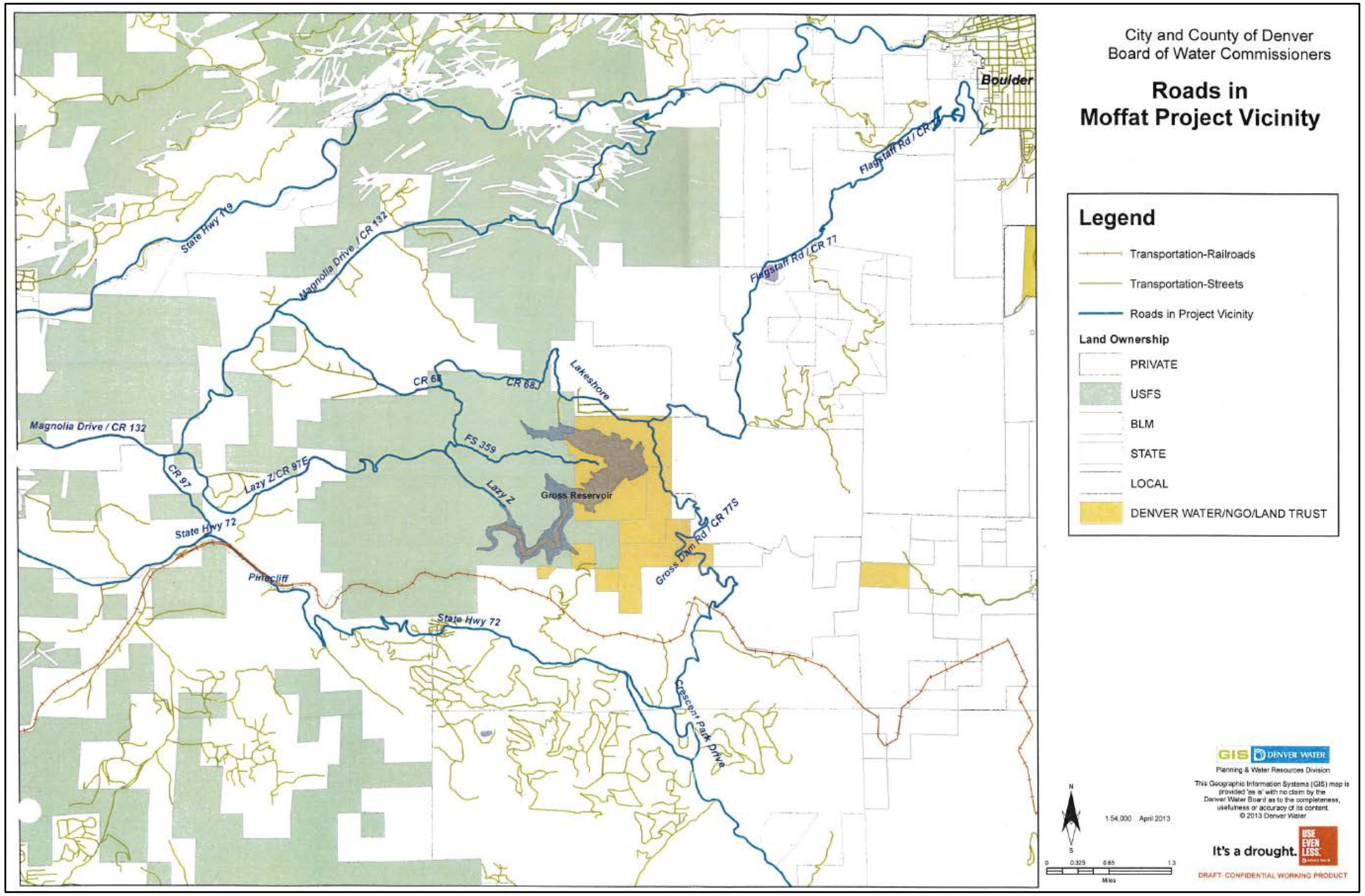
Highways and Roadways in Gross Reservoir Vicinity

State Highways
- State Highway 72 Coal Creek Canyon Drive
- State Highway 93
- State Highway 119

Boulder County
- CR 77S – Gross Dam Road
- CR 77 – Flagstaff Road
- CR 132 Magnolia Dr
- CR 97
- CR 97E Lazy Z Road

Gilpin County (SH 72 & CR 97)

Jefferson County
- Crescent Park Drive



Area Roadway Map

Access Routes for Trucking of Biomass - East

- East side haul via Gross Dam Road and SH 72 to the East.
- Early trucking of biomass uses Crescent Park Drive until SH 72 and Gross Dam Road intersection improved (Q4 2022).
- No truck traffic on SH 72 from Gross Dam Road intersection to Pinecliff.
- No truck traffic on Flagstaff Road.

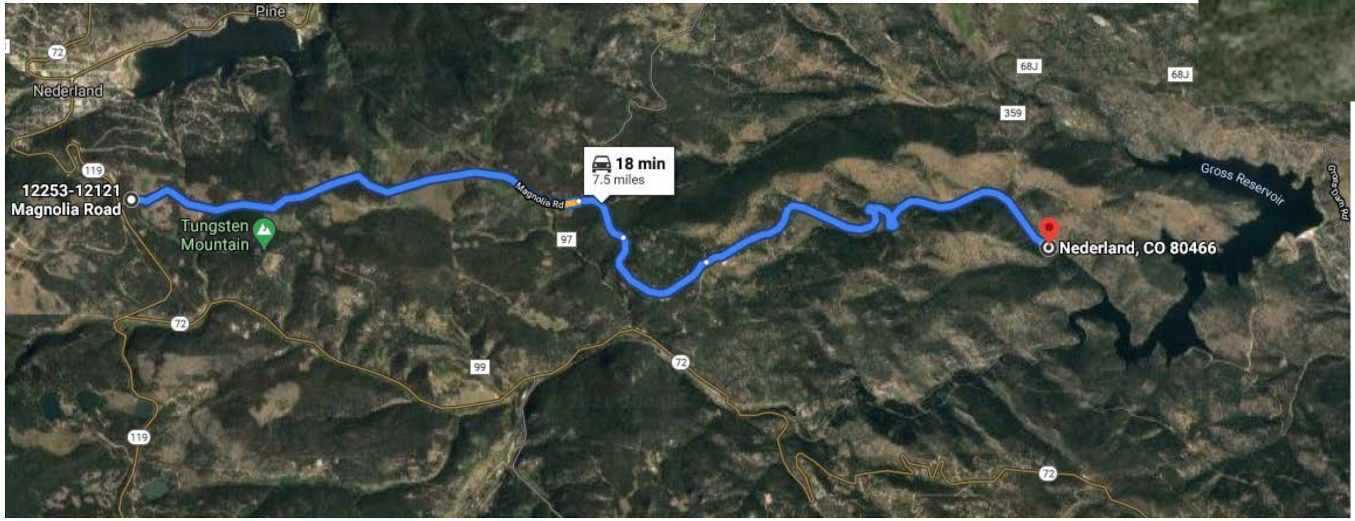
On-site Access Roads

Truck route from site to SH 72 and SH 93 intersection

Access Routes for Trucking of Biomass - West

- West Side Access via Lazy Z Road (CR 97E) to CR 97 to SH 72 or SH 119 depending on destination
- No Trucking on SH 72 from Gross Dam Road intersection to Pinecliff
- No trucking on CR 132 Magnolia Rd East to SH 119

On-site Access Roads



Truck route from site to CR 132 and SH 119 intersection

Schedule

- Develop Access and Support Facilities, Materials Lab, Initial Tree Clearing, Surface Prep of Dam – 2022
- Foundation Excavation and Grouting – 2023
- Stilling Basin and Dam Raise – 2024 thru 2026
- Reservoir Tree Clearing – 2025-2026
- Dam Bridge, Crest, HPU Building, Reclamation, Demobilization - 2027

Anticipated Project Timeline

Activity	1	2	3	4	5	6	7
Site Mobilization							
Dam surface preparation, Materials Lab, early site grading for temporary facilities							
Public access to South Shore closed (North Shore open throughout construction)							
Install temporary recreation facilities, public road improvements, site development							
Quarrying operations							
Dam foundation excavation, grouting, plant setup							
Dam raise activities - materials trucking							
Forestry activities/tree clearing							
First fill							

Presently, Denver Water anticipates Year 1 to begin in 2022. Updated 8/2020

Discussion

- Did we answer the questions you had?
- Is there any other feedback you have for us?

February 10, 2021, Tree Removal Plan Stakeholder Meeting Agenda and Meeting Minutes

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DENVER WATER

Gross Reservoir Expansion Project

MEETING AGENDA & MINUTES

Meeting Title:	Stakeholder Coordination meeting on Tree Removal	**Date/Time:**	02/10/2021 2 p.m.
Prepared By:	M. Brasfield/A. Denault	**Location:**	Online - Teams
Reviewed By:	Denver Water and Tetra Tech Boulder County, Gilpin County, Jefferson County, Town of Superior and CDOT review pending	**Project #/File #:**	Docket SI-20-0003 1041 Permit Application for GRE Project

Meeting Summary:
Boulder County Planning and Permitting staff, Gilpin County staff, Jefferson County staff, CDOT staff and Town of Superior staff met with Denver Water staff to discuss tree removal activities in order facilitate a common understanding of timelines and expectations related to vegetation clearing, disposal and transportation, and address questions raised in Denver Water's 1041 Permit Application to the County for the Gross Reservoir Expansion Project.

Attendees	
Travis Bray – Denver Water	Mike Thomas – Boulder County
Ashley Denault – Denver Water	Conrad Lattes – Boulder County
Doug Raitt – Denver Water	Amy Willits – Boulder County
Melissa Brasfield – Denver Water	Bob Kiepe – Boulder County
Jarrod Smith – Black & Veatch	Erica Rogers – Boulder County
Sarah McCall – Tetra Tech	Liana James – Boulder County
Rachel Miller – Tetra Tech	Abel Montoya – Gilpin County
Timothy Bilobran – CDOT – Region 4	Stephen Strohminger – Gilpin County
Kevin Brown – CDOT Region 1	Alex Ariniello – Town of Superior
Rick Solomon – CDOT Region 1	Steve Durian – Jefferson County
Roberto Medina – CDOT Overweight	

Action Items:

Notes:
Mike Thomas provided an update on the 1041 Permit Application by Denver Water process to date. He referenced a meeting in December between Boulder County and CDOT that discussed tree removal activities and noted this meeting will allow affected agencies the ability to comment, present concerns and ask questions.

He turned the meeting over to Doug.

Project Overview and Agency Involvement

- Doug provided a GRE Project overview.
- He provided an overall timeline for the 1041 Permit Application.
  - Doug noted Denver Water will share this Tree Removal Plan for agency review in early March.
- Doug reviewed the work areas and acknowledged that all the work areas are in Boulder County but the access to site touches other jurisdictions.
- Doug acknowledged many agencies have been involved in the GRE Project to date.

Tree Removal Planning

- Doug stated that tree removal will occur in two phases. The initial clearing around site development areas will occur in Q2 2022. The larger reservoir inundation area clearing will occur closer to the end of the project completion. This work will likely occur over two seasons around 2025.
- Doug noted transportation management, environmental protections and how Denver Water will dispose of this material will all be included in the Tree Removal Plan.

Past Tree Removal Plans

- Doug stated that an updated plan in 2019 used the previous reports (2008) as a foundation. The 2019 plan identified four removal alternatives. After coordination with stakeholders, Denver Water is moving forward with one alternative in the 2021 Final Tree Removal Plan. The plan identified 36 unique stands of trees and approximately 24,000 tons of biomass from reservoir tree clearing.
  - Doug noted that 20-22 tons of tree biomass per truck results in a lot of materials and trucks to transport offsite.
  - Denver Water made assumptions about merchantable timber options based on current condition, which will be revisited as we get closer to disposal.
- Doug noted Denver Water is required to remove as much biomass as possible from the inundation area for water quality concerns.

Areas of removal

- Doug described the tree clearing phases for both the site development locations and the reservoir inundation area. The early phase clearing is about 50-60 acres depending on final design and locations of facilities.
- Abel asked about how Denver Water will coordinate with agencies on Tree Removal Plan input.
  - Doug said Denver Water will be providing the Tree Removal Plan for review to stakeholders including Boulder County and Gilpin County in early to mid-March. Denver Water will allow agencies time to comment and provide feedback to Denver Water. After comments are received, Denver Water will review and make updates to the final Tree Removal Plan. Once final, the Plan will be submitted to FERC for review and approval (July 2021).
    - Melissa added that the agencies will have a 30-day comment period to allow time to respond.
    - Conrad said that Boulder County would not be able to review the Tree Removal Plan before the 1041 has been fully processed.
    - Travis noted that Boulder County stated in its comments that it expected an opportunity to review the plans during the 1041 process and that Denver Water is trying to accommodate that request.
  - Doug said Denver Water will present the information to agencies on the current timeline and will press on as best we can with the review and comments we receive.
- Abel asked about the possibility of using the rail line to reduce truck traffic.
  - Doug noted he did not include that information in this presentation but has met with the Union Pacific Railroad representatives to discuss use at the siding for the GRE Project. Doug noted that rail line is difficult to use currently for a number of reasons including

requirements to use active rail engines to hold cars in place in addition to being a very active line with Amtrak and other traffic. The area is also very narrow and there are certain rules around maintaining clearance from the main line that complicate its use for the GRE Project. Denver Water did explore using rail and will be sure to address that in our Tree Removal Plan.

- Abel made a note that Boulder County is likely to continue to receive comments throughout this process and wanting to make Denver Water aware of that process.
    - Doug said Denver Water understands Boulder County will continue to receive comments, is doing its best to respond to the comments we have now and agrees there will be more input as the process continues.
- Doug discussed the grade in the area around the reservoir and why that makes some of this tree removal work more difficult.

Equipment

- Doug discussed the different standard types of equipment that will be used for the tree removal work.
- Doug said more than half of the tree removal will use helicopter logging because of the grade discussed earlier. The use of helicopters was identified as the most effective and efficient way to remove the timber. Using helicopters also reduces the duration of tree removal activities. Landing sites will be required for processing of material and transportation preparation (mulch/burn/etc.).

Disposal Options

- Doug discussed the various disposal options Denver Water investigated.
    - The recommendation from our forestry consultants was that landfill disposal is the status quo. Doug noted landfill disposal is the starting point for assessment, but Denver Water is looking at ways to reduce biomass on site to reduce truck trips.
    - Air Curtain Destructors are a way to reduce the biomass to haul off site, but air quality concerns, as well as wildfire concerns, might make this difficult.
    - Grinding and chipping of material on site could be used for power generation off-site.
    - Cordwood options depend on the merchantable cost. There is some local use and interest. This option will be reevaluated as we get closer to the disposal phase.
    - Biochar was evaluated for onsite processing, but the long processing times cause limitations for on-site use, but this doesn’t mean biochar isn't an offsite option.
- Doug noted logging roads will need to be developed on the west side of the reservoir to access certain areas around the reservoir for tree activities. Roads conditions will limit transportation options (low-clearance, high-capacity trailers will not be used).

Environmental Consideration

- Doug discussed the various environmental considerations that will be incorporated into the final Tree Removal Plan including:
    - Elk winter range timing, as well as nesting season (raptors and other birds), that could pose work limitations in some areas.
    - Noise mitigation.
    - Erosion control.
    - Dust suppression.
    - Spill response.
- Rick Solomon mentioned that Roberto is on the call and oversees the overweight and oversized office. Rick also noted the UPRR bridge on SH 72 has a 14’ 6” clearance which may limit the transport of large equipment like what has been shown in this presentation.
    - Doug said the Denver Water contractor will be made aware of this and will be identifying how to get the necessary equipment to site given the restrictions in place along the route.
- Roberto asked if Denver Water has weights for the trailers that will be used.
    - Doug said Denver Water does not have that information at this time. The box truck shown on the screen earlier is similar to a conventional WB-50 style truck. This truck will fit the

improvements on the east side. Denver Water will be considering transport vehicle configurations as part of the evaluation of the west side access roads process.

Removal Methods

- Doug discussed the work performed by the forestry consultants who looked at all the different removal options and different considerations including: the most cost effective and efficient tree removal and disposal, maximizing biomass utilization, minimizing tree removal traffic and minimizing nuisance factors.

Tree Removal Approach

- Doug described the arrangement of the preferred approach, which has four landings sites around the reservoir where tree processing will occur. He noted the location on the North Shore has complex access but the quantity of materials is lower at that location. This location will require short wheelbase trucks to move material off-site.
- Doug noted the Tree Removal Plan and helicopter landings are only for the larger reservoir inundation area clearing and do not apply to the first phase of tree clearing.
- Multiple landing areas on the east side of the reservoir balances the amount of biomass between east and west landings and reduces west side community haul truck traffic impacts.

Highways and Roadways

- Doug described the planned intersection improvement at SH 72 and Gross Dam Road. However, until that intersection is improved, Denver Water will use Crescent Park Drive and SH 72 through 2022 for safety reasons.
- Doug noted CR 97 and 97E are roads that might need some local improvements in the future.
- Doug noted the east haul routes all use Gross Dam Road and SH 72 and, depending on the final disposal location, the route will differ once trucks reach SH 93. There will be no traffic West on SH 72 toward Pinecliffe from Gross Dam Road. Also, there will be no trucks on Flagstaff Road. Doug noted he believes this road has a restriction against trucks.
    - Mike added there is a length warning on Flagstaff Road, but no prohibition.
- Doug noted CR 97 was the original aggregate delivery route for the original dam construction.
- Doug noted that final destination on the west side is likely the landfill. There may be merchantable timber depending on market conditions at the time of the work, which Denver Water will continue to investigate.
- Doug added that there is not a lot of daily volume with the chipping disposal method.

Additional Questions

- Conrad asked if Denver Water has selected a landfill for the material.
    - Doug said the landfill on SH 93, south of SH 72 seems like a good candidate for the early clearing. He noted that landfill location is also a candidate for the later reservoir clearing.
- Mike asked once you get out to SH 119 where do you go from there? Are you still unsure of that final destination?
    - Doug said at this time Denver Water would be speculating. It could come back to the landfill on SH 93. That would be the best guess, but it will depend on market conditions, as well as energy producers.
        - Mike followed up that if we assume the west side goes to a landfill where would it go.
            - Doug said the material would be in tractor trailers rated for over the highway so Denver Water can make suggestions for a route based on that. He noted contractors take guidance from Denver Water and there can be contractual restrictions. Doug noted if there is input from agencies that there is a preferred route, Denver Water is open to suggestions.
            - Roberto suggested Denver Water not look at the route through US 6 to SH 58 due to emergency services limitations and difficulty responding if there is an incident.

            - Doug asked if trucks should then stay on SH 119. He also noted that as Denver Water gets closer to getting a proposal out for the tree removal work and learns more from the first phase of tree clearing, partners can coordinate on final routing.
- Roberto asked what the total volume coming out the west side would be.
    - Doug noted Denver Water does not have the exact percentage but probably that approximately 60% of the 24,000 tons is on the west side.
    - Doug noted Denver Water will get some additional input on routes from stakeholders as part of the March review.
- Steve Durian stated that he had heard commitments that nothing will go through the City of Boulder. Is that correct? And if so, what routes will you use?
    - Doug noted Denver Water has committed to not using Flagstaff Road for trucks.
    - Steve proposed the route could be SH 93 North to Table Mesa to SH 157 to SH 119 to Longmont. Is that still a possible route?
        - Doug noted that, while he isn't sure Denver Water would preclude City of Boulder roads, he can't think of reasons Denver Water would route traffic that way. If there is material going to a sawmill, trucks might use that route. It's more likely they would go SH 93 or I-70.
        - Roberto asked if SH 119 to Boulder Canyon was an option.
            - Doug said Denver Water is not sure we would use that route.
            - Mike asked that, once on SH 93 North toward Longmont, how will trucks go around City of Boulder? He noted the turn from Broadway is adequate but the turn to Table Mesa is tight. He noted it's complicated and would suggest Denver Water look at those areas.
            - Doug noted that Denver Water will be in an approval process for the tree removal with grading permits, which could include a haul route determination. He added that the only reason Denver Water is looking to Longmont is the sawmill.
            - Doug also noted Denver Water doesn't like the landfill option but is limited with time constraints and volume.
- Tim asked about the west haul route and whether the blue line on the map is a connection between the onsite point of departure, going toward SH 119. He noted that the intersection at Magnolia and SH 119 does not have auxiliary lane. Denver Water may want to evaluate that intersection earlier on in the process as well.
    - Doug noted Denver Water will add that to the traffic engineer study list.
- Doug noted Denver Water is updating some traffic impacts studies for the intersection and looking at the west side with preliminary studies. Denver Water saw agency comments in the 1041 comment that noted CDOT Region 4 interest. Denver Water will work on additional studies for Region 4 issues and connections. Doug added there will be separate traffic studies based on the area and there will be an overall traffic impact analysis with Boulder County focus, as well as studies tailored for Region 1 and Region 4 areas. He noted the Region 4 studies should capture Gilpin County interests as well.
    - Abel asked when those will be available for review.
        - Doug explained Denver Water is waiting on recreation to open this season to get updated traffic numbers. Denver Water will be spending the next four months updating what has been done previously since the traffic data has aged and will try to get Region 4 area around mid-summer.
- Rick discussed the access permit on SH 72 and Gross Dam Road and that he would like to see that application sooner rather than later. He noted that, as Doug explained, there is a lot of equipment and CDOT would prefer to bring that equipment through the improved intersection. He added that the new access would displace the current access and with that work there are some Right of Way acquisitions. He also noted these acquisitions are time consuming and stressed that it would be in Denver Water's best interest to get working on that soon.

- Doug agreed the sooner Denver Water can get that intersection improved the better. Denver Water is sending that message to Boulder County and think it will take 9 months for the property acquisitions.
- Rick added he cannot expedite that review process for the application.
  - Doug said Denver Water is leading that process and plans to dedicate the property acquisitions back to the respective agencies after project completion. Doug added Denver Water wants to be set on geometry before acquiring properties.
  - Mike noted Boulder County will not sign off on the access permit until after 1041 approval. Based on the schedule, that puts starting the access permit process in August and agrees that it is on Denver Water's radar. Mike also noted if the county were doing the property acquisition, they would wait to begin the acquisition until the roadway alignment was complete as well.

Union Pacific Railroad Coordination

November 2017 PowerPoint Presentation—Commodities by Rail Study

November 1, 2017, UPRR Commodity Delivery Meeting Minutes

April 26, 2018, Concept Rail To Truck Terminal System for Cementitious Materials Located At Union Pacific Railroad's Crescent Siding; Report prepared by Penta Engineering for Denver Water and Boulder County

September 19, 2018, UPRR Crescent Siding Field Meeting Minutes

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November 2017 PowerPoint Presentation—Commodities by Rail Study

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GROSS RESERVOIR EXPANSION PROJECT

DENVER WATER

COMMODITIES BY RAIL STUDY

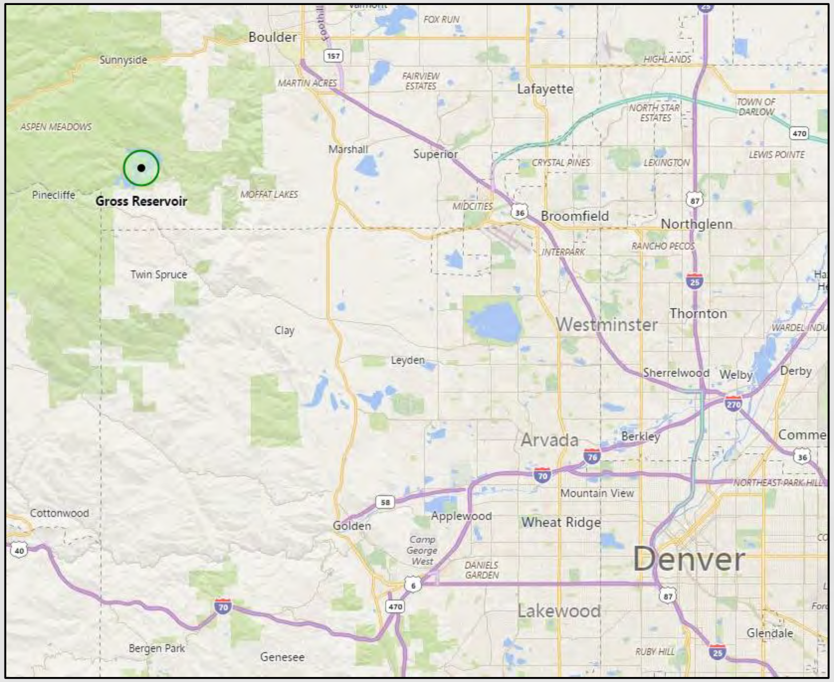
November, 2017

Project Status

- In January 2017, the Board of Water Commissioners authorized the expenditures for program management and design engineering services to support and achieve a construction completion by the end of 2025.
- Denver Water received the Army Corps of Engineers (Corps) ROD and 404 Permit on July 6, 2017.
- Denver Water completed all necessary steps and opportunities in the Federal Energy Regulatory Commission (FERC) license amendment process and now awaits the FERC decision, which is expected in 2018.

DENVER WATER

Gross Dam is Located in Boulder County

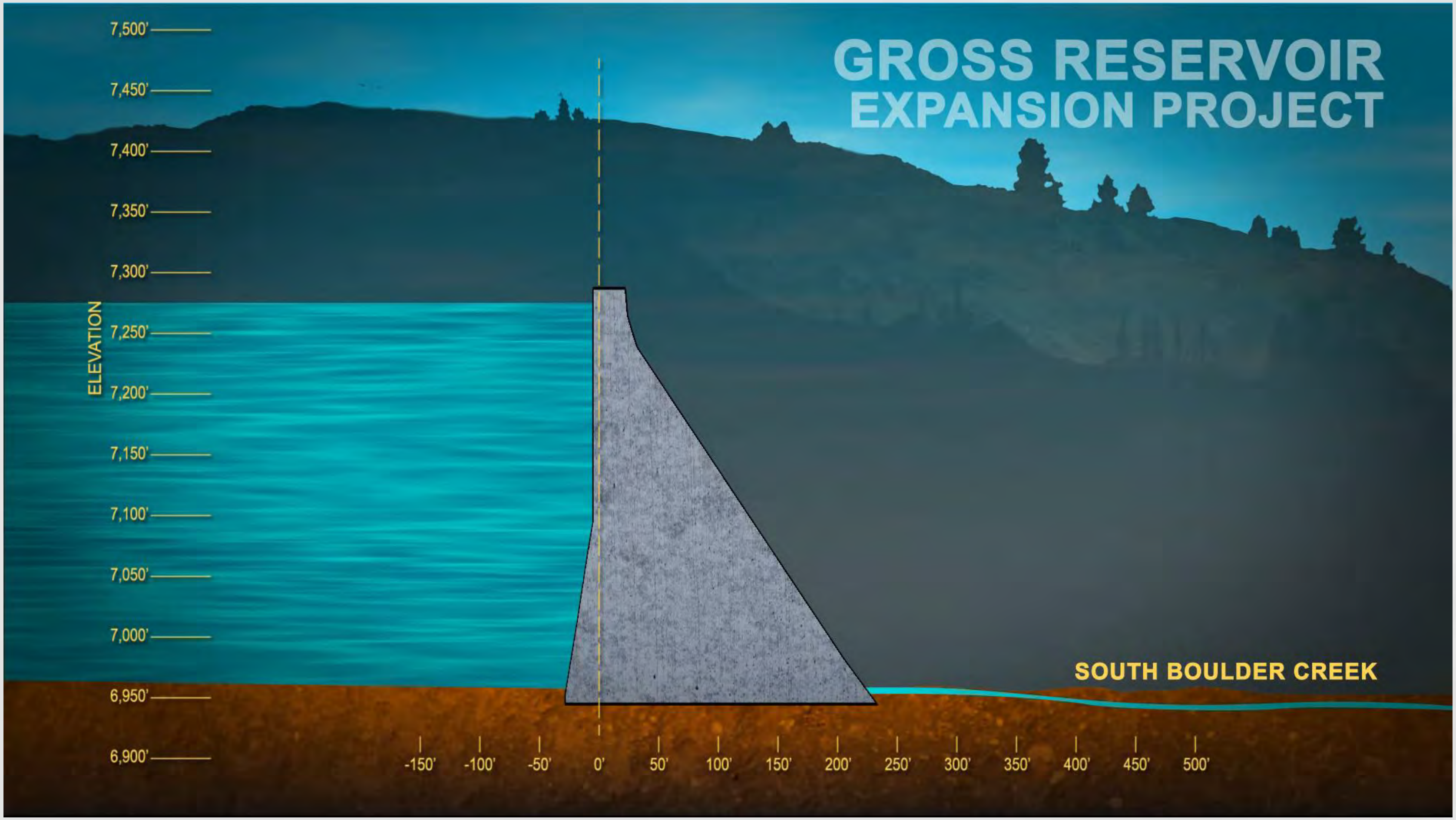


Gross Dam (Original)

- Built between 1951-1955
- 340 foot tall curved concrete gravity dam
- 627,000 cubic yards of concrete
- Impounds 41,811 acre-feet in Gross Reservoir
- Spillway over the dam crest in a controlled ogee section
- Original design was based on a future 125 foot raise
- Hydropower Generation added in 2007

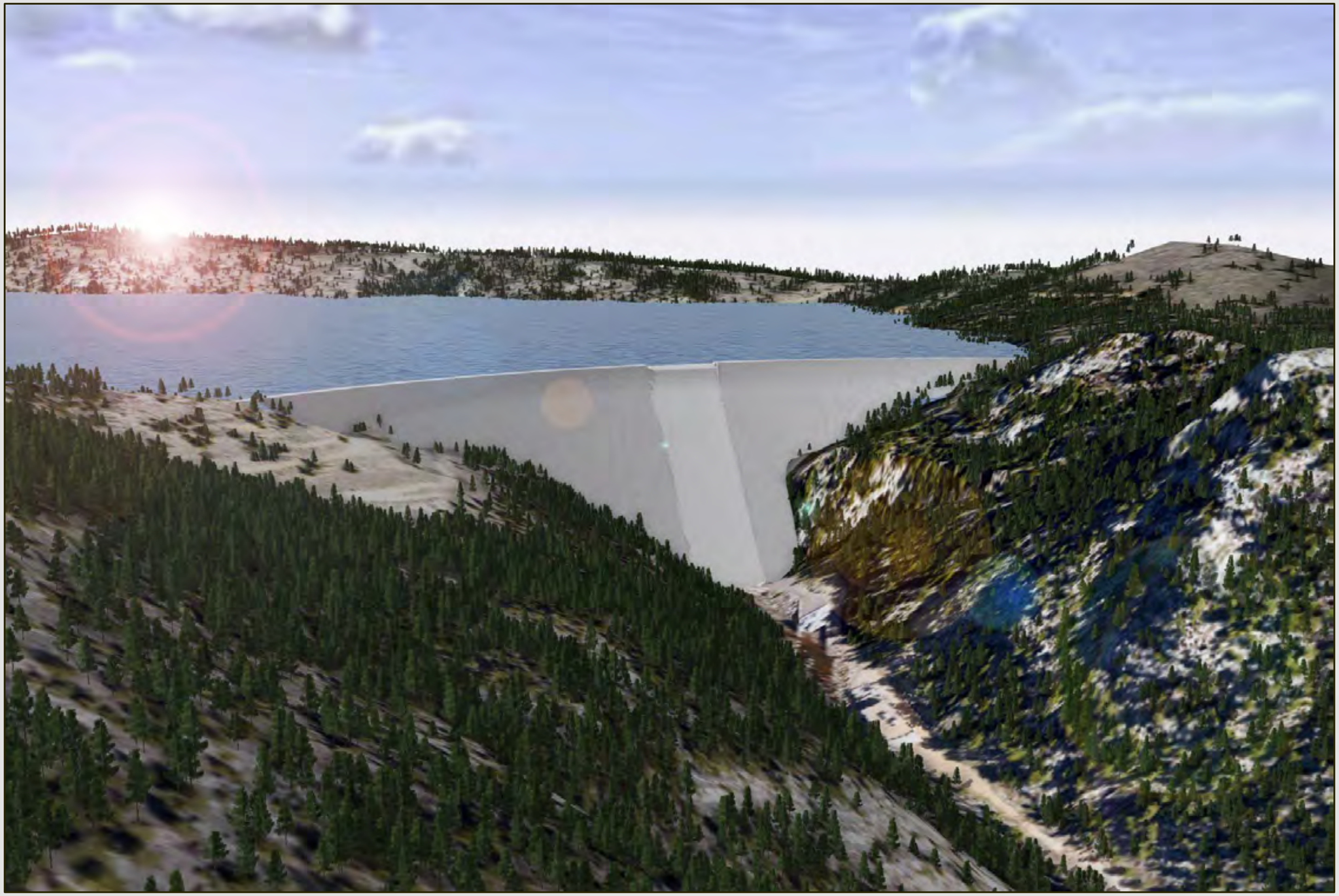
Existing Dam and Reservoir

Progression of Dam Raise



DENVER WATER

New Dam and Reservoir



DENVER WATER

Preliminary Engineering – Aggregate to be Site Produced

- On-site Quarry Study Indicates Fine and Coarse Aggregate Can Be Produced On-Site
- Cement and Flyash Require Import by Truck or Rail from Off-Site

Good quality and quantity

Feasible to make sand

Onsite material makes good concrete

Schedule

2017 – Get Ready

2018 – Design

2019 – Design & Test Quarry

2020 – Regulatory Approval, Bid, Quarry

2021 – Dam Prep and Quarry

2022 – Roller Compacted Concrete Raise Year 1

2023 – Roller Compacted Concrete Raise Year 2

2024 – Conventional Concrete Spillway

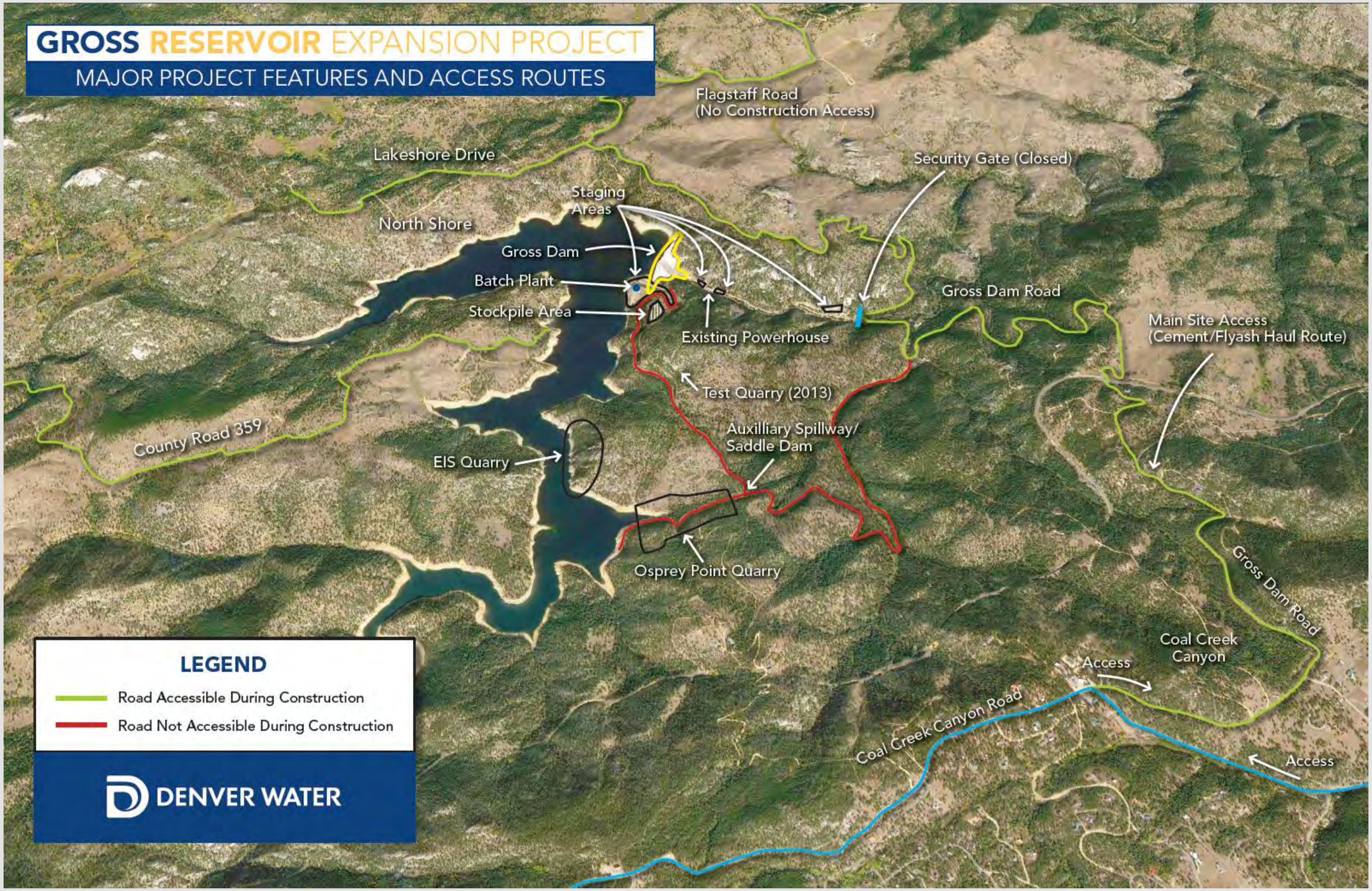
2025 – Tree Removal

Quantities

From 2015 Estimate

Element	Quantity
Roller Compacted Concrete	817,800 CY
Conventional Concrete	56,700 CY
Cement	77,900 Tons
Flyash	77,900 Tons

Access to Gross Dam Site



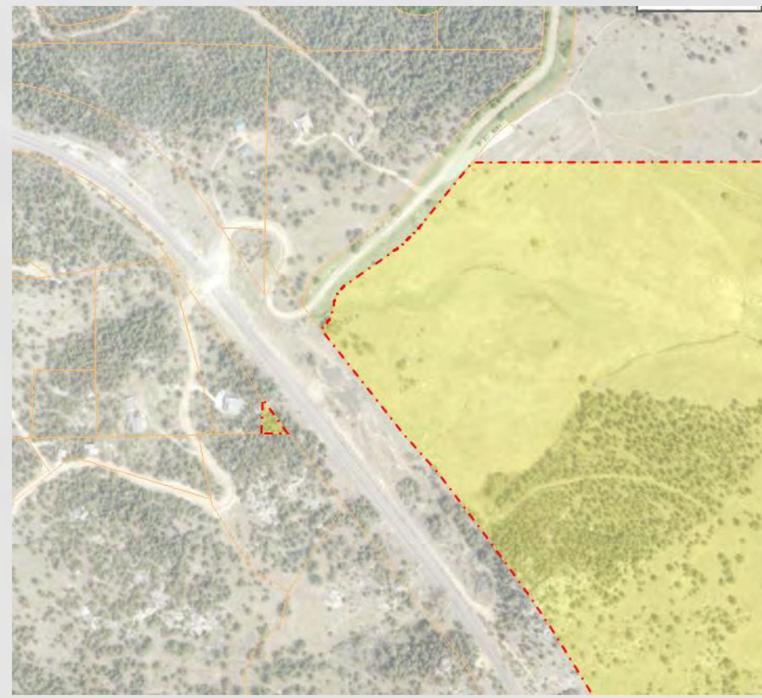
UPRR Siding at Gross Dam Road

- Double Track at Gross Dam Road Rail Crossing
- House Track on North Side of UPRR ROW Adjacent to State Property

Material Handling at UPRR Siding

- Property Adjacent to UPRR Siding Controlled by Colorado Parks and Recreation
- Easement Required from CPW to Erect Temporary Material Handling Facilities for Rail Car Offloading

Account Number:	R0039504
Owner:	STATE OF COLORADO
Mailing Address:	DEPT OF NATURAL RESOURCES 1313 SHERMAN ST STE 618
City:	DENVER CO
Zip:	80203-2240
Sec-Town-Range:	27 -1S -71
Subdivision:	TR, NBR 910 WALKER RANCH AREA
Parcel Number:	157900000030
Property Address:	2500 KNEALE
Location:	UNINCORPORATED



Rail Delivery Feasibility Considerations

- Maximum Daily Consumption of Cement and Flyash
- Batch Plant Storage Capacity of Cement and Flyash
- Storage Capacity of Cement and Flyash at Siding
- Offloading Capacity at Siding
- Rail Delivery Capacity, # of Cars, Turnaround Time
- Hours of Operation and Disruption Mitigation
- Reliability of Rail Delivery
- Cost of Rail Delivery vs. Alternatives

UPRR Siding Utilization Considerations

- Number of cars in unit train deliveries of cement and flyash – Determine maximum siding capacity
- UPRR will drop off the unit trains and Denver Water must have a locomotive or means to move the unit trains for offloading
- UPRR will grant Denver Water an easement to use the house track. UPRR will explore the potential re-alignment of the house track
- Rail car leases for cement and flyash

Rail Car Offloading Equipment

- Air slide – Capacity about 100T/hr
- For the cement products, they are almost exclusively using airslides and bucket conveyors.

Holcim Trident Site - Crescent Siding Facilities (from D Hertel email 7/21/14)

Action Going Forward

Assigned to	Action	Target Completion
Denver Water	Develop quantities and delivery windows for cement and flyash commodities	Q2 2018
Denver Water	Identify sources of cement and flyash being considered for the project	Q2 2018
Denver Water	Determine configuration for offloading facility at House Track siding	Q2 2018
UPRR	Determine weekly schedule for unit trains that House Track can accommodate and UPRR can service	Q2 2018
UPRR	Provide a form of agreement that UPRR would propose for House Track lease	Q4 2017

Questions?

November 1, 2017, UPRR Commodity Delivery Meeting Minutes

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DENVER WATER

Gross Reservoir Expansion Project

MEETING MINUTES

Meeting Title:	UPRR Commodity Delivery	**Date/Time:**	November 1, 2017/1pm
Prepared By:	Courtney Anstaett	**Location:**	UPRR Denver Office
Reviewed By:	Doug Raitt	**Project Number**	195942 – 1.7.7

Meeting Purpose

Updating UPRR on potential services they may be able to provide the Gross Reservoir Expansion.

Team Members in Attendance			
Doug Raitt	Jeff Martin	Greg Zamensky	Frank Forlini III (point of contact)
Melissa Meier	Brian Leslie	LT Griffin	

Meeting Notes

I. Overview of the current project status and needs for the Gross Reservoir Expansion (see attached PowerPoint)
    a. Denver Water has secured a 404 Permit from the US Army Corps of Engineers for the Gross Reservoir Expansion (GRE) project.
    b. A design consultant will be selected in December, 2017 to advance the design of the project.
    c. The project is to be complete by 2025. Site work will start in 2020.
    d. Fine and coarse aggregate for the dam concrete will be produced on site.
    e. Denver Water is renewing a feasibility study of rail delivery of cement and fly ash to the UPRR Crescent siding adjacent to Gross Dam Road.
    f. Approximately 875,000 cy of concrete is required. 77,900 tons of cement and 77,900 tons of fly ash may be required. Final quantities will depend on the approved design of the dam.
    g. A delivery terminal for cement and fly ash is being studied at the Crescent siding. The original dam construction utilized this location for material deliveries.
    h. Temporary use of the adjacent Colorado Parks property would be required in addition to the UPRR property.

II. Services UPRR can provide
    a. Leasing of track
        i. 1200 FT @ $8 ft./yr.
    b. Leasing property at off load site
    c. UPRR picks up cars at producer and delivers to “Crescent” site, and return to origin
    d. Trains would likely be “specials”
        i. 12 hour cycle time to avoid multiple crews.
            1. Crew would unload
    e. Action Item: Melissa Meier to provide approved rail contractors

f. Action Item: Frank Forlini to provide Sample Track Agreement

III. Action by Denver Water

a. Denver Water to provide a material consumption estimate to help UPRR determine delivery requirements.
b. Both parties will meet in early 2018 to provide a status update for ongoing efforts.

**Actions Item Log is attached*

April 26, 2018, Concept Rail To Truck Terminal System for Cementitious Materials Located At Union Pacific Railroad's Crescent Siding; Report prepared by Penta Engineering for Denver Water and Boulder County

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GROSS RESERVOIR EXPANSION
CONCEPT RAIL TO TRUCK TERMINAL SYSTEM
FOR CEMENTITIOUS MATERIALS
LOCATED AT UNION PACIFIC RAILROAD'S CRESCENT SIDING

Presented to:

DENVER WATER

BOULDER COUNTY, CO

Prepared by:

PENTA®
PENTA Engineering Co. LLC
www.pentaengineering.com

Project No. 2018-0313

April 26, 2018

EXECUTIVE SUMMARY

I. PURPOSE

Denver Water is planning to raise the concrete dam at Gross Reservoir to increase the water storage capacity. To support this objective, roads and infrastructure have to be improved and additional infrastructure will be required to minimize impact to area residents by reducing the total amount of traffic on the rural roads.

PENTA Engineering Corp. LLC. (PENTA) was commissioned to perform a conceptual level study for a temporary cement distribution terminal located at the Crescent Siding of the Union Pacific Rail Road (UPRR). The terminal will receive and store shipments of cement and fly ash by rail at this terminal, which will be shipped by trucks to the ready-mix plant(s) located at or close to the proposed dam site.

II. FINDINGS

PENTA evaluated two options.

(1) The first option would be to unload the railcars using a pneumatic conveyance system to a storage silo and then to the cement trucks.

(2) The second option would be to unload railcars using a mechanical conveyance to a storage silo and then to the cement trucks.

The terminal would be positioned near the center of the Crescent Siding, which is readily accessible and is located south of the intersection of the UPRR main line and Gross Dam Road. Drive time over the existing roads from the UPRR crossing to the dam site is approximately 17 minutes and is 20 minutes using the paved Highway 72.

- For the new Gross Reservoir project, Denver Water estimates that 75,000 tons of cement and 75,000 tons of fly ash will be consumed over two construction seasons. Each annual construction season is of 33-week duration.
- A ratio of 1:1 cement to fly ash is considered for rail car unloading, terminal storage and truck loading
- The maximum combined storage capacity required for one week is 7,000 tons of cement and fly ash. However, it is predicted that there could be four (4) occurrences requiring combined storage of 5,000 tons in one week, and several weeks just below this amount. For this study, the terminal design is based on storage/week of 5,000 tons consisting of 2,500 tons of cement and 2,500 tons of fly ash.

- The Crescent Siding has 1,200 linear feet of tracks including two switches. This will stage 20 rail cars, 10 full cars to be offloaded and 10 empty cars ready to be returned.

- The Crescent Siding is built on fill that was placed on a virgin hill side, which will require extra care during construction of the rail unloading pit. There are three sets of tracks on this fill. The need to minimize earth excavation to build the unloading pit for withdrawal, favors a pneumatic system over a mechanical system.
- Although we have studied a direct rail to truck system option using transloaders, the required high capacity conveyance makes it unsuitable for this specific operation.
- For the mechanical railcar withdrawal system, the unloading pit will require deeper excavation under the trucks, sheets piles to protect the adjacent sets of track and higher cost. The pneumatic conveyance system requires shallow pits.
- The pneumatic conveyance system together with a storage silo for this application will require a much shallower pit than the one for option discussed before.
- The storage silos were sized to have 3 days of storage for the cement and the fly ash. Since the fly ash density is approximately half the density of cement, the storage volume required for the fly ash is twice that of the cement. Therefore, we have included two silos for fly ash, each with a capacity of 550 tons and one silo for cement with a capacity of 1,100 tons.
- The electrical scope of work includes supplying approximately 1,100 ft of power line to power the facility. Additionally, the electrical scope of work includes designing and supplying the MCC's and controls for operating the facility. The MCC will consist of approximately 25 buckets for 21 motors and for providing power to the office area and control panel. PLC control of the system will be accomplished using an Allen-Bradley CompactLogix PLC to control the flow of material from the rail car unload to the appropriate silo and then the subsequent loading of trucks from the silo. The design also includes all necessary lighting for the temporary terminal.

A. CAPITAL COST ESTIMATE

The project costs including salvaging for a terminal with 1,100 tons each of cement and fly ash storage is estimated at **$ 9,300,000** for the pneumatic system. A comparison of the costs appears below:

	Cost
Cost with 2200-ton storage and pneumatic conveyance	$ 9,300,000
Cost with 2200-ton storage and mechanical conveyance	$ 9,200,000

The assumptions, details and the basis of the capital cost estimates for the above are shown after Appendix "C".

B. PROJECT SCHEDULE

This project construction schedule will be approximately the same duration irrespective of the system selected to load the silos and is estimated to take approximately 12 to 14 months from the time it is authorized. We estimate a pre-contract duration of six months for Denver Water's considering time for planning, EPC bid period, selection of EPC contractor, and award period. The temporary terminal would be located on properties owned by UPRR, Denver Water, and Colorado State Parks, we have assumed that the Land use agreements and /or permits will have been negotiated prior to start of the project.

III. RECOMMENDATIONS

To minimize initial modifications to the UPRR siding and minimize reclamation efforts in removing the equipment and structures at the completion of the dam project, PENTA recommends the terminal storage capacity of 2,200 tons of cement/fly ash storage with pneumatic equipment for unloading rail cars at a rate of 80 – 85 tph. The transfer rate this equipment provides is adequate to offload the 11 rail cars in a 16-hour period. Higher capacity rail car unloading systems would have the disadvantage of requiring larger below grade chambers and modification to the UPRR siding. The rail unloading equipment would be required to occupy the current UPRR maintenance road. Vehicles needing to go beyond this equipment will be required to go around the unloading area by crossing the Crescent Siding tracks. Costs have been included for the rail crossing.

PENTA has built several cement terminals throughout the United States since 2000 and is familiar with many different types of installation. PENTA is an engineering company with a Design-Build sister company licensed to operate in Colorado. PENTA's significant knowledge of, and hands-on experience in completing these types of projects from concept to start-up will be a significant benefit to this project and to Denver Water.

PENTA Engineering Company LLC

David Smith
Project Manager

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TABLE OF CONTENTS

APPENDICES

1. Introduction

Denver Water is planning on a complex project to raise the concrete dam at Gross Reservoir to increase the water storage capacity. To support the primary objective of raising the dam, a substantial investment is needed to improve the roads and infrastructure required for supporting construction.

Denver Water is in the planning stage of the project and exploring various options to minimize impacts to area residents by reducing the total amount of traffic on the rural roads. PENTA Engineering Corp. LLC. (PENTA) was commissioned to perform a conceptual level study to define a temporary cement distribution terminal located at the Crescent Siding of the Union Pacific Rail Road (UPRR). The intent is to receive shipments of cement and fly ash by rail at this location. and transfer to trucks.

Shipments of cement and fly ash would be off loaded from rail cars and conveyed into storage silos. From the storage silo the materials would be transferred to trucks that will transport the cement and fly ash to the construction site that is required to batch the massive amount of concrete required to widen and raise the dam to the desired height. Construction duration is estimated to require two annual 33-week construction seasons.

2. Findings

The terminal would be positioned near the center of the Crescent Siding. The area is readily accessible and is located south of the intersection of the UPRR main line and Gross Dam Road. Drive time over the existing roads from the UPRR crossing to the dam site takes approximately 17 minutes, and the crossing is located 20 minutes from the paved Highway 72.

There are numerous system configuration and equipment options for rail to truck terminals. Three systems were considered (pneumatic loading of silos, mechanical loading of silos and direct transloading). Transloading was discounted due to lack of storage and the mechanical and pneumatic options were selected based upon various design constraints. The Crescent Siding Terminal has been configured as follows:

- To handle both fly ash and cement materials
- The bulk density for volume calculations of cement is 88 lbs. per cu. ft. and for fly ash is 45 lb. per cu. ft.
- Designed to handle combined cement and fly ash 5,000 tons per week
- Designed to minimize initial disturbance of the UPRR rail siding and subsequent efforts to remove equipment and demolish structures required to return the site to original condition
- To systematically unload 10 rail cars in 24-hour period
- To provide storage capacity for a 3-day supply of cement and fly ash

- To concurrently load cement and fly ash into trucks at a rate commensurate with anticipated peak construction demands
- To have high reliability
- To off load trucks into the silos which provides additional flexibility and confidence in the ability to supply materials for construction

Land use agreements and local construction permits will be required. Logistics with suppliers and rail road deliveries will be critical as the siding can only accommodate 20 rail cars. In coming deliveries would be 10 rail cars. After delivery, the locomotive would immediately remove 10 empty rail cars. Removing the empty rail cars immediately is critical to create space for the unloading process.

Terminal Configuration

1. Control dust emissions, noise and environmental impacts
2. Crescent Siding 1,200 ln. ft. with two switches will stage 20 rail cars, 10 full cars to be offloaded and 10 empty cars ready to be returned.
3. Near peak consumption is 5,000 tons per week for several weeks. The highest (peak) demand is 7,000 tons, which is projected to last only 1 week throughout the construction period.
4. The ratio of cement to fly ash is 1:1.
5. Rate commensurate with consumption of 5,000 ton per week will be to unload 10 rail cars in a 24-hour period
6. The rail car unloading rate would be 80 – 85 tph. This requires approximately 16 hours to transfer materials to storage which includes allowance for setting and moving the railcars during the unloading phase.
7. To provide a 3-day supply, the terminal includes storage for 1,100 tons cement and 1,100 tons fly ash.
8. Truck spout load transfer rate maximum is 350 tph for cement and 175 tph for fly ash.
9. The terminal includes two load spouts to load cement and fly ash into trucks, simultaneously.
10. Truck loading time at the terminal site is 15 minutes gate to gate. This includes time needed to open hatches, move truck under load spout, fill and trim truck, move truck and close hatches
11. Total trucks, each of 25-ton capacity, loaded per day will be 44 each for cement and fly ash at near peak demand. Terminal has capacity to load over 90 trucks, which is sufficient to meet or exceed peak demand periods.
12. Provisions are made to operate the terminal 24 hours per day to meet contractors demands
13. Two to three personnel are required to operate the terminal.
14. A Track Mobile is included to move rail cars.

To minimize initial modifications to the UPRR siding and reduce reclamation efforts to remove the equipment and structures after the project is completed, a pneumatic system with 80 – 85 tph unload rate has been selected for this study. The transfer rate this equipment provides is adequate to offload the 10 rail cars in a 16-hour period. Higher capacity rail car unloading systems would have similar costs but have the disadvantage of requiring larger below grade chambers and modification to the UPRR siding. The rail unloading equipment will occupy the current UPRR maintenance road. Vehicles needing to go beyond this equipment will be rerouted to go around the unloading area by crossing the Crescent Siding tracks. Railroad crossing is included in the estimated cost.

The temporary terminal would be located on properties owned by UPRR, Denver Water, and Colorado State Parks. Land use agreements will need to be negotiated and the temporary facilities are to be removed from other's properties upon completion of the project.

The amount of desired storage capacity at the terminal should consider the risks associated with extended delivery disruptions. The unit costs for increasing or decreasing storage capacity of the silos is approximately. Modifying storage capacity by a couple hundred tons does not significantly alter the base costs of the terminal.

Design and construction of the temporary terminal should be conducted by a firm experienced with the nuances of cement and fly ash handling. Material handling issues with terminals can be more complex and problematic than concrete batch plants. If not initially addressed correctly material handling issues produce operational problems that lead to delays and are costly to correct. Issues and design concerns include:

- Cement consolidation and pack-set issues that occurs in the rail cars and silos
- If grinding aid is utilized to manufacture the cement, over flow and flooding issues are common when the cement is aerated.
- Use of lump breakers, for materials have clumps, frozen or contain ice chunks
- Structural issues of the silos from resulting rat holing or uneven draw down
- Provide necessary hopper openers and mechanics to ensure rail cars are completely emptied
- Provide safe access to top of rail cars to visually confirm they are completely emptied
- Sufficient dust control at the unload station is provided
- Reduce number of mechanical transfer points to minimize potential dust emissions points.
- Reduced fan, blower and compressor noise levels for area residents and the State Park
- Provide both positive and negative pressure relief on the silos
- Protect loading spout from inclement weather
- Provide systems so that truck drivers can load their own trucks
- Protect loading spout from truck inadeptly moving away from the load station with it still engaged
- Provide access to open and close hatches for the trucks

The criteria utilized for this evaluation will need to be confirmed for final designs along with logistics of receiving rail cars and dispatching trucks

2.1 Terminal Costs

The project costs including salvaging for a terminal with 1,100 tons each of cement and fly ash storage is estimated at:

CapEx with Pneumatic System:	$ 9,300,000
CapEx with Mechanical System:	$ 9,200,000

2.2 Schedule

Procurement of equipment and construction of the terminal will require approximately 12 - 14 months after an award. It is unknown how schedule may be affected due to road construction and other dam infrastructure projects.

Denver Water makes decision	24 wk
Award Terminal Contract	2 wk
Procure Equipment and Construct	52 - 60 wk

2.3 Rail Unloading and Truck Loading

Justification for amount of storage at the temporary terminal is based upon the risks and high costs associated with insufficient onsite storage and inventory to complete a mass concrete pours. Sufficient storage to sustain a mass concrete pour that allows time to correct any unforeseen disruption issues should be considered.

It is understood that the project will include the upgrade of several miles of paved roadway and widen the existing gravel roads to the construction site. Utilizing the Crescent Siding will reduce road use from the paved highway 72 to the Crescent Siding by approximately 88 truck trips per day at near peak consumption.

Due to the importance of having adequate cement and fly ash supplies to batch concrete and avoid disrupting mass pours, the storage capacity of the terminal has been based upon 3 days for combined weekly consumption rate 5,000 tons of cement and fly ash equating to 357 tons of cement per day and 357 tons of fly ash per day.

The Crescent Siding will accommodate 20 rail cars. To keep pace with near peak consumption 10 full rail cars, need to be delivered in a 24-hr. period and 10 empty rail cars removed. UPRR and the cement and fly ash suppliers will need to refine and confirm final logistic requirements, define shipping limitations and identify delivery risks. This study is based upon receiving one shipment of 10 cars in 24-hour period.

Crescent Siding and Area of Interest for Terminal

Due to the topography the storage silos would be located about 90 ft from the track. There is an elevation difference of approximately 35 feet from the RR siding down to the silo foundation level. The UPRR access road would be utilized to access the rail unloading area. A new access road would be constructed for the truck loading area. Temporary scaffold stairs will be placed along the slope for personnel to walk between the two areas.

Future Terminal Access Entry

Looking Toward Terminal Area Standing at Future Entry

UPRR Crossing at Gross Dam Road

UPRR Access Road Crescent Siding

UPRR Crescent Siding Switch

UPRR Crescent Siding, Trucks Parked Near Unloading Area
from Left to Right, Siding Track, Parking Track and UPRR Main Line

Future Terminal and Silo Area

2.3.1 The Terminal Facility Includes:

1. UPRR Crescent Siding 1,200 ln. ft. switch to switch with a storage capacity of 20 cars including room for locomotive and a Track Mobile

2. Track Mobile of approximately 1000 hp to shuttle rail cars at the siding having a slight grade.
3. Rail car access ladder and platform with safety cable for personnel to open and close hatches
4. Rail Car unloading mechanical system with minimum unloading rate of 80 – 85 tph for cement and 40 – 42 tph Fly ash
5. Pneumatic piping to top of silos with diverter valve and long radius wear back flanged elbows.
6. Gravel access roads
7. Separate storage silos for cement and fly ash with capacity to store a 3-day supply
8. Dust collection at the rail car unload station, top of silos and load spouts.
9. Truck access platforms to open and close hatches
10. Ability to load both cement and fly ash concurrently into trucks
11. Two independent truck loading mechanical systems with positioner and spouts
12. Spout transfer capacity maximum load rate of 350 tph cement and 175 tph fly ash
13. For emergency deliveries of cement and fly ash to the terminal by truck, provide fill lines for trucks to pneumatically unload product into the silos
14. Electrical utility tap and overhead power lines and disconnect
15. Compressor equipment and enclosure
16. Modular electrical room
17. Prefab Office or Trailer for Terminal employees and truck drivers.

At the end of the project, the equipment will be removed, all foundations demolished, and the terminal site returned to near original condition.

2.3.2 List of Major Mechanical Equipment

• Pneumatic rail car unload system and compressor system`	1 lot
• Diverter valve	1 ea
• Bin Vent dust collectors for each silo	3 ea
• Pressure Relieve Valve for silos	3 ea
• Truck Blow off lines	3 ea
• Silos	3 ea
• Maintenance and control gates	6 ea
• Silo Hopper Aeration System	3 ea
• Integral Dust Collection for Load Spout	2 ea
• Positioners	2 ea
• Load Spouts	2 ea
• Compressed air, dryer and receiver system	1 ea
• Compressed air piping	1 lot
• Scales	optional

- Rail access platform 1 ea
- Truck access platforms 2 ea

To meet 5,000 ton per week consumption rate, the rail unloading will have the capacity to off load and transport materials to the silos, approximately 4 rail cars of cement and 7 rail cars of fly ash are required in a 24-hour period. Selection of equipment for unloading at a rate of 80 - 85 tph of cement should be adequate if substantial storage silos are provided. At the 80 – 85 tph. rate, this would require about 16 hours to move and offload 11 rail cars. During construction of the dam, it is assumed that truck loading will be performed 24 hours per day, 7 days per week. Personnel will be able to simultaneously load trucks and off load the rail cars. A short disruption may occur when personnel are moving rail cars. This disruption can be eliminated if the truck drivers are trained to fill their own trucks. It will take about 1.3 hours to offload a rail car at an 80 tph rate. Due to bulk density differences for this study it is assumed that common sized rail cars are used to transport both materials. The rail cars would have fly ash capacity of 55 ton and the mechanical unloading equipment would offload at an adjusted rate of 40 tph.

- Unload 4 cars of cement at 80 tph rate plus 10 min to move cars = 6 hours
- Unload 7 cars of fly ash = 9 hours
- Delays and other = 1 hour

To support dam construction the truck loading portion of the terminal is assumed to operated 24 hours. per day during large pours. The maximum spout loading rate for cement would be at 350 tph, and due to a lower bulk density, 175 tph for fly ash. The total cycle time for a truck entering the facility on average is anticipated at 15 minutes gate to gate. This includes time to open truck hatches allow 2 minutes, spot truck under load spout allow 1 minutes, load and trim allow 7 minutes, and close hatches allow 2 minutes, and wait time allow 3 minutes.

APPENDIX "A"

Criteria and Assumptions for Concept Design

The following parameters and calculation have been considered for establishing the configuration and storage capacities of the temporary terminal.

1. Primary Mission

   - Support construction of the dam
   - Operating hours for dam construction 24 hrs. per day
   - Project duration expected to require two construction seasons
   - Terminal to be temporary and properties returned to original state
   - Prime contractor/terminal operator will be responsible for the logistics of UPRR deliveries and loading into trucks

2. Geotechnical and Storm Water Drainage Observations

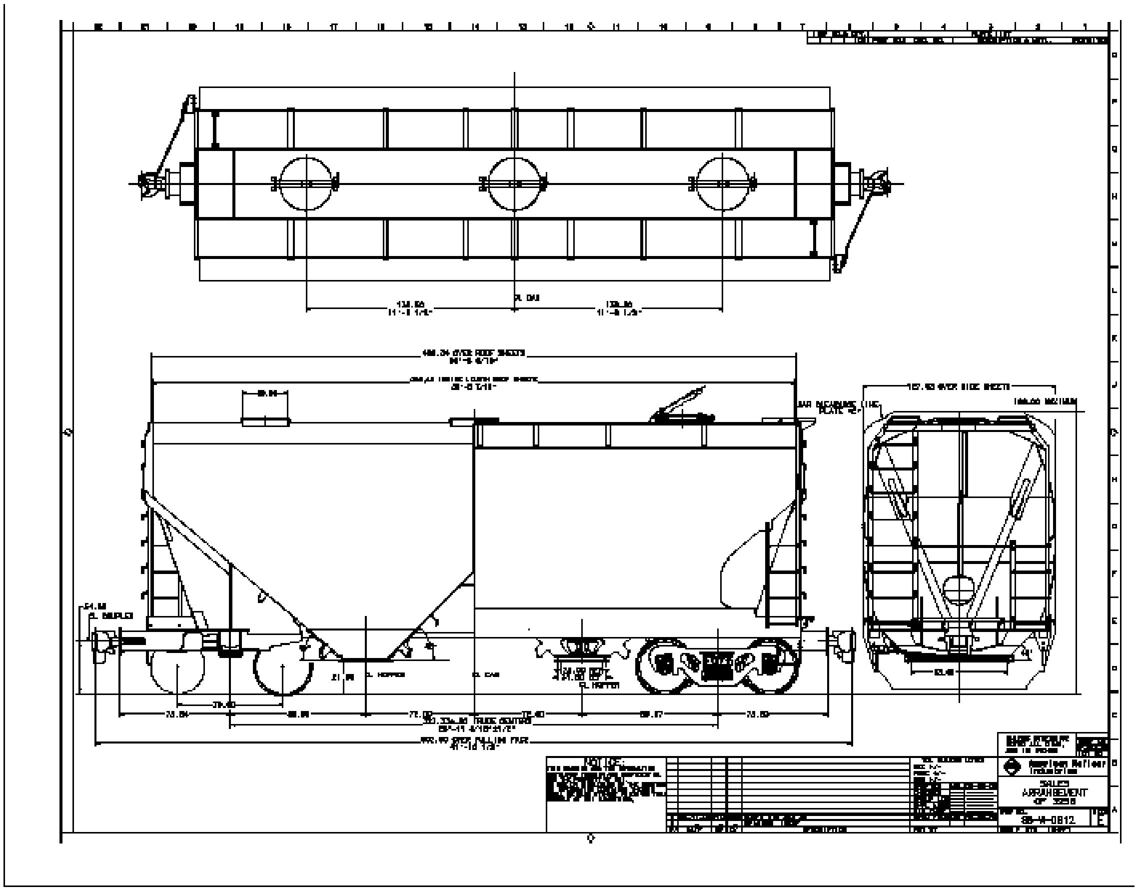
   - Based upon visual field observations terminal would be located on disturbed fill derived from the original construction the rail road and subsequent maintenance and erosion control activities. Outcropping rock was not observed in the area.
   - Detailed geotechnical subsurface data is not currently available
   - For costing purposes, assume the silos are located on disturbed fill extending to a depth of 15 ft depth.
   - Drainage in the targeted silo area appears to be sheet runoff with no significant erosion or drainage issues. The RR forms a break in the drainage patter and water is diverted away from the area.

3. UPRR and Crescent Siding

   - UPRR has three tracks in the area of interest that consist of a main line, a parking track, and the Crescent Siding Track.
   - There is a maintenance access road adjacent to the siding track
   - The UPRR siding is approximately 1,200 ft long
   - Manual RR switches are located at both ends of the siding
   - Usable storage length of the siding is approximately 900 ft (total length 1,200 ln. ft. switch to switch, deduct curve sections 150 ln ft, deduct space needed for Locomotive at both ends of siding 150 ln. ft).
   - Rail car length 45 ln. ft.
   - Number of rail cars on siding 20 each

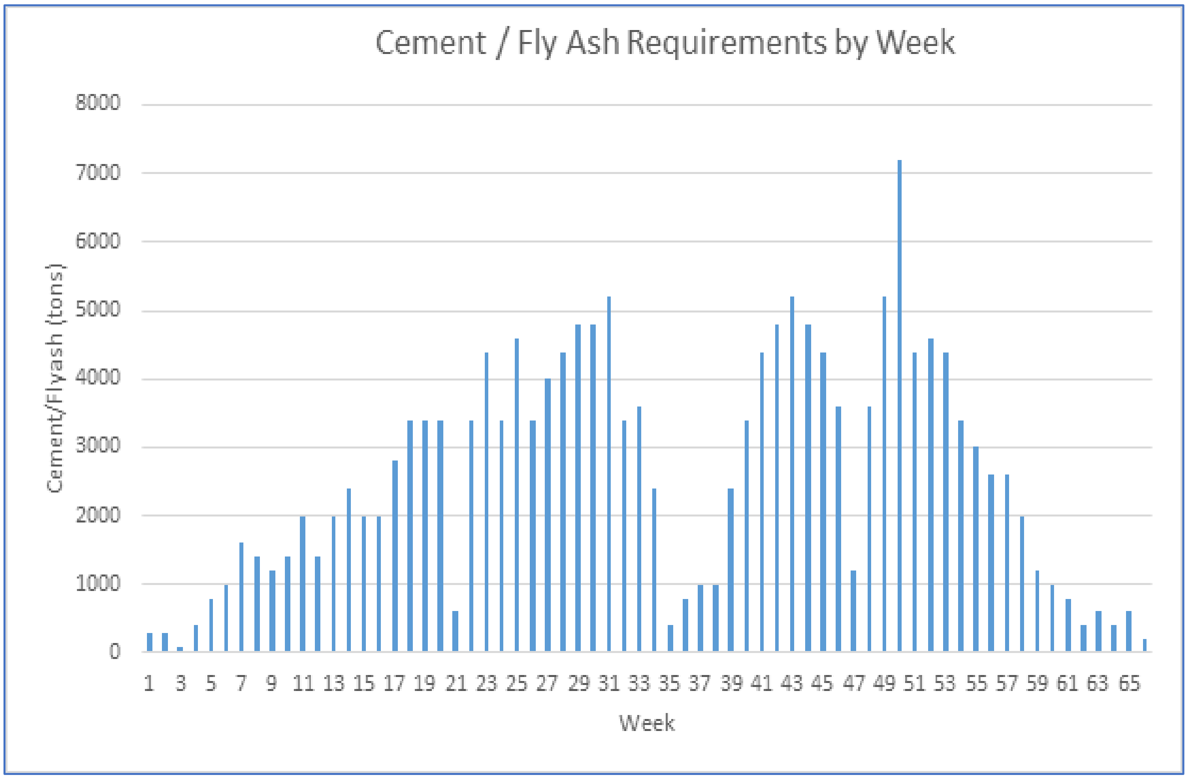
4. Rail Car and Truck Data

   - Capacity of rail car considered 110 tons of cement or 55 tons of fly ash
   - Rail car models use average length of 45 ln. ft.
   - Rail car are gravity bottom dump containing two discharge points
   - Rail cars used for cement and fly ash have same discharge hopper dimensions
   - Truck capacity of cement 25 tons per load
   - Truck capacity of fly ash 12 tons per load



5. Cement and Fly Ash

- Cement 88 lbs. per cu. ft.
- Fly ash 45 lbs. per cu. ft.
- Ratio of 1:1 cement and fly ash considered for rail car unloading, terminal storage and truck loading.
- Cement/fly ash requirement by week design rate considered 5,000 tons, 2,500 tons of cement, 2,500 tons of fly ash
- Dam construction during mass concrete placement 24 hr. per day by 7 day per week
- Cement transfer from storage to truck design rate 357 tons per day (1:1 ration x 5,000 ton per week / 7 day per week)
- Fly ash transfer from storage to truck design rate 357 tons per day (1:1 ration x 5,000 ton per week / 7 day per week)
- Denver Water's estimated total consumption for the project is 75,000 tons cement and 75,000 tons fly ash to be consumed over two construction seasons



Denver Water Usage Chart

6. Rail Unload Equipment

- Cement 88 lbs. per cu. ft.
- Fly ash 45 lbs. per cu. ft.
- Access and safety rail required to access to top of rail cars to open and close hatches.
- For near peak consumption, unload 357 tons per day cement and fly ash 357 tons per day
- Utilize unloading equipment that reduces amount of excavation and modification to UPRR siding track bed.
- There is insufficient room between tracks to locate structural columns per UPRR design standards.
- Unload rate of cement for pneumatic equipment 80 - 85 tph.
- Unload time for cement approximately 5 hours per day
- Unload rate of fly ash for pneumatic equipment 40 – 45 tph.
- Unload time for fly ash for pneumatic equipment 9 hours per day
- Total rail car unloading time near peak consumption 15 (9 + 6) hours per day plus 1-hour shuttle cars = 16 hours per day.

7. Cement and Fly Ash Storage

- The amount of desired storage is a preferential decision that ultimately is based upon the final logistic consumption details and the risks associated with both disruptions of the rail road and or truck transport.
- Due to importance of not disrupting concrete placement and considering the potential for significant disruption of deliveries, allow for 3 days of storage
- Near peak cement consumption 357 ton per day x 3 days allow 1,100 tons silo storage capacity.
- Near peak fly ash consumption 357 ton per day x 3 days allow 1,100 tons for silo storage capacity.

8. Truck Loading

- Consumption schedule may require load of trucks 24 hours per day
- Cement trucks per day near peak consumption 14 trucks at 25 ton per load
- Fly ash trucks per day near peak consumption 30 trucks at 12 ton per load
- Total trucks per day 44
- Typical spout load rate 350 tph cement, 175 tph fly ash
- Cycle time to open hatch, fill truck and close hatch 15 minutes
- Total time during 24-hour period to load 44 trucks = 11 hours per day
- Truck scales are optional and may be dependent upon the contractual requirements to track the amount of material trucked from the terminal.

9. Terminal Access Roads and Civil

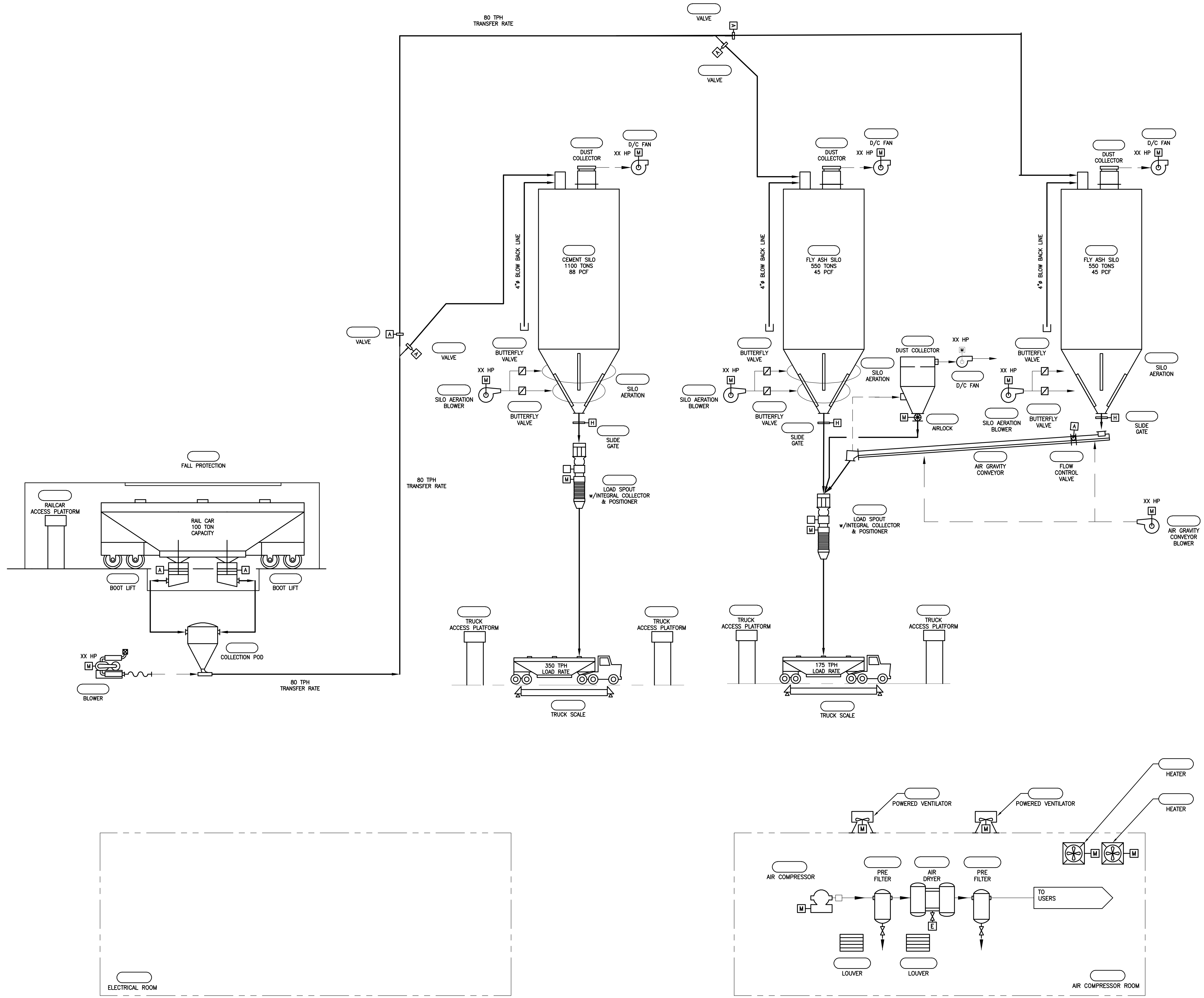
- Construct gravel roads and expand entry from Gross Dam Road
- Relocate area fencing
- Provide lockable gates at entry and UPRR access road
- Clear and grub trees from the area
- Reclaim area after removal of equipment and demolition of foundations

10. Terminal Operation

- Requires 2 personnel to operate the terminal and move rail cars. Maintenance personnel will be needed to repair equipment on an as needed basis.
- A temporary construction type trailer or modular unit will be adequate for personnel.
- Porta Jon is utilized for sanitary.
- Bottled water is utilized for potable water.
- It is assumed that the area cellular service systems will be upgraded to facilitate communications with the truck drivers and the concrete batch plant.

APPENDIX “B”

Flowsheet and General Arrangement Drawings



LEGEND

EQPMT-NO / DESCRIPTION	EQUIPMENT NUMBER WITH DESCRIPTION
QUANTITY	EXPECTED OPERATING QUANTITY
CAPACITY	EQUIPMENT DESIGN CAPACITY

A	PNEUMATIC OPERATOR	H	MANUAL OPERATOR
E	ELECTRIC OPERATOR	C	COMBUSTION ENGINE
F	HYDRAULIC OPERATOR	M	ELECTRIC MOTOR
G	GRAVITY OPERATOR	VS	VARIABLE SPEED

LINE STYLES — LINE DEFINITIONS

- EXISTING EQUIPMENT
- NEW EQUIPMENT
- FUTURE FLOW
- NEW FLOW
- FUGITIVE DUST COLLECTION
- WATER SUPPLY
- SLURRY
- COMPRESSED AIR

DEFINITIONS OF UNITS

AP	AMBIENT PRESSURE	in WG
AT	AMBIENT TEMPERATURE	°F
DP	DEW POINT	°F
F	FLUID FLOW RATE	gpm
FD	FLUID DENSITY	lb/ft3
FM	FLUID MASS FLOW RATE	lb/min
FP	FLUID PRESSURE	psi
GA	ACTUAL GAS FLOW RATE	acfm
GD	GAS DENSITY	lb/ft3
GH	GAS MOISTURE (VOLUME)	%
GM	GAS MASS FLOW RATE	lb/min
GN	STANDARD GAS FLOW RATE (70°F)	scfm
GP	GAS STATIC PRESSURE	in WG
GP1	GAS STATIC PRESSURE	psi
GV	GAS VELOCITY	ft/min
LA	DUST LOADING	gr/acf
LN	DUST LOADING	gr/scf
M	MATERIAL FLOW RATE (DRY)	stph
M1	MATERIAL FLOW RATE (WET)	stph
MD	MATERIAL BULK DENSITY	lb/ft3
MH	MATERIAL MOISTURE (MASS)	%
MP	MOTOR POWER RATING	hp
Q	DRY LHV HEAT FLOW RATE	Btu/hr
Q1	DRY LHV HEAT FLOW RATE	10^6 Btu/hr
QS	DRY LHV SPECIFIC HEAT CONSUMPTION	10^6 Btu/ton
R	EQUIPMENT ROTATIONAL SPEED	rpm
SB	SPECIFIC SURFACE (BLAINE)	cm2/g
S1	MAXIMUM SIZE	inch
S2	RETAINED – 50 MESH	%
S3	RETAINED – 170 MESH	%
S4	RETAINED – 200 MESH	%
S5	RETAINED – 325 MESH	%
S6	RETAINED – 400 MESH	%
S7	80% PASSING XX SIZE	um
T	TEMPERATURE	°F

PRELIMINARY

NOT FOR CONSTRUCTION

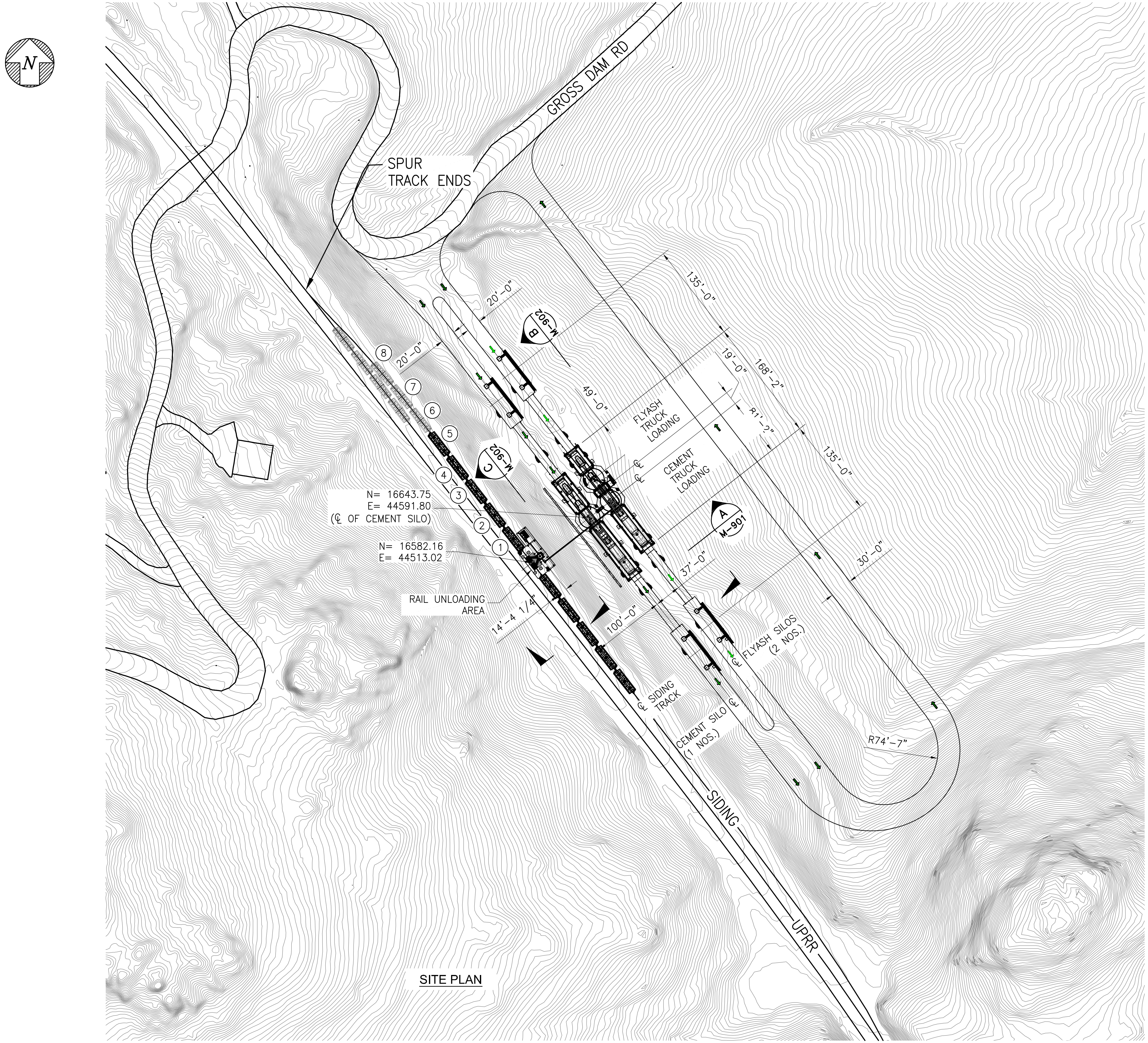
REV.	DATE	DESCRIPTION	BY	CHKD.	APPR.
A	20APR18	ISSUED FOR REVIEW	FG	–	DH

PENTA
PENTA Engineering Co. LLC
10123 Corporate Square Drive, St. Louis, MO 63132-2905
www.penta.net; Phone: 314-878-0123; Fax: 314-878-0120

DENVER WATER

GROSS RESERVOIR EXPANSION, BOULDER, CO
CONCEPT TERMINAL DESIGN
MECHANICAL
FLOW DIAGRAM

DESIGNED: GEARHEART	DATE: 23MAR18	PENTA DRAWING NUMBER	180313-M-001	REV. A
DRAWN: GEARHEART	DATE: 24MAR18	CLIENT DRAWING NUMBER		
CHECKED: –	DATE: –			
APPROVED: HADZISELIMOVIC	SCALE: NONE			



SITE PLAN

PRELIMINARY
NOT FOR CONSTRUCTION

REV.	DATE	DESCRIPTION	BY	CHKD.	APPR.
A	20APR18	ISSUED FOR REPORT	SM	–	DH

PENTA
PENTA Engineering Co. LLC
10123 Corporate Square Drive, St. Louis, MO 63132-2905
www.penta.net; Phone: 314-878-0123; Fax: 314-878-0120

DENVER WATER

GROSS RESERVOIR EXPANSION, BOULDER, CO
CONCEPT TERMINAL DESIGN
GENERAL ARRANGEMENT
SITE PLAN

DESIGNED:	MHASKAR	DATE: 23MAR18	PENTA DRAWING NUMBER	180313-M-900	REV. A
DRAWN:	MHASKAR	DATE: 24MAR18	CLIENT DRAWING NUMBER		
CHECKED:	–	DATE: –			
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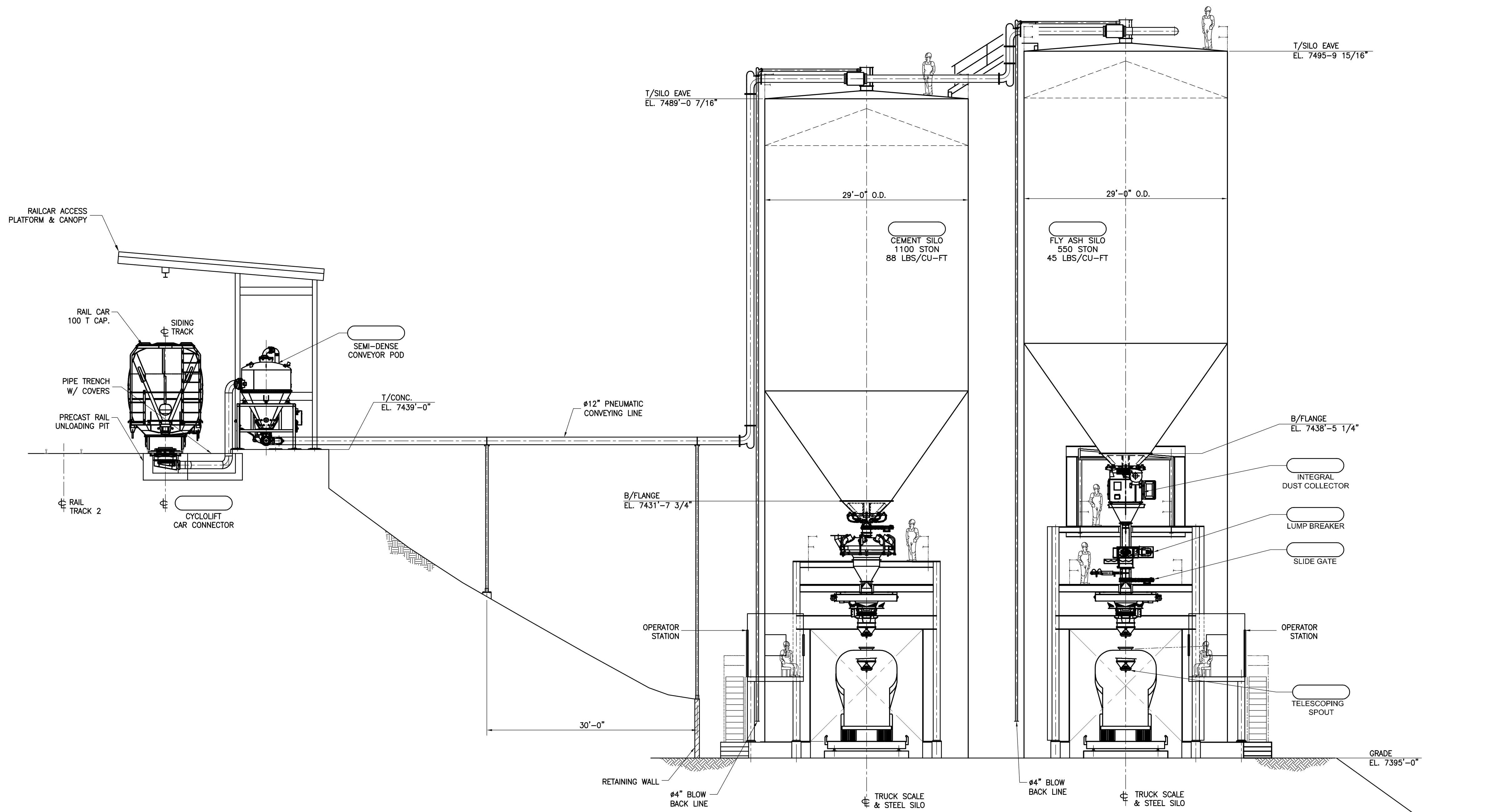

SECTION A M-900

PRELIMINARY
NOT FOR CONSTRUCTION

REV.	DATE	DESCRIPTION	BY	CHKD.	APPR.
A	20APR18	ISSUED FOR REPORT	SM	–	DH

PENTA
PENTA Engineering Co. LLC
10123 Corporate Square Drive, St. Louis, MO 63132-2905
www.penta.net; Phone: 314-878-0123; Fax: 314-878-0120

DENVER WATER

GROSS RESERVOIR EXPANSION, BOULDER, CO
CONCEPT TERMINAL DESIGN
MECHANICAL
SECTION A

DESIGNED:	HAAS	DATE:	23MAR18	PENTA DRAWING NUMBER	REV.
DRAWN:	BHOIR	DATE:	23MAR18	180313-M-901	A
CHECKED:	–	DATE:	–	CLIENT DRAWING NUMBER	
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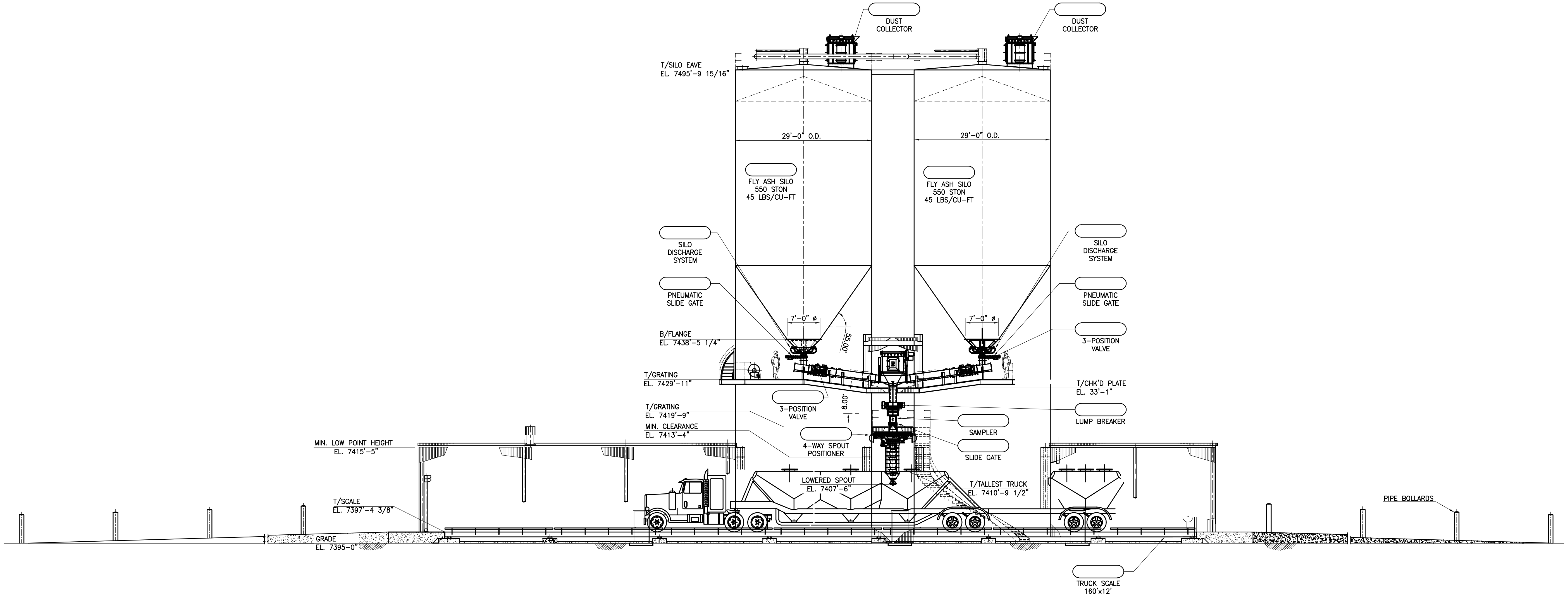
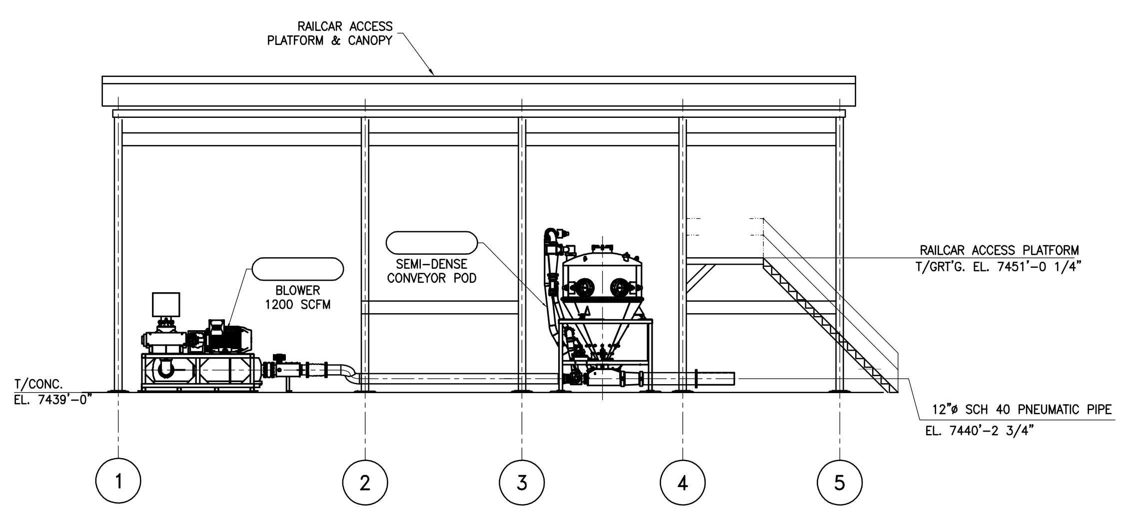


SECTION B / M-900



SECTION C / M-900
1/8"=1'0"

PRELIMINARY
NOT FOR CONSTRUCTION

REV.	DATE	DESCRIPTION	BY	CHKD.	APPR.
A	20APR18	ISSUED FOR REPORT	SM	–	DH

PENTA
PENTA Engineering Co. LLC
10123 Corporate Square Drive, St. Louis, MO 63132-2905
www.penta.net; Phone: 314-878-0123; Fax: 314-878-0120

DENVER WATER

GROSS RESERVOIR EXPANSION, BOULDER, CO
CONCEPT TERMINAL DESIGN
MECHANICAL
SECTIONS B & C

DESIGNED:	HAAS	DATE:	23MAR18	PENTA DRAWING NUMBER: 180313-M-902	REV. A
DRAWN:	BHOIR	DATE:	23MAR18	CLIENT DRAWING NUMBER	
CHECKED:	–	DATE:	–		
APPROVED:	HADZISELIMOVIC	SCALE:	3/32"=1'0"		

APPENDIX "C"

Capital Cost Estimate

	DENVER WATER				
	GROSS RESERVOIR DAM PROJECT				
	CRESCENT SIDING WITH 1,100 tons CEMENT AND FLY ASH STORAGE				
	CONCEPTUAL TERMINAL RAIL TO TRUCK				
	PRELIMINARY OPINION OF COSTS				
	April 27, 2018 Rev 0				
Line No.	**Description**	**Factor**	**Pneumatic Option Total $**		**Mechanical Option Total $**
1	Contractor General		$ 167,000		$ 167,000
2	General Site Work and Construction Roads		$ 261,000		$ 261,000
3	Terminal Access Roads with Chip and Seal Paving for Dust Control		$ 70,000		$ 70,000
4	Piles and Deep Foundations		$ 216,000		$ 216,000
5	Railroad Siding Modifications and Remove at End of Project		$ 67,000		$ 126,000
6	Slope Access Stairs		$ 37,000		$ 37,000
7	Rail Unloading System Transport to Silos		$ 637,000		$ 648,000
8	Pneumatic Pipe to Silos with Diverters		$ 187,000		not in option
9	Foundations Silos, Office Building, Supports		$ 818,000		$ 818,000
10	Cement Silo 1,100 ton Capacity		$ 816,307		$ 816,307
11	Fly Ash Silo 1 550 ton Capacity		$ 752,000		$ 752,000
12	Fly Ash Silo 2 550 ton Capacity		$ 693,000		$ 693,000
13	Truck and Rail Hatch Access Platforms		$ 72,000		$ 72,000
14	Compressor, Compressor Room and Electrical Room		$ 362,000		$ 399,000
15	Electrical		$ 775,000		$ 810,000
16	Salvage, Sell and Reclaim		$ 301,000		$ 301,000
17	Subtotal		$ 6,231,307		$ 6,186,307
18	Local County Tax	4.985%	$ 129,000		$ 126,000
19	Freight	7%	$ 436,000		$ 433,000
20	Permits Fees and Municipal Inspections	allow	$ 15,000		$ 15,000
21	Land and RR Rental fees		not included		
22	Geotechnical		$ 15,000		$ 15,000
23	EPCM, Construction Management and Procurements	12%	$ 897,000		$ 897,000
24	Laboratory Testing, Surveys, Scans		$ 20,000		$ 20,000
25	Subtotal		$ 7,743,000		$ 7,692,307
26	Contingency	20%	$ 1,549,000		$ 1,538,000
27	**Total $ with 1,100 ton Storage for Cement and Fly Ash**		**$ 9,290,000**		**$ 9,230,000**

Adder for Truck Scales : $75,000 each supplied and installed

Assumptions for Capital Cost Calculations

- Based on first quarter 2018
- Does not include price escalations or adjustments
- State taxes are excluded
- Local Boulder County taxes of 0.049 have been included
- Costs based on installation of 1,100 tons each of cement and fly ash storage
- Truck scales included in base costs,

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September 19, 2018, UPRR Crescent Siding Field Meeting Minutes

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MEETING NOTES

Gross Reservoir Expansion - UPRR Crescent Siding Field Meeting

Date of Meeting: September 19, 2018
Location: Gross Dam Road and UPRR Crescent Siding, 1:00 pm
Minutes Prepared by: Doug Raitt

Attendees		
Name	**Company**	**Tel.**
Doug Raitt	Denver Water - Engineering	720.837.7288
Frank Forlini III	Union Pacific Railroad - Sales	402.544.5445
Haley Warner	UPRR	
Sean Smith	UPRR Maintenance	
Brian Leslie	UPRR Operations	

Purpose of Meeting

Meet UPRR representatives on site and review approach to delivery of cement and fly ash to a temporary terminal located at the Crescent Siding and Gros Dam Road.

Site Safety:

All parties listened to Sean provide a pre-walk safety talk. PPE was worn by each person. No one was to foul the track which meant coming closer than 4 feet to the nearest rail. Look for hazards and keep together.

Discussion Points:

Doug described the proposed use of the "House Track" (the track on the north side), for use in the delivery of fly ash and cement in covered hopper cars for offloading at a temporary terminal facility.

Doug further advised that a contractor would be selected mid-year 2019 and that contractor would be the entity to enter into an agreement with UPRR. Denver Water would require the contractor to follow UPRR rules and restore the site at the completion of use.

Denver Water may require the use of adjacent open space on the north side of the UPRR right-of-way and would enter into an agreement for property lease in that event.

UPRR representatives described the need for flaggers if the adjacent track was fouled during terminal construction of offloading operations. UPRR now utilizes RailPros (http://www.railprosfs.com/) for short term flagging staffing. A longer term assignment might be bid out by UPRR if the duration extended. Flagging by RailPros was said to be more expensive that UPRR, about $2,800/day.

The house track would be leased to the contractor is used for terminal operations. Some ties might need to be replaced prior to use and UPRR would assess the condition after use to determine if additional tie replacement would be required.

Delivery cars of boith fly ash and cement should be able to carry 112-113 tons per car. 39 ft cars with twin hopper discharge chutes were assumed to be utilized.

Frank was going to prepare his estimates for pricing based on the site visit, vendor source information and input from the UPRR staff. He didn't provide a timeline but was working diligently on a proposal.

UPRR notes from Frank with the Outlook meeting invitation:

- "Per our conference call today regarding Denver Water's opportunity to ship inbound cement to Crescent, CO, for the construction of the Gross Dam, below are the take away items. Please let me know if missed anything, misunderstood anything, or if you have any questions. Thanks!
- The project would start in 2020 and it would be a four year project. They would ship ~60 cars/week Apr-Nov during the four year period. They are interested in using/leasing track KP670-36-118, a house track in Crescent, CO, off of siding 117 on the Moffat Tunnel Sub (screen prints below).
- Initial feedback is that Denver Water could lease Track 118 to unload inbound cement. UP would utilize Siding 117 for drop and pull and to move the cars while the customer is unloading on Track 118 as necessary.
- Looks like 118 is roughly ~1300' and 117 is ~7850' so ~20 cars could be held on Track 118. It would require 3 switches per week to handle the necessary volumes.

- A local does not go to this location today. A dedicated train/crew would be required to drop, pull, and provide industry switching. Would most likely come out of North Yard.
- It looks like 118 is ~33' from the ML. They need to be at least 25' away in order to unload safely and meet our requirements; otherwise, they need to have flaggers, which could be contracted out (Ie. Rail Pros).
- Attached below are the FRA Track Mobile Standards that we provide to industries for guidance. It doesn't reference anything regarding handling different grades; therefore, I've sent a request internally and will let you know what I am able to find out.
- Next Steps:
- Frank to contact MTM Sean Smith to determine how far away Track 118 is from the ML and hold a potential onsite meeting (Melissa will be on maternity leave).
- Frank to submit CSP to get SU, Locomotive, Network Planning, etc. feedback/approval and to get estimated costs so that we can provide the customer with a rate to see if this option is economical for them. Review schedule of work. "

- Budget

Action Item List			
Item	**Action Required**	**Responsible Party**	**Target Date**
1	Review UPRR proposal when submitted.	Raitt/Hertel	3 weeks after receipt

Appendix B:
USFS Tree Removal Plan Approval Letter

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United States Department of Agriculture | Forest Service | Arapaho and Roosevelt National Forests and Pawnee National Grassland | 2150 Centre Avenue Building E
Fort Collins, CO 80526
970-295-6600
TDD: 970-295-6794
Fax: 970-295-6696

File Code: 2770
Date: July 2, 2021

Melissa Brasfield
Communications Specialist
via email
grossreservoir@denverwater.org

Dear Ms. Brasfield:

According to Articles 416, 422 and 423 of the Federal Energy Regulatory Commission Order Amending and Extending License Term dated July 16, 2020, Denver Water submitted final Recreation Management, Invasive Species Management and 2021 Tree Removal Plans, respectively, to the Forest Service for approval. The final Recreation Management Plan was submitted on June 29, 2021, the final Invasive Species Management Plan was submitted on June 9, 2021, and the final 2021 Tree Removal Plan was submitted on June 10, 2021.

I appreciate the opportunity to review and comment on the draft plans prior to our final review of the plans.

I am approving the final Invasive Species Management Plan as submitted on June 9, 2021, and the 2021 Tree Removal Plan as submitted on June 10, 2021. The final Recreation Management Plan, submitted on June 29, 2021, satisfies condition 24 of the Gross Reservoir license amendment.

If you have any questions, please contact Mike Johnson at 970-531-9609 or at Michael.johnson6@usda.gov

Sincerely,

MONTE WILLIAMS
Digitally signed by MONTE WILLIAMS
Date: 2021.07.02 15:04:10 -06'00'

MONTE WILLIAMS
Forest Supervisor

Appendix C:
2019 Tree Removal Plan

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Gross Reservoir Expansion Project—Final Tree Removal Plan

Final—September 25, 2019

Prepared for:

Denver Water
1600 West 12th Ave.
Denver, CO 80204

Prepared by:

Tetra Tech
350 Indiana St., Ste. 500,
Golden, Colorado 80401

Dahl Environmental Services & Associates, LLC
23890 Genesee Village Rd.
Golden, CO 80401

Contents

Figures

Tables

Attachments

List of Acronyms

2008 TRP	Supplement Gross Reservoir Tree Removal Plan for Pool Enlargement
ACD	Air Curtain Destructor
ARNF	Arapahoe Roosevelt National Forest
BCN	Biochar Now!
CDPHE	Colorado Department of Public Health and Environment
Corps	U.S. Army Corps of Engineers
CO-WRAP	Colorado State Forest Service Wildfire Risk Assessment Process/Portal
CSFS	Colorado State Forest Service
Nederland CFSY	Nederland Community Forestry Sort Yard
DBH	Diameter at breast height
Denver Water	Board of Water Commissioners for the City and County of Denver
DES	Dahl Environmental Services
DN	Forsythe II Decision Notice
EA	Environmental Assessment
EIS	Environmental Impact Statement
F	Fahrenheit
FERC	Federal Energy Regulatory Commission
Forest Service	U.S. Forest Service
FS	Forest Service Road
GRE	Gross Reservoir Expansion
HL	Helicopter Logging
MCS	Mixed Conifer Stand
NEPA	National Environmental Policy Act
PPS	Ponderosa Pine Stand
Scribner	Scribner Decimal C Rule Measurement for Board Meet
SEA	Supplemental Environmental Assessment
SHPO	State Historic Preservation Office
Tetra Tech	Tetra Tech, Inc.
TRP	Tree Removal Plan

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Executive Summary

The Gross Reservoir Expansion Project (GRE) proposed by the Board of Water Commissioners for the City and County of Denver (Denver Water) would expand the capacity of the existing reservoir and require the clearing of approximately 415 acres of forested land surrounding the reservoir.

The Project involves raising the reservoir by 124 feet to elevation 7,406 feet. The reservoir storage capacity would be expanded by 77,000 acre-feet, which includes 72,000 acre-feet for Denver Water's storage needs and 5,000 acre-feet for a dedicated "environmental pool", an environmental enhancement for the Project. Denver Water received a Section 404 permit for the Project from the U.S. Army Corps of Engineers in 2017 and is awaiting an amendment to its hydropower license from the Federal Energy Regulatory Commission. Land Stewardship Associates, LLC prepared a Tree Removal Plan (2008 TRP) for Denver Water, an initial plan in July, and a supplement in October (LSA 2008a and 2008b).

In December 2018, Denver Water requested an updated TRP be developed to accomplish the following:

- Evaluate tree removal and disposal options.
- Develop cost estimates for each option.
- Identify access and road management plans.
- Develop an overall schedule as well as recommend a preferred option in consultation with the U.S. Forest Service (Forest Service), Colorado State Forest Service (CSFS), Boulder County, Jefferson County and Denver Water.

Dahl Environmental Services (DES) and Tetra Tech, Inc. (Tetra Tech) evaluated a suite of tree removal and disposal options and prepared four alternatives. An analysis of these alternatives was conducted using the following criteria:

- The most cost-effective and efficient tree removal and disposal option.
- Maximize biomass utilization.
- Minimize tree removal traffic.
- Minimize nuisance factors such as noise, light, and odor.

Based on the stated objectives, field reconnaissance, inventory collection, market reviews, timber resource professionals, harvesting operators, and the LogCost analysis, Alternative Three is recommended as the most cost-effective tree removal option for the Project.

Alternative Three makes use of four log landing sites: (1) Winiger Ridge, (2) Winiger Gulch Road, (3) Osprey Point Road, and (4) North Shore Point for primary processing of all harvested logs and biomass. For biomass utilization, this preferred alternative provides a suite of disposal options that include full utilization and removal from the project area as well as complete onsite disposal utilizing air curtain destructors (ACDs). To minimize tree removal traffic, we recommend project debris be treated onsite utilizing ACDs. Use of ACDs would significantly reduce truck traffic associated with debris disposal and provide useable Biochar for landscape restoration.

This recommended alternative is based on DES's experience with logging engineering, harvest systems design and implementation guided by Colorado's Best Management Practices (CSFS 2013).

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1. Background

1.1 Gross Reservoir Expansion Project

The Gross Reservoir Expansion (GRE) Project, also known as the Moffat Collection System Project, is a water supply project proposed by the Board of Water Commissioners for the City and County of Denver (Denver Water). The Project would expand the capacity of the existing reservoir and require the clearing of approximately 415 acres of forested land surrounding the reservoir (Figure 1). Unit acreages were determined with Dahl Environmental Services (DES) geospatial mapping.

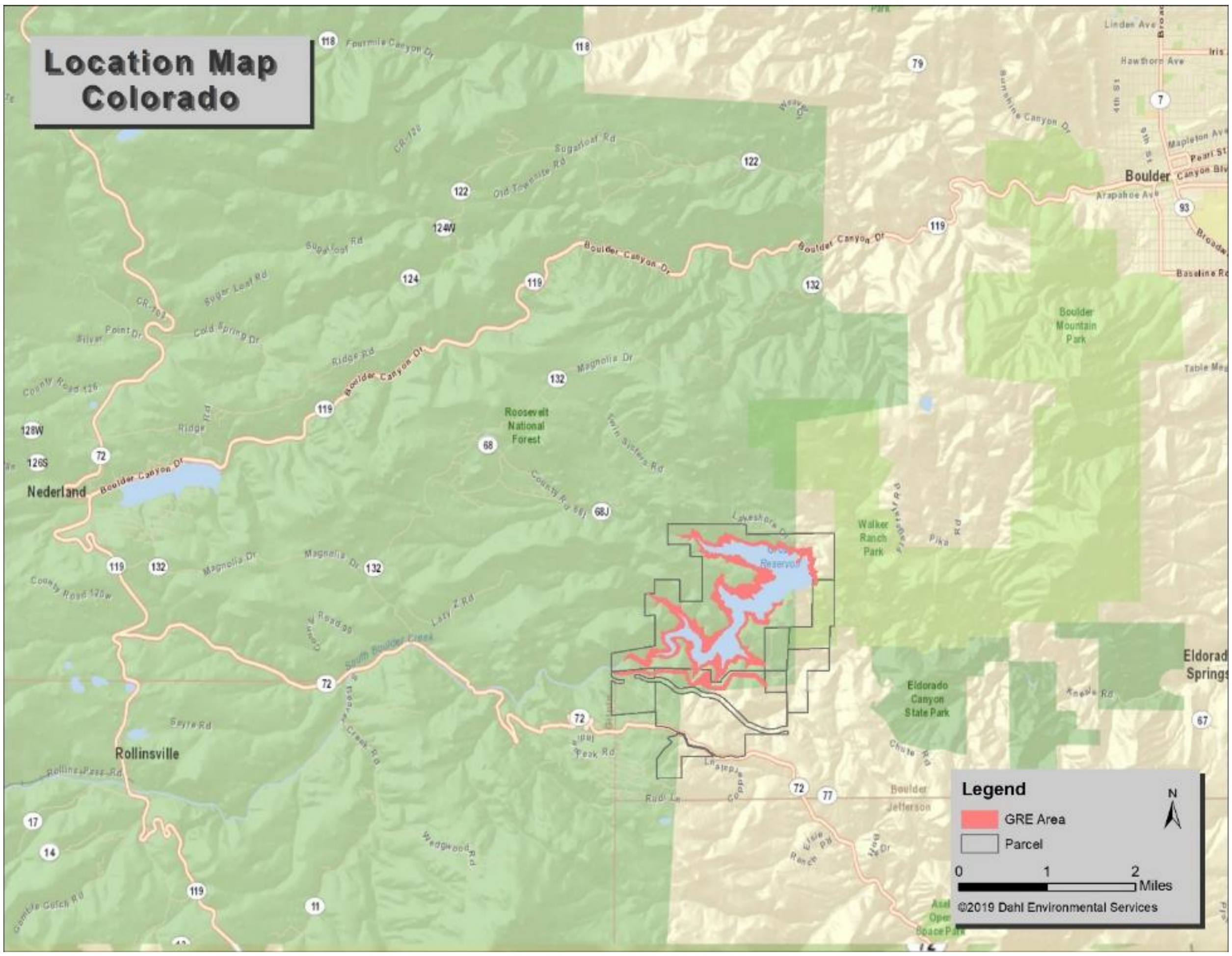


Figure 1: Project Location Map

The Project involves raising the water level in the reservoir by 124 feet, from an elevation of 7,282 feet to an elevation of 7,406 feet. The reservoir storage capacity would be expanded by 77,000 acre-feet from 41,811 to 118,811 acre-feet—72,000 acre-feet for Denver Water's storage needs and 5,000 acre-feet for a dedicated "environmental pool" to store water owned by the cities of Boulder and Lafayette to be used to enhance flows in South Boulder Creek during low flow periods. The surface area of the reservoir would be expanded by approximately 400 acres and the length of the reservoir shoreline would increase by approximately 3 miles.

In December 2018, Denver Water requested an updated Tree Removal Plan (TRP) be developed to for the Project to accomplish the following:

- Evaluate tree removal and disposal options.
- Develop cost estimates for each option.
- Identify access and road management plans.
- Recommend a preferred option in consultation with the U.S. Forest Service (Forest Service), Colorado State Forest Service (CSFS), Boulder County, Jefferson County, and Denver Water.

DES and Tetra Tech, Inc. (Tetra Tech) evaluated a suite of harvesting options for the Project and prepared four alternatives to remove Project biomass. The alternatives were developed by selecting log landings sites that would serve to facilitate acceptable receiving and process areas for the log-removal operations. Slope, access, and landing site suitability severely limited available landing locations. Additionally, to determine the best landings areas for the alternative locations, LogCost was utilized to optimize tractor, cable, and helicopter yarding systems to develop and frame the four alternatives with following criteria:

- The most cost-effective and efficient tree removal and disposal option.
- Maximize biomass utilization.
- Minimize tree removal traffic.
- Minimize nuisance factors such as noise, light, and odor.

Tetra Tech and DES developed this TRP after completing a field reconnaissance. DES conducted extensive field reconnaissance given access limitations. Aspects of the field reconnaissance include the following.

- Inventory collection. DES conducted stand inventory plots on 13 stands. The results are displayed in Sections 2.3.3. DES conducted market reviews with woody biomass processing operators listed in Section 8.4.
- Interviews with timber resource professionals. DES conducted interviews with resources professionals detailed in Section 8.4.
- Interviews with harvesting operators. DES conducted interviews with cable, helicopter and conventional ground yarding system operators throughout the western United States. Contacts are listed in Section 8.4.
- LogCost analysis. DES developed four harvest alternatives utilizing LogCost 18.1. Additionally, DES consulted with former Forest Service logging engineer, developer of the LogCost program.

1.2 Project Benefits

Gross Reservoir is owned and operated by Denver Water as part of its raw water supply system. Water stored in Gross Reservoir is from South Boulder Creek and the Williams Fork and Fraser rivers diverted from the West Slope through the Moffat Tunnel. Expanding Gross Reservoir is a critical component of Denver Water's strategy to ensure the quality, reliability and resiliency of its collection system that provides water to more than 1.4 million customers in its service area.

1.3 Project Environmental Permitting

The following sections highlight the extensive environmental studies and permitting that have been completed to date in support of the Project. An environmental assessment (EA) of the Project was carried out in accordance with the National Environmental Policy Act (NEPA), whereby the U.S. Army Corps of Engineers (Corps) served as the lead agency with jurisdiction under the Clean Water Act. A Final Environmental Impact Statement (EIS) for the Project was completed in 2014. This was followed by the Corps' Record of Decision and 404 Permit for the Project. Since Gross Dam and Reservoir are features of a Federal Energy Regulatory Commission (FERC)-licensed hydroelectric project, the FERC has jurisdiction under the Federal Power Act and an Amendment to the existing license is required. This TRP incorporates information gleaned from the robust environmental studies and permitting completed to date for the Project.

1.3.1 Water Quality Certification

The Colorado Department of Public Health and Environment (CDPHE) reviews and issues Water Quality Certifications under Section 401 of the Federal Water Pollution Control Act of 1972, also known as the Clean Water Act. A 401 Certification is required for any federal license or permit that is issued to construct or operate a facility that may result in any fill or discharges into navigable waters. This certification was issued for the Project in June 2016.

The 401 Certification acknowledges Denver Water's commitment to prepare a TRP "to remove as much organic matter as practicable from the inundation area" as a measure to preclude additional methylation or diminish the present level of methylation of mercury in Gross Reservoir.

1.3.2 Record of Decision and 404 Permit

A major responsibility of the Corps is administering the permitting program under Section 404 of the Clean Water Act. Permit review and authorization is a thoughtful and lengthy process that encourages avoidance of impacts, followed by minimization of impacts and, finally, requiring mitigation for unavoidable impacts to the aquatic environment. After more than a dozen years of study, the 404 Permit for the Project was issued in July 2017.

The Final EIS evaluates and discloses the potential adverse and beneficial impacts associated with the removal of trees and vegetation around the reservoir rim prior to initial filling The assessments found that the effects of the project would be mitigated through careful, comprehensive mitigation programs and ongoing monitoring during construction and tree removal activities.

1.3.3 FERC Hydropower License Amendment

The Gross Reservoir Dam includes a 7.6-megawatt hydropower unit that is licensed for operation by FERC. The license amendment process requires that FERC evaluate multiple areas such as the economic, engineering, environmental, and socioeconomic effects of Project's development and operation. Denver Water expects to receive the License Amendment in 2019.

In February 2019, the FERC released its Final Supplemental Environmental Assessment (SEA), concluding with a recommendation that FERC amend the hydropower license and include the mandatory conditions of the Forest Service, CDPHE, and the mitigation measures and plans requested by Denver Water in its application.

The FERC Final SEA references the Forest Service's Standard Administrative Conditions, including Condition 27, which requires a Final TRP. Specifically, at least 90 days prior to tree removal within the inundation area of the enlarged reservoir, Denver Water must file a TRP with the FERC. The TRP would address the removal of trees around Gross Reservoir to maximize product utilization and minimize traffic and environmental effects. The TRP would address (1) roads to be improved, constructed, and used for tree removal activities; (2) restoring roads to pre-project conditions; (3) travel management considerations such as prevention of public use of temporary roads created for tree removal; (4) transportation management during tree removal activities; and (5) how project-related traffic would be managed to minimize disruption on Forest Service roads and provide for visitor safety. The plan's schedule for tree removal would consider, among other items, key winter range timing for elk (December 1 through March 30) and raptor nesting season (varies depending on species). The TRP will be used to support the development of the Final TRP that Denver Water will submit to FERC.

1.3.4 Wildlife and Plant Considerations

DES interviewed and consulted with Forest Service resource specialists to understand the wildlife considerations documented in the various environmental permitting documents and how they apply to this TRP. At the recommendation of Forest Service staff, we reviewed wildlife timing restrictions for the adjacent Forsythe Fuels Reduction Project (Forsythe 2012) and the Terrestrial Wildlife Specialist Report including the Biological Assessment and Evaluation for Forsythe II Project (Baker 2016). The wildlife report is relevant to the Project and this TRP specifically because of overlapping species and habitats. A chart of the federally listed and sensitive species was compiled by the Arapaho-Roosevelt National Forest (ARNF) and it provides an overview of the wildlife species that may be affected by the implementation of the TRP on the Project area. Twenty-one terrestrial species were evaluated by ARNF staff biologists to determine whether the species or their habitat are present within the Project area. This evaluation identified 1 federally threatened or endangered species, 12 Forest Service sensitive species, and 8 management indicator species.

The Final EIS prepared by the Corps indicated the Preble's meadow jumping mouse is not known or expected to be present at Gross Reservoir and would not be likely to be adversely affected by the proposed construction and reservoir enlargement activities. In addition, the U.S. Fish and Wildlife Service reviewed potential effects to the Preble's meadow jumping mouse and issued a Biological Opinion on December 6, 2013, that the Project is "not likely to affect" the Preble's meadow jumping mouse. These species were carried forward for analysis. Federally listed wildlife species and Forest Service Management Indicator and Sensitive Species that may be affected by implementation of the TRP are presented in Table 1. All sensitive plant areas potentially impacted by TRP would be surveyed prior to project implementation. See, FERC EA, Appendix A, New Condition, No. 22 - Special Status Plants Relocation Plan.

Table 1:
Federally Listed Wildlife Species and Forest Service Management Indicator and Sensitive Species

Threatened/ Endangered Species	Management Indicator Species	Sensitive Species			
		Mammals	Birds	Amphibians	Insects
Preble's meadow jumping mouse	Elk, Mule deer, Golden-crowned kinglet, Hairy woodpecker, Mountain bluebird, Pygmy Nuthatch, Warbling vireo, Wilson's warbler, Boreal toad	American marten, Fringed myotis, Hoary bat, Townsend's big-eared bat	Bald eagle, Flammulated owl, Lewis' woodpecker, Northern goshawk, Olive-sided flycatcher	Boreal toad, Northern leopard frog, Wood frog	N/A

Source: Forsythe (2012)

DES identified timing restrictions for tree removal activities based on this information, from wildlife reports by the ARNF staff specialists, and guidelines by biologists from Colorado Parks and Wildlife. Key periods for wildlife protection during the Project and TRP activities are as follows:

- Flammulated owl nest sites: April 1 through August 30.
- Elk severe winter range: December 1 through March 30.
- All raptor nest buffers: March 1 through September 15.
- Migratory Bird Treaty Act: March 1 through July 31.
- If no Raptor nest are present, the timeframe would be September 1 through November 30th . This provides a three-month operating window to remove timber and biomass.

These restrictions, although limited in duration, potentially restrict tree removal activities. Consultation with the agency (Forest Service) to discuss waivers, particularly with the flammulated owl would be critical; see map in Section 8.1.4. Raptor protection is detailed in FERC's Final SEA for GRE in Condition No. 21; Raptors Protection Measures (FERC 2019).

During implementation of the TRP, Denver Water will work with the Forest Service and Colorado Parks and Wildlife to develop measures to avoid, minimize, or mitigate potential impacts to raptors and songbirds during helicopter yarding operations that occur during the raptor- and bird-related wildlife protection season. Further, Denver Water will work with these agencies to avoid, minimize, or mitigate potential impacts to elk during the winter, given the Project overlap with severe winter range for elk.

1.4 Archaeological Considerations

Two archaeological sites are present in the Project area. The first site is located on the west side of the site. The ARNF archaeologist indicated the site needs to be mitigated before any timber is removed. The second site, a prehistoric site, is located near the trailhead of Forest Service Road (FS) 359. This site could be impacted during road reconstruction activities at this location. The ARNF archaeologist stated that mitigating the site would require a significant work effort and require a Memorandum of Understanding with the State Historic Preservation Officer (SHPO) and seven Native American tribes. The TRP is designed to avoid this site by connecting FS 359 to FS 97 for all biomass removal.

Denver Water will manage cultural and historic resources in accordance with two existing Programmatic Agreements with the SHPO issued for the Project.

2. Tree Removal

2.1 Overview

The Project encompasses approximately 415 acres, of which 145 acres is Denver Water property, and 270 acres is National Forest. The land that would be cleared is between the elevations of 7,282 feet and 7,406 feet.

Clearing would remove approximately 140 to 1,170 trees/acre or an estimated 208,400 trees with approximately 24,000 tons of woody biomass along an estimated 12.5 miles of shoreline within the inundated area. Most are coniferous trees that range in size from 8 to 50 feet tall and vary in diameter at breast height (DBH) from 2 to 30 inches. Thirty-six unique stands of trees were identified for complete removal along the shoreline. Shoreline vegetation includes predominately ponderosa pine and Douglas-fir, with some Colorado blue spruce and Rocky Mountain juniper with inclusions of grass/shrub meadow stand. The value of the sawtimber produced is below the cost of production, so the sawtimber is considered non-merchantable, i.e., biomass. The TRP requires that all quantities of biomass would be completely removed down to a minimum material length and diameter of 2 inches within the inundation area.

Removal systems would be based largely on helicopter logging with cable ground support and, where accessible, conventional ground-based logging to bring biomass material to selected landings due to the steep terrain. Woody biomass material would be chipped, ground, or converted to biochar and delivered to feasible markets in Colorado.

2.2 Objectives

The Project objectives for clearing of the reservoir inundation area include preparing an updated TRP that recommends the following:

- The most cost-effective and efficient tree removal and disposal options.
- Maximize product utilization.
- Minimize tree removal traffic.
- Minimize nuisance factors such as noise, light, and odor.

Project-specific objectives for clearing of the reservoir inundation area are the following:

- Provide a new TRP for the reservoir inundation area that updates the TRP developed in 2008 (2008 TRP; LSA 2008a, 2008b) and incorporates current knowledge and best industry practices for tree removal and disposal options taking into consideration the topographic and access constraints. The desired condition is to remove all trees, shrubs and associated debris within the inundation area to minimize future floating debris when the expanded reservoir fills.
- Develop a safe transportation system of haul and access roads that reduce the noise and travel impacts on nearby communities.
- Provide an estimate of the number of truck trips for the various options for timber waste and merchantable timber removal and the likely path of egress from the site.

- Evaluate the advantages and disadvantages and estimate costs of each option and recommend the preferred methods.
- Propose locations for staging and disposal of material.
- Preliminary design of access and haul roads associated with the preferred alternative.

2.3 Forest Resources

2.3.1 Background

The first forest inventory was completed by the CSFS in the Gross Reservoir Forest Management Plan (CSFS 2005) and it became the basis for the inventory in the 2008 TRP (LSA 2008a, 2008b). DES modeled tree tonnage/acre for each stand based on the 2008 TRP utilizing contemporary cruise models and published tree weight data (Lynch 2005). Therefore, tree weights for this TRP are based on tree species, cubic foot volumes, and diameter using the best available science to arrive at total biomass harvest tons. In our research, the 2008 TRP weight estimates seemed to be unusually high for typical Front Range forests. The tree weights in the 2008 TRP therefore were adjusted as described below using local Front Range green forest weights by species and estimated merchantable board foot Scribner volumes (i.e., Scribner Decimal C Rule Measurement for Board Meet), total cubic foot stem volumes, and live weights of stems and branches for each of the 36 stands in the 2008 TRP. These data have been illustrated in the DES Stand Inventory Spreadsheet (Section 8.2.2).

2.3.2 Procedure

Board foot Scribner and total cubic foot volumes, including stump and entire stem to tip, were estimated for each species, diameter class DBH, height, and trees/acre listed in each stand table in the 2008 TRP using equations in Forest Service publications (Meyers and Edminster 1972, Edminster et al. 1980). Weights for each tree stem were calculated using a value of 65.65 pounds per cubic foot (Lynch 2005). After an extensive literature search, a formula was identified for estimating Ponderosa pine branch weight based on the tree's DBH (Cochran et al. 1984). This log normal metric equation was converted to English units and re-fit as a second-degree polynomial equation, which was used to calculate branch weight for each DBH and height class. No suitable weight estimates could be found in the literature for Douglas-fir that could be used with these data, so the Ponderosa pine estimates were used for Douglas-fir. DBH class individual tree volumes and weights were multiplied by tree/acre values, then by stand acreages, to obtain total stand estimates.

2.3.3 Inventory Conclusion

Table 2 shows the final revised 2008 TRP summary in acreage and number of trees (LSA 2008b) of all stands analyzed on 370 acres. The total tons to be removed equals 20,320 tons from all harvest stands. Table 2 data were extracted from LSA 2008a, Appendix IV, Residue Volume Calculations, and updated with DES tons per acre and geospatial mapping (see Section 8.2.1).

Table 2:
Revised 2008 TRP Stand Inventory Summary

Species	Total Acres	Total Trees	Tons/Acre	Total Tons
Ponderosa/Doug-Fir	370	174,909	54.92	20,320

Additionally, the refined stand map delineations will require some adjustments in the geospatial referencing of the stand locations on the maps. These adjustments amounted to approximately 45 acres. Table 3 shows the revised acreage estimated by DES and the resulting total tons to be removed, including 2,035 tons of surface fuels (Section 2.3.5), which equals 24,398 tons from all harvested stands. See DES Stand Inventory Summary for more detail (Section 8.2.2).

Table 3:
DES Stand Inventory Summary

Species	Total Acres	Total Trees	Tons/Acre	Total Tons
Ponderosa/Doug-Fir	415	207,970	53.89	22,363
Surface fuels	415			2,035

2.3.4 Forest Inventory

DES delineated the Project inundation area into 35 stands (Stand Map, Section 8.1.2) and grouped the stands into three forest types: Ponderosa Pine Stand (PPS), Mixed Conifer Stand (MCS) and Meadow Stand. A check cruise of the 2008 TRP inventory (LSA 2008a, 2008b) was done taking a total of 13 sample points that were distributed throughout the 36 Stands. The check cruise inventory was processed using BIOCRUZ, a timber cruising software program developed by the Forest Service Rocky Mountain Research Station. A Basal Area Factor of 20 was used for each sample point. At each sample point, every tree that was 2 inches or more at DBH was recorded as a tally tree. Established trees under 2 inches in DBH on the same 1/100-acre plot were counted by species as estimates of regeneration. Standard errors for the inventory range from 9 percent to 17 percent. The comparative check cruise can be found in Section 8.2. The stand descriptions in the following sections are grouped into common stand characteristics to describe vegetation and conditions on the ground.

2.3.4.1 Ponderosa Pine Stands

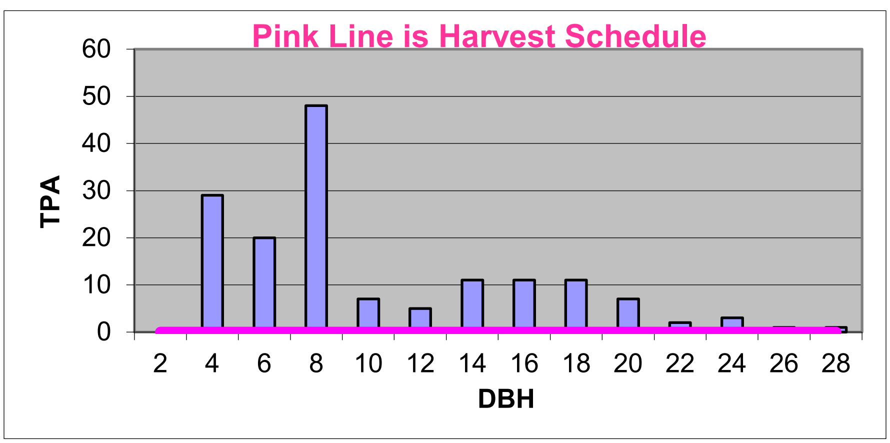
Stand 16

PPS covers approximately 249 acres based on data from the CSFS Wildfire Risk Assessment Portal (CO-WRAP). Applying BIOCRUZ to Stand 16, a sample plot was created within the PPS that has approximately 155 trees per acre with an average diameter of 12 inches and an average height of 45 feet. Stand 16 has two-age classes: trees in the 6- to 10-inch DBH that are about 45 to 80 years old and trees in the 18- to 22-inches DBH that are approximately 160 to 200 years old. Site Index for ponderosa pine is estimated at 40 (100-year base) (Lynch 2005). Stand 16 has approximately 9,038 board feet/acre (Scribner), or 2,268 cubic feet/acre (Figure 2). Additionally, there is approximately 52 tons per acre of woody biomass. The average stand density is 116 square feet of basal area per acre. The PPS stands are generally located on south to southwest aspects. Slopes vary between 5 and 50 percent. Accessibility and operability are good for helicopter and cable logging on 80 percent of the property. This stand has a high load of litter and downed logs are estimated to be 5 tons per acre (CO-WRAP).

GRE Stand 16 Tree Removal—Ponderosa Pine Stand Statistics

dbh	TPA	Cuft	Scrib	Cut%	CutTPA	CutCuft	CutScrib	ResidTPA	ResidBA
2	0	0	0	100	0	0	0	0	0
4	29	30	0	100	29	30	0	0	0
6	20	30	0	100	20	30	0	0	0
8	48	200	265	100	48	200	265	0	0
10	7	85	275	100	7	85	275	0	0
12	5	46	111	100	5	46	111	0	0
14	11	210	774	100	11	210	774	0	0
16	11	353	1514	100	11	353	1514	0	0
18	11	416	1810	100	11	416	1810	0	0
20	7	414	1927	100	7	414	1927	0	0
22	2	91	426	100	2	91	426	0	0
24	3	219	1049	100	3	219	1049	0	0
26	1	82	410	100	1	82	410	0	0
28	1	91	441	100	1	91	441	0	0
Totals	156	2267	9002		156	2267	9002	0	0

PPS Stand Statistics			
Trees/Acre	155	Basal Area/Acre	116
Average Diameter	16 inches	Average Tons/Acre	52
Average Height	45 feet	Slopes	5 to 50%
Board Feet/Acre	9038		
Cubic Feet/Acre	2268		



Note: The pink line above is the harvest schedule, which illustrates a clear cut of all trees in Stand 16. (TPA = Tons per Acre)

Figure 2: GRE Stand 16 Tree Removal—Ponderosa Pine Stand Statistics

2.3.4.2 Mixed Conifer Stands

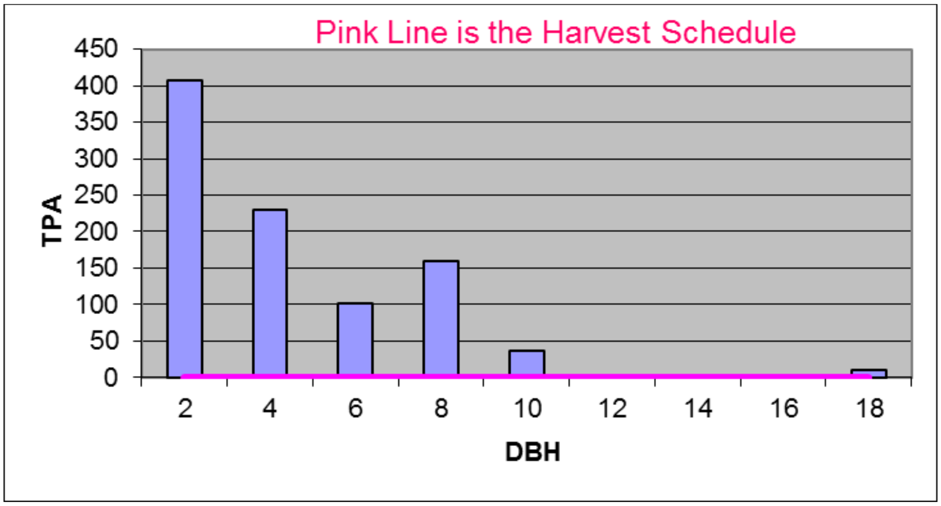

Stand 24

Applying BIOCRUZ to Stand 24 provides a typical example of stands within the MCS type. MCS covers approximately 104 acres (CO-WARP) consisting of 60 percent Douglas-fir and 40 percent ponderosa pine, Blue spruce and aspen. The MCS dominant trees and co-dominant trees range in age from 100 to 160 years and have a DBH of approximately 18 inches. Stand 24 is typical of the MCS with smaller trees of ponderosa pine that are less than 12 inches DBH and are approximately 10 to 80 years old. Stand 24 has an average of 82 tons per acre of woody biomass. The stand is generally located on north and northeast aspects with slopes varying between 8 and 70 percent. On average, there are 900 trees per acre that have an average diameter of 9 inches and an average height of 31 feet. The Site Index for Douglas-fir is estimated at 40 (100-year base) (Lynch 2005). The stand has approximately 5,018 board feet/acre (Scribner) and 2,240 cubic feet/acre (Figure 3). Average stand density is 142 square feet of basal area per acre. Accessibility and operability would be good for helicopter and cable logging capability on 90 percent of the stands with construction of the proposed haul and skid roads. This stand has a high load of litter and downed logs that was estimated to be 7 tons per acre (CO-WRAP).

GRE Stand 24 Tree Removal—Mixed Conifer Stand Statistics

dbh	TPA	Cuft	Scrib	Cut%	CutTPA	CutCuft	CutScrib	ResidTPA	ResidBA
2	407	184	0	100	407	184	0	0	0
4	229	120	0	100	229	120	0	0	0
6	102	164	0	100	102	164	0	0	0
8	160	913	1722	100	160	913	1722	0	0
10	37	423	1376	100	37	423	1376	0	0
12	0	0	0	100	0	0	0	0	0
14	0	0	0	100	0	0	0	0	0
16	0	0	0	100	0	0	0	0	0
18	10	439	1920	100	10	439	1920	0	0
Total	945	2243	5018		945	2243	5018	0	0

MCS Stand Statistics			
Trees/Acre	900	Basal Area/Acre	142
Average Diameter	9 inches	Average Tons/Acre	82
Average Height	31 feet	Slopes	8 to 70%
Board Feet/Acre	5018		
Cubic Feet/Acre	2240		



Note: The pink line above is the harvest schedule, which illustrates a clear cut of all trees in Stand 24.

Figure 3: Mixed Conifer Stand Statistics

2.3.4.3 Meadow Stand

The Meadow Stand is an estimated 62 acres in size (CO-WRAP). The vegetation includes widely scattered ponderosa pine, Douglas-fir and Rocky Mountain juniper with isolated mountain mahogany, and yucca plants scattered throughout the stand. Grasses and forbs include blue gramma, Thurber fescue, buckwheat, and American vetch. Height of the understory vegetation varies from 1 to 3 feet. It is estimated there is approximately 1 ton per acre of woody biomass in Stand 18. Slopes vary from 5 to 40 percent. Aspects are mostly eastern and southeastern.

Stand 18

Accessibility and operability are very good (tractor, cable capability) across 90 percent of the stands for construction of proposed haul and skid roads. Slopes vary between 0 percent and 40 percent. Stand 18 has a low load of grass litter that has been estimated to be 1 ton per acre.

2.3.5 Project Fuel Model Assessment

The classification system used in this TRP is contained in the Forest Service General Technical Report RMRS-GTR-153 Standard Fire Behavior Fuel Models: A Comprehensive Set for Use with Rothermel's Surface Fire Spread Model (Scott and Burgan 2005). The second, older system is published in Forest Service General Technical Report INT-GTR-122 Aids to Determining Fuel Models for Estimating Fire Behavior (Anderson 1982). The latter remains in use because it is somewhat easier to apply and comprehend making it an effective tool for non-technical applications. A crosswalk table in (Scott and Burgan 2005) was applied to the CO-WRAP report results so the categories on Surface Fuel map could be interpreted based on the Anderson Fuel Models. The Anderson Fuel Model is followed by the Scott and Burgan model with a brief description and total property acres. The best representative hazardous fuel models describing hazardous fuel loading and conditions on this property are fuel models, GS2 (grass) at 1.10 tons/acre, TU2 (ponderosa pine) at 1.3 tons/acre, and TU5 (mixed conifer) at 7 tons/acre These tons per acre should be considered in addition to the green tree weights across the 415 acres. Based on CO-WRAP fuel load assessments, there are approximately 2,000 tons of surface fuels across the inundation area (Table 4).

Table 4:
CO-WRAP Inundations Surface Fuel Loading

Vegetation Class	Acres	Surface Fuels (tons per acre)	Surface Fuel Total Tons
Ponderosa Pine	249	5	1245
Mixed Conifer	104	7	728
Grass/Shrub	62	1	62
Total	415		2035

2.4 Project Tree Removal Systems

2.4.1 *Helicopter*

Helicopter Logging (HL) is a method of logging that can be used where stands are inaccessible. Cables are dropped from the helicopter and used to remove cut trees and woody biomass. The use of helicopters reduces the infrastructure required to log a specific stand and greatly reduces the schedule and timing of operations. It also can increase the operational productivity in remote stands with limited access.

Courtesy of Columbia Helicopters Model 107-II Vertol

Helicopter logging can vary given size of the helicopter-based pay load capacity and flight times and capacities. Our choice for HL is the Columbia model 107–II Vertol helicopter which can extract 20, 000 cubic feet (about 660 tons) of woody biomass per a 9-hour day. The Vertol has a lift capacity of 6,200 pounds at an elevation of 5,000 feet. The double-rotor Columbia helicopter provides flexibility and increased stability in cross winds to log and deliver woody biomass at precise sites.

HL is accomplished by suspending a long line of wire below the aircraft with chokers attached. In some operations, a grapple may be used instead of chokers. The long line is typically between 90 and 300 feet in length, depending upon topography and the height of trees above which the helicopter must hover. Long chokers may be used and are pre-set on trees in the stand. The choker ends are then brought together to make up loads that are estimated as being slightly less than the helicopter's lifting capacity.

Courtesy of Market-it Forestry and R&R Conner's Heli-Logging, image of a Heli- bucket

HL ground crews hand cut and bunch tree and woody biomass with chokers before the helicopter starts to work. A one-person faller can hand fell about one-third acre per day. Logs and biomass must be bucked so individual logs and biomass do not exceed the net lifting capability of the helicopter. Tree cuts must be complete so that each log is free of the adjacent trees. All trees, brush (dead or alive) and biomass are flush cut with the topography of the ground and removed from the stand. All limbs attached to trees are airlifted and processed at the log landing zone. Old remnant tree stumps from the historical wildfires must be cut at ground level for HL removal.

Logs and biomass are connected to chokers and bunched and then connected to the hook at the end of the helicopter's long line. The helicopter then climbs vertically to lift the logs off the ground and clear the forest canopy. Woody biomass that cannot be bunched or yarded by chokers are collected and placed in a Heli-bucket or Heli-cargo nets to be airlifted with other woody material and processed on the landing.

The inhaul element involves flying the load of logs from the hooking point to the landing. At the landing, the pilot sets the logs biomass and Heli buckets on the ground in the drop zone and releases the chokers from the hook. With the load released, the pilot clears the log landing and enters the outhaul element to return to the stands for another load of logs. The entire process, outhaul, hook, inhaul, and unhook, is commonly referred to as a turn (USFS 2018).

Courtesy of John Deere Feller Buncher Yarder

2.4.2 *Ground-Based*

Feller Buncher. A feller buncher is a self-propelled machine with a cutting head that can hold more than one woody stem at a time. The cutting head is used strictly for cutting, holding, and placing the stems on the ground. Feller bunchers do not have processing capabilities.

Tracked machines with self-leveling cabs can operate on slopes up to 50 percent. Tracked machines without self-leveling cabs can operate on slopes up to 40 percent. For safety reasons, wheeled feller bunchers should be restricted to slopes below 40 percent. Ground and tree conditions affect the slope at which the equipment can operate. Rough, broken ground or many ground obstructions limit the slopes to less than the maximum. A swing boom feller buncher is a tracked machine with the cutting head mounted on a boom. The machine does not have to drive up to each tree to cut it. Larger trees also reduce the feasible operating slope because of the mass that can be handled safely (USFS 2018).

Ground Skidders: Wheeled or track skidders that are built on an articulated chassis with the cab and engine mounted on the forward articulation and either a cable drum and arch or grapple mounted on the rear articulation. Many modern skidders include both a cable drum and a grapple. Wheeled skidders typically have a small blade mounted on the front that can be used to push material out of the way and level small ground obstructions. A grapple can pick up more than one woody stem at a time. A cable skidder has a skid line with chokers attached. The number of chokers used depends on the size of trees being extracted. Cable skidders have a fixed arch over

Courtesy of Caterpillar a wheeled skidder with the arch grapple transporting logs

which the cable runs through a fairlead. The arch provides lift to the large ends of the logs and can be used as forwarders transporting logs to landings.

Mulchers Masticators: Mulchers chop and grind vegetation into small particles that become native forest surface soil duff material. Mulchers may be used to clean up a stand following conventional timber or felling operations. Mulchers can reduce limbs, tops, and cull material to shredded particles on the forest floor and that degrade more quickly back into the soil (USFS 2018). Track driven mulchers can be used very effectively on slopes up to 40 percent with extremely low ground pressure required.

Courtesy of Tiger Equipment Model 470 Tiger Mulcher

Forwarders are articulated machines consisting of an operator's cab and a log bunk. They are basically tractors pulling a wagon load of wood. Forwarders currently exist having up to eight wheels. The cab may be fixed or capable of rotating on the chassis. Many forwarders have a boom mounted grapple for loading and unloading material.

Traction and flotation can be increased by adding tracks that slide on over the dual wheels or by opting for wider tires. Tire chains may also be applied for additional traction in snow or mud.

Courtesy of John Deere- single bunk forwarder

Forwarders are limited to extracting processed material. They are typically operated with a harvester capable of producing cut to length material. The harvester is also capable of stacking the processed logs near a skid trail accessible to the forwarder. Manual felling and processing do not have this capability which limits the forwarders productivity.

Compared to skidders, forwarders cost more to purchase and so require a higher rate of productivity to justify the cost.

A typical cut to length system uses either self-loading trucks or the forwarder loads the log trucks. Roadside landings can be used since there are no space requirements for a loader or processor. The forwarder can simply unload into decks at the roadside, facilitating subsequent loading of the log trucks.

Courtesy of U.S. Forest Service San Dimas Experiment Station, Air Curtain Burner

Air curtain destructors (ACDs) are skid-mounted systems designed and constructed to optimize the air curtain concept. High velocity air is blown across and down at an optimum angle into the pit creating the air curtain on top and a rotational turbulence within the firebox. The high velocity air creates the rotational turbulence providing an oxygen-enriched environment in the combustion zone that accelerates the combustion process (like the effect of fanning a fire). The temperature within the firebox is usually above 2,000°F. The high velocity air over the firebox creates an air curtain that traps unburned particulate until it is completely consumed. Nearly complete combustion is achieved with minimal amounts of escaped particulates, virtually eliminating smoke.

Vertical refractory walls aid in the combustion process by retaining and reflecting the high temperatures generated within the firebox. The combustion process reduces the wood waste to usable biochar and carbon ash by approximately 98 percent, leaving about 2 percent in volume (100 tons of wood, or 2 to 4 tons of ash and biochar). Twin refractory lined panel doors at the rear of the firebox allow for ash removal. The unit has no bottom and can be dragged on its skids with the rear door panels open for dumping ash.

The skids and durability of the unit allow it to be dragged around the site for repositioning or from site to site depending upon the terrain and distance to be moved. The ash may be left in place, disposed of, or used as a soil amendment by mixing it with the soil at the site or other locations. (USFS 2002)

Air Burners, LLC manufactures several skid-mounted systems with burn rates ranging from 1 to 15 tons per hour. The larger units are more difficult to transport or move around the site. Due to their size, special permits are required for transporting over roads. Systems can be customized to meet specific needs. The standard units can also be leased.

Personal communication with Air Burners North American Sale representative confirmed the S-330 Air Burner production rates of 10 to 12 tons per hour are appropriate (M. Schmitt 9.11.19). Boulder County has an S-220 what has a production capacity of 7 ton per hour, a production rate approximately 30 percent less than the S-330.

2.4.3 *Cable Based*

Cable Yarder. A cable yarder is ground-based rubber tire or track equipment that uses a system of cables to pull or fly logs from the stump to the landing. It generally consists of an engine, drums, and spar, but has a range of configurations and variations such as the Yoder yarding. The Yoder can be configured to function as a shovel logger, a cable line logger, standing skyline and swing yarder. The Yoder is very versatile in logging performance. Yoder yarder have a short span cable reaching out 600 feet and a long span cable reach to 1,000 feet depending on equipment model. The Yoder yarder is most suitable for steep ground where it is difficult to access the logs with other machinery. It can be used as a Swing yarder on flatter areas with lighter loads. The basic cable Yoder yarding system is recommended for use.

Courtesy of R&R Conner's Logging with a Yoder Yarder

2.4.4 *Hand Felling*

Chainsaw felling and processing is generally considered feasible for any type of treatment. However, its major disadvantage is the decreased productivity compared to mechanical options. This decreased productivity may translate into increased treatment costs (USFS 2018).

2.4.5 *Landings*

On the landing zone, there is typically a grapple loader moving material from the drop zone to the processing or decking area. The mechanical processing equipment provides for a variety of outputs; may include sawlogs, cordwood, chipping, grinding and biochar log shredder at the landing (Gaspard 2019). A second loader may be involved in loading trucks to transport processed biomass and biochar, which is loaded onto dump trucks or truck and trailers for transportation to potential markets (Gaspard 2019). The amount of processed biochar that is stored and later loaded into cubic yard bags varies depending on size fraction of the biochar from 250 to 600 pounds. A second loader may be involved to transport processed biomass and biochar, which would be loaded onto dump trucks or truck and trailers for transportation to potential markets.

Courtesy of BCN, Log Shredder Loading a Kiln

–Courtesy of BCN, Processed Biochar in Cubic Yard Bags Stored on Landing zone for Shipping

Planning for helicopter logging and landing areas is critical. It is important that enough space and support are available at each landing site to support the functionality of log dropping and processing biomass, to include having enough transportation available to remove the large volumes of timber and biomass from the landing area. Helicopter logging typically requires two landings, a service landing for refueling and one for dropping off the extracted timber. The following diagrams illustrate the general dimensions and support space needed for adequate HL sites. Typical Heli-log landing zones and service pads are illustrated below:

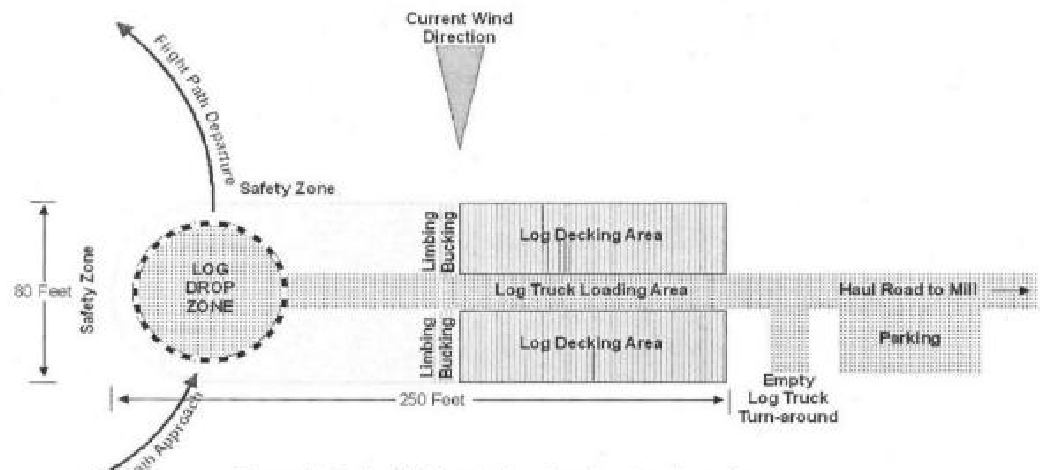
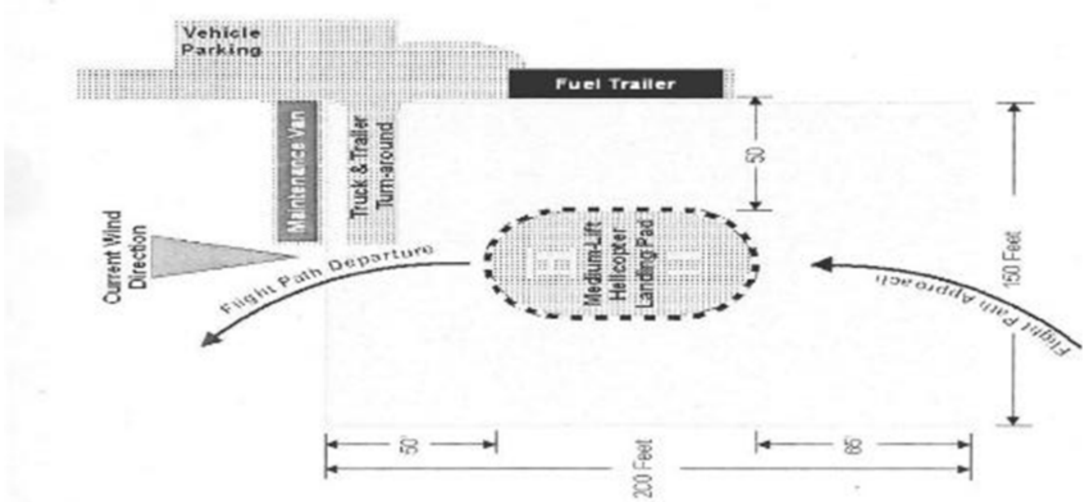


Figure 1. Typical Helicopter-Log Landing Configuration

Heli-Log and Processing Landing



*–Courtesy of Markit! Forestry, Heli landing and processing site**

Landing Heli-Service Pad

* This image captures the complete Heli-landing zone operation. The landing area displays a hot active helicopter yarding area with, log processor de-limber, grapple loader, grapple sort loader, front end loader with extended scoop for loading chip trucks and horizontal wood-chip grinder.

2.4.6 *Tree Removal Summary*

The recommended best practices for the TRP will make use of multiple harvest methods that feature primarily the following:

- Helicopter and cable systems will be the harvest methods for the stands with slopes 40 percent or greater.
- Felling will be done by mechanical tree processors on slopes 40 percent and under. On slopes over 40 percent, hand felling will be done.
- Logs and biomass delivered to landing sites will be handled by grapple loaders to sort material for processing.
- The main landing for log processing and helicopter service will be on Winiger Ridge for Alternatives One through Three. The landing for Alternative Four is located on the east side of Gross Reservoir.
- Access and haul routes will be concentrated on the west side of the reservoir using FS 97 and FS 359 for Alternatives One through Three. Alternative Four will utilize the Dam Road for debris removal.
- Temporary skid trails will be constructed below the new high watermark (7,406 ft) of the new inundation area to facilitate tree removal.
- All stands will receive final site cleanup by mulching and/or hand removing all wood material and biomass inside the inundation areas down to a size of two inches in length and diameter .
- All trees, brush (dead or alive) and biomass will be flush cut with the topography of the ground and removed from the inundation areas i.e., designated stands; reference Section 8.1.
- Disturbed areas outside the inundation will be restored to original conditions according to restoration guidelines in the TRP.

2.5 Project Tree Removal Alternatives

To identify a preferred alternative, a series of alternatives were developed using log landing sites and yarding methods for tree removal that were analyzed using LogCost 18.1. Alternative Three represents the most cost-effective harvesting option, reducing debris removal and traffic through the westside communities while accomplishing tree removal activities in one season of TRP operations. The landing areas would be fully functional to accept logs, sort and process material for transportation. All landing alternatives described in the following tables and maps can support both helicopter and ground-based systems.

2.5.1 *Alternative One: 1-Log Landing*

This alternative would make use of one main log landing on Winiger Ridge for primary processing of all harvested biomass (Figure 4; Section 8.1.5). Biochar Now (BCN; Gaspar 2018) processing is feasible with this alternative due to infrastructure requirements. Table 5 summarizes the merits of selecting Alternative One.

Table 5:
Merits of Selection—Alternative One

Advantages	Disadvantages
• Minimum landing construction impacts (one landing) • Minimum service landing construction impacts (one service landing) • Provides multiple biomass disposal options	• Long helicopter round trips for yarding biomass • Minimizes opportunities for cable and ground yarding equipment thereby increases costs • Very labor-intensive biomass treatments on landing area • High community (west side) haul truck traffic impacts • Susceptible to operational shutdowns from mechanical issues • Second highest stand removal cost alternative

Alternative One meets only one of the evaluation criteria, shown in bold, as listed below. A detailed Summary Evaluation of this alternative along with harvesting costs is provided in Table 6. Road construction costs are identified in Table 13.

- The most cost-effective and efficient tree removal and disposal option.
- Maximize biomass utilization.
- Minimize tree removal traffic.
- Minimize nuisance factors such as noise, light, and odor.

This alternative could be paired with any of the recommended disposal methods—chips, cordwood, air curtain destructor, or Biochar—that are discussed in detail in Section 3 (and summarized in Table 17).

Table 6:
Summary Evaluation—Alternative One

Stand ID	Acres	Stems	Tons	Tree Removal Method	Biomass Removal Method	Stand Removal Cost
1	5.6	1,389	194	Hand Felling - Helicopter	Hand work Heli-bucket	$54,472
2	19.7	14,125	1,419	Hand Felling - Helicopter	Hand work Heli-bucket	$271,373
3	12.5	3,838	456	Hand Felling - Helicopter	Hand work Heli-bucket	$112,872
3A	19.2	5,894	701	Hand Felling - Helicopter	Hand work Heli-bucket	$177,409
4	5.9	738	126	Hand Felling - Helicopter	Hand work Heli-bucket	$49,626
5	14.2	3,649	708	Hand Felling - Helicopter	Hand work Heli-bucket	$170,995
6	19.4	7,488	795	Hand Felling - Helicopter	Hand work Heli-bucket	$171,382
6A	6.3	2,432	258	Hand Felling - Helicopter	Hand work Heli-bucket	$57,750
7	3.7	463	79	Hand Felling - Helicopter	Hand work Heli-bucket	$29,126
8	9.2	2,824	336	Hand Felling - Helicopter	Hand work Heli-bucket	$89,476
9	7.3	1,591	370	Hand Felling - Helicopter	Hand work Heli-bucket	$90,688
10	5.9	1,664	487	Hand Felling - Helicopter	Hand work Heli-bucket	$107,733
10A	30.9	7,663	1,073	Hand Felling - Helicopter	Hand work Heli-bucket	$440,123
11	13.9	3,920	1,147	Hand Felling - Helicopter	Hand work Heli-bucket	$253,578
11A	6.6	1,861	544	Hand Felling - Helicopter	Hand work Heli-bucket	$127,886
12	16.2	4,018	562	Hand Felling - Helicopter	Hand work Heli-bucket	$188,666
13	33.6	24,091	2,420	Hand Felling - Helicopter	Mulcher	$616,738

Table 6:
Summary Evaluation—Alternative One

Stand ID	Acres	Stems	Tons	Tree Removal Method	Biomass Removal Method	Stand Removal Cost
14	4.6	6,210	246	Hand Felling - Helicopter	Hand work Heli-bucket	$60,650
14A	9.3	12,555	498	Hand Felling - Helicopter	Hand work Heli-bucket	$118,656
15	6.1	1,873	223	Hand Felling - Helicopter	Hand work Heli-bucket	$62,138
16	27.1	19,431	1,952	Hand Felling - Helicopter	Hand work Heli-bucket	$403,146
16A	15.1	10,827	1,088	Hand Felling - Helicopter	Hand work Heli-bucket	$224,540
17	11.7	3,299	965	Feller/Buncher/Skidder	Mulcher	$47,393
17A	8.6	2,425	709	Hand Felling - Helicopter	Hand work Heli-bucket	$117,207
18	14.8	4,544	540	Feller/Buncher/Skidder	Mulcher	$35,896
19	4.4	616	248	Feller/Buncher/Skidder	Mulcher	$18,464
20	7.6	2,333	277	Feller/Buncher/Skidder	Mulcher	$23,642
20A	14.1	4,329	515	Feller/Buncher/Skidder	Mulcher	$44,075
21	5.5	3,944	396	Feller/Buncher/Skidder	Mulcher	$25,384
22	14.7	4,513	537	Feller/Buncher/Skidder	Mulcher	$51,031
23	1.2	1,620	64	Hand Felling - Helicopter	Hand work Heli-bucket	$12,073
24	26.1	30,537	1,630	Hand Felling - Helicopter	Hand work Heli-bucket	$314,767
24A	6.8	7,956	425	Feller/Buncher/Skidder	Mulcher	$71,937
25	3.2	2,294	230	Hand Felling - Helicopter	Hand work Heli-bucket	$47,176
26	4.1	1,017	142	Hand Felling - Helicopter	Hand work Heli-bucket	$39,557
Surface Fuels			2,035			Cost Included
Totals	**415.1**	**207,970**	**24,398**			**$4,727,624**

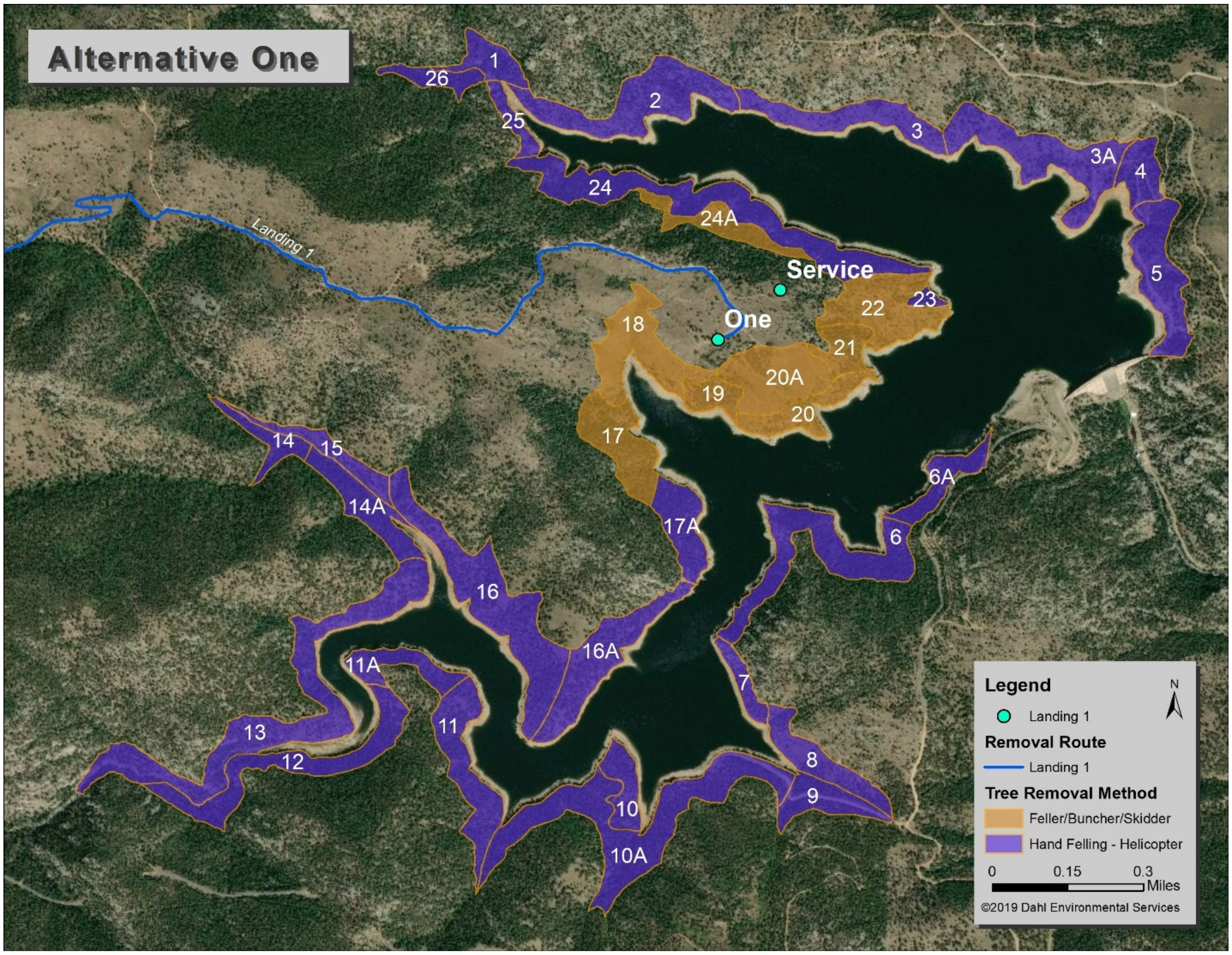


Figure 4: Alternative One: 1-Log Landing

2.5.2 *Alternative Two: 2-Log Landings*

This alternative would make use of two main log landing sites: one on Winiger Ridge, Landing 1 and Landing 2 at the lower terminus of the Winiger Gulch Road for primary processing of all harvested logs and biomass (Figure 5; Section 8.1.6). Landing 2 was ground-verified with a local helicopter vendor and selected to utilize a location which is approximately 2 acres in size in a flat valley bottom at the end of Winger Gulch on FS 97 (see topographic map to the right). This Heli-landing site is within the inundation area. The landing site would be pre-logged using tractor-cable yarding and site-graded to prepare the landing site for helicopter activity.

Heli-Landing 2

Table 7 summarizes the merits of selecting Alternative Two.

Table 7:
Merits of Selection—Alternative Two

Advantages	Disadvantages
• Reduced helicopter round trips for yarding biomass with two landing areas • Minimum service landing construction impacts (one service landing) • Reduced susceptibility to operational shutdowns from mechanical issues with two landing areas compared to a single landing • Increases opportunities for cable and ground yarding, reducing operating costs • Provides multiple biomass disposal options	• Possibly extends harvesting operating period • Very labor-intensive biomass treatment with two landing areas • High community (west side) haul truck traffic impacts • Third highest stand removal costs

Alternative Two meets only one of the evaluation criteria, shown in bold, as listed below. A detailed Summary Evaluation of this alternative along with harvesting costs is provided in Table 8. Road construction costs are identified in Table 13.

- The most cost-effective and efficient tree removal and disposal option.
- Maximize biomass utilization.
- Minimize tree removal traffic.

- Minimize nuisance factors such as noise, light, and odor.

This alternative could also be paired with any of the recommended disposal methods: chips, cordwood, and air curtain destructor, which are discussed in detail in Section 3 (and summarized in Table 17).

Table 8:
Summary Evaluation—Alternative Two

Stand	Landing	Acres	Stems	Tons	Tree Removal Method	Biomass Removal Method	Stand Removal Cost
1	1	5.6	1,389	194	Hand Felling - Helicopter	Hand work Heli-bucket	$54,472
2	1	19.7	14,125	1,419	Hand Felling - Helicopter	Hand work Heli-bucket	$271,373
3	1	12.5	3,838	456	Hand Felling - Helicopter	Hand work Heli-bucket	$112,872
3A	1	19.2	5,894	701	Hand Felling - Helicopter	Hand work Heli-bucket	$177,409
4	1	5.9	738	126	Hand Felling - Helicopter	Hand work Heli-bucket	$49,626
5	1	14.2	3,649	708	Hand Felling - Helicopter	Hand work Heli-bucket	$170,995
6	1	19.4	7,488	795	Hand Felling - Helicopter	Hand work Heli-bucket	$171,382
6A	1	6.3	2,432	258	Hand Felling - Helicopter	Hand work Heli-bucket	$57,750
7	1	3.7	463	79	Hand Felling - Helicopter	Hand work Heli-bucket	$29,126
8	1	9.2	2,824	336	Hand Felling - Helicopter	Hand work Heli-bucket	$89,476
9	1	7.3	1,591	370	Hand Felling - Helicopter	Hand work Heli-bucket	$90,688
10	2	5.9	1,664	487	Hand Felling - Helicopter	Hand work Heli-bucket	$79,935
10A	2	30.9	7,663	1,073	Hand Felling - Helicopter	Hand work Heli-bucket	$440,123
11	2	13.9	3,920	1,147	Hand Felling - Helicopter	Hand work Heli-bucket	$219,999
11A	2	6.6	1,861	544	Hand Felling - Helicopter	Hand work Heli-bucket	$106,848
12	2	16.2	4,018	562	Hand Felling - Helicopter	Hand work Heli-bucket	$142,799
13	2	33.6	24,091	2,420	Hand Felling - Helicopter	Mulcher	$479,165
14	2	4.6	6,210	246	Feller/Buncher/Skidder	Mulcher	$66,104
14A	2	9.3	12,555	498	Cable	Cable Cleanup	$113,068
15	2	6.1	1,873	223	Feller/Buncher/Skidder	Mulcher	$17,826
16	2	27.1	19,431	1,952	Hand Felling - Helicopter	Mulcher	$392,536
16A	2	15.1	10,827	1,088	Hand Felling - Helicopter	Hand work Heli-bucket	$191,101
17	1	11.7	3,299	965	Feller/Buncher/Skidder	Mulcher	$43,145
17A	1	8.6	2,425	709	Hand Felling - Helicopter	Hand work Heli-bucket	$117,207
18	1	14.8	4,544	540	Feller/Buncher/Skidder	Mulcher	$35,896
19	1	4.4	616	248	Feller/Buncher/Skidder	Mulcher	$18,464
20	1	7.6	2,333	277	Feller/Buncher/Skidder	Mulcher	$23,642
20A	1	14.1	4,329	515	Feller/Buncher/Skidder	Mulcher	$44,075
21	1	5.5	3,944	396	Feller/Buncher/Skidder	Mulcher	$25,384
22	1	14.7	4,513	537	Feller/Buncher/Skidder	Mulcher	$51,045
23	1	1.2	1,620	64	Hand Felling - Helicopter	Hand work Heli-bucket	$12,078
24	1	26.1	30,537	1,630	Cable	Cable Cleanup	$314,767
24A	1	6.8	7,956	425	Feller/Buncher/Skidder	Mulcher	$71,937
25	1	3.2	2,294	230	Hand Felling - Helicopter	Hand work Heli-bucket	$47,148
26	1	4.1	1,017	142	Hand Felling - Helicopter	Hand work Heli-bucket	$39,534

Table 8:
Summary Evaluation—Alternative Two

Stand	Landing	Acres	Stems	Tons	Tree Removal Method	Biomass Removal Method	Stand Removal Cost
Surface Fuels				2,035			Cost Included
Totals		**415**	**207,970**	**24,398**			**$4,368,993**

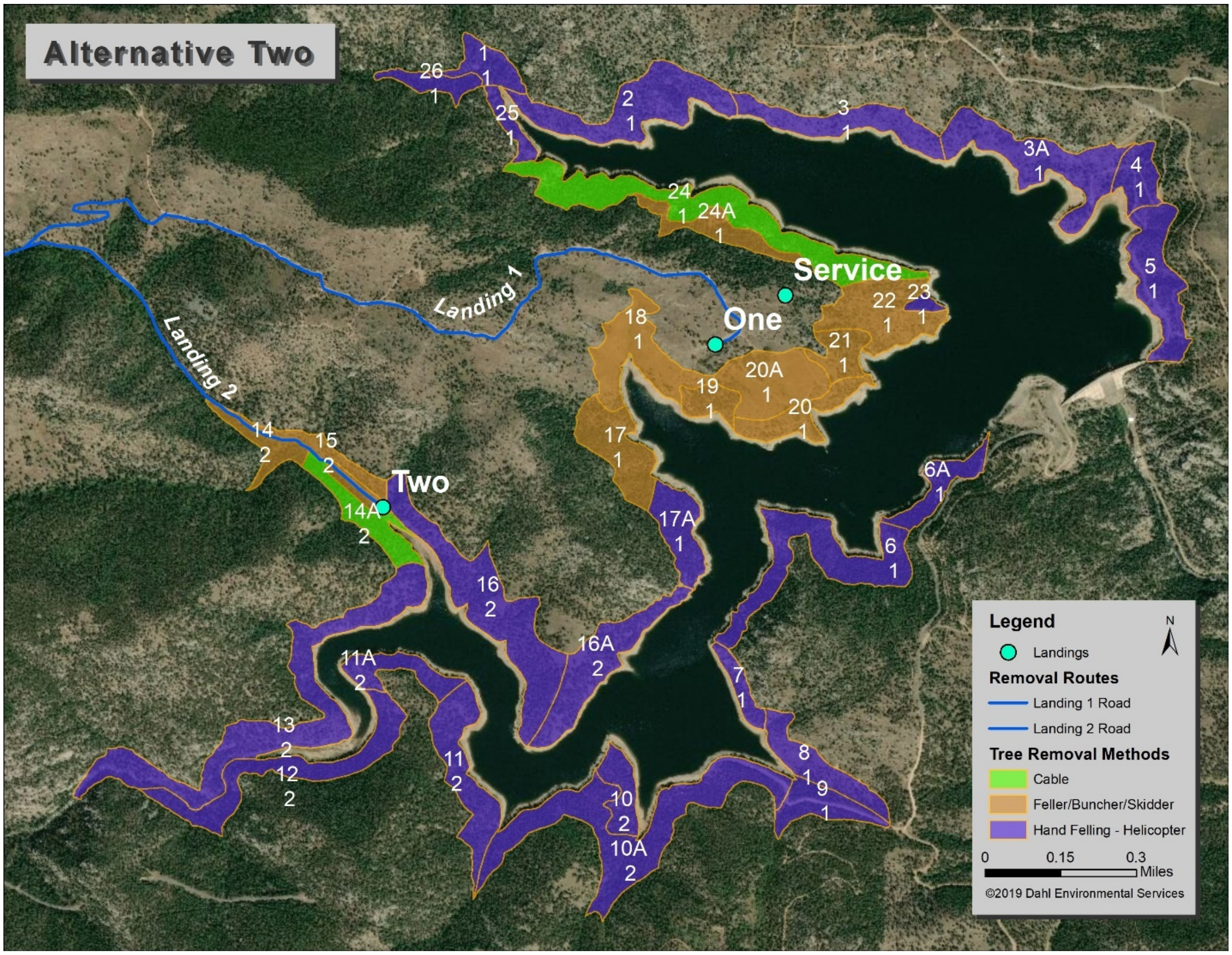


Figure 5: Alternative Two: 2-Log Landings

2.5.3 *Alternative Three: 4-Log Landings*

This alternative would make use of four log landing sites: (1) Winiger Ridge, (2) Winiger Gulch Road, (3) Osprey Point Road, and (4) North Shore Point for primary processing of all harvested logs and biomass (Figure 6; Section 8.1.7). Two of the landings, 3 and 4, utilize Gross Dam Road for removal of material. Coordination of tree removal activities and dam construction activities would minimize potential conflicts. Table 9 summarizes the merits of selecting Alternative Three.

Table 9:
Merits of Selection—Alternative Three

Advantages	Disadvantages
• Least stand removal cost alternative • Maximizes opportunities for cable and ground yarding equipment thereby reducing costs • Reduces west side community haul truck traffic impacts • Best operational options from unplanned shutdowns or mechanical issues with four landing areas • The least helicopter round trips for yarding biomass • Provides a spectrum of biomass disposal opportunities i.e., cordwood, chips and energy • Provide opportunities to minimize impacts on wildlife • Potential to reduce 1,000 tons of carbon emissions by eliminating disposal truck traffic.	• Most landing construction impacts (four landings) • Most service landing construction impacts (two service locations) • Increases east side community haul truck traffic impacts

Alternative Three meets all of the evaluation criteria listed below. A detailed Summary Evaluation of this alternative along with harvesting costs is provided in Table 10. Road construction costs are identified in Table 13.

- The most cost-effective and efficient tree removal and disposal option.
- Maximize biomass utilization.
- Minimize tree removal traffic.
- Minimize nuisance factors such as noise, light, and odor.

This alternative could also be paired with any of the recommended disposal methods: chips, air curtain destructor, and cordwood, which are discussed in detail in Section 3 (and summarized in Table 17).

Table 10:
Summary Evaluation—Alternative Three

Stand	Landing	Acres	Stems	Tons	Stand Removal Method	Biomass Removal Method	Stand Removal Cost
1	1	5.6	1,389	194	Hand Felling - Helicopter	Hand work Heli-bucket	$54,472
2	1	19.7	14,125	1,419	Hand Felling - Helicopter	Hand work Heli-bucket	$271,373
3	4	12.5	3,838	456	Feller/Buncher/Skidder	Mulcher	$50,152
3A	4	19.2	5,894	701	Feller/Buncher/Skidder	Mulcher	$49,447
4	4	5.9	738	126	Feller/Buncher/Skidder	Mulcher	$8,194

Table 10:
Summary Evaluation—Alternative Three

Stand	Landing	Acres	Stems	Tons	Stand Removal Method	Biomass Removal Method	Stand Removal Cost
5	4	14.2	3,649	708	Feller/Buncher/Skidder	Mulcher	$39,105
6	1	19.4	7,488	795	Hand Felling - Helicopter	Hand work Heli-bucket	$171,382
6A	1	6.3	2,432	258	Hand Felling - Helicopter	Hand work Heli-bucket	$57,750
7	3	3.7	463	79	Hand Felling - Helicopter	Mulcher	$32,086
8	3	9.2	2,824	336	Hand Felling - Helicopter	Mulcher	$96,836
9	3	7.3	1,591	370	Feller/Buncher/Skidder	Mulcher	$36,367
10	3	5.9	1,664	487	Hand Felling - Helicopter	Mulcher	$85,475
10A	3	30.9	7,663	1,073	Hand Felling - Helicopter	Mulcher	$567,771
11	2	13.9	3,920	1,147	Hand Felling - Helicopter	Mulcher	$231,119
11A	2	6.6	1,861	544	Hand Felling - Helicopter	Hand work Heli-bucket	$106,848
12	2	16.2	4,018	562	Hand Felling - Helicopter	Hand work Heli-bucket	$142,799
13	2	33.6	24,091	2,420	Hand Felling - Helicopter	Hand work Heli-bucket	$452,285
14	2	4.6	6,210	246	Feller/Buncher/Skidder	Mulcher	$63,921
14A	2	9.3	12,555	498	Cable	Cable Cleanup	$113,068
15	2	6.1	1,873	223	Feller/Buncher/Skidder	Mulcher	$17,826
16	2	27.1	19,431	1,952	Hand Felling - Helicopter	Hand work Heli-bucket	$370,856
16A	2	15.1	10,827	1,088	Hand Felling - Helicopter	Hand work Heli-bucket	$191,101
17	1	11.7	3,299	965	Feller/Buncher/Skidder	Hand work Heli-bucket	$35,460
17A	1	8.6	2,425	709	Hand Felling - Helicopter	Hand work Heli-bucket	$117,207
18	1	14.8	4,544	540	Feller/Buncher/Skidder	Mulcher	$35,896
19	1	4.4	616	248	Feller/Buncher/Skidder	Mulcher	$18,464
20	1	7.6	2,333	277	Feller/Buncher/Skidder	Mulcher	$23,642
20A	1	14.1	4,329	515	Feller/Buncher/Skidder	Mulcher	$44,075
21	1	5.5	3,944	396	Feller/Buncher/Skidder	Mulcher	$25,384
22	1	14.7	4,513	537	Feller/Buncher/Skidder	Mulcher	$51,045
23	1	1.2	1,620	64	Hand Felling - Helicopter	Hand work Heli-bucket	$12,078
24	1	26.1	30,537	1,630	Cable	Cable Cleanup	$314,767
24A	1	6.8	7,956	425	Feller/Buncher/Skidder	Mulcher	$71,937
25	1	3.2	2,294	230	Hand Felling - Helicopter	Hand work Heli-bucket	$47,148
26	1	4.1	1,017	142	Hand Felling - Helicopter	Hand work Heli-bucket	$39,534
Surface Fuels				2,035			Cost Included
Totals		**415**	**207,970**	**24,398**			**$4,046,868**

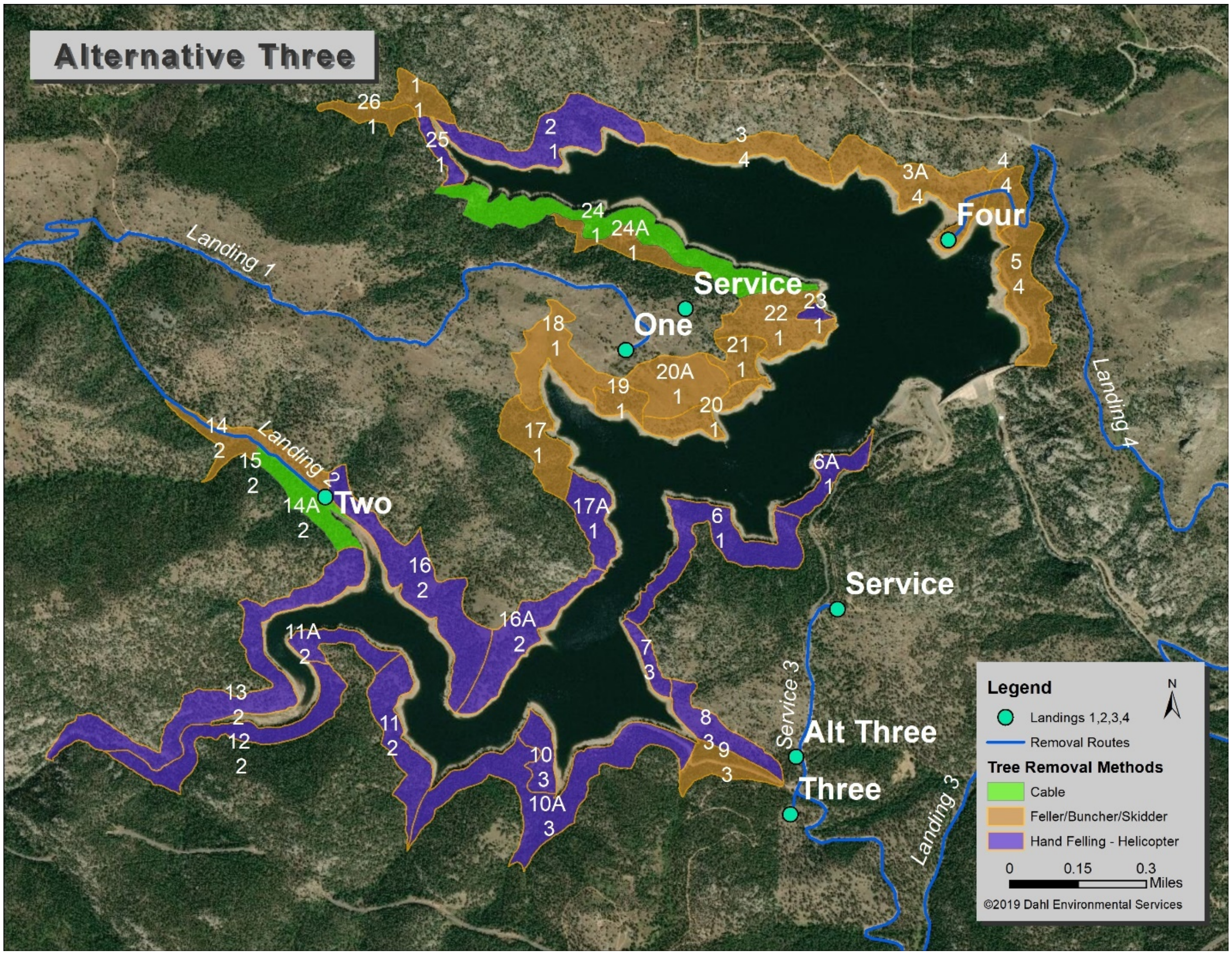


Figure 6: Alternative Three: 4-Log Landings

2.5.4 *Alternative Four: 1-Log Landing*

Alternative Four would make use of one log landing site located at the junction of Gross Dam Road and Osprey Point Road. Landing 3 would be the primary yarding and processing site for all harvested logs and biomass. Landing 3 is accessed by the Gross Dam Road for removal of material (Figure 7; Section 8.1.8). A backup for Landing 3 would be used as a contingency to support Landing 3. A helicopter service landing is identified as Service (Landing) and utilizes access by Gross Dam Road. Coordination of tree removal activities and dam construction activities would minimize potential conflicts.

Table 11 summarizes the merits of selecting Alternative Four.

Table 11:
Merits of Selection—Alternative Four

Advantages	Disadvantages
• Minimum landing construction impacts (one landing) • Minimum service landing construction impacts (one service landing) • Potentially reduces road construction costs by using the Gross Dam Road • Reduces west side community impacts • Provides multiple biomass disposal options	• Longest helicopter round trips for yarding biomass • Minimizes opportunities for cable and ground yarding equipment thereby increases costs • Very labor-intensive biomass treatments on landing area • High community haul truck traffic impacts (Gross Dam Road) • Highly congested landing; limited size • Most susceptible to operational shutdowns from mechanical issues (Similar to Alternative One) • Highest stand removal cost alternative • Significantly increases biomass disposal costs (increased transportation costs)

Alternate 4 meets one of the evaluation criteria and partially meets a second criteria for the westside communities to the reservoir, as shown in bold and listed below. A detailed Summary Evaluation of this alternative along with harvesting costs is provided in Table 12. Road construction costs are identified in Table 13.

- The most cost-effective and efficient tree removal and disposal option.
- Maximize biomass utilization.
- Minimize tree removal traffic.
- Minimize nuisance factors such as noise, light, and odor.

This alternative could be paired with any of the recommended disposal methods: chips, air curtain destructor, and Biochar, which are discussed in detail in Section 3 (and summarized in Table 17).

Table 12:
Summary Evaluation—Alternative Four

Stand	Landing	Acres	Stems	Tons	Stand Removal Method	Biomass Removal Method	Stand Removal Cost
1	1	5.6	1,389	194	Hand Felling - Helicopter	Hand work Heli-bucket	$70,276
2	1	19.7	14,125	1,419	Hand Felling - Helicopter	Hand work Heli-bucket	$397,518
3	4	12.5	3,838	456	Hand Felling - Helicopter	Hand work Heli-bucket	$149,346
3A	4	19.2	5,894	701	Hand Felling - Helicopter	Hand work Heli-bucket	$228,562
4	4	5.9	738	126	Hand Felling - Helicopter	Hand work Heli-bucket	$58,105
5	4	14.2	3,649	708	Hand Felling - Helicopter	Hand work Heli-bucket	$203,764
6	1	19.4	7,488	795	Hand Felling - Helicopter	Hand work Heli-bucket	$197,741
6A	1	6.3	2,432	258	Hand Felling - Helicopter	Hand work Heli-bucket	$65,209
7	3	3.7	463	79	Hand Felling - Helicopter	Hand work Heli-bucket	$28,049
8	3	9.2	2,824	336	Hand Felling - Helicopter	Hand work Heli-bucket	$75,767
9	3	7.3	1,591	370	Feller/Buncher/Skidder	Mulcher	$30,527
10	3	5.9	1,664	487	Hand Felling - Helicopter	Hand work Heli-bucket	$88,959
10A	3	30.9	7,663	1,073	Hand Felling - Helicopter	Hand work Heli-bucket	$454,493
11	2	13.9	3,920	1,147	Hand Felling - Helicopter	Hand work Heli-bucket	$243,479
11A	2	6.6	1,861	544	Hand Felling - Helicopter	Hand work Heli-bucket	$125,790
12	2	16.2	4,018	562	Hand Felling - Helicopter	Hand work Heli-bucket	$181,096
13	2	33.6	24,091	2,420	Hand Felling - Helicopter	Hand work Heli-bucket	$616,501
14	2	4.6	6,210	246	Hand Felling - Helicopter	Hand work Heli-bucket	$69,923
14A	2	9.3	12,555	498	Hand Felling - Helicopter	Hand work Heli-bucket	$134,973
15	2	6.1	1,873	223	Hand Felling - Helicopter	Hand work Heli-bucket	$70,303
16	2	27.1	19,431	1,952	Hand Felling - Helicopter	Hand work Heli-bucket	$427,381
16A	2	15.1	10,827	1,088	Hand Felling - Helicopter	Hand work Heli-bucket	$220,165
17	1	11.7	3,299	965	Hand Felling - Helicopter	Hand work Heli-bucket	$212,090
17A	1	8.6	2,425	709	Hand Felling - Helicopter	Hand work Heli-bucket	$144,479
18	1	14.8	4,544	540	Hand Felling - Helicopter	Hand work Heli-bucket	$162,196
19	1	4.4	616	248	Hand Felling - Helicopter	Hand work Heli-bucket	$58,846
20	1	7.6	2,333	277	Hand Felling - Helicopter	Hand work Heli-bucket	$76,899
20A	1	14.1	4,329	515	Hand Felling - Helicopter	Hand work Heli-bucket	$145,403
21	1	5.5	3,944	396	Hand Felling - Helicopter	Hand work Heli-bucket	$90,857
22	1	14.7	4,513	537	Hand Felling - Helicopter	Hand work Heli-bucket	$155,284
23	1	1.2	1,620	64	Hand Felling - Helicopter	Hand work Heli-bucket	$16,263
24	1	26.1	30,537	1,630	Hand Felling - Helicopter	Hand work Heli-bucket	$431,804
24A	1	6.8	7,956	425	Hand Felling - Helicopter	Hand work Heli-bucket	$108,607
25	1	3.2	2,294	230	Hand Felling - Helicopter	Hand work Heli-bucket	$66,476
26	1	4.1	1,017	142	Hand Felling - Helicopter	Hand work Heli-bucket	$51,080
Surface Fuels				2,035			Cost Included
Totals		**415**	**207,970**	**24,398**			**$5,858,210**

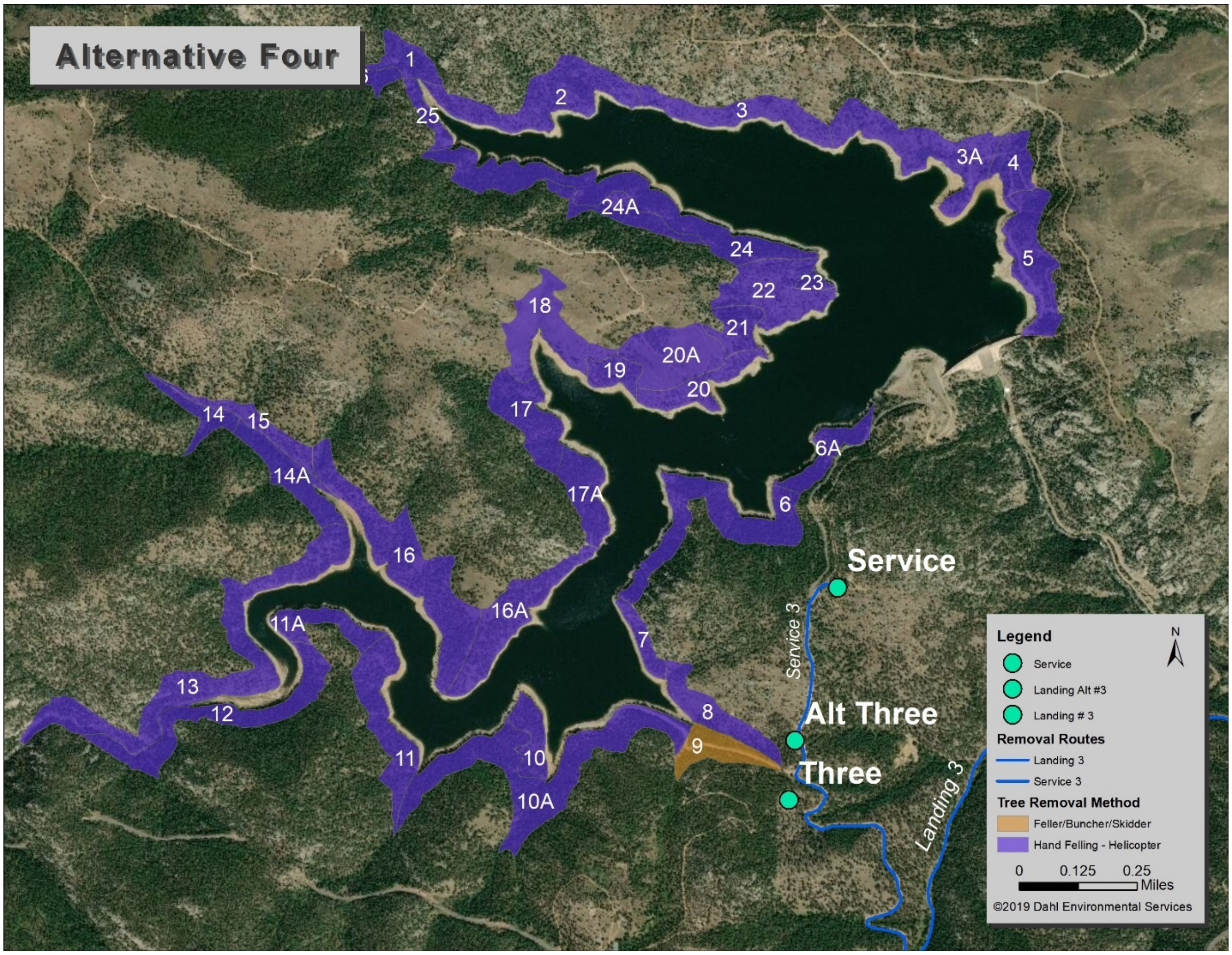


Figure 7: Alternative Four: 1-Log Landings

2.5.5 *LogCost Summary*

All costs in the TRP are based on 2019 prices; no future price increases were calculated. Denver Water will adjust costs based on economic events and inflation experience prior to contracting the implementation of the final TRP.

Log costs for Alternatives One, Two, Three, and Four are shown in (Table 13).

Table 13:
LogCost Summary

		Alternative One		Alternative Two		Alternative Three		Alternative Four	
Stands	**CCF**	**$/CCF**	**$/Stand**	**$/CCF**	**$/Stand**	**$/CCF**	**$/Stand**	**$/CCF**	**$/Stand**
1	50	$1,088	$54,472	$1,088	$54,472	$1,088	$54,472	$1,406	$70,276
2	386	$702	$271,373	$703	$271,373	$702	$271,373	$1,030	$397,518
3	117	$964	$112,872	$965	$112,872	$27	$50,152	$1,276	$149,346
3A	179	$990	$177,409	$991	$177,409	$26	$49,447	$1,277	$228,562
4	38	$1,305	$49,626	$1,305	$49,626	$14	$8,194	$1,529	$58,105
5	199	$858	$170,995	$858	$170,995	$15	$39,105	$1,024	$203,764
6	207	$827	$171,382	$828	$171,382	$827	$171,382	$955	$197,741
6A	67	$861	$57,750	$862	$57,750	$861	$57,750	$973	$65,209
7	24	$1,213	$29,126	$1,214	$29,126	$1,233	$32,086	$1,169	$28,049
8	86	$1,039	$89,476	$1,041	$89,476	$1,104	$96,836	$881	$75,767
9	100	$906	$90,688	$907	$90,688	$13	$36,367	$305	$30,527
10	134	$802	$107,733	$621	$79,935	$603	$85,475	$664	$88,959
10A	701	$627	$440,123	$632	$440,123	$775	$567,771	$648	$454,493
11	315	$804	$253,578	$697	$219,999	$730	$231,119	$773	$243,479
11A	150	$851	$127,886	$711	$106,848	$770	$106,848	$839	$125,790
12	144	$1,308	$188,666	$991	$142,799	$1,020	$142,799	$1,258	$181,096
13	659	$893	$616,738	$685	$479,165	$717	$452,285	$936	$616,501
14	64	$946	$60,650	$70	$66,104	$70	$63,921	$1,093	$69,923
14A	130	$911	$118,656	$374	$113,068	$374	$113,068	$1,038	$134,973
15	57	$26	$62,138	$26	$17,826	$26	$17,826	$1,233	$70,303
16	531	$758	$403,146	$700	$392,536	$733	$370,856	$805	$427,381
16A	296	$757	$224,540	$646	$191,101	$769	$191,101	$744	$220,165
17	265	$10	$47,393	$10	$43,145	$10	$35,460	$800	$212,090
17A	195	$600	$117,207	$601	$117,207	$600	$117,207	$741	$144,479
18	138	$802	$35,896	$803	$35,896	$802	$35,896	$1,175	$162,196
19	65	$9	$18,464	$9	$18,464	$9	$18,464	$905	$58,846
20	71	$26	$23,642	$26	$23,642	$26	$23,642	$1,083	$76,899
20A	131	$26	$44,075	$26	$44,075	$26	$44,075	$1,110	$145,403
21	108	$28	$25,384	$28	$25,384	$28	$25,384	$841	$90,857
22	137	$26	$51,031	$26	$51,045	$26	$51,045	$1,133	$155,284
23	17	$709	$12,073	$710	$12,078	$710	$12,078	$957	$16,263
24	427	$736	$314,767	$154	$314,767	$154	$314,767	$1,011	$431,804
24A	111	$55	$71,937	$55	$71,937	$55	$71,937	$978	$108,607

Table 13:
LogCost Summary

Stands	CCF	Alternative One		Alternative Two		Alternative Three		Alternative Four	
		$/CCF	$/Stand	$/CCF	$/Stand	$/CCF	$/Stand	$/CCF	$/Stand
25	63	$748	$47,176	$748	$47,148	$748	$47,148	$1,055	$66,476
26	36	$1,097	$39,557	$1,098	$39,534	$1,098	$39,534	$1,419	$51,080
Totals	**6398**		**$4,727,624**		**$4,368,993**		**$4,046,868**		**$5,858,210**
Road $			**$391,553**		**$451,920**		**$451,920**		**$0**
Total			**$5,119,177**		**$4,820,913**		**$4,498,788**		**$5,858,210**

2.6 Access and Road Management

For Alternatives One through Three, as described in Section 2.5, the primary site access to the west side of the Project would be via FS 359 (aka Winiger Ridge Road) and FS 97(aka Lazy Z Road or Haul Road). These roads are primarily two-track gravel/dirt roads. Winiger Ridge is accessed from FS 359 and its subsidiary branches and Winiger Gulch from FS 97. A short and steep existing jeep trail connects these two roads approximately 0.85 miles from the east end of FS 97 and would be improved for truck transportation of biomass. To avoid an archaeological site near the start of FS 359 and shorten the route out of the site to the west this connecting road would be utilized for Alternatives 1, 2 and 3 tree removal traffic. FS 97 becomes Boulder County Road (CR) 97E (Lazy Z Road) to the west and connects to CR 132 (Magnolia Drive) before eventually connecting to State Highway 72 via CR 97. Construction of this road may require NEPA analysis. Any improvements necessary on CR 97 will require permission from Boulder County.

No haul traffic would be permitted to travel east on State Highway 72 towards Pinecliff but would be diverted further west to State Highway 119 for transport off site to biomass disposal facilities. In addition, Denver Water has committed to not use Flagstaff Road, Crescent Park Drive and CR 68J (accessed from Magnolia Drive and Lakeshore Drive) for hauling materials. Also, FS 359 must be closed seasonally per the FERC license, and the Heitler easement on FS 97 must be acknowledged. While the preferred route onto State Highway 72 is from CR 97, if this county road proves to be too steep for improvement then haul traffic may be diverted further west on Magnolia Drive (CR 132) to State Highway 119 and then south.

Proposed access roads are shown in Figure 8, and conceptual roadway drawings are provided in Attachment 1.

Major portions of FS 359 and FS 97, as highlighted in Figure 8, would need some improvement to bring in harvesting equipment, support equipment and to transport residue/biomass. The existing FS 359 averages from 10 to 12 feet in width and has grades up to 21 percent. The FS 97 road is generally wider and does not exceed 15 percent in grade. The planned improvements to these access roads includes an average width of 12 to 14 feet and a maximum grade of 15 percent. The surfaces of these roads would be graded for drainage, compacted and additional gravel base added, as necessary. Horizontal curves on these roads would be improved to allow haul truck access. Approximately every half-mile the roadway would be widened, for a short section, to 24 feet in width to allow two-way traffic to pass.

For Alternatives Three and Four, as described in Section 2.5, portions of Gross Dam Road (County Road 77S) would be used for site access to Landings 3 and 4. The existing Gross Dam Road is a gravel road in good condition and currently wide enough for two-way traffic. Any tree removal work along the east side that utilized Gross Dam Road would be coordinated with dam construction activities to avoid conflicts. Tree removal haul traffic on this side of the Project would originate from either Landing 3 or 4, travel along Gross Dam Road to State Highway 72 then travel east towards a designated biomass disposal facility. Crescent Park Drive near the south end of Gross Dam Road would not be used by haul traffic.

It is likely that boats or barges would be used on Gross Reservoir to transport personnel and equipment involved in tree removal activities along the shoreline. However, since helicopters would be more practical for biomass transport it is not expected that barges would be used to transport cut trees across the reservoir to pertinent landing points.

Access road management would include road maintenance during tree removal activities and erosion control that could include side drainage ditches, as appropriate. Upon the completion of tree removal activities these primary access roadways would be restored to their original condition or eliminated depending on Forest Service or Denver Water requirements.

A detailed travel management plan would be developed by the future Contractor for the final alternative of the TRP for FERC 4e Condition 27 that would address (1) roads to be improved, constructed, and used for tree removal activities; (2) restoring roads to pre-project conditions; (3) travel management considerations such as prevention of public use of temporary roads created for tree removal; (4) transportation management during tree removal activities; and (5) how project-related traffic would be managed to minimize disruption on Forest Service roads and provide for visitor safety.

The Contractor hired for tree removal will be encouraged to limit haul truck traffic during school bus pick up and drop off times as well as commuting hours. Truck traffic associated with three removal activities will likely follow the same guidelines as trucks for construction activities.

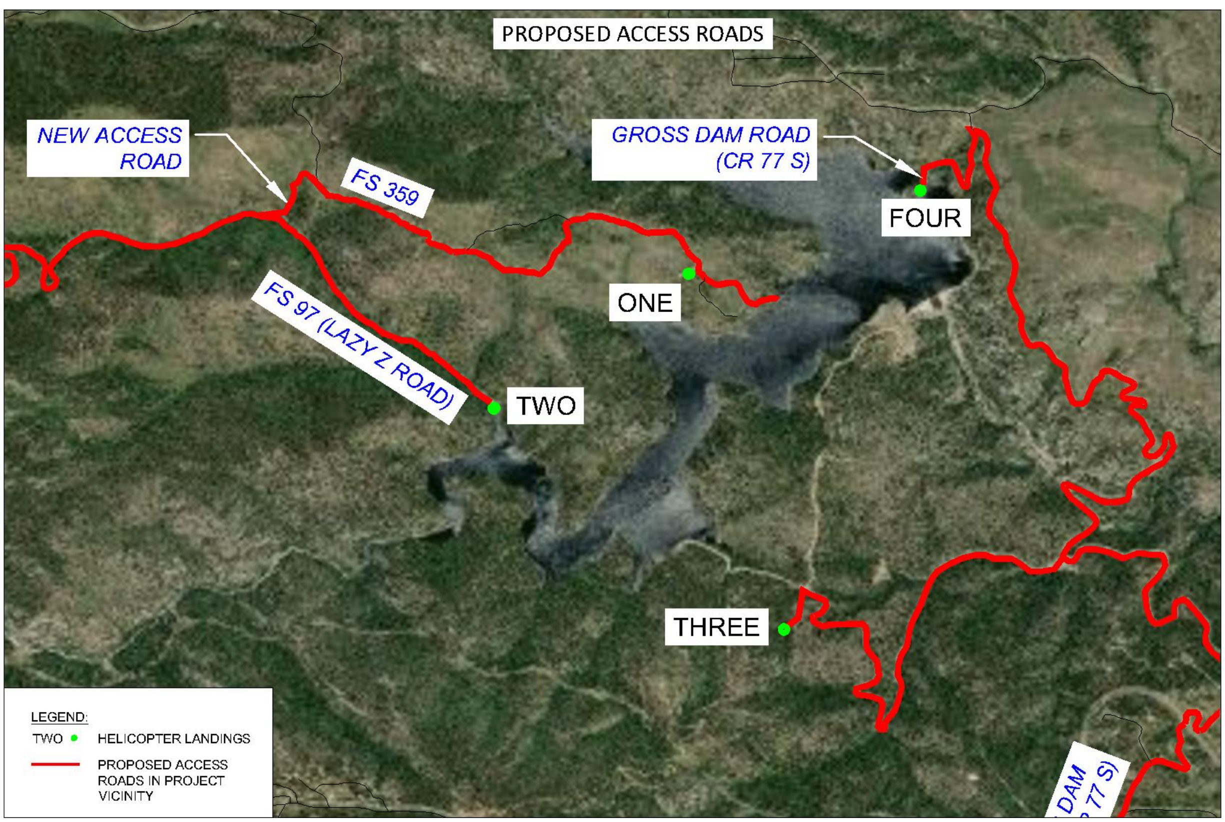


Figure 8: Proposed Access Roads

2.7 Restoration and Rehabilitation

Tree removal, skidding, biomass grinding, chipping and/or biochar operations would take place on Denver Water-owned and National Forest System lands. When these operations take place above the new pool elevation of 7,406 feet, rehabilitation of roads and other operational areas not desirable for future management must occur.

Denver Water-owned lands around the reservoir are managed in accordance with the 2016 Forest Management Plan (CSFS 2016). National Forest System lands around Gross Reservoir are managed in accordance with the Arapaho-Roosevelt National Forests Land and Resource Management Plan.

2.7.1 National Forest System Rehabilitation Standards

Once tree removal has been completed, Denver Water would restore FS roads to their existing FS Maintenance Level 2 (roads open for use by high clearance vehicles) as directed by the Forest Service in accordance with Condition 27. In addition, the Forsythe II Decision Notice (DN; USFS 2017) identified a number of existing roads in the Gross Reservoir area for closure and deconstruction. Several of these roads (FS 359.1c, 1f, 1q, 1r, and 1s), are planned for use in the TRP, so they must be deconstructed after use in the tree removal project. Other roads planned for retention for future management, notably the Winiger Ridge Road FS 359 and Lazy Z/ FS 97 (Winiger Gulch Road), are planned for use in the Project and must be reconditioned as needed. The DN also contains standards for use and rehabilitation of skid trails, landings and non-system temporary roads in tree removal operations that should be followed as directed by the Forest Service.

2.7.2 Denver Water-Owned Lands Rehabilitation Standards

The 2016 Forest Management Plan for the Denver Water-owned lands surrounding Gross Reservoir recommends utilizing Colorado's Best Management Practices (CSFS 2013) to protect natural resources values for all forest management operations, which would include the tree removal for the reservoir expansion and skid trails, landings, processing sites and temporary roads located above the new pool level.

Skid trails, landings, processing sites and temporary roads above the new pool level would be returned to natural contours; water-barred as needed to prevent erosion and gullying; covered with slash, certified weed-free mulch, or otherwise barricaded to future traffic; and reseeded with a seed mix approved for the sites by the CSFS.

The primary existing permanent road on Denver Water lands on the west side to be used in the tree removal project is the last 0.5 mile of FS 359 from the National Forest boundary to the new pool edge. Surface drainage on this road would be restored by out sloping the road surface and installation of armored water bars with spacing as shown in Table 14.

Table 14:
Water Bar Spacing for Road Restoration

Road Grade %	Unstable Soils (High Erosion Hazard)	Stable Soils (Low Erosion Hazard)
2	135 feet	170 feet
5	100 feet	140 feet
10	80 feet	115 feet
15	60 feet	90 feet
20	45 feet	60 feet
25+	30 feet	40 feet

New soil disturbance would be seeded with a seed mix approved by the Forest Service and covered with certified weed-free mulch. If the Gross Dam Road is utilized on the east side of the site for tree removal, then rehabilitation would be coordinated with the Dam construction works.

3. Tree and Debris Disposal

3.1 Disposal Options

3.1.1 Process and Utilize Chips

Grinding whole trees and hauling to biomass utilization facilities is an option for debris disposal. Large grinders are used to convert entire trees into rough chips. These chips can be used as fuel for steam generation, compost or simply dumped in a landfill. Several utilization facilities operate in the greater project working area. Eagle Valley Green Energy in Gypsum and Confluence Energy in Kremmling are potential purchasers of biomass for energy production. A1 Organics in Commerce City and Renewable Fiber Inc. in Fort Lupton provide disposal locations.

Grinder operations are straight forward. Slash is decked in large piles and fed through the grinder with a track hoe or loader, the grinder blows chips into a pile or a truck and the chips are hauled to a utilization facility. The Morbark 4600XL Wood Hog can process debris at the rate of 100 tons per hour. Given the production capacity of this grinder, 1,000 tons of debris could be processed during a 10-hour day. At this rate, it would take approximately 24 days to grind the slash and debris generated by the tree removal project. Chip vans, capable of holding approximately 100 cubic yards of chips, would carry approximately 23–27 tons per load. Given the estimated 24,000 tons of debris, this would generate approximately 1,000 truckloads of chips.

3.1.2 Biochar

Biochar production provides an option to utilize all the biomass and tree removal debris from the Project.

BCN uses a slow-pyrolysis technology (slow burning/cooking in an enclosed kiln) to make its biochar. In general, each kiln burns about 2,000 pounds of wood and would produce approximately 600 pounds of biochar in 24 hours. BCN would pay $60 per dry ton for the feedstock delivered whole tree to the shredder location. BCN would need about $5 million upfront to purchase the biochar equipment needed for the tree removal. BCN would take care of all the processing (shredding) and haul the shredded material offsite, and production of the biochar in the local area to provide local jobs; processing biomass by BCN would reduce the woody material by 80 percent. The processed biochar can then be transported via dump trucks to markets (Gaspard 2019).

3.1.3 Sawlogs

Most of the trees to be removed under the TRP in the Project area are not highly desirable by the timber industry because of their relative short height and number of limbs (knots). Conventional logging truck access to most of the wood is restrictive and very expensive. One operator (Carl Spaulding, VP and General Manager, Renewable Fiber Inc., Fort Lupton, Colorado) indicated there is “no merchantable material” in the Project area. Accordingly, the focus of the TRP is to treat Project material as debris.

3.1.4 Pellets

Material from the tree removal activities could be utilized as pellets. Confluence Energy in Kremmling, Colorado, would purchase biomass at $35 to $40 per ton delivered at the Kremmling facility.

3.1.5 Cordwood

Cordwood production may be possible by selecting a producer such as Sweetman Enterprises Inc. The cordwood firm expressed interest in contracting the entire 24,000 tons of woody material, Sweetman would convert to cordwood and chips at the landing locations. Sweetman Enterprises Inc. did not provide pricing information; however, there is interest in developing a business partnership with Denver Water on the tree removal program.

In recent conversations, JCK Corporation, a firewood supplier, confirmed that they chiefly procure dry, dead wood for cordwood production. They will not pay for dead or green wood. JCK may be interested in receiving green wood at a storage area on Denver Water lands for year-long processing of green wood to dry wood, but will not receive green wood at their Henderson facility. Since 90 percent of the wood from the TRP will be green, JCK is not a viable alternative for disposal of cordwood.

Nederland Community, Colorado, is a firewood-dependent community for home heating. There may be an opportunity to provide “goodwill” cordwood through vendors such as Sweetman Enterprises Inc. or others. It will be important to balance “free use” firewood with the existing commercial market in the area.

3.1.6 Ethanol

Ethanol production from biomass is possible; however, according to Scott Haase, Renewable Energy Scientist, National Renewable Energy Lab the National Renewal Energy Laboratory in Lakewood, Colorado, “the markets have deteriorated significantly and are currently not an economically viable option in Colorado”.

3.1.7 Boulder Log Yard

Nederland Community Forestry Sort Yard (CFSY) provides another utilization and disposal option. Operationally, the Nederland CFSY could receive both logs and chips. Nederland tipping fee is approximately $4.00 per cubic yard. The tree removal project would produce approximately 24,000 cubic yards. The Nederland CFSY, operated by Boulder County, provides the closest off-site disposal location. Disposing saw logs at the sort yard would provide opportunities for local firewood cutters and could generate community goodwill.

3.1.8 Air Curtain Destructor

ACDs or burners are widely used in land clearing projects throughout the world. An ACD is a simple machine that is, in fact, a large mobile incinerator. Combustible material is loaded into the large bin and a fan blows a high-pressure curtain of air across the top of the bin. The curtain recirculates combustible gases and smoke until only heat and a minimum of pollutants escape from the bin. ACDs have a 96 to 98 percent reduction rate, so 2,000 pounds of slash turns into 40 to 80 pounds of ash and a limited amount of biochar. ACDs provide an efficient, environmentally friendly feasible option for debris disposal. A U.S.

Forest Service San Dimas Technology and Development Center evaluation of ACDs, indicated ACDs efficiently disposed of large quantities of fuels while releasing very little emission particulate matter (USFS 2005). Residual ash and biochar have beneficial use and can be applied to disturbed areas during restoration activities. A larger FireBox can eliminate 10 to 12 tons of woody debris per hour, reducing approximately 100 tons during a 10-hour day. A single operator can support three ACDs on a single landing. Three ACDs working in combination could eliminate 24,000 tons of debris in 80 burning days. Additional burners would reduce disposal times. Utilizing air curtain destructors essentially eliminates product removal traffic from local and state highways. Environmental impacts are minimal as near complete combustion is achieved with minimal amounts of escaped particulates, virtually eliminating smoke (Section 8.3). Ash and biochar can be stored on site to be used for site restoration.

Results of real-time ambient air testing by Lockheed Martin Technology Service for the United States Environmental Protection Agency/Environmental Response Team in Puerto Rico showed that “there were no significant emission releases during debris burning”. The ambient air monitoring and sampling was conducted at the request of the U.S. EPA and the Corps to evaluate air emissions during ongoing burns destroy all burnable woody debris generated by Hurricane Jeanne (Lockheed Martin 2005)

Utilization of ACDs would require coordination with the Forest Service, Boulder County Sheriff, CDPHE, and local fire districts.

3.1.9 Foothills Landfill

Loading and hauling chips to a landfill is the most expensive disposal option considering haul costs and tipping fees. Haul costs are determined using landing 1, 2, and 3 as starting areas for chip trucks. Foothills Landfill is located at 8900 Highway 93 near Golden and is the closest landfill to the project area. Quoted tipping fees at Foothills landfill are $22.80 per ton.

3.2 Summary of Tree Disposal Methods

Approximately 24,000 tons of forest residue and debris would be produced during the tree removal phase of the Project. The following is a discussion of debris disposal methods and opportunities. Depending on Denver Water’s decision, each method is feasible and implementable. Table 15 summarizes the disposal options.

Table 15:
Debris Disposal Methods

Disposal Methods	Total Tons	Grinding Cost/Ton	Hauling Cost/Ton	Operating Cost /Ton	Tipping Cost/Ton	Revenue/ Ton	Total Cost/Ton	Total Cost
Sweetman Enterprises, Inc. Logs/Cordwood	24,000						No Cost Disclosures	
Confluence Energy-Chips	24,000	$6	$35			$37	$3	$72,000
Eagle Valley Electric-Chips	24,000	$6	$35			$35	$6	$144,000
Air Curtain Burner-Logs	24,000			$9			$9	$216,000

Table 15:
Debris Disposal Methods

Disposal Methods	Total Tons	Grinding Cost/Ton	Hauling Cost/Ton	Operating Cost /Ton	Tipping Cost/Ton	Revenue/ Ton	Total Cost/Ton	Total Cost
Nederland CFSY-Chips/Logs	24,000	$6	$7		$4		$17	$408,000
A1 Organics Inc-Chips	24,000	$6	$17				$23	$552,000
Renewable Fiber Inc-Chips	24,000	$6	$22				$28	$672,000
Foothills Landfill-Chips	24,000	$6	$19		$23		$48	$1,152,000
BCN-Logs, Biochar Now (BCN)	24,000			$208		$60	$148	$3,552,000

3.2.1 Maximize Biomass Utilization

To meet this evaluation criteria, the method that best maximizes biomass utilization is grinding. Grinding debris into chips and removing from the site to a facility would utilize 100 percent of the Project biomass. For this method, the most cost-effective option is to transport the chips from the Project area to the Eagle Valley facility in Gypsum, Colorado. Eagle Valley has been paying an average of approximately $35 per delivered ton, which would offset the transportation cost. Confluence Energy in Kremmling quoted a price of $35-$40 per delivered ton.

Refer to Section 3.1.2, Biochar., Biochar production from Biochar Now (Gaspard 2019) would also utilize 100 percent of the Project biomass; however, the upfront investment cost of $5 million is significant.

3.2.2 Minimize Project Traffic

To meet this evaluation criteria, ACDs is the best method for minimizing debris removal traffic. ACDs can eliminate up to 98 percent of all Project debris on site, thereby eliminating approximately 900 chip truck loads from local and state highways. Eliminating truck traffic associated with debris removal could reduce approximately 1,000 tons of carbon emissions (Mathers et.al.)

3.2.3 Minimize Tree Removal and Disposal Costs

This evaluation criteria takes into account tree removal and disposal costs. For example, Alternative Three, as discussed in Section 3.2.5, is the most cost-effective in terms of tree removal. To minimize disposal costs, a multi-prong disposal approach could be used such as: air curtain destructors, cordwood production, and chipping. The multiple disposal method approach is the most cost-effective for tree disposal based on:

- Multiple landing sites minimize helicopter distances and maximizes daily payloads.
- Provides the least-cost option for utilization of Project biomass on all four landing locations.
- Disposing biomass using small cordwood operations and air curtain destructors virtually eliminates slash and debris while creating useable biochar.

3.2.4 Summary of Alternatives and Costs

The following table summarizes the costs for tree removal and debris disposal options. These costs include the improvement of the Winiger Ridge Road (FS 359 and Lazy Z Road (FS 97). Total costs range from $4,714,788 (Alternative Three) to as much as $9,358,210 (Alternative Four) for tree removal and biochar production (Table 16).

Table 16:
Tree Removal and Disposal Options

Alternatives	Tree Removal Costs	Debris Disposal: Air Curtain Destructor	Debris Disposal: Chip Utilization (Eagle Valley Green Energy)	Debris Disposal: Biochar NOW	Total Removal and Disposal Cost
1	$5,119,177	$216,000			$5,335,117
	$5,119,177		$144,000		$5,215,177
	$5,119,177			$3,500,000	$8,619,177
2	$4,820,913	$216,000			$5,036,913
	$4,820,913		$144,000		$4,916,913
3	$4,498,788	$216,000			$4,714,788
	$4,498,788		$253,750		$4,752,538
4	$5,858,210	$216,000			$6,074,210
	$5,858,210		$253,750		$6,111,960
	$5,858,210			$3,500,000	$9,358,210

Note: See Section 3.1.5 for cordwood options.

Multiple disposal methods in combination could be employed for each alternative. Table 16 is provided for estimation purposes.

3.3 Preferred Alternative Selection

Considering the stated objectives, field reconnaissance, inventory collection, LogCost analysis, and professional consultation, Alternative Three is the best choice and preferred alternative that meets all the evaluation criteria stated in Denver Water's Request for Proposal for this TRP. Alternative Three utilizes a combination of air curtain destructors, cordwood production, and chipping methods for tree disposal. The preferred alternative is based on the following rationale:

- Multiple landing sites (four) minimize helicopter distances and maximize daily payloads.
- Provides the least-cost option for utilization of Project debris using multiple disposal methods at all four landing locations.
- Disposing debris using small cordwood operations and air curtain destructors virtually eliminates disposal of slash and debris while creating useable biochar from the air curtain destructors.
- Minimize harvest operating period.
- Maximize disposal options.
- Potential to significantly reduce debris disposal traffic.
- Maximum flexibility to manage wildlife constraints.
- Most efficient harvesting option.
- Potential to minimize environmental impacts.
- Potential to maximize environmental benefits.

3.4 Conclusions for TRP

In this TRP, four tree removal alternatives for the GRE along with recommended disposal methods for each alternative were analyzed (see comparisons in Table 17). Our analysis of each alternative was guided by the following criteria:

- 1: The most cost-effective and efficient tree removal and disposal option.
- 2: Maximize biomass utilization.
- 3: Minimize tree removal traffic.
- 4: Minimize nuisance factors such as noise, light, and odor.

Based on these criteria, the preferred alternative that best meets Denver Water's objectives is Alternative Three. This alternative provides the least-cost option for tree and debris removal as it minimizes traffic and nuisance factors.

The largest factor in determining the tree removal costs associated with the TRP is the yarding distances needed for helicopters. With four strategically placed landing locations identified in Alternative Three, the helicopter yarding distances are greatly reduced, resulting in removal costs being approximately $322,000 lower than the next lowest cost alternative.

For biomass utilization, Alternative Three provides a suite of disposal options including full utilization and removal from the project area as well as complete onsite disposal utilizing ACDs. Existing market and production sources were used to develop the best practices for feasible utilization of biomass. When considering biomass utilization, Full utilization of biomass debris would require trucking project debris from the project site. Transporting 24,000 tons of processed project debris would require approximately 900 chip trucks moving material through FS 97 and the Gross Dam Road. Round trips would generate approximately 1,800 trucks on local roads. To minimize tree removal traffic, project debris could be treated onsite utilizing ACDs. Use of ACDs would significantly reduce truck traffic associated with project debris disposal and provide useable Biochar for landscape restoration. Eliminating truck traffic associated with debris removal could reduce approximately 1,000 tons of carbon emissions. ACDs would be permitted by Colorado Department of Health and Environment and would be subject to Boulder County fire restrictions.

The LogCost assessment completed for the TRP fully analyzed contemporary harvesting technologies and helicopter opportunities, including aerial and cable systems as well as ground-based systems to select Alternative Three as the preferred alternative. Based on a systems feasibility assessment, the minimum transportation system was designed to efficiently remove and dispose of project biomass and woody debris while minimizing impacts on local community and protecting nonmarket benefits such as wildlife and archaeology.

Table 16 and 17 display the range of costs associated with disposal options analyzed in the TRP. Costs range from $4,752,538 for complete utilization by chipping and removing debris from the project area to $4,714,768 to completely dispose of the debris on the project site by ACD. Complete disposal on site, in addition to the benefits listed above, would save approximately $37,000, but likely lengthen the schedule for tree removal.

The analysis of the tree removal alternatives is based on our experience with logging engineering, harvest systems design, and implementation guided by Colorado's Best Management Practices (CSFS 2013). The overarching guiding principle was to develop a TRP that would minimize impacts on the community and maximize biomass utilization at the most cost-effective price point.

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Table 17:
Summary Decision Table

GRE Alternative Summary	Alternative One			Alternative Two		Alternative Three			Alternative Four		
	Chips	**AC Burner**	**BioChar**	**Chips**	**AC Burner**	**Chips**	**AC Burner**	**Cordwood**	**Chips**	**AC Burner**	**BioChar**
Tree Removal and Biomass Disposal Costs	$5,215,177	$5,335,177	$8,619,177	$4,916,913	$5,036,913	$4,752,538	$4,714,788	$34,000*	$6,111,960	$6,074,210	$9,358,210
Haul Truck/Dump Truck Traffic	900 Haul	None	180 Dump	900 Haul	None	827 Haul	None	80 Haul	900 Haul	None	180 Dump
Permit: Colorado Parks and Wildlife, Forest Service, Boulder County, CDPHE	N/A	CDPHE	N/A	N/A	CDPHE	N/A	CDPHE	N/A	N/A	CDPHE	N/A
Air Emissions	Moderate	Low	None	Moderate	Low	Moderate	Low	Moderate	Moderate	Low	None
Noise Levels	High	Low	Low	High	Low	High	Low	Low	High	Low	Low
Wildlife Conflicts	High	Moderate	Low	High	Moderate	High	Moderate	Low	High	Moderate	Low
Product Utilization	High	Low	Moderate	High	Low	High	Low	416 Cords	High	Low	Moderate
Biochar Percent/Ton	0%	3%	20%	0%	3%	0%	3%	0%	0%	3%	20%
Most cost-effective and efficient method	No	Yes	Yes	No	Yes	No	Yes	No	No	Yes	Yes
Maximizes product utilization	Yes	No	Yes	Yes	No	Yes	No	Yes	Yes	No	Yes
Minimizes hauling traffic	No	Yes	Yes	No	Yes	No	Yes	Yes	No	Yes	Yes
Minimizes nuisance factors such as noise, light, and odor.	No	Yes	Yes	No	Yes	No	Yes	No	No	Yes	Yes

* Estimated costs to supply cordwood to Northshore Wood Yard

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4. Reservoir Tree Removal Schedule

The Master Schedule (see Figure 9) is provided to set the implementation stage for the TRP to allocate calendar dates strategically and provide tactical guidance for daily work activities. The schedule categorizes project activities into logical working tasks. The time frames are reduced to accomplish the TRP in one year in accordance with wildlife timing restrictions. Task activities are designed to be flexible and can be adjusted to future operating plans. The following is the schedule rationale:

- Site preparation (Site Prep) is intended to pre-stage and prepare work to establish infrastructure for roads, landings and skid trails. The schedule time frame for Site Prep is 3 months in advance of tree removal operations.
- Tree removal starts by getting wood and biomass on the ground with timber felling or fellerbuncher. This is done to start the drying process ahead of skidding and yarding and to benefit reduced weights for helicopter yarding. Tree felling is scheduled for 3 months. Skidding, yarding, and helicopter yarding is scheduled for 5 months, and should be done simultaneously on all four landings.
- Timber processing is scheduled to complement the yarding process. As logs and biomass are delivered to the landing sites, they would be processed by chipping or grinding or placed into an air curtain burner. Depending on utilization decisions, material could be processed into biochar or utilized for local firewood consumption. Timber processing takes approximately 5 months.
- Transportation removes project debris and waste by chip truck and trailers and dump trucks over project road systems for Alternative Three, simultaneously on all four landings. Chips could go to Eagle Valley for electric energy. On site disposal with air curtain destructors would reduce vehicle traffic while providing biochar as a by-product. Transportation occurs simultaneously with timber processing during the same 5-month period.
- Restoration of temporary roads and all disturbed sites above elevation 7,406 feet would occur following timber removal operations. This could take approximately 5 months in late summer and fall time periods.
- Restrictions would be aggressively mitigated with agencies as time frames become firm. The work plan schedule overlaps with many of the wildlife timing restrictions and seasons of the year. Given this uncertain schedule, flexibility would be essential in adjusting the master schedule in the implementation of the TRP.

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Figure 9: Project Schedule

Task	Start	End	Duration	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	April	May	June	Jul	Aug	Sept	Oct	Nov	Dec
Project	8/1/2024	12/31/2025	517																	
Site Preparation																				
Road Construction	8/1/2024	10/31/2024	91																	
Developing Landing Locations	8/1/2024	10/31/2024	91																	
Developing Skid Trails	9/1/2024	10/31/2024	60																	
Tree Removal																				
Timber Felling	12/1/2024	2/28/2025	89																	
Feller Buncher	12/1/2024	2/28/2025	89																	
Hand Felling	12/1/2024	2/28/2025	89																	
Skidding and Yarding	3/1/2025	7/31/2025	152																	
Helicopter Yarding	3/1/2025	7/31/2025	152																	
Timber Processing																				
Log Processing	3/1/2025	7/31/2025	152																	
Chipping	3/1/2025	7/31/2025	152																	
Grinding	3/1/2025	7/31/2025	152																	
Biochar	3/1/2025	12/31/2025	305																	
Log Product Processing	3/1/2025	7/31/2025	152																	
Transportation																				
A1 Fiber	3/1/2025	7/31/2025	152																	
Gypsum, CO	3/1/2025	7/31/2025	152																	
Biochar	3/1/2025	7/31/2025	152																	
Cordwood	3/1/2025	7/31/2025	152																	
Boulder Wood Processing	3/1/2025	7/31/2025	152																	
Restoration																				
	8/1/2025	12/31/2025	152																	
Restrictions																				
Raptor Protection Measures	3/1/2025	7/31/2025	152																	
Owl Nests	5/1/2025	8/10/2025	101																	
Goshawk	3/1/2025	9/30/2025	213																	
Raptor Nest Breeding	3/1/2025	9/15/2025	198																	
Elk Winter Range	12/1/2024	3/30/2025	119																	

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5. Managing Waterborne Wood Debris

Naturally occurring woody debris would remain in Gross Reservoir as the reservoir fills due to vegetation debris that could not be removed during the tree removal activities. Most of this material would be existing naturally occurring litter and material smaller than 2 inches in diameter and length. This material would eventually float down the reservoir to the dam site. At other dam sites, this material has been prevented from entering the dam using booms to capture the floating material. Once the reservoir is operational, debris management would be an essential element of reservoir operations (BC Hydro, 2015).

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7. Terms and Definitions

7.1 Forestry

Basal area	The cross-sectional area of a single stem, including the bark, measured at breast height (4.5 feet).
Board foot (bd ft, bf)	The amount of wood contained in an unfinished board 1 inch thick 12 inches long and 12 inches wide.
Biochar	Charcoal produced from plant matter such as wood chips and stored in the soil as a means of removing carbon dioxide from the atmosphere. Biochar is charcoal made from biomass (such as wood) by pyrolysis i.e. the thermal decomposition of materials at elevated temperatures in an inert atmosphere, (Wikipedia),
Blowdown	Trees or trees felled or broken off by wind.
Chipper	A mobile machine consisting of infeed conveyor, debarker (sometimes), and chipper, with chips being blown into a chip truck or a pile.
Coppice	The production of new stems from the stump or roots; to cut the main stem at the base or to injure the roots to simulate the production of new shoots for regeneration.
Defensible space	An area around a structure where fuels and vegetation are treated, cleared or reduced to slow the spread of wildfire towards the structure.
Density-dependent mortality	Trees which die as a result of other (usually larger) trees being able to out-compete them for light, water, and nutrients.
Chain	A unit of length equal to 66 feet and composed of 100 links, 1 mile has 80 chains.
Clear cut	A stand in which essentially all trees have been removed in one operation.
Diameter at breast height (dbh)	The diameter of a stem of a tree at 4 ½ feet above the ground
Cubic foot	A unit of true volume and measures 1 x 1 x 1 ft., 100 ft.^{3} = ccf
Dominant trees	A species exerting the greatest influence on its character because of its life form or great abundance in silviculture an individual or species in the upper layer of the canopy.
Even-aged stand	A stand of trees composed of a single age class.

Fuel break	A generally wide strip of land on which native vegetation has been permanently modified so that a fire burning into it can be more readily controlled.
Fuel loading	The oven-dry weight of fuel per unit area.
Improvement cutting	The removal of less desirable trees of any species in a stand of poles or larger trees, primarily to improve composition and quality.
Ladder fuels	Vegetative materials with vertical continuity that allows fire to burn from the ground level up to the branches and crowns of trees.
Ladder fuels	Combustible materials that provides vertical continuity between vegetation strata and allows fire to climb into the crowns of trees or shrubs with relative ease
Mean diameter	Of a group of trees, quadratic mean diameter, the diameter corresponding to the mean basal area.
Noxious weed	A plant specified by law as being especially undesirable, troublesome, and difficult to control.
Patch	A small part of a stand or forest.
Pure stand	A stand composed principally of one species, conventionally at least 80 percent based on numbers, basal areas, or volumes.
Riparian area	Related to, living, or located in conjunction with a wetland, on the bank of a river or stream but also at the edge of a lake or tidewater.
Scarification	Mechanical removal of competing vegetation or interfering debris, or disturbance of the soil surface, to enhance reforestation.
Scribner decibel C log rule	A modification of the Scribner rule from which the board foot volume is taken to the closest 10 board foot and then the last digit is dropped.
Scribner rule	A diagram long ruled assumes 1-inch boards and 0.25-inch kerf is based on diameter at the small end of the log disregards taper and does not provide for overrun.
Serotinous	Pertaining to fruit or cones that remain on a tree without opening for one or more years.
Shaded fuel break	It is a carefully planned thinning of dense tree cover and underlining brush. These are placed in strategic locations along ridges, access roads or other locations such as subdivisions. Ref., Firesafe San Mateo A shaded fuel break is an easily accessible strip of land of varying width (depending on fuel and terrain), in which fuel density is reduced, thus improving fire control opportunities. The stand is thinned, and remaining trees are pruned to remove ladder fuels. Brush, heavy ground fuels,

	snags, and dead trees are disposed of and an open, park-like appearance is established., Ref., CSFS
Sheltered wood	The cutting of most trees leaving those needed to produce sufficient shade to provide a new age class of trees.
Silviculture	The art and science of controlling and establishment of growth, composition, health, and quality of forests.
Skid road	A road on which logs are hauled.
Slash	The residue, e.g., treetops and branches, left on the ground after logging or accumulating as a result of storm, fire, girdling, or delimbing.
Snag	A standing, generally unmerchantable dead tree from which the leaves and most of the branches have fallen.
Stand	A contiguous group of trees sufficiently uniform in age-class distribution, composition, and structure, and growing on a site of sufficiently uniform quality, to be a distinguishable unit.
Sucker	A shoot arising from below the ground either from a rhizome or from a root.
Fuel break	Generally, a wide 60 to 1,000 feet strip of land on which the native vegetation has been permanently modified so that a wildfire burning into can be more readily controlled.
Thinning	A cultural treatment made to reduce stand density of trees primarily to improve growth, enhance forest health, or recover potential mortality.
Thinning from below or low thinning	The removal of trees from the lower crown classes favored those in the upper crown classes i.e., large trees.
TPA	Trees per acre.
Uneven-aged stand	A stand with trees in three or more distinct age classes, either intimately mixed or in small groups,
Windbreak	A strip of trees or shrubs maintained mainly to alter windflow and microclimates in the sheltered zone, usually farm buildings,
Windfirm	Trees able to withstand strong winds and resist windthrow,

Source: Helms, J. A. (1998)

7.2 Logging

Barge	A roomy, usually flat-bottomed boat used chiefly for the transport of goods on waterways and usually propelled by towing.
Bioenergy Renewable	energy made available from materials derived from biological sources (energy derived from biomass).
Biomass	Dry weight of organic matter (i.e., plants and animals) in an ecosystem.
Best Management Practices (BMPs)	Effective economical practices associated with silvicultural operations that minimize nonpoint source pollution (soil erosion and stream sedimentation) (see Colorado's Best Management Practices).
Box Culvert	A wooden, open bottom culvert, usually constructed from on-site materials, utilized for the temporary, short term crossing of small streams or drainages.
Bridge Abutment	The end foundation upon which the bridge superstructure rests.
Cable Logging	A yarding system employing winches, blocks, and cables.
Coarse Woody Debris	Typically, sound or rotting logs, stumps, or large branches that have fallen or been cut and left in the woods, or trees and branches that have died but remain standing or leaning.
Coniferous Tree	Any of various mostly needle-leaved or scale-leaved, chiefly evergreen, cone-bearing gymnosperms trees or shrubs such as pines, spruces, and firs.
Conventional	Harvesting of trees by using any combination of mechanical or hand felling and rubber-tired or tracked skidding equipment.
Crown closure	The percent crown closure in a forest stand is assessed from aerial photographs. Crown closure is based on the amount of ground area covered by the tree crowns (i.e., vertical projection).
Culvert	A tunnel or a drain under a road that carries water from a stream or drainage from one side to the other. Examples include plastic pipes, corrugated metal pipes, box culverts, and arch culverts.
Danger Tree	A tree that is hazardous because of location or lean, physical damage, overhead hazards, deterioration of the limbs, stem or root system, or any combination.
Deactivation	To render a road, trail, or any excavated feature inactive or ineffective. For roads, deactivation measures include removal of culverts and bridges, re-contouring the slope, and in some cases planting or seeding.

Debris Trap	Engineered structure located across moving waterways to intercept and collect floating debris (such as fallen trees) and keeping it from continuing downstream. Examples include fin-booms and shear booms.
Deciduous Tree	Broad-leaved tree that sheds all its leaves during one season (e.g., aspen, cottonwood).
Ephemeral	Lasting a very short time. In the case of ephemeral drainages, these include seasonal streams, non-classified drains and intermittent seepages that only flow during certain months of the year.
Feller Buncher	A type of motorized harvester used in logging. It consists of a standard heavy equipment base with a tree-grabbing device furnished with a circular saw or a pinching device designed to cut small trees off at the base. The machine then places the cut tree in a stack suitable for a skidder or forwarder, or other means of transport (yarding) for further processing (e.g., delimbing, bucking, loading, or chipping).
Fiber	The hard-fibrous substance of trees that composes the body and its branches, and which is covered by the bark.
Freshet	A flood resulting from a heavy rain or a spring thaw.
Grubbing	Removal of stumps, roots, embedded logs, organics, and unsuitable soils before or concurrently with construction activities.
Hand Felling or Falling	To cut down a tree by using mechanical or non-mechanical hand tools (e.g., chainsaw) and without the use of heavy equipment.
Harvesting	The felling, skidding and on-site processing and loading of tree and products on to trucks.
Headpond	wholly or partly filled artificial lake or reservoir storing water.
Helicoidal	Shaped like a spiral, resembling that of a screw thread.
Merchantable Tree	A tree that has attained sufficient size, quality and (or) volume to make it economically suitable for harvesting and transport to a processing plant.
Non-merchantable	A tree that is economically unsuitable for harvesting and processing into other commercial Tree products. This designation may result due to tree size, amount of rot, type of species or overall quality.
Partial Cutting	A harvest system in which only some of the trees are harvested. Retention may include leave trees based on size criteria, importance to wildlife, etc.
Permanent Access	For the purpose of this TRP, a newly constructed or upgraded existing road that road would continue to be used after the commencement of reservoir filling.

Piling Bridge	A bridge where the roadway is supported by piles driven into the river or stream bed.
Project Activity Zone	Area within which a project's components would be found or would occur, but not including existing transportation infrastructure that would be used without modification to transport materials or personnel required for the project.
Pulp	The fibrous material in a tree used to make cellulose products such as paper.
Riparian	Relating to the transitional area or zone found between land and a fresh-water feature such as a river, lake or wetland.
Road Permit	An agreement entered into under the road use permit from a county or U.S. Forest Service that allows a person who has the right to harvest timber under a license, agreement, or permit, to construct a road, or maintain or use an existing road
Seismic Trail	A trail located along a seismic line, which is a straight line (usually 1 to 10 meters in width) cut through the forest by the oil and gas industry as part of resource exploration procedures.
Sensitive Soils	Soils that, because of their slope gradient, texture class, moisture regime, or organic matter content, have a very high hazard for displacement, surface erosion, or compaction.
Siltation	The (typically undesirable) increase in concentration and or deposition of waterborne silt in a body of water.
Skid Roads/Trails	An excavated or bladed logging trail used by tracked or rubber-tired skidders to drag logs from the felling site to a landing or roadside processing area. Skid trails are often utilized on slopes deemed too steep for the safe movement of machinery, or in protected areas to concentrate and minimize potential site degradation caused by machinery.
Skidder	A heavy four-wheel or tracked machine used to haul logs, especially over rugged terrain. Crawler tractors and grapple skidders are examples.
Skidder Crossing	A non-engineered crossing constructed over a small stream, drainage or wet area to allow access to heavy machinery without damaging stream banks or sensitive soils. Examples include rudimentary bridges constructed from on-site material; logs placed side by side (corduroy), and small diameter culverts.
Slope Stability	Susceptibility of a slope to erosion and slides.

Slumping	A mass movement process in which slope failure occurs on a usually curved slip surface and the unit moves downslope as an intact block, frequently rotating outward.
Temporary Access Road	A constructed, or reconstructed, road that would be obliterated at the end of the project
Obliterated Road	Road that would be deactivated prior to the commencement of reservoir filling.
Waterborne	Floating on or transported by water.

Source: GLOSSARY; BC Hydro; Vegetation Clearing and Debris Management Plan Site C Clean Energy Project Revision 1: June 5, 2015.

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8. Maps and Supplemental Data and Information

8.1 Maps

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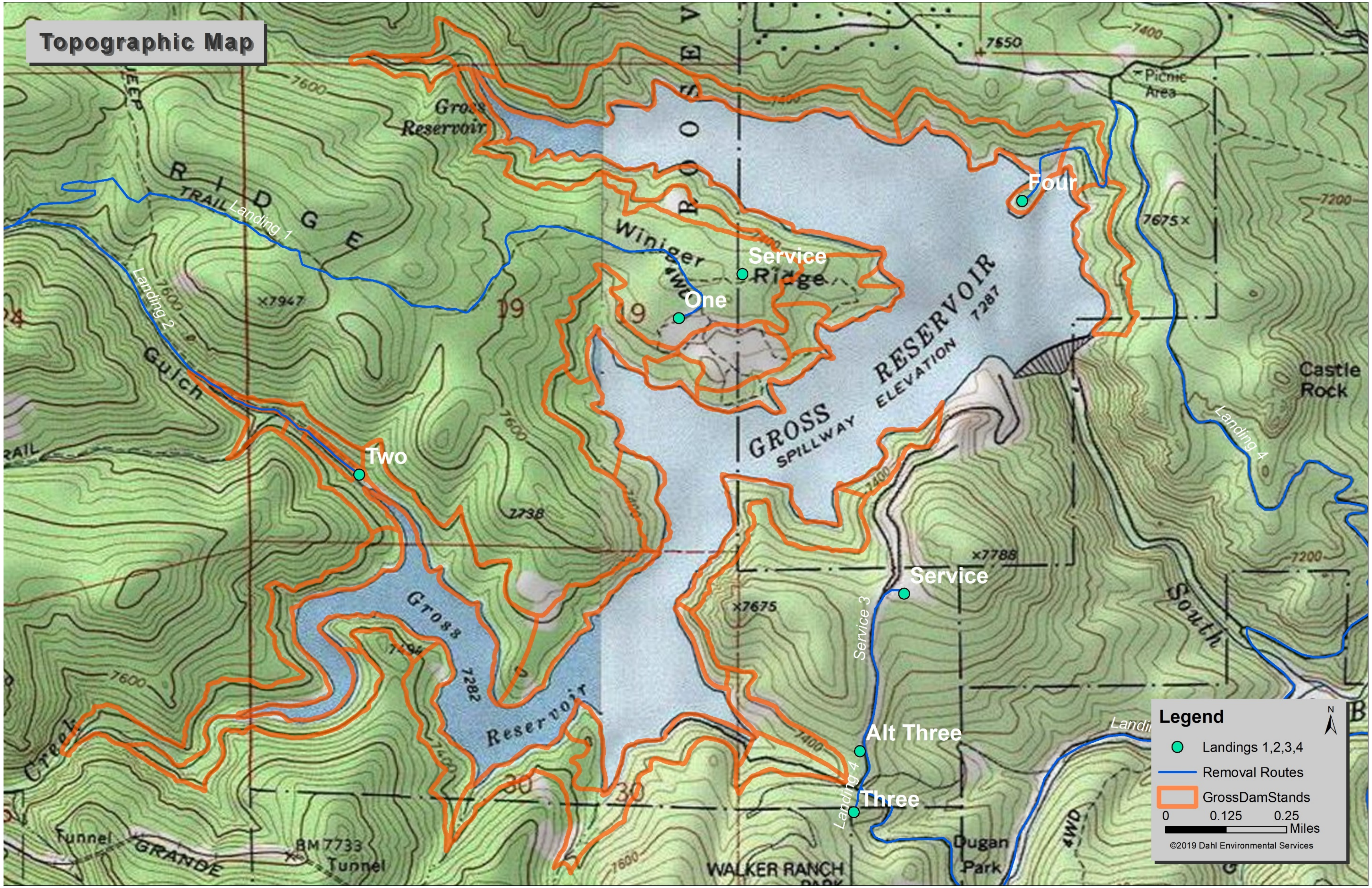
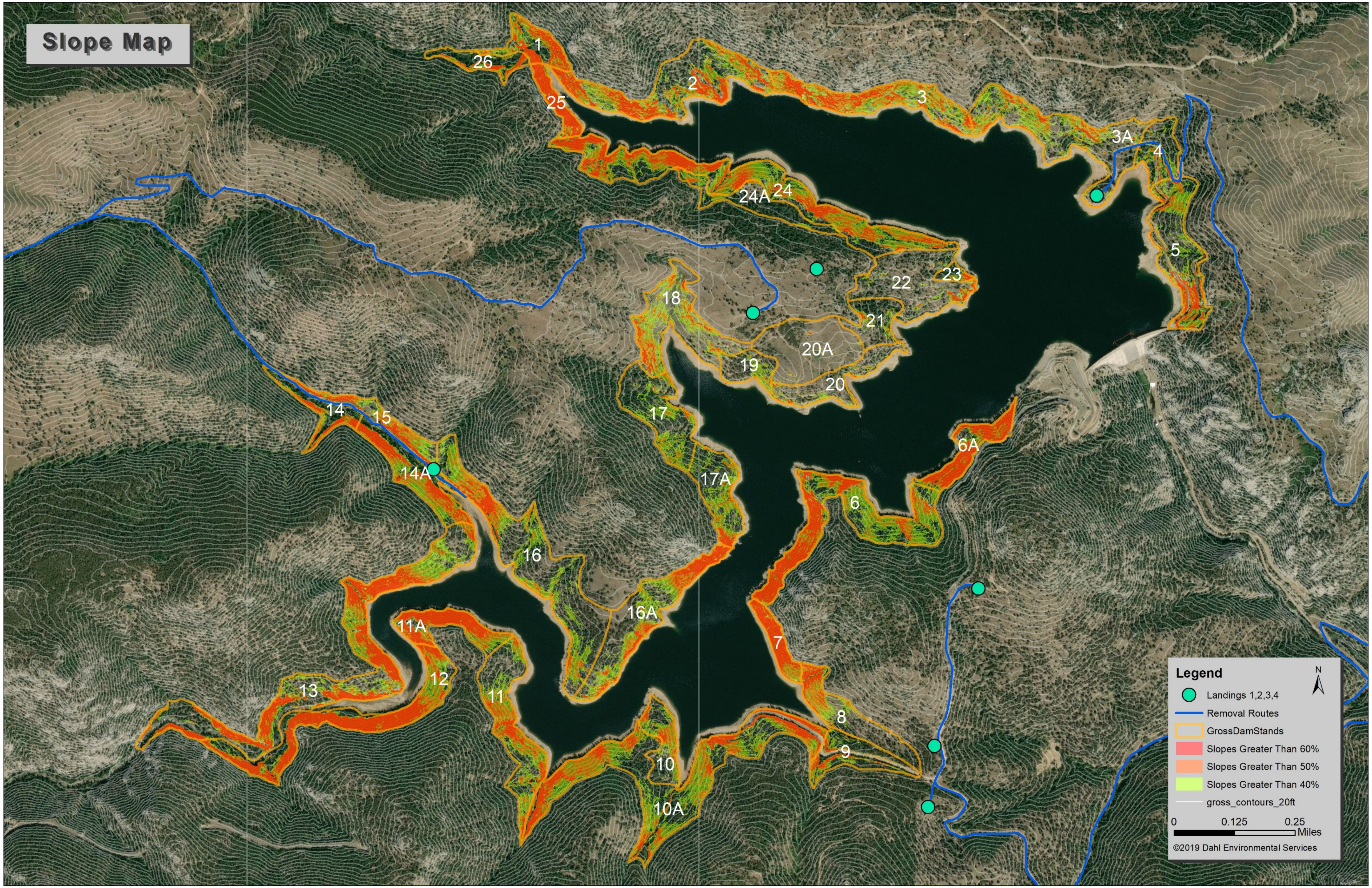
8.1.1 *Topographic, Landing, and Road Map*



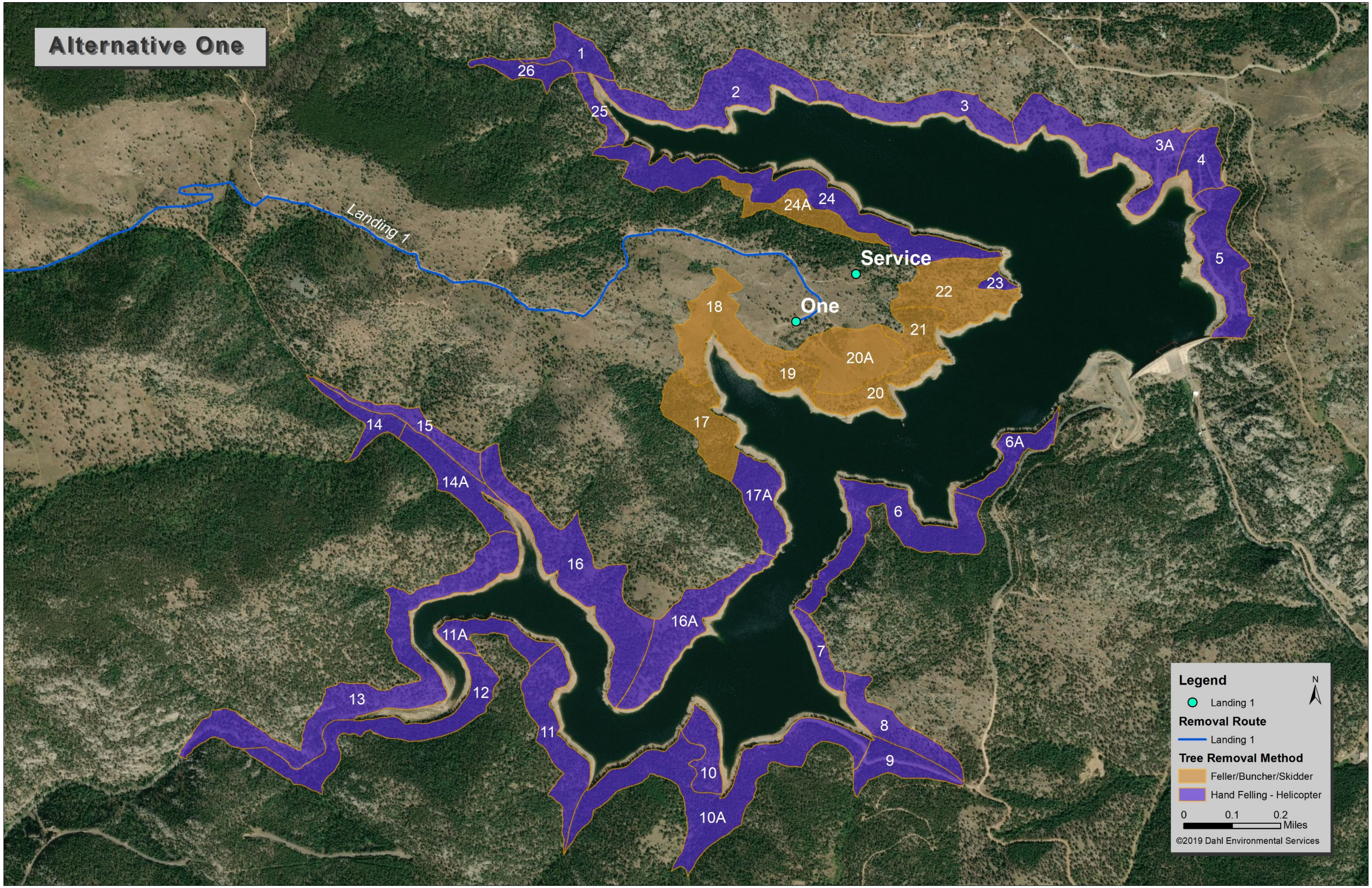
8.1.2 *Stand and Inundation Map*

8.1.3 *Slope Map*

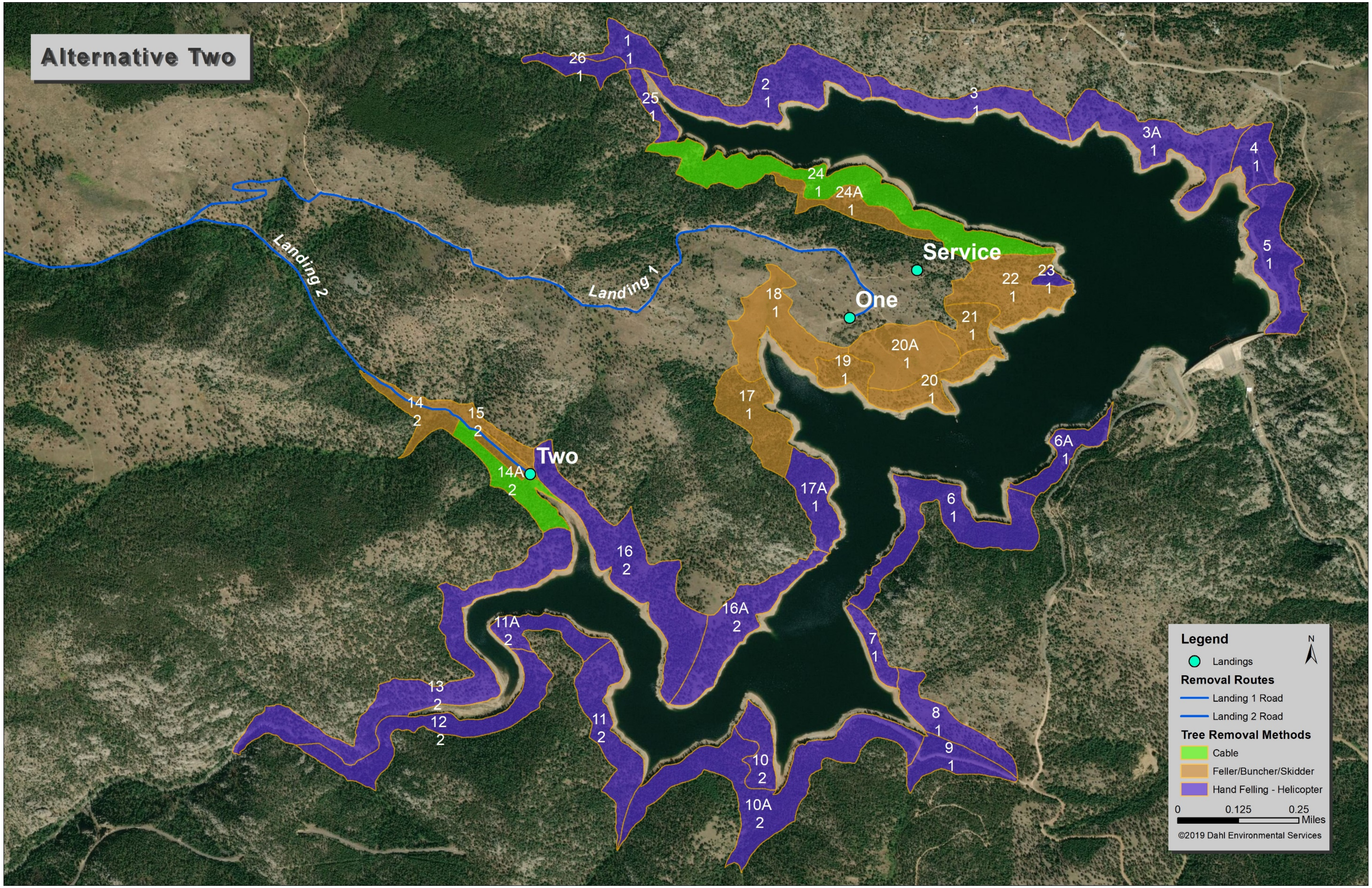


8.1.4 *Wildlife Locations*

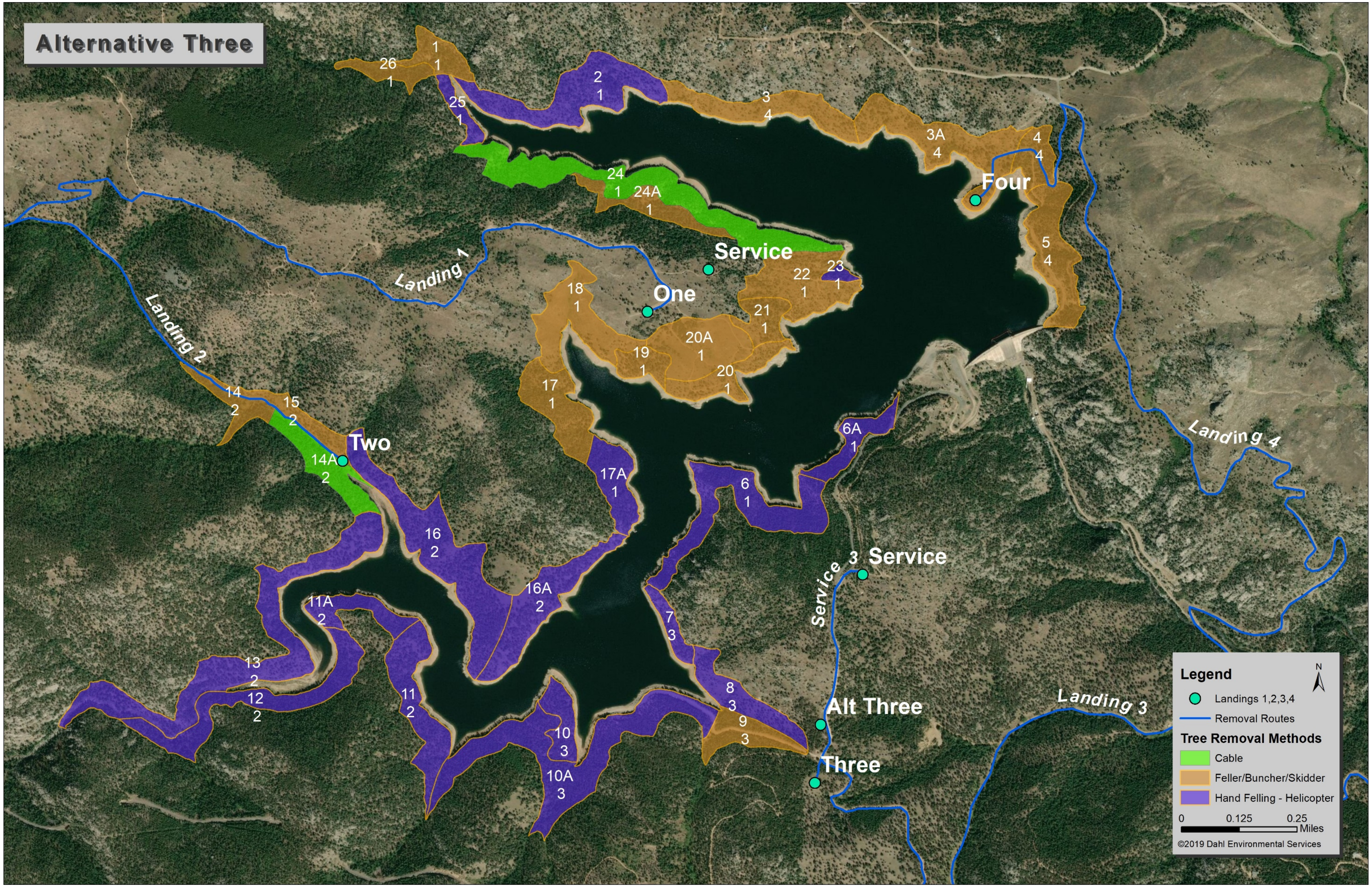
8.1.5 *Alternative One*



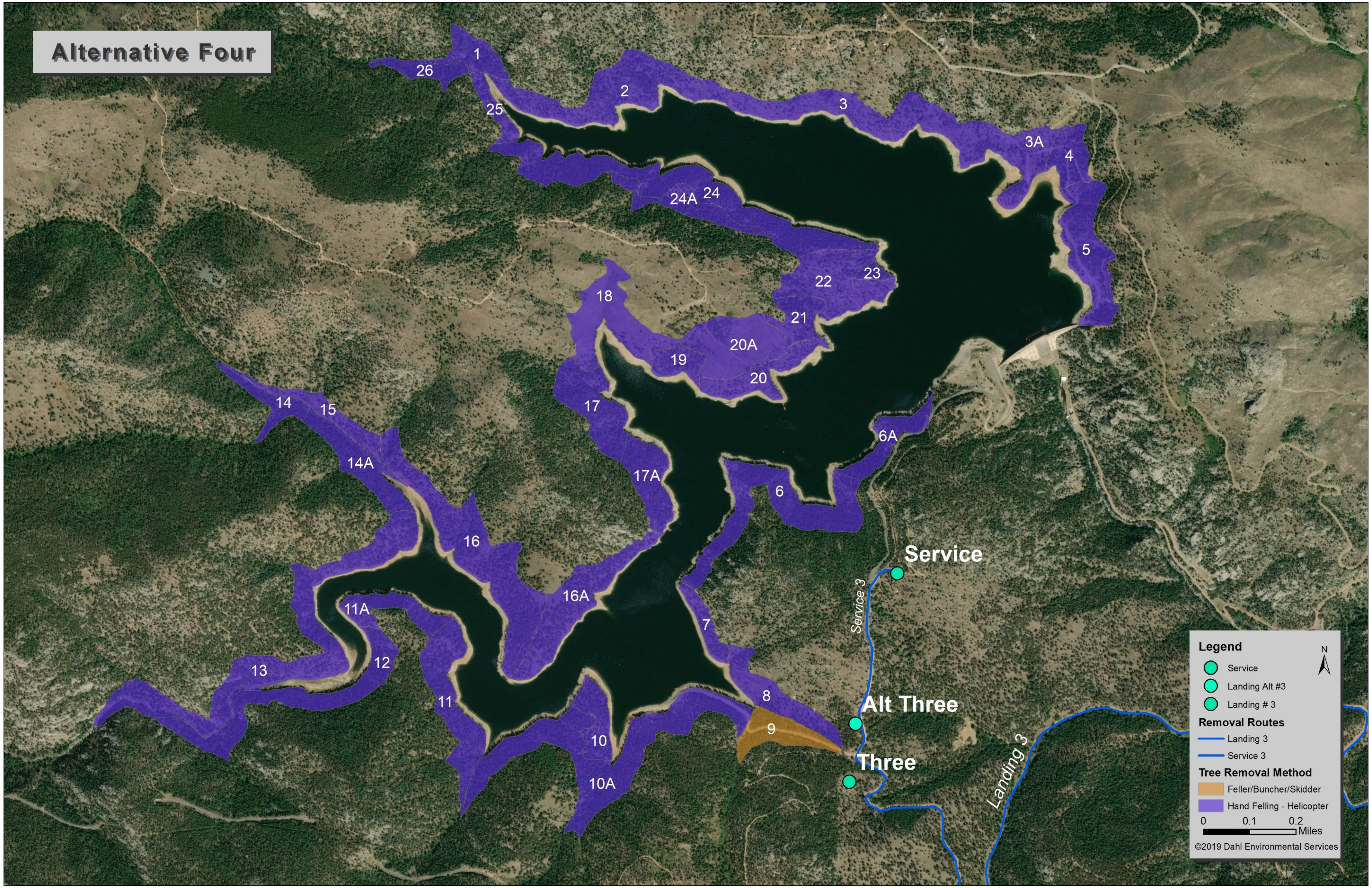
8.1.6 *Alternative Two*



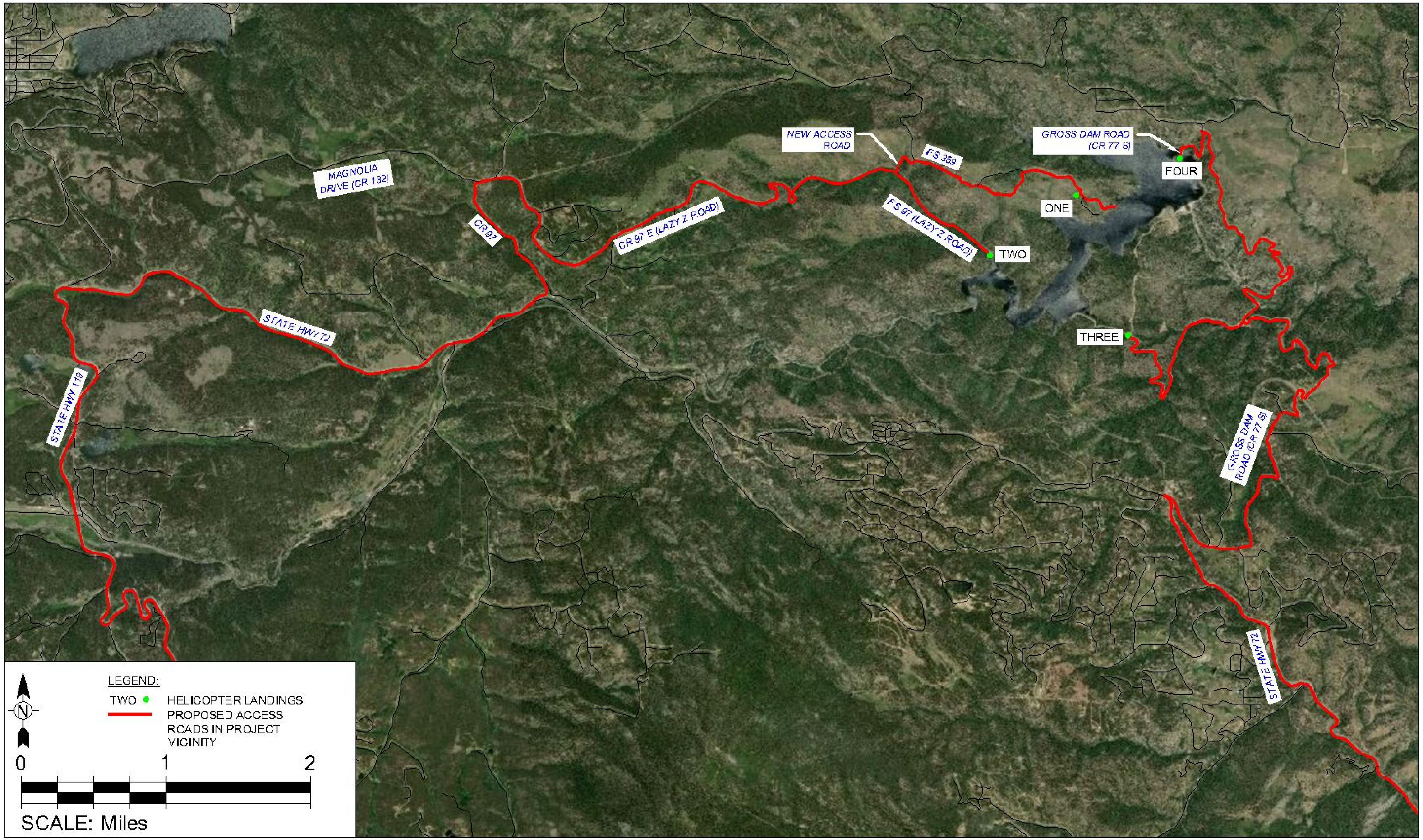
8.1.7 *Alternative Three*



8.1.8 *Alternative Four*



8.1.9 *Proposed Access Roads in Project Vicinity*



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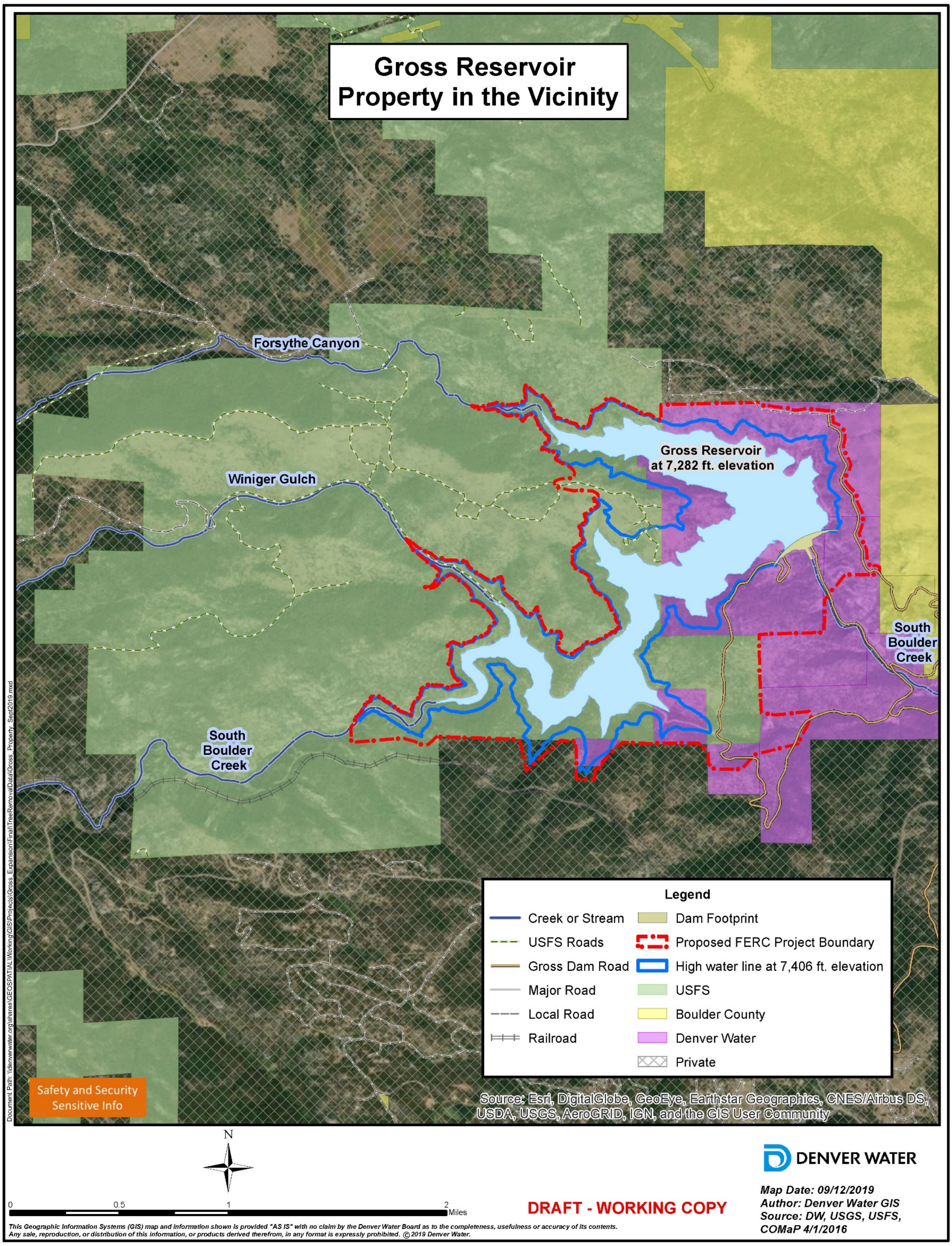
8.1.10 *Property Ownership Boundaries in Project Vicinity*



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8.2 Forest Inventory Data

8.2.1 *Revised 2008a (Appendix IV) LSA Table*

Table 18:

Gross Dam Reservoir Woody Biomass Volume in Tons

Stand ID	Acres	Tons/Acre	Total Tons
1, 10A, 12, 16	54	34.72	1874.76
2, 13,16, 21, 25	99	72.03	7131.43
3, 3A, 8, 15, 20, 22	68	36.51	2482.68
4, 7	10	21.3	213.03
5	14	49.84	697.83
6	25	41	1025.12
9	7	50.74	355.16
10, 11, 17	44	82.49	3629.74
14, 23	14	53.57	750.01
19	4	56.35	225.42
24	31	62.46	1936.17
	370		**20321.19**

LSA Table was revised using DES calculated tons per acre.

8.2.2 *DES Inventory Table*

Table 19:

DES Stand Data

Stand ID	Acres	Tons/Acre	Tons
1	5.6	34.72	194.43
2	19.7	72.03	1418.99
3	12.5	36.51	456.38
3A	19.2	36.51	700.99
4	5.9	21.30	125.67
5	14.2	49.84	707.73
6	19.4	41.00	795.40
6A	6.3	41.00	258.30
7	3.7	21.30	78.81
8	9.2	36.51	335.89
9	7.3	50.74	370.40
10	5.9	82.49	486.69
10A	30.9	34.72	1072.85
11	13.9	82.49	1146.61
11A	6.6	82.49	544.43
12	16.2	34.72	562.46
13	33.6	72.03	2420.21
14	4.6	53.57	246.42
14A	9.3	53.57	498.20
15	6.1	36.51	222.71

Table 19:
DES Stand Data

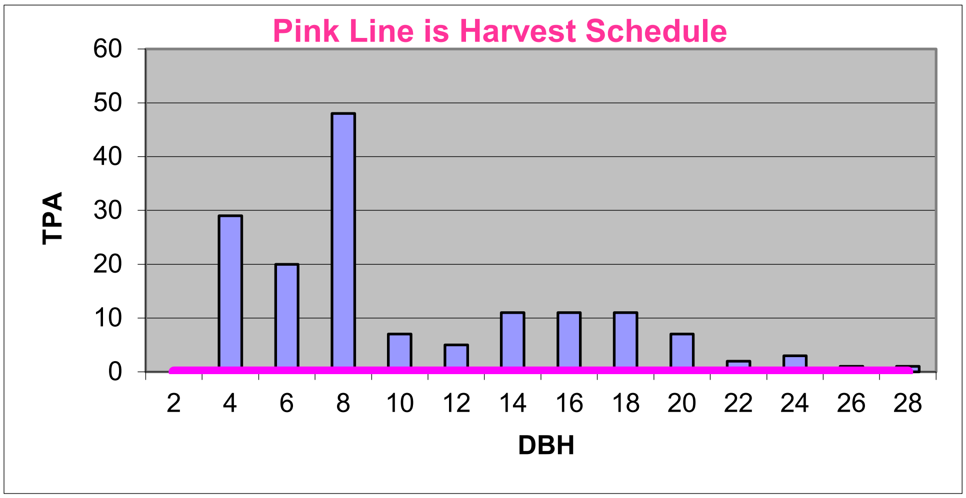
Stand ID	Acres	Tons/Acre	Tons
16	27.1	72.03	1952.01
16A	15.1	72.03	1087.65
17	11.7	82.49	965.13
17A	8.6	82.49	709.41
18	14.8	36.51	540.35
19	4.4	56.35	247.94
20	7.6	36.51	277.48
20A	14.1	36.51	514.79
21	5.5	72.03	396.17
22	14.7	36.51	536.70
23	1.2	53.57	64.28
24	26.1	62.46	1630.21
24A	6.8	62.46	424.73
25	3.2	72.03	230.50
26	4.1	34.72	142.35
	486.1		**24,422.28**

8.2.3 *Biocruz Data for Project Ponderosa Pine Stand 16*

GRE Stand 16 Forest Inventory
BioCruz Program 5/3/2019 12:12:16 PM
BAF:20 Points Sampled: 5 Avg # Trees/Plot: 6
Stand Name: Stand 16 Species: All Species Living and Dead Trees
Limit of error at 1 Standard Deviation= 17%

	DBH	10	20	30	40	50	60	70	80	TOTAL
Stems	2	0	0	0	0	0	0	0	0	0
CUVOL	2	0	0	0	0	0	0	0	0	0
SCRIB	2	0	0	0	0	0	0	0	0	0
Stems	4	0	29	0	0	0	0	0	0	29
CUVOL	4	0	30	0	0	0	0	0	0	30
SCRIB	4	0	0	0	0	0	0	0	0	0
Stems	6	0	20	0	0	0	0	0	0	20
CUVOL	6	0	30	0	0	0	0	0	0	30
SCRIB	6	0	0	0	0	0	0	0	0	0
Stems	8	0	39	0	9	0	0	0	0	48
CUVOL	8	0	133	0	67	0	0	0	0	200
SCRIB	8	0	96	0	169	0	0	0	0	265
Stems	10	0	0	0	0	7	0	0	0	7
CUVOL	10	0	0	0	0	85	0	0	0	85
SCRIB	10	0	0	0	0	275	0	0	0	275
Stems	12	0	0	5	0	0	0	0	0	5
CUVOL	12	0	0	46	0	0	0	0	0	46
SCRIB	12	0	0	111	0	0	0	0	0	111
Stems	14	0	0	0	4	7	0	0	0	11
CUVOL	14	0	0	0	55	156	0	0	0	210
SCRIB	14	0	0	0	165	608	0	0	0	774
Stems	16	0	0	0	0	9	3	0	0	11
CUVOL	16	0	0	0	0	245	108	0	0	353
SCRIB	16	0	0	0	0	1036	477	0	0	1514
Stems	18	0	0	0	2	9	0	0	0	11
CUVOL	18	0	0	0	66	349	0	0	0	416
SCRIB	18	0	0	0	282	1528	0	0	0	1810
Stems	20	0	0	0	0	0	6	2	0	7
CUVOL	20	0	0	0	0	0	298	116	0	414
SCRIB	20	0	0	0	0	0	1382	545	0	1927
Stems	22	0	0	0	0	2	0	0	0	2
CUVOL	22	0	0	0	0	91	0	0	0	91
SCRIB	22	0	0	0	0	426	0	0	0	426
Stems	24	0	0	0	0	0	1	1	0	3
CUVOL	24	0	0	0	0	0	103	116	0	219
SCRIB	24	0	0	0	0	0	491	558	0	1049
Stems	26	0	0	0	0	1	0	0	0	1

	DBH	10	20	30	40	50	60	70	80	TOTAL
CUVOL	26	0	0	0	0	82	0	0	0	82
SCRIB	26	0	0	0	0	410	0	0	0	410
Stems	28	0	0	0	0	1	0	0	0	1
CUVOL	28	0	0	0	0	91	0	0	0	91
SCRIB	28	0	0	0	0	441	0	0	0	441
Stems	TOTAL	0	88	5	15	36	10	3	0	157
CUVOL	TOTAL	0	193	46	188	1100	509	232	0	2268
SCRIB	TOTAL	0	96	111	615	4725	2350	1102	0	9000



8.2.4 *Biocruz Data for Project Mixed Conifer Stand 24*

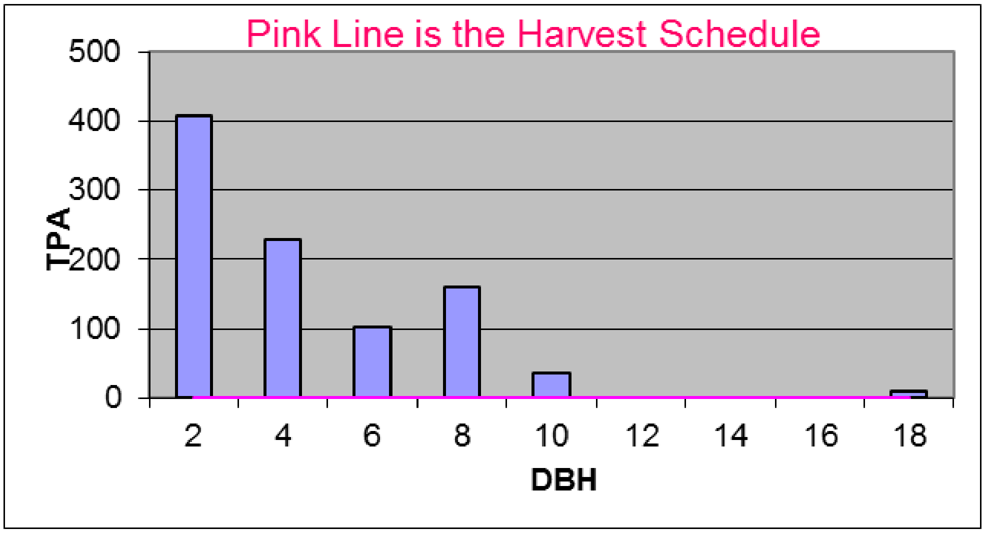
GRE Stand 24 Forest Inventory

BioCruz Program 4/29/2019 5:30:53 PM

BAF:20 Points Sampled: 1 Avg # Trees/Plot: 8

Stand Name: Stand 24 Species: All Species Living and Dead Trees

DBH	10	20	30	40	50	60	70	80	TOTAL
2	0	407	0	0	0	0	0	0	407
2	0	184	0	0	0	0	0	0	184
2	0	0	0	0	0	0	0	0	0
4	229	0	0	0	0	0	0	0	229
4	120	0	0	0	0	0	0	0	120
4	0	0	0	0	0	0	0	0	0
6	0	102	0	0	0	0	0	0	102
6	0	164	0	0	0	0	0	0	164
6	0	0	0	0	0	0	0	0	0
8	0	0	103	57	0	0	0	0	160
8	0	0	576	337	0	0	0	0	913
8	0	0	1061	661	0	0	0	0	1722
10	0	0	0	0	37	0	0	0	37
10	0	0	0	0	423	0	0	0	423
10	0	0	0	0	1376	0	0	0	1376
12	0	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0	0	0
18	0	0	0	0	10	0	0	0	10
18	0	0	0	0	439	0	0	0	439
18	0	0	0	0	1920	0	0	0	1920
TOTAL	229	509	103	57	47	0	0	0	945
TOTAL	120	348	576	337	862	0	0	0	2243
TOTAL	0	0	1061	661	3296	0	0	0	5018


Pink Line is the Harvest Schedule
500
400
300
200
100
0
TPA
2
4
6
8
10
12
14
16
18
DBH

8.3 Supplemental Reports

- Gross Dam CO-WRAP
- BiocharNow!
- U.S. Forest Service Operations
- Air Curtain Destructors
- https://airburners.net/sales_brochures/firebox_a.pdf

8.4 DES Consultation, Outreach, and Marketing

- Joe Duda, Deputy State Forester, Colorado State Forest Service (CSFS)

  - Market Opportunities for Biomass
  - Ethanol production possibilities
  - Logging and harvesting technology

- Meg Halford, Forester, CSFS, Franktown district office

  - Chatfield Dam removal specifications
  - Specs were straightforward: Remove all material 2 inches or greater
  - Mastication: no chip depth greater than 2 inches
  - Markit! has removed approximately 35,000 cubic feet of material
  - 136 loads to A1 Organics
  - Treatment costs to date: Approximately $5,000,000 (300 acres)
  - Suggested a discussion with Allen Owen, CSFS Boulder

- Pat Gaynor, Vice President—Business Development Markit Forestry Road, Colorado Springs, CO

  - Ground-based logging technology and helicopter logging
  - Biochar production cost technology
  - Feasibility of the Project on-site production and jobs

- Sweetman, J., 2019, Sweetman Enterprises Inc., Henderson, CO

  - The Sweetman cordwood firm expressed interest in contracting the entire 25,000 tons of woody material converting to cordwood and chips at the landing locations
  - Sweetman Enterprises Inc. did not provide pricing information

- James Gaspard, CEO, General Manager, Biochar Now! Berthoud, CO

  - Biochar technology and costs
  - Feasibility applying biochar technology to GRE

- Allen Owen, Area Forester CSFS Boulder, CO

- Prior forest planning for the Gross Dam
- Acquiring copies of former forest plans for GRE
- Discussing the history of GRE and CSFS working relationship

- Dave Greenwood, Forester, Idaho Department of Lands—St. Marie's, ID

  - Logging costs and harvest technology

- Sarah Lyngholm, State Forester Montana DNR – Division of Forestry

  - Logging Costs and logging systems

- Wyatt Taylor, Forester, Oregon Department of Forestry, Corvallis Oregon

  - Logging engineering and operating costs

- Scott Haase, Mechanical Engineer, Renewable Energy Scientist, National Renewable Energy Laboratory, U.S. Department of Energy of Energy, Lakewood, CO

  - Provided economic marketing potential of ethanol production in Colorado

- Mark Mathis, General Manager, Confluence Energy, Kremmling, Colorado

  - Provided market information regarding biomass utilization for production of pellets in Colorado

- Michel Schmitt, North American Sales Manager, Air Burner Inc., Palm City, Fl

  - Discussed Air Curtain burner production rates, emissions, and costs

- Lynne Cady Deibel, Forest wildlife biologist, ARNF Supervisor's Office, Fort Collins, CO

  - Meeting April 15, 2019—participants:

    – Lynne Deibel, Forest Wildlife Biologist
    – Sue Struthers, Forest Archaeologist
    – Kevin Zimlinghaus, Forester-TMA, Boulder Ranger District
    – Bjorn Dahl, Dahl Environmental Services
    – Lyle Laverty, The Laverty Group

  - Discussions summary:

    – The Forest Service Appendix A, Standard Administrative Conditions to Determine Seasonal Constraints and Permitting Requirements, on the 30 conditions detailed in Appendix A
    – Discussed the Wildlife 4e conditions, Limited Operating Periods

  - Discussion focused surveys to be conducted prior to operations and on the limited operations periods for elk, flammulated owl, northern goshawk, Preble's Meadow Jumping Mouse and the archaeology of the "flumes"

- Sue Struthers, Forest Archaeologist:

  - Sue pointed out the archaeological site, flume, on the west side of Winiger gulch in the inundation zone needed to be mitigated before any timber is removed
  - Additionally, a prehistoric is located near the trailhead of FS 359. Sue indicated this would be a new undertaking and would require significant work to mitigate the site with a memorandum of understanding with the State Historic Preservation Officer and seven Native American tribes
  - Sue indicated the Forest Service will need to consult on the TRP if there is a road reconstruction on FS 359

- Bodie Dowding, Forester, Oregon Department of Forestry, Corvallis, Oregon

  - Received information on logging costs and helicopter and cable technology

- Lisa Ball, Forester, U.S. Forest Service, Pacific Northwest Region, Portland Oregon

  - Discussed logging costs and application of LOGCOST
  - Application of equipment use for timber harvest

- Jason Todhunter, professional logger, Montana Loggers Association, Missoula, Montana

  - Discussed, logging costs and application of equipment technology

- Rex Storm, professional logger and forester, Associate Oregon Loggers Association, Corvallis, Oregon

  - Discussed logging costs and harvest technology for skyline and helicopter logging

- Scott Pexton, VP of operations, A1 Organics, Denver, Colorado

  - Discussed Biomass Utilization and costs for delivering product i.e. biomass

- Steve Rheinberger (Berger), Forester, Logging Eng., Retired U.S. Forest Service, Pacific Northwest, Portland Oregon

  - Discussed with Steve Rheinberger (Father of LogCost Development for U.S. Forest Service) the application of LogCost 8.1 to GRE
  - Further, discuss the application of Skyline and Haul Cost models to be applied with LogCost

- Brian Connors, CEO and owner, R&R Conner Helicopters, Connors, Montana

  - Discussed Heli logging and yarding costs and technology.

   - DES had conversations on hello logging specific statistics on flying weights, turn times and daily production using helicopters.

- Nate Kupko, Operations Manager, R&R Conner Helicopters, Connors, Montana
   - Discussed Heli logging and yarding costs and technology
   - Discussed the application of a Yoder yarder as a cable and swing yarder

- Steve Hayes, CF., Research Forester, Bureau of Business & Economic Research, University of Montana, Missoula, MT
   - Discussed helicopter logging and costs were operating technology
   - He provided a list of helicopter companies operating all over the Northwest United States
   - Steve is an expert on forest industry research and Montana and Northwest United States

- David Hoorax, Forester, Operations Manager, Columbia Helicopters, Inc., Aurora, OR
   - Reviewed and discussed helicopter operations and configurations for yarding three-time sent loads of wood.
   - Provided critical information on Heli-yarding medium and heavy loads and costs of yarding configurations.

- Kurt Koffman, Forester, Croman Heli logging Inc. Eugene, Oregon
   - Discussed specifics on helicopter flying time tons per hour size of ship forward maximum lift mobilization felling costs cutting and production rates
   - Discussed size of helicopters from Sikorsky's the Bell helicopters for log yarding

- Wayne Harrington, Mgr. Community Forestry Sort Yard Boulder City Netherland CO
   - Provided information on Boulder County log sorting yard costs and products receivable
   - Wayne was extremely helpful on providing information for all and dumping fees and processing would products

- Dr. Wayne Sheppard USFS (Retired) Rocky Mountain Forest and Range Experiment Station
   - Provided critical information on revised GRE inventory and biomass tonnage
   - Validated DES cruise inventory

- Dr. Kurt Mackes, Forester, Prof. of Forest Biometrics, Colorado State University, Fort Collins Colorado
   - Reviewed and provided DES cruise inventory and biomass tonnage information
   - Validated DES cruise inventory

- Tim Reader, Forester, Staff Economist-Marketing, CSFS, Fort Collins, CO

  - Researching potential markets for biomass utilization

- Carl Spaulding, VP and Gen. Manager, Renewable Fiber Inc., Lupton, Colorado

  - Discussed market opportunities and utilization for biomass
  - Reviewed transportation and haul cost information

- Dave Rich Manager Public Works Gilpin County, Blackhawk, CO

  - Consulted about biomass energy for the community

- Ben Pfohl, Staff Forester, Boulder Field Office, CSFS, Longmont, Colorado

  - Reviewed the GRE 2016 Forest management plan and inventory information

- Dawn Baumhover, Community Center Manager Town of Nederland, Colorado

  - Reviewed market opportunities and utilization in the town of Nederland
  - Discussed jobs employment and income opportunities for the surrounding community of Netherland

- Kevin Zimlinghaus, Timber Management Forester, Boulder Ranger District, ARNF, Forest Service

  - Discussed provided information on the foresight II fuels management plan
  - Provided maps critical information on the Project
  - Reviewed GRE implementation requirements
  - Provided critical information on transportation and community issues

- Mark Morgan, Forester, CEO. Morgan Timber Products

  - Discussed timber harvest technologies, market opportunities and history of GRE past logging activities
  - Reviewed logging costs and sawmill production

- Chuck Dennis, CEO, Forester, West Range Forest Products, Gypsum, CO

  - Discussed market opportunities at the Eagle Valley County biomass electric facility
  - Discussed Haul Costs and transportation for chip trucks

- Dr. Dennis Lynch, Forester, Prof. Emeritus, Forest Resource Mgmt., Fort Collins, CO

  - Reviewed past studies on harvest in the GRE the project area
  - Provided previous cost information on harvest logging activities

- Robert Chalifoux, Pres., General Manager, Heli quest international Inc. Broomfield, CO
    - Reviewed helicopter logging possibilities and yarding information
    - Did a walk-through of their helicopter operations and facilities at the Jefferson County Airport
    - Carson Johnson, operations manager, Heli quest international Inc., Broomfield, CO
    - Discussed Heli yarding strategies and tactics for GRE
    - Reviewed Heli yarding capabilities and costs
- Steve Chronister, Falling Contractor, High Country Timber Fallers, Klamath Falls, OR
    - Provided felling production costs and tactical information on directional tree falling
- Douglas Laraby, Forester, Director of Planning, Winter Park Resort, Winter Park, CO
    - Reviewed Winter Park helicopter logging and possibilities for GRE logging and yarding information
    - Review yarding and landing requirements for helicopter logging
    - Provide helicopter and landing processing costs for logging
- Brittany Wise, Commercial Operations Manager, Erickson Helicopters, Portland, OR
    - Discussed Erickson sky cranes for logging in Colorado very interested
    - Erickson has the medium level helicopters to provide competitive yarding costs
    - requires local Sawyers and landing cruise to process material.
- Angie Gee, District Ranger, Boulder Ranger District, U.S. Forest Service Arapaho-Roosevelt National Forests & Pawnee National Grassland, Boulder, CO 80301
    - Discussed flammulated owl limited operating constraints
    - Discussed connector road possible NEPA review
    - Discussed cultural resources mitigation
    - Coordination and timing of Forsythe II project activities
    - Schedules and closures for Forest Service recreation sites.

Attachment 1:
Conceptual Haul Road Drawings

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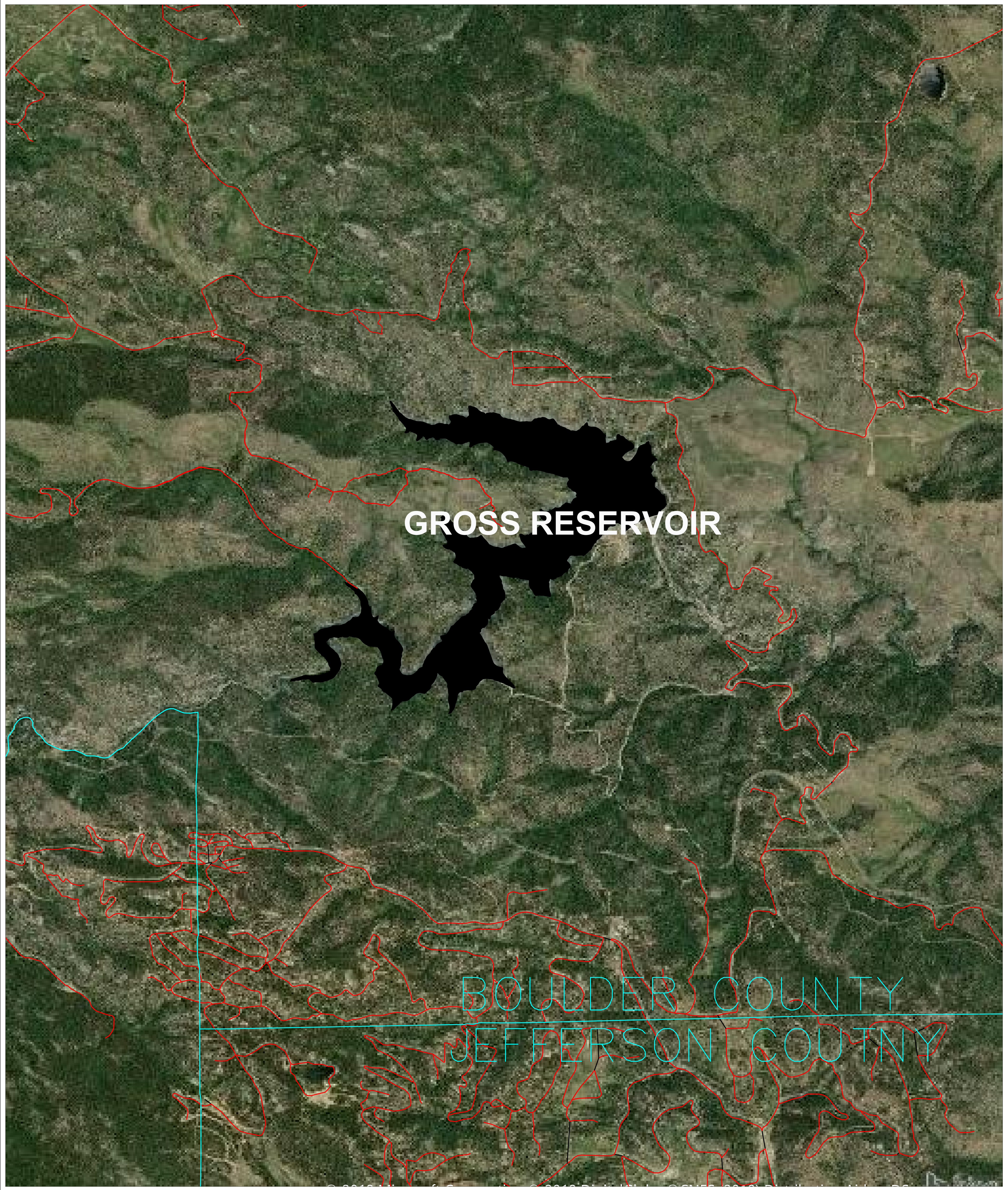
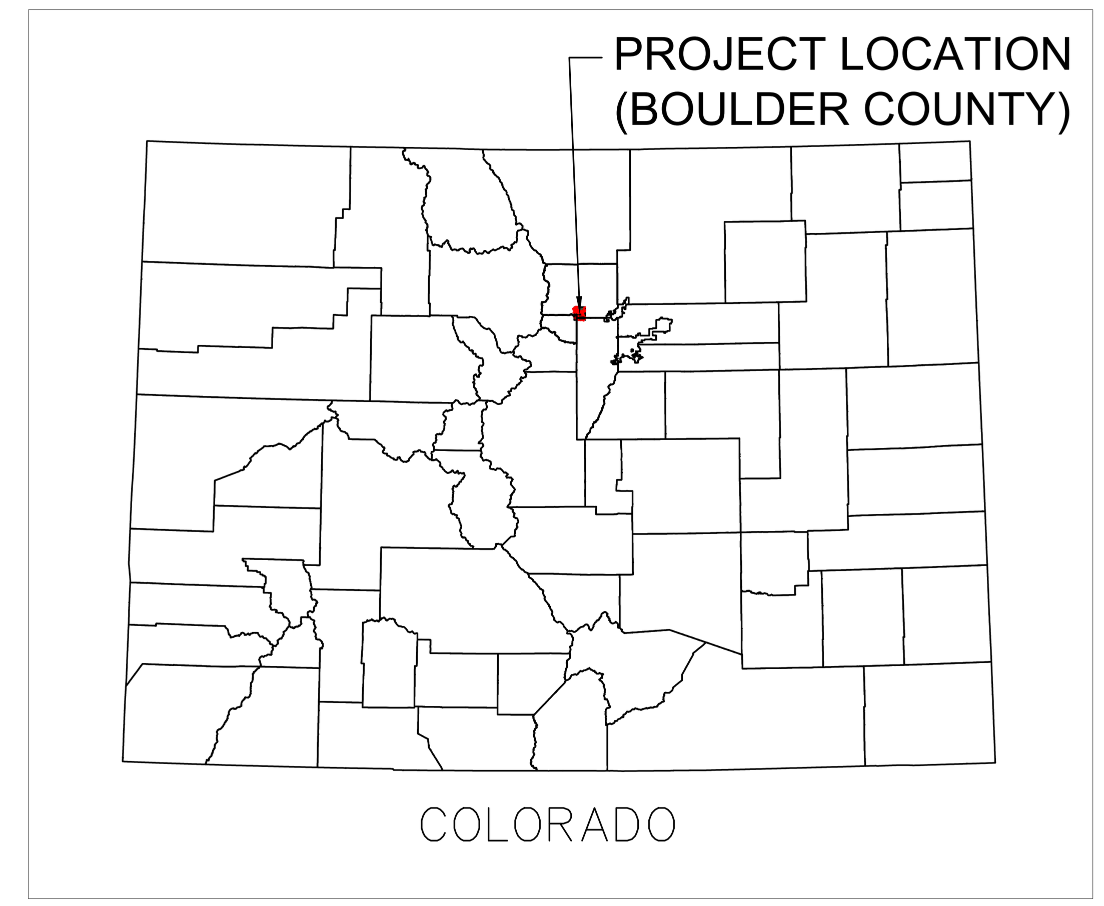
DENVER WATER - GROSS RESERVOIR EXPANSION PROJECT
CONCEPTUAL HAUL ROAD DRAWINGS
BOULDER COUNTY, CO



VICINITY MAP



LOCATION MAP (N.T.S.)

Sheet	Title	Rev. No	Date
G-01	COVER SHEET	A	9/25/2019
G-02	GENERAL CONSTRUCTION NOTES	A	9/25/2019
C-01	KEY MAP/TRANSPORTATION PLAN	A	9/25/2019
C-02	ROAD SECTIONS AND DETAILS	A	9/25/2019
RD-01	ROAD LAYOUT PLAN AND PROFILE (SHEET 1 OF 9)	A	9/25/2019
RD-02	ROAD LAYOUT PLAN AND PROFILE (SHEET 2 OF 9)	A	9/25/2019
RD-03	ROAD LAYOUT PLAN AND PROFILE (SHEET 3 OF 9)	A	9/25/2019
RD-04	ROAD LAYOUT PLAN AND PROFILE (SHEET 4 OF 9)	A	9/25/2019
RD-05	ROAD LAYOUT PLAN AND PROFILE (SHEET 5 OF 9)	A	9/25/2019
RD-06	ROAD LAYOUT PLAN AND PROFILE (SHEET 6 OF 9)	A	9/25/2019
RD-07	ROAD LAYOUT PLAN AND PROFILE (SHEET 7 OF 9)	A	9/25/2019
RD-08	ROAD LAYOUT PLAN AND PROFILE (SHEET 8 OF 9)	A	9/25/2019
RD-09	ROAD LAYOUT PLAN AND PROFILE (SHEET 9 OF 9)	A	9/25/2019

ACCESS ROAD SURVEY CONDUCTED BY SHORT ELLIOT HENDRICKSON INC. BETWEEN JUNE 1ST AND JUNE 20TH, 2019.

HORIZONTAL DATUM:

THIS PROJECT DATUM IS COLORADO STATE PLANE NORTH ZONE. NGS CONTROL POINT MAGNOLIA WAS UTILIZED.

(US SURVEY FEET) = 1,236,991.16' NORTH 3,025,807.55' EAST

VERTICAL DATUM

NGS MAGNOLIA (NAVD88)= 8094.28'

CONTROL POINT TABLE

PNT NO.	NORTH	EAST	ELEV	DESCRIPTION
1	1236991.16	3025807.55	8094.28	NGS MAGNOLIA
300	1224773.22	3022400.14	8043.05	SEH RPC NO.5 REBAR
301	1228852.06	3028500.16	7758.16	SEH RPC NO.5 REBAR
302	1224362.40	3035802.46	7442.52	SEH RPC NO.5 REBAR

ADDITIONAL TOPOGRAPHIC SURVEY DATA PROVIDED BY DENVER WATER FROM UNKNOWN ORIGINAL SOURCE.

LEGEND

- 80 — EXISTING TOPOGRAPHIC CONTOUR–MAJOR
- EDGE OF ROAD
- 24+00 24+50 25+00 25+50 26+00 26+50 — CENTERLINE OF ROAD WITH STATION MARKS
- SURVEYED TREE LOCATION
- OH — EXISTING OVERHEAD ELECTRIC
- STM — CULVERT
- x — EXISTING FENCELINE

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DENVER WATER
GROSS RESERVOIR EXPANSION PROJECT
TREE REMOVAL HAUL ROADS
COVER SHEET

PROJ:	194-6713
DESN:	AMI
DRWN:	AMI
CHKD:	JPF

G-01

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Bar Measures 1 inch, otherwise drawing not to scale

CONSTRUCTION DRAWING NOTES:

1. THE CONTRACTOR SHALL HAVE KNOWLEDGE OF, AND WILL WORK IN COMPLIANCE WITH, THE TERMS AND CONDITIONS STATED IN THE PERMITS ISSUED BY OR TO DENVER WATER, AND IS SUBJECT TO THE SAME SANCTIONS FOR VIOLATIONS OF SUCH PERMITS.
2. ALL ACTIVITIES AUTHORIZED UNDER THE PERMITS ISSUED MUST BE IN STRICT CONFORMANCE WITH THE SPECIFICATIONS AND DETAILS DEPICTED ON THE CONSTRUCTION DRAWINGS.
3. NONE OF THE ISSUED PERMITS ALLOW FOR THE RIGHT TO TRESPASS UPON THE LANDS OR INTERFERE WITH THE PROPERTY AND/OR RIPARIAN RIGHTS OF LANDOWNERS NOT PARTICIPATING IN THE PROJECT.
4. ALL CONSTRUCTION ACTIVITY, INCLUDING OPERATION OF MACHINERY, EXCAVATION, FILLING, GRADING, CLEARING OF VEGETATION, DISPOSAL OF WASTE, AND STOCKPILING OF MATERIAL WILL TAKE PLACE WITHIN THE LAYDOWN OR ACCESS ROADS.
5. EQUIPMENT SHALL UTILIZE THE INTERSECTION OF ACCESS ROADS AND EXISTING ROADS FOR TURNING. WORK AREAS FOR TREE CLEARING WILL ALSO PROVIDE AREAS FOR EQUIPMENT TURNING AND PARKING.
6. FUGITIVE DUST RESULTING FROM CONSTRUCTION ACTIVITIES SHALL BE MINIMIZED TO THE MAXIMUM EXTENT PRACTICABLE BY IMPLEMENTING APPROPRIATE CONTROL MEASURES. A WATERING VEHICLE SHALL BE AVAILABLE FOR THE DURATION OF PROJECT ACTIVITIES, INCLUDING THROUGHOUT RESTORATION.

EXCAVATION, BACKFILL, COMPACTION

THIS SECTION SPECIFIES THE TECHNICAL AND CONSTRUCTION REQUIREMENTS FOR EXCAVATION, BACKFILL, COMPACTION, AND SURFACE AGGREGATE PLACEMENT FOR THE PROJECT.

PART 1 GENERAL

SUBMITTALS

1. ALL SUBMITTALS SHALL BE APPROVED BY CONTRACTOR QC MANAGER WITH CONCURRENCE BY DENVER WATER REPRESENTATIVE PRIOR TO START OF WORK.
2. SURFACE AGGREGATE: SUBMIT DOCUMENTATION INDICATING THAT SELECTED AGGREGATE MEETS THE REQUIREMENTS FOR AGGREGATE STATED ON THIS DRAWING.
3. SUBMIT FIELD COMPACTION TEST REPORTS FOR SUBGRADE FILL, SUBGRADE SOIL, AND SURFACE AGGREGATE.
4. GEOTEXTILE: SUBMIT LABORATORY TEST RESULTS DOCUMENTING GEOTEXTILE ENGINEERING PROPERTIES. THIS DOCUMENT SHALL INCLUDE GRAB STRENGTH, SEWN SEAM STRENGTH, TEAR STRENGTH, ULTRAVIOLET STABILITY, APPARENT OPENING SIZE, PERMITIVITY, AND OTHER PROPERTIES AS REPORTED BY THE MANUFACTURER.

PART 2 PRODUCTS

2.1 EXCAVATED SUITABLE MATERIALS

AT MINIMUM, EXCAVATED SUITABLE MATERIALS SHALL BE:

- FREE OF DEBRIS, SNOW, ICE, FROZEN SOIL OR MUD.
- FREE OF VISIBLE OR KNOWN CONTAMINATION.
- FREE OF LUMPS AND ROCKS LARGER THAN ½ THE LIFT THICKNESS WITH A MAXIMUM SIZE OF 6 INCHES.
- FREE OF VEGETATION, WASTE, AND ANY OTHER DELETERIOUS MATTER.

ALL EXCAVATED SUITABLE MATERIALS WILL BE SUBJECT TO APPROVAL BY THE FIELD ENGINEER WITH CONCURRENCE BY DENVER WATER REPRESENTATIVE.

2.2 BACKFILL MATERIAL

FILL MATERIAL CONSISTS OF EXCAVATED SUITABLE MATERIALS FREE OF CONTAMINANTS AS DETERMINED BY THE FIELD ENGINEER WITH CONCURRENCE BY DENVER WATER REPRESENTATIVE. THE FILL WILL BE UTILIZED TO RAISE THE EXISTING GRADE AND CONSTRUCT SLOPES.

2.3 SUBGRADE SOIL

SUBGRADE SOIL IS THE COMPACTED NATIVE SOIL THAT IS OBTAINED AFTER STRIPPING TOPSOIL, MOISTURE CONDITIONED TO NEAR THE OPTIMUM MOISTURE CONTENT, AND COMPACTED TO 95% OF MAXIMUM DRY DENSITY IN ACCORDANCE WITH ASTM D698. THE PREPARED SUBGRADE SHOULD BE INSPECTED FOR SOFT OR LOOSE AREAS BY PROOF-ROLLING IN ACCORDANCE WITH SECTION 3.5. SOFT OR LOOSE AREAS SHALL BE OVER-EXCAVATED AND BACKFILLED WITH SUITABLE FILL AND COMPACTED IN ACCORDANCE WITH SECTION 3.5 AND 3.6 OR AS DIRECTED BY THE FIELD ENGINEER WITH CONCURRENCE BY DENVER WATER REPRESENTATIVE. THE COMPACTED SUBGRADE WILL BE TESTED IN ACCORDANCE WITH SECTION 3.8.

2.4 SURFACE AGGREGATE

ROAD SURFACE, SHALL CONSIST OF 4 to 6-INCHES THICK COMPACTED LAYER OF SURFACE AGGREGATE THAT SHALL MEET COLORADO DEPARTMENT OF TRANSPORTATION STANDARD SPECIFICATIONS FOR HIGHWAY CONSTRUCTION, SECTION 703 SURFACE COURSE AGGREGATE AS SHOWN IN TABLE BELOW. (SEE DETAIL 1 AND 2 ON SHEET C-11 FOR ROAD SECTION DETAILS). ANY MODIFICATION TO THIS SPECIFICATION NEEDS TO BE APPROVED BY THE FIELD ENGINEER WITH CONCURRENCE BY DENVER WATER REPRESENTATIVE.

SIEVE	GRADATION (PERCENT PASSING BY WEIGHT) SURFACE COURSE	
	CLASS 5	CLASS 6
1-1/2 IN.	100	
1 IN.	95-100	100
3/4 IN.		95-100
NO. 4	30-70	30-65
NO. 8		25-55
NO. 200	3-15	3-12

2.5 GEOTEXTILE

GEOTEXTILE IF REQUIRED SHALL BE TENCATE MIRAFI HP270 OR AN APPROVED EQUIVALENT, WHICH SHALL HAVE EITHER EQUAL OR SUPERIOR ENGINEERING PROPERTIES. EQUIVALENT SUBSTITUTIONS SHALL BE APPROVED BY THE FIELD ENGINEER WITH CONCURRENCE BY DENVER WATER REPRESENTATIVE.

2.6 PIPE MATERIALS

PIPE SHALL BE GALVANIZED STEEL CORRUGATED METAL PIPE OR ENGINEER APPROVED EQUIVALENT.

PART 3 EXECUTION

3.1 PREPARATION

1. IDENTIFY THE REQUIRED LINES, LEVELS, CONTOURS, AND DATUM.
2. THE CONTRACTOR SHALL CONTACT THE COLORADO UTILITY CALL CENTER (COLORADO 811) FOR DELINEATION OF UTILITIES PRIOR TO START OF EARTH WORK.
3. NOTIFY UTILITY COMPANIES TO REMOVE AND/OR RELOCATE UTILITIES.
4. PROTECT UTILITIES FROM DAMAGE DURING THE PERFORMANCE OF ANY EARTH WORK.

3.2 CLEARING

1. REMOVE VEGETATION, TRASH, DEBRIS, AND OTHER UNDESIRABLE MATERIALS SUCH AS ROCK (LARGER THAN 6 INCHES) AND OBSTRUCTIONS FROM THE CONSTRUCTION AREAS. LIMIT STUMP REMOVAL TO IMPACTED AREAS.

3.3 EXCAVATION

1. EXCAVATE ON-SITE SOIL TO THE INDICATED ELEVATION AND DIMENSION AS SHOWN ON THE CONSTRUCTION DRAWINGS.
2. CUT SLOPES SHALL NOT EXCEED 2H:1V.
3. MAINTAIN STABLE SLOPES AT ALL TIMES.
4. GRADE THE TOP PERIMETER OF THE EXCAVATION AREAS TO PREVENT SURFACE WATER FROM DRAINING INTO EXCAVATED AREAS, OR UNPROTECTED SLOPES.
5. THE EXCAVATED SOILS SHOULD BE SUITABLE FOR RE-USE AS EMBANKMENT OR MISCELLANEOUS FILL PROVIDED THE BACKFILL DENSITY CAN BE ACHIEVED.
6. NOTIFY FIELD ENGINEER OF UNEXPECTED SUBSURFACE CONDITIONS (I.E., UNCOMPACTABLE, UNSUITABLE, OR BEDROCK) AND DISCONTINUE AFFECTED WORK IN THE AREA UNTIL NOTIFIED TO RESUME WORK.

3.4 STOCKPILING

1. STOCKPILE MATERIAL ON-SITE AT THE LOCATION(S) INDICATED BY THE FIELD ENGINEER WITH CONCURRENCE BY DENVER WATER REPRESENTATIVE.
2. HEIGHT OF STOCKPILES SHOULD BE DETERMINED BY FIELD ENGINEER WITH CONCURRENCE BY DENVER WATER REPRESENTATIVE TO PREVENT EXCESS WIND AND WATER EROSION.
3. DIFFERENT MATERIAL SHALL BE STOCKPILED SEPARATELY FROM EACH OTHER TO PREVENT INTERMIXING.
4. DIRECT SURFACE WATER AWAY FROM ALL STOCKPILE LOCATIONS TO PREVENT EROSION OR DETERIORATION OF MATERIALS.
5. ALL STOCKPILES SHALL HAVE SILT FENCE OR APPROVED ALTERNATE INSTALLED AROUND THE BASE TO PREVENT OFFSITE MIGRATION OF SEDIMENT. THE ENVIRONMENTAL SITE MANAGER WILL SELECT APPROPRIATE MEANS WITH CONCURRENCE OF DENVER WATER REPRESENTATIVE.

3.5 FILL PLACEMENT

1. ALL FILL SHOULD BE APPROVED BY THE FIELD ENGINEER WITH CONCURRENCE BY DENVER WATER REPRESENTATIVE PRIOR TO PLACEMENT.
2. FILL REQUIRED TO OBTAIN THE DESIRED FINISH GROUND SURFACE ELEVATION SHOULD BE PLACED IN UNIFORM TWELVE (12) INCH OR THINNER LOOSE LIFTS AND COMPACTED TO 95% OF MINIMUM DRY DENSITY IN ACCORDANCE WITH ASTM D698.
3. GRADE THE FILL SLOPES TO 2H:1V OR FLATTER.
4. GRADE SUBGRADES TO DRAIN AND PREVENT WATER PONDING
5. COMPACTION SHALL BE OBTAINED BY THE USE OF MULTIPLE-WHEEL PNEUMATIC-TIRED ROLLERS, OR OTHER EQUIPMENT APPROVED BY THE FIELD ENGINEER WITH CONCURRENCE BY DENVER WATER REPRESENTATIVE FOR BACKFILL SOILS. GRANULAR FILL SHALL BE COMPACTED USING VIBRATORY EQUIPMENT OR OTHER EQUIPMENT APPROVED BY THE CONTRACTOR. COMPACTION SHALL BE ACCOMPLISHED WHILE THE FILL MATERIAL IS AT THE SPECIFIED MOISTURE CONTENT. COMPACTION OF EACH LAYER SHALL BE CONTINUOUS OVER THE ENTIRE AREA.
6. PROOF-ROLLING: PERFORM AS DIRECTED BY THE FIELD ENGINEER WITH CONCURRENCE BY DENVER WATER REPRESENTATIVE TO DETERMINE LOCATION OF UNACCEPTABLE SOFT AREAS. PROOF-ROLLING SHALL BE PERFORMED USING A HEAVY OR FULLY LOADED PNEUMATIC TIRE DUMP TRUCK. UNACCEPTABLE AREAS SHALL BE STABILIZED IN ACCORDANCE WITH THIS SPECIFICATION.

3.6 ROADWAYS

1. ALL PROJECT ROADS WILL BE CROSS-SLOPED AT 1% TO ALLOW FOR STORM WATER FLOW OVER THE ROADWAY.
2. THE DIRECTION OF THE CROSS-SLOPE FOR THE ROADS WILL BE DETERMINED BY THE FIELD ENGINEER WITH CONCURRENCE BY DENVER WATER REPRESENTATIVE DURING CONSTRUCTION.
3. SUBGRADE INSPECTION: INSPECT THE COMPACTED SUBGRADE FOR DETERMINATION OF SOIL-TYPE AND THE NEED FOR GEOTEXTILE PLACEMENT.
4. GEOTEXTILE INSTALLATION: INSTALL THE GEOTEXTILE FOR ROADWAYS ON UNSUITABLE SOIL SUBGRADES. THE FIELD ENGINEER WITH CONCURRENCE BY DENVER WATER REPRESENTATIVE WILL DESIGNATE LOCATIONS WHERE THE GEOTEXTILE IS REQUIRED. ALL GEOTEXTILES SHALL BE INSTALLED IN ACCORDANCE WITH MANUFACTURERS INSTRUCTIONS.
5. SURFACE AGGREGATE
   - 5.1. PLACE SURFACE AGGREGATE BY END-DUMPING ON THE PREVIOUSLY PLACED AGGREGATE OR COMPACTED SUBGRADE.
   - 5.2. PROVIDE A MINIMUM 4 INCH LAYER OF SURFACE AGGREGATE (OVER THE GEOTEXTILE, IF REQUIRED BY THE FIELD ENGINEER WITH CONCURRENCE BY DENVER WATER REPRESENTATIVE) FOR ACCESS ROADS BEFORE PERMITTING ANY TRAFFIC.
   - 5.3. ALL SURFACE AGGREGATE SHOULD BE COMPACTED WITH A SMOOTH DRUM VIBRATORY ROLLER TO OBTAIN 98 % OF THE MAXIMUM DRY DENSITY AS DETERMINED BY ASTM D698, STANDARD PROCTOR. AS AN ALTERNATIVE, A TEST FILL METHOD IN LIEU OF ASTM D698 AND AS APPROVED BY THE FIELD ENGINEER WITH CONCURRENCE BY DENVER WATER REPRESENTATIVE, MAY BE USED FOR CONTROL OF COMPACTION.
   - 5.4. REPLACE TOPSOIL IN DISTURBED AREAS AS INDICATED ON THE DRAWINGS.
   - 5.5. REVEGETATE IN ACCORDANCE WITH THE APPROVED STORMWATER POLLUTION PREVENTION PLAN.
6. TRUCK TURNAROUNDS WILL BE LOCATED BY CONTRACTOR WITH CONCURRENCE OF DENVER WATER REPRESENTATIVE.
7. IF ROCK IS PRESENT ON EXISTING ROAD CHECK WITH DENVER WATER REPRESENTATIVE FOR DEPTH AND PLACEMENT OF AGGREGATE BASE.

3.7 CLEANUP AND SITE RESTORATION

1. REMOVE STOCKPILE: LEAVE AREA IN A CLEAN AND NEAT CONDITION. GRADE THE SURFACE IN ACCORDANCE WITH THE CONSTRUCTION DRAWINGS.
2. MISCELLANEOUS FILL MUST BE TRACKED OR TAMPED IN PLACE TO ACHIEVE UNYIELDING SURFACE.
3. GRADE MISCELLANEOUS FILL AS OUTLINED ON THE DRAWINGS OR AS DESIRED BY THE FIELD ENGINEER WITH CONCURRENCE BY DENVER WATER REPRESENTATIVE TO RESEMBLE THE NATURAL GROUND SURFACE.
4. UPON COMPLETION OF TREE REMOVAL WORK THE CONTRACTOR SHALL RESTORE THE HAUL ROADS TO THE ORIGINAL CONDITION AS DIRECTED BY DENVER WATER. THE CONNECTOR ROAD BETWEEN FS 359 AND CR 97E SHALL BE OBLITERATED AND THE HAUL ROAD REVEGETATED IN ACCORDANCE WITH THE DIRECTIONS OF DENVER WATER.

3.8 FIELD QUALITY CONTROL TESTING

1. ALLOW THE FIELD ENGINEER AND DENVER WATER REPRESENTATIVE (IF DEEMED NECESSARY BY OWNER) TO INSPECT AND APPROVE SUBGRADES AND FILL LAYERS BEFORE CONSTRUCTION WORK IS PERFORMED.
2. THE FIELD ENGINEER WITH CONCURRENCE BY DENVER WATER REPRESENTATIVE SHALL APPROVE ALL MATERIAL USED FOR FILL. APPROVAL SHALL BE OBTAINED BEFORE USE OF MATERIAL ON THE SITE BY THE CONTRACTOR.
3. THE FIELD ENGINEER AND DENVER WATER REPRESENTATIVE (IF DEEMED NECESSARY BY OWNER) SHALL BE PRESENT TO OBSERVE ALL FILL PLACEMENT AND COMPACTION OPERATIONS.
4. MATERIAL GRADATION (PARTICLE SIZE ANALYSIS) SHALL BE PERFORMED AT 1 TEST PER 5,000 CY OR MINIMUM OF 1 PER DAY PER SECTION.
5. FIELD DENSITY TESTS AND IN-PLACE MOISTURE SHALL BE PERFORMED BY THE CONTRACTOR IN ACCORDANCE WITH THE CRITERIA BELOW:
   - ROADWAY: PERFORM AT LEAST ONE FIELD TEST OF SUBGRADE AND FILL MATERIAL FOR EVERY 500 LINEAR FEET OR AS DIRECTED BY THE FIELD ENGINEER WITH CONCURRENCE BY DENVER WATER REPRESENTATIVE, BUT IN NO CASE LESS THAN ONE (1) TEST PER LIFT OF FILL.
   - OTHER UNPAVED AREAS: PERFORM AT LEAST ONE FIELD TEST OF SUBGRADE AND FILL MATERIAL FOR EVERY 10,000 SQ. FT. OR AS DIRECTED BY THE FIELD ENGINEER WITH CONCURRENCE BY DENVER WATER REPRESENTATIVE, BUT IN NO CASE LESS THAN ONE (1) TEST PER LIFT OF FILL.
   - TRENCHES/OUTLET PIPE: PERFORM AT LEAST ONE FIELD TEST OF SUBGRADE AND FILL MATERIAL FOR EVERY 100 LINEAR FEET OR AS DIRECTED BY THE FIELD ENGINEER WITH CONCURRENCE BY DENVER WATER REPRESENTATIVE, BUT IN NO CASE LESS THAN ONE (1) TEST PER LIFT OF FILL.

REFERENCE:

IN-PLACE DENSITY TEST: ASTM D1556, ASTM D2922, ASTM D2167, ASTM D6938.

IN-PLACE MOISTURE TEST: ASTM D6938

MOISTURE DENSITY RELATIONSHIP: ASTM D698

PARTICLE SIZE ANALYSIS: ASTM C136 / D422

STORMWATER POLLUTION PREVENTION PLAN

THE CONTRACTOR SHALL COMPLY WITH THE COLORADO DEPARTMENT OF PUBLIC HEALTH AND ENVIRONMENT (CDPHE) APPROVED SWPPP, ITEMS LISTED BELOW.

SPILL PREVENTION, CONTAINMENT, AND COUNTERMEASURES NOTES

GENERAL

SPILLS WILL BE IMMEDIATELY REPORTED TO DENVER WATER, BY THE PRIME CONTRACTOR. DENVER WATER WILL KEEP AN UP-TO-DATE LIST OF QUALIFIED EMERGENCY RESPONSE CONTRACTORS WITH THE CAPABILITY OF REACHING THE PROJECT SITE QUICKLY.

IN THE EVENT THAT A SPILL OCCURS ON THE SITE, THE FOLLOWING NOTIFICATION PROCEDURE WILL BE FOLLOWED:

1. SUBCONTRACTOR NOTIFIES THE DENVER WATER CONSTRUCTION MANAGER.
2. THE CONSTRUCTION MANAGER NOTIFIES THE SUPERINTENDENT, PROJECT MANAGER AND THE DENVER WATER CONSTRUCTION MANAGER.
3. DENVER WATER REPORTS THE SPILL TO THE CDPHE DIVISION FOR SPILL PREVENTION AND RESPONSE.

ESTIMATED CUT AND FILL TOTALS			
LOCATION	CUT	FILL	NET
NEW CONNECTOR ROAD	5197 CU. YD.	4666 CU. YD.	531 CU. YD CUT

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DENVER WATER
GROSS RESERVOIR EXPANSION PROJECT
CONCEPTUAL HAUL ROAD DRAWINGS
CONSTRUCTION GENERAL NOTES

PROJ:	194-6713
DESN:	AML
DRWN:	AML
CHKD:	JPP

G-02

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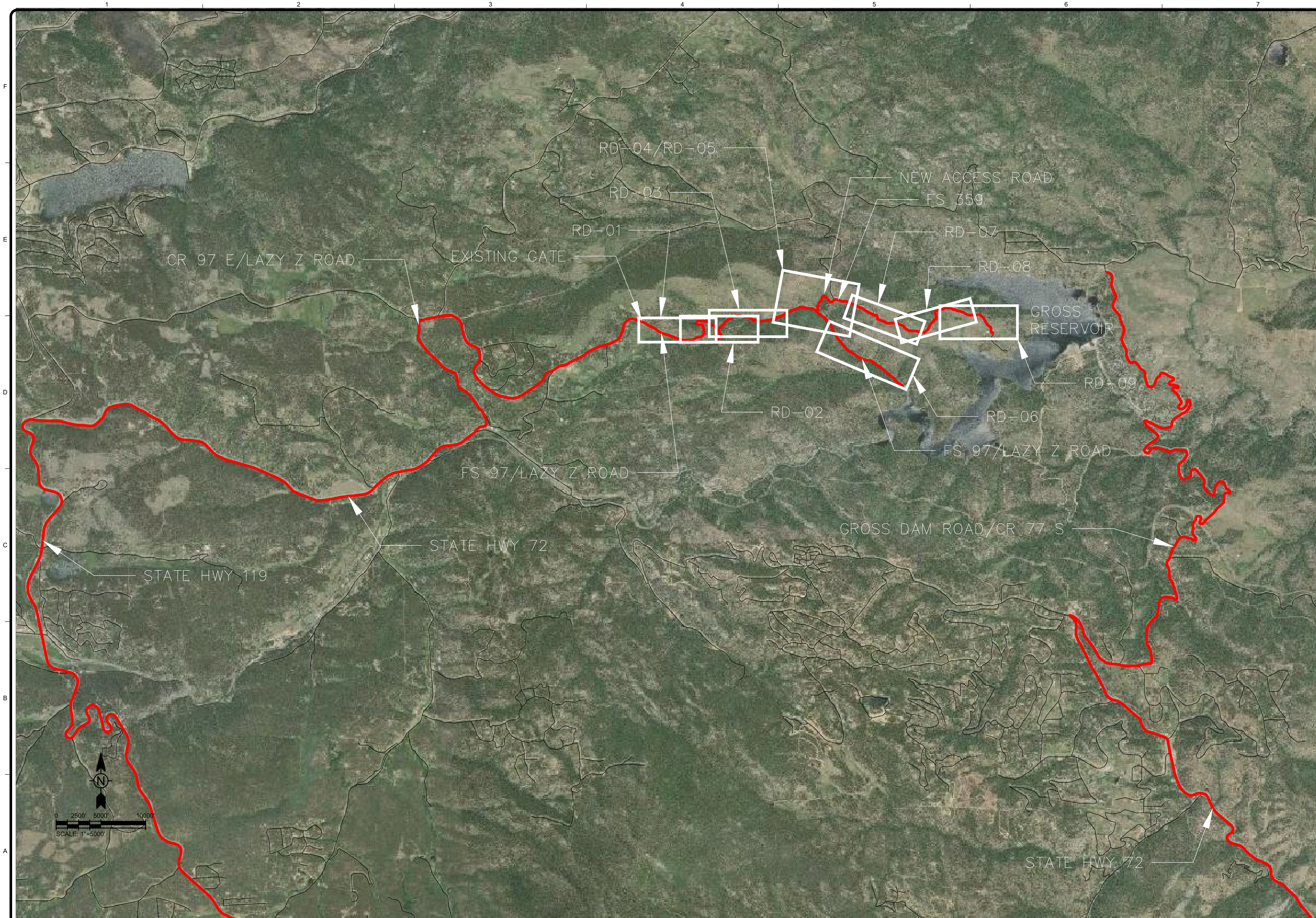

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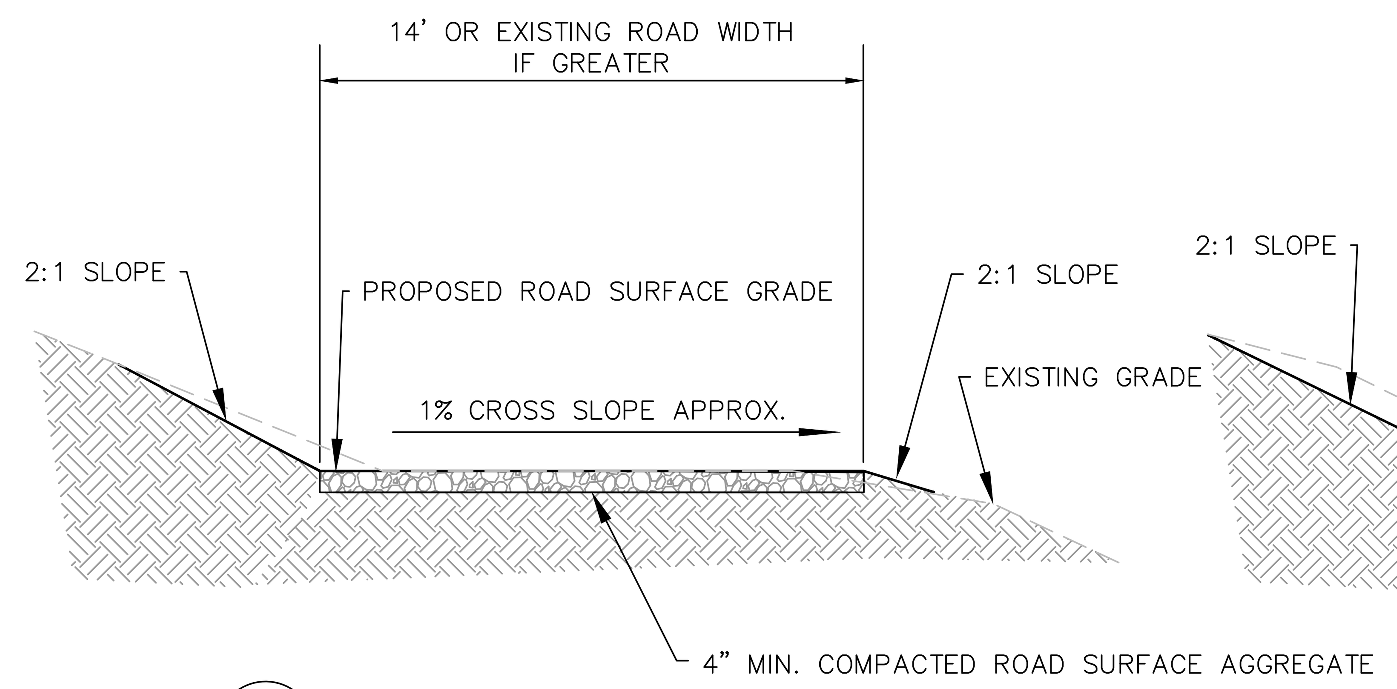
DENVER WATER

GROSS RESERVOIR EXPANSION PROJECT
KEY MAP AND TRANSPORTATION PLAN

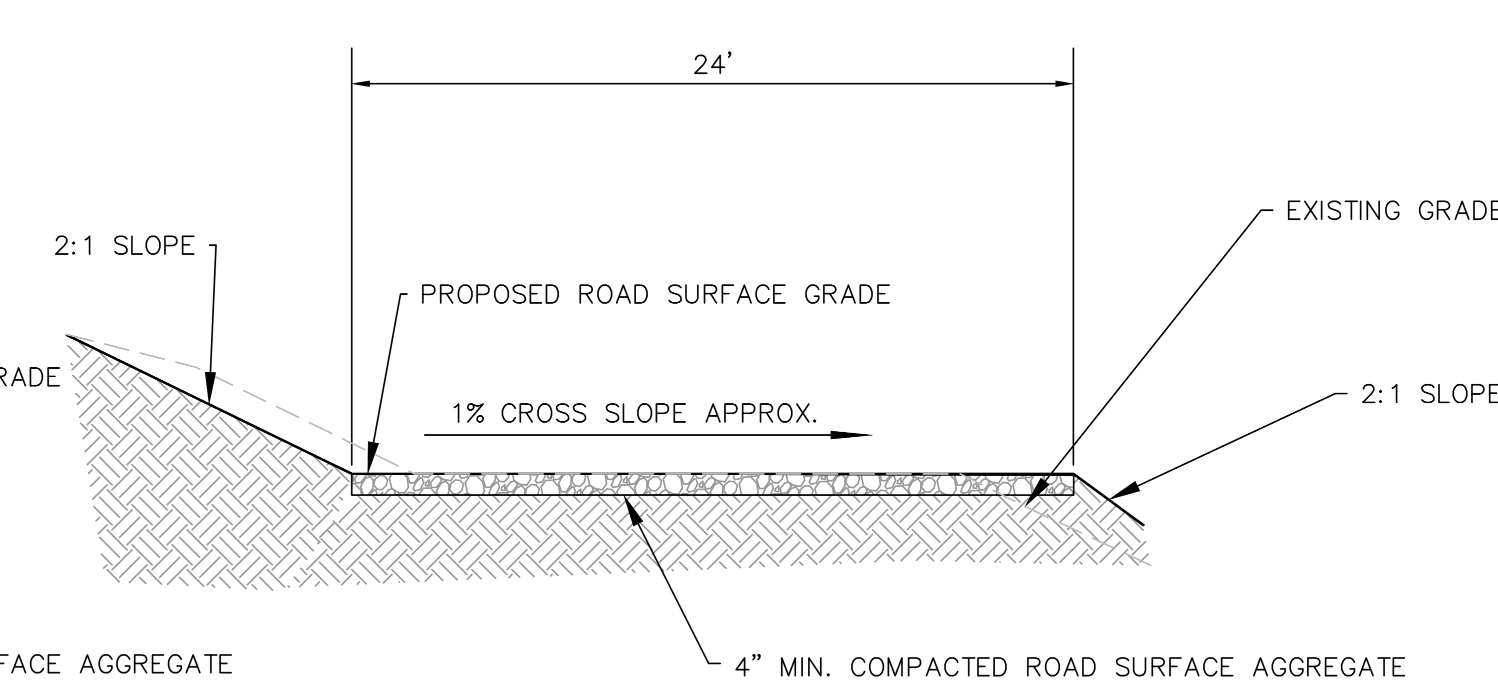
PROJ:	194-6713
DESN:	AML
DRWN:	ENM
CHKD:	JPP

C-01

Bar Measures 1 inch, otherwise drawing not to scale



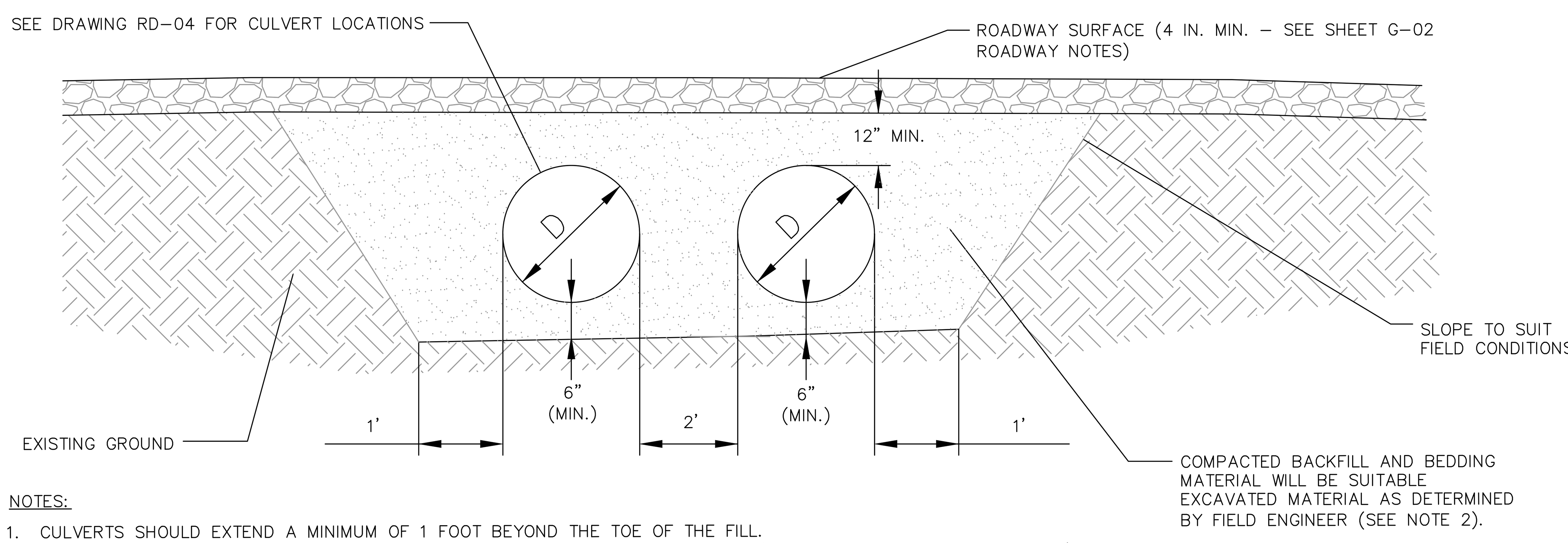
1 TYP ACCESS ROAD CROSS SECTION TYP.
NOT TO SCALE



2 TYP PASSING/PULL OUT LANE CROSS SECTION TYP.
NOT TO SCALE

CONSTRUCTION SPECIFICATIONS

1. SIDE SLOPES IN CUT AND FILL AREAS SHALL BE 2:1 (H:V) UNLESS OTHERWISE DESIGNATED ON DRAWINGS.

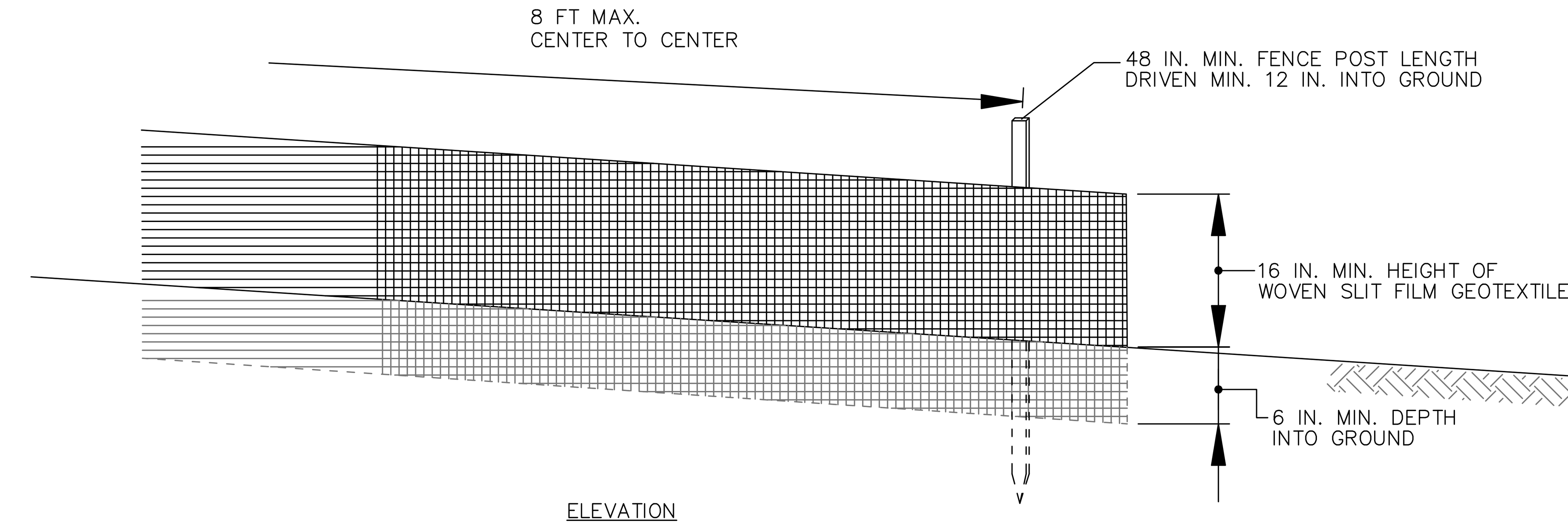


NOTES:

1. CULVERTS SHOULD EXTEND A MINIMUM OF 1 FOOT BEYOND THE TOE OF THE FILL.
2. CULVERT BACKFILL WILL BE COMPACTED TO 95% OF THE MAXIMUM DRY DENSITY (±4% OPTIMUM MOISTURE CONTENT).

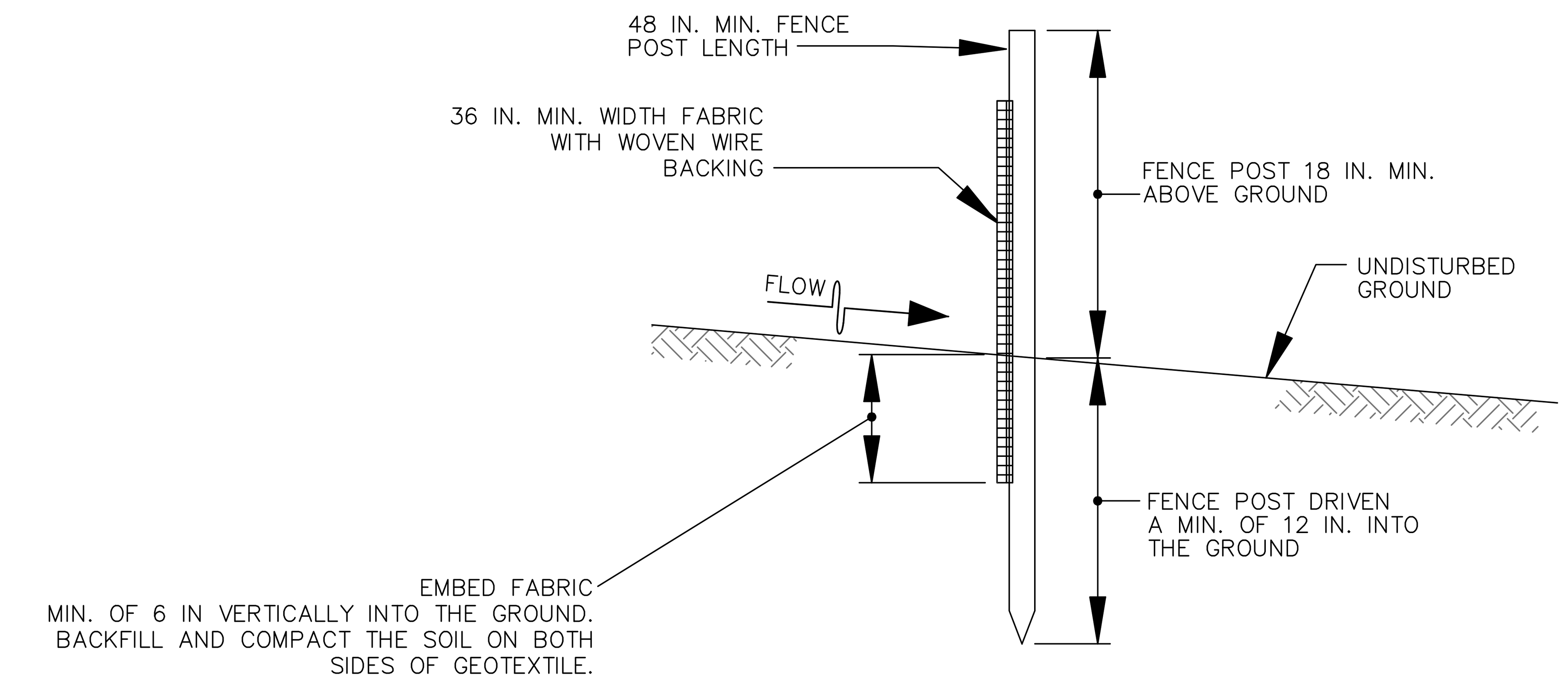
CULVERT CROSSINGS SCHEDULE EXISTING CULVERTS

CULVERT	DIAMETER (IN.)	# OF PIPES	MATERIAL	START INVERT (FT)	END INVERT (FT)	PROPOSED TEMPORARY LENGTH (FT)
C–1	36"	2	CMP	7674	7654	100
C–2	24"	1	CMP	7654	7642	50



ELEVATION

3 TYP SILT FENCE DETAIL
NOT TO SCALE



CROSS SECTION

SILT FENCE SPECIFICATIONS

1. FENCE POST SHALL BE MADE OF EITHER HOT ROLLED STEEL, AT LEAST 4 FEET LONG WITH TEE OR Y–BAR CROSS SECTION, SURFACE PAINTED OF GALVANIZED, MINIMUM NOMINAL WEIGHT 1.25 LB/FT², AND BRINDELL HARDNESS EXCEEDING 140, OR WOOD.
2. SILT FENCE MATERIAL SHALL BE POLYPROPYLENE, POLYETHYLENE, OR POLYAMIDE WOVEN OR NON WOVEN FABRIC. THE FABRIC WIDTH SHOULD BE 36 INCHES, WITH A MINIMUM UNIT WEIGHT OF 4.5 OZ/YD, MULLEN BURST STRENGTH EXCEEDING 190 LB/IN.², ULTRAVIOLET STABILITY EXCEEDING 70%, AND MINIMUM APPARENT OPENING SIZE OF U.S. SIEVE NO. 30.
3. WOVEN WIRE BACKING TO SUPPORT THE FABRIC SHALL BE GALVANIZED 2"X4" WELDED WIRE, 12 GAUGE MINIMUM.
4. POSTS, WHICH SUPPORT THE SILT FENCE, SHALL BE INSTALLED ON A SLIGHT ANGLE TOWARD THE ANTICIPATED RUNOFF SOURCE. POST MUST BE EMBEDDED A MINIMUM OF 1 FOOT DEEP AND SPACED NOT MORE THAN 8 FEET ON CENTER. WHERE WATER CONCENTRATES, THE MAXIMUM SPACING SHALL BE 6 FEET.
5. LAY OUT FENCING DOWN–SLOPE OF DISTURBED AREA, FOLLOWING THE CONTOUR AS CLOSELY AS POSSIBLE. THE FENCE SHALL BE SITED SO THAT THE MAXIMUM DRAINAGE AREA IS ¼ ACRE/100 FEET OF FENCE.
6. THE TOE OF THE SILT FENCE SHALL BE TRENCHED IN WITH A SPADE OR MECHANICAL TRENCHER, SO THAT THE DOWN–SLOPE FACE OF THE TRENCH IS FLAT AND PERPENDICULAR TO THE LINE OF FLOW. WHERE FENCE CANNOT BE TRENCHED IN (E.G., PAVEMENT OR ROCK OUTCROP), WEIGHT FABRIC FLAP WITH 3 INCHES OF PEA GRAVEL ON UPHILL SIDE TO PREVENT FLOW FROM SEEPING UNDER FENCE.
7. THE TRENCH MUST BE A MINIMUM OF 6 INCHES DEEP AND 6 INCHES WIDE TO ALLOW FOR THE SILT FENCE FABRIC TO BE LAID IN THE GROUND AND BACKFILLED WITH COMPACTED MATERIAL.
8. SILT FENCE SHALL BE SECURELY FASTENED TO EACH SUPPORT POST OR TO WOVEN WIRE, WHICH IS IN TURN ATTACHED TO THE STEEL FENCE POST. THERE SHALL BE A 3–FOOT OVERLAP, SECURELY FASTENED WHERE ENDS OF FABRIC MEET.
9. REMOVE ACCUMULATED SEDIMENT AND DEBRIS WHEN BULGES DEVELOP IN SILT FENCE OR WHEN SEDIMENT REACHES 50% OF FENCE HEIGHT. REPLACE GEOTEXTILE IF TORN. IF UNDERMINING OCCURS, REINSTALL FENCE.

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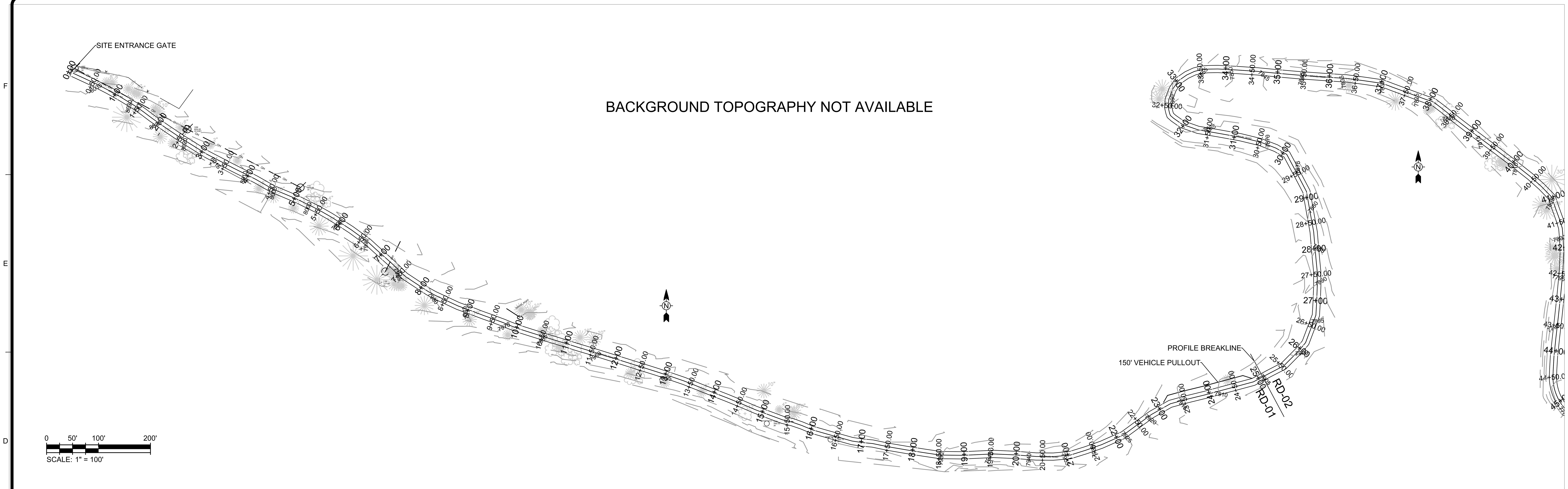
DENVER WATER
GROSS RESERVOIR EXPANSION PROJECT
CONCEPTUAL HAUL ROAD DRAWINGS
ESC AND ROAD DETAILS (SHEET 1 OF 1)

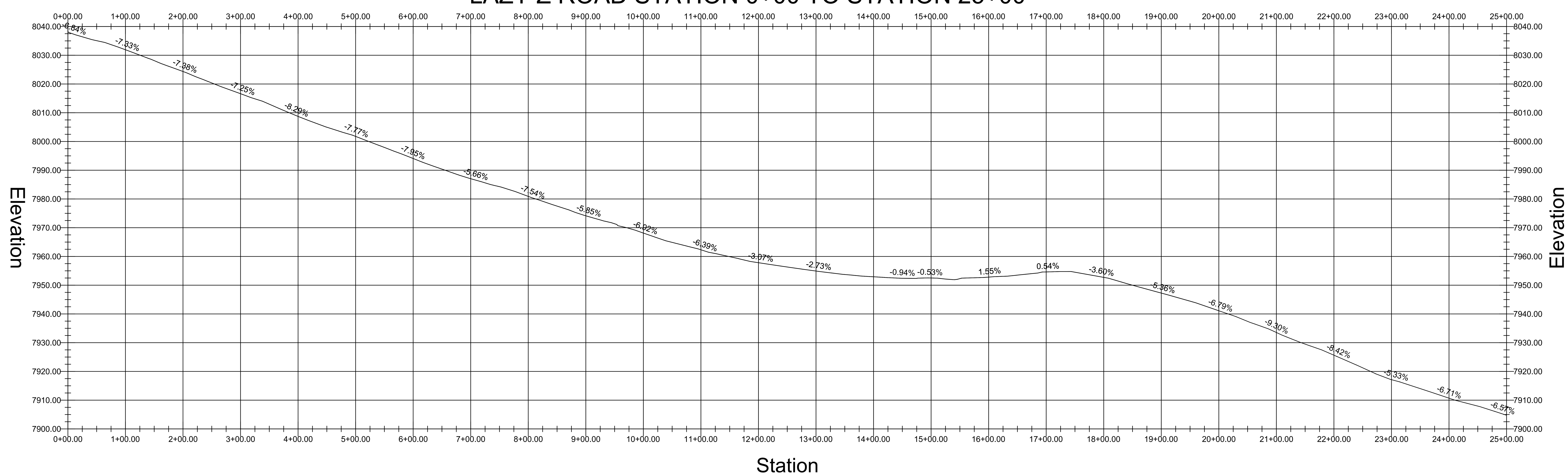
PROJ:	194-6713
DESN:	AML
DRWN:	ENM
CHKD:	JPP

C-02

Bar Measures 1 inch, otherwise drawing not to scale



LAZY Z ROAD STATION 0+00 TO STATION 25+00



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GROSS RESERVOIR EXPANSION PROJECT
CONCEPTUAL HAUL ROAD DRAWINGS
ROAD LAYOUT PLAN AND PROFILE (SHEET 1 OF 9)

PROJ:	194-6713
DESN:	AML
DRWN:	ENM
CHKD:	JPP

RD-01

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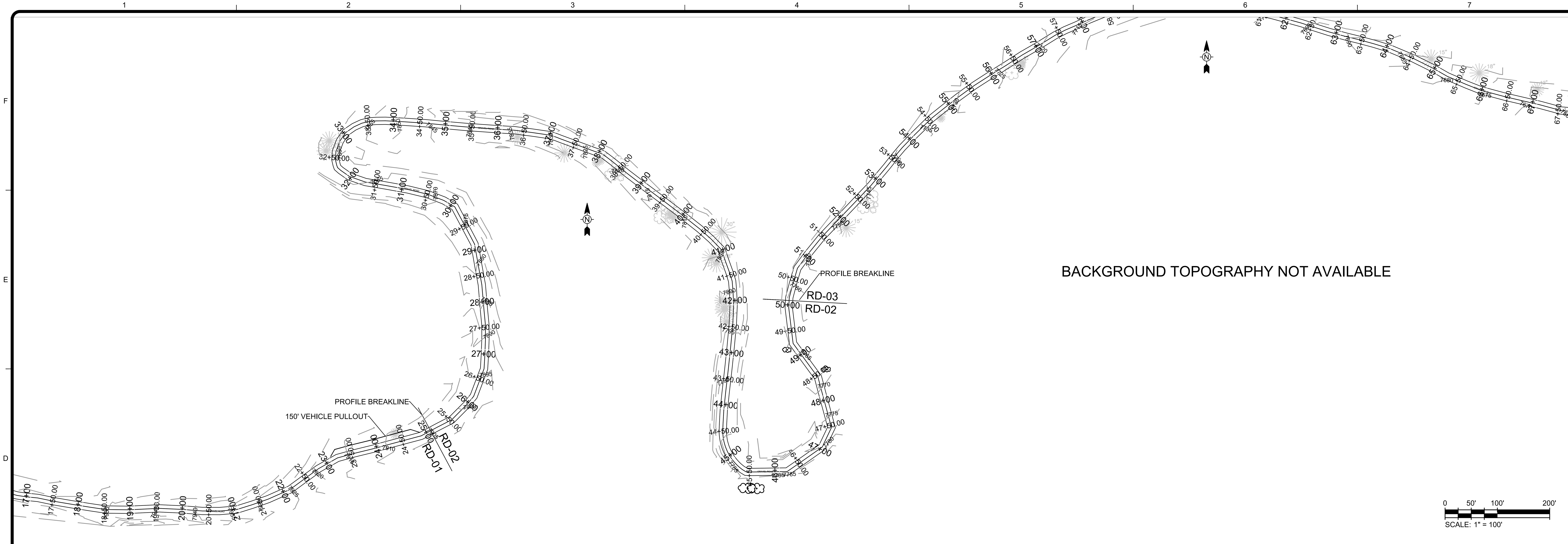

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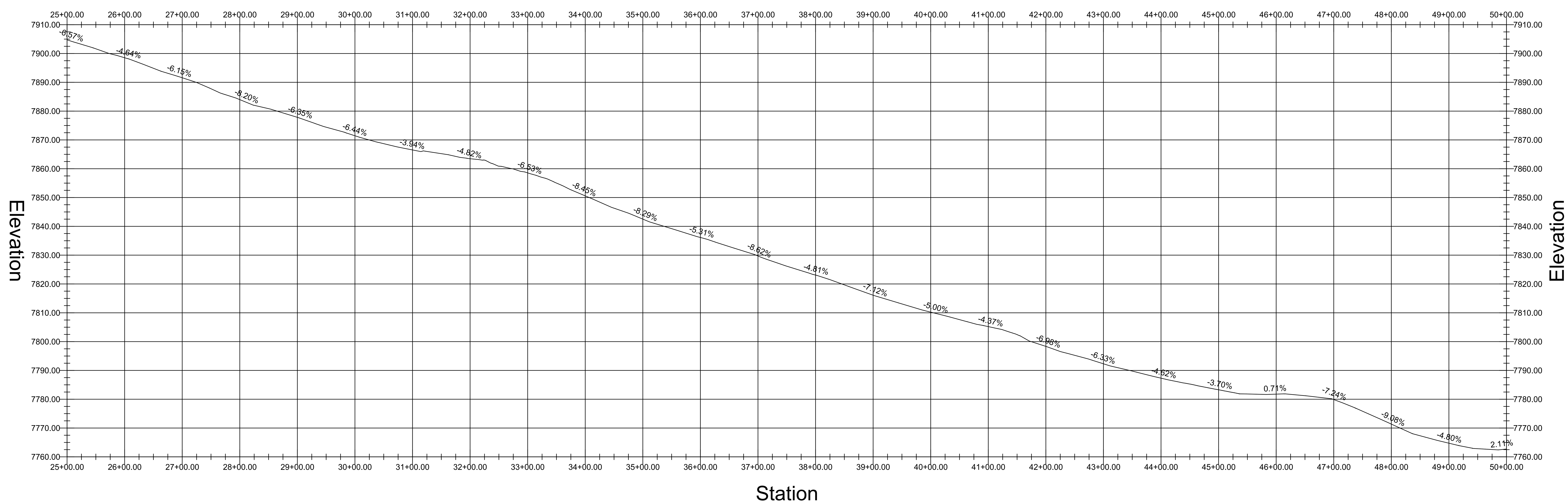

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CONCEPTUAL HAUL ROAD DRAWINGS
ROAD LAYOUT PLAN AND PROFILE (SHEET 2 OF 9)

PROJ:	194-6713
DESN:	AML
DRWN:	ENM
CHKD:	JPP

RD-02

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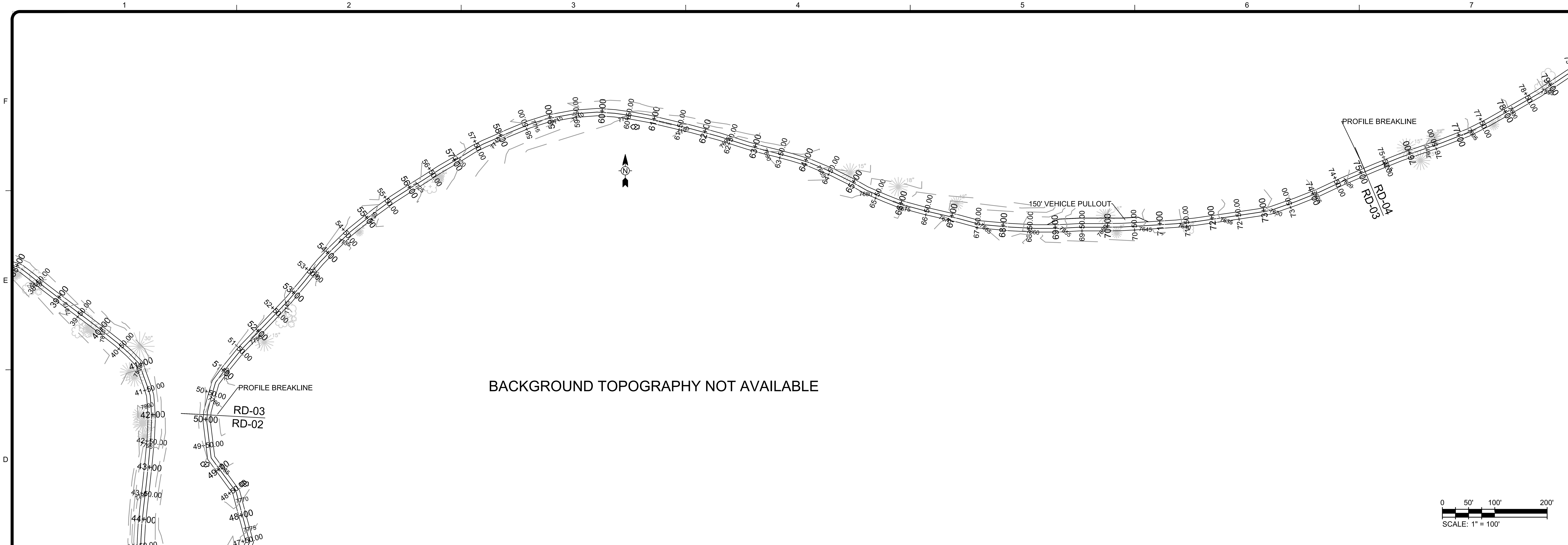
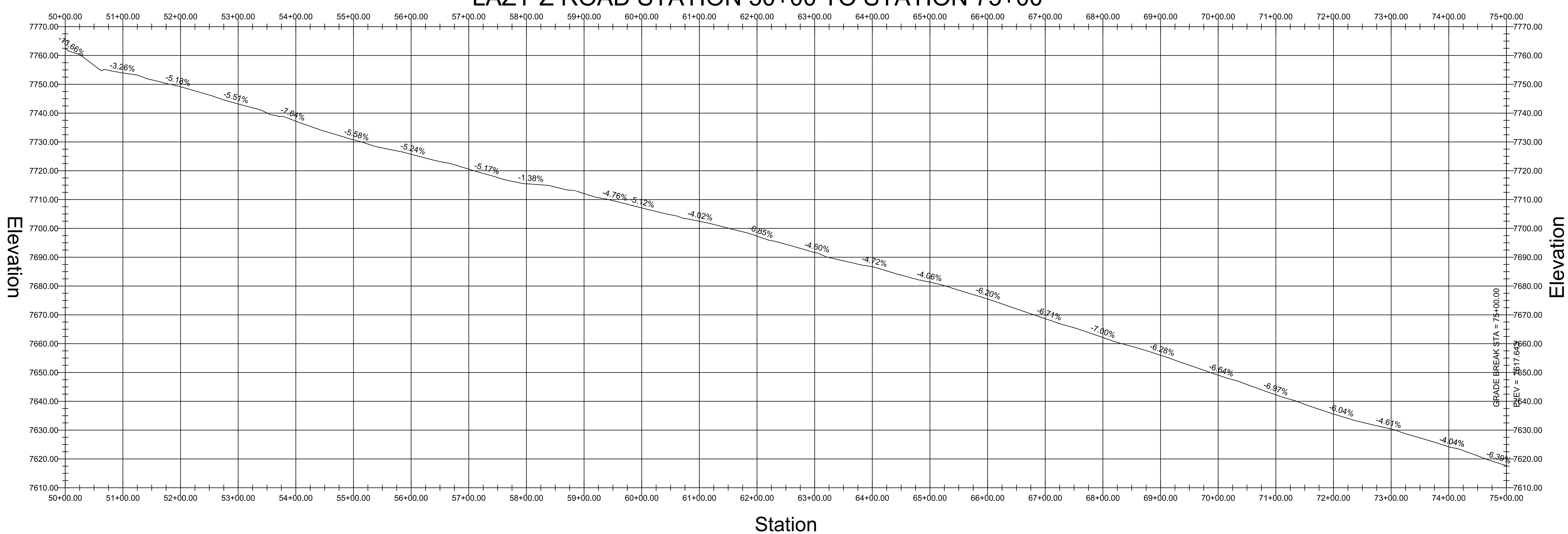


LAZY Z ROAD STATION 50+00 TO STATION 75+00



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CONCEPTUAL HAUL ROAD DRAWINGS
ROAD LAYOUT PLAN AND PROFILE (SHEET 3 OF 9)

PROJ:	194-6713
DESN:	AML
DRWN:	ENM
CHKD:	JPP

RD-03

Bar Measures 1 inch, otherwise drawing not to scale

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CONCEPTUAL HAUL ROAD DRAWINGS
ROAD LAYOUT PLAN AND PROFILE (SHEET 4 OF 9)

PROJ:	194-6713
DESN:	AML
DRWN:	ENM
CHKD:	JPP

RD-04

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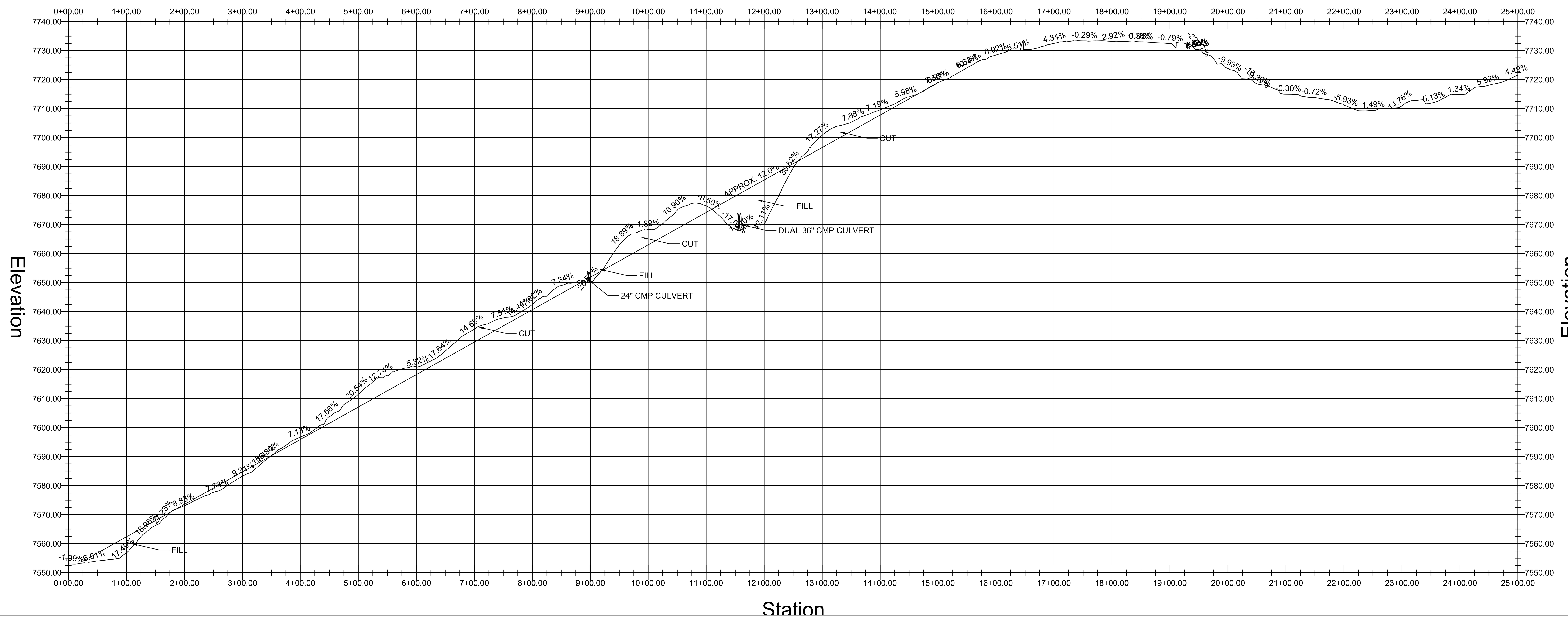
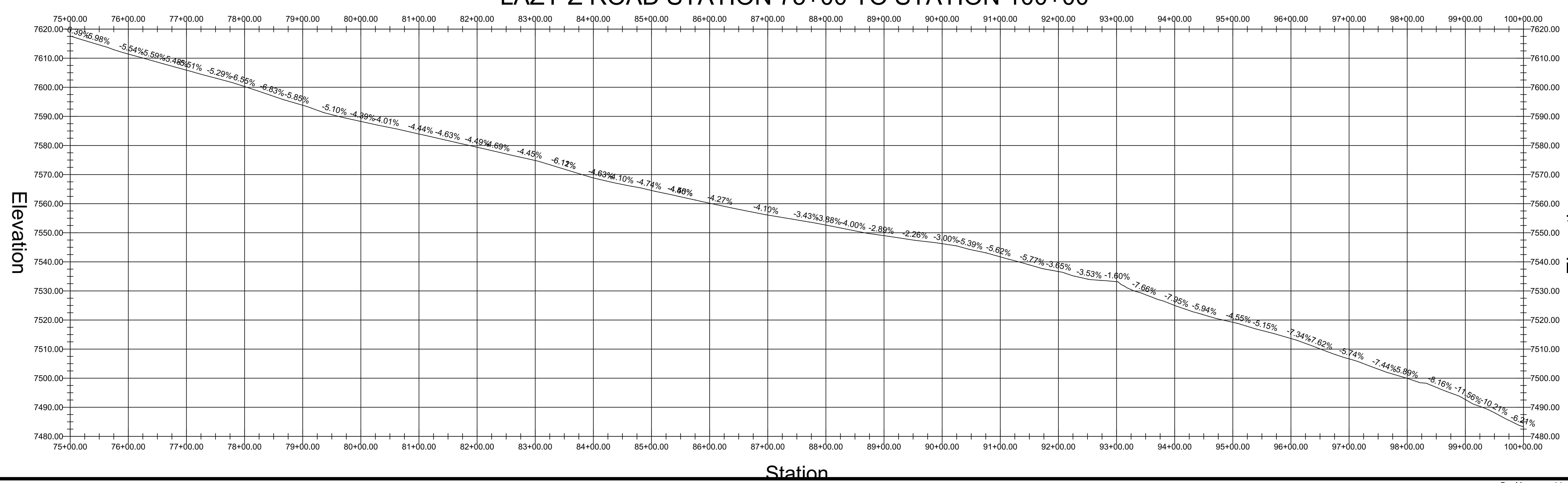
Bar Measures 1 inch, otherwise drawing not to scale

CONNECTOR ROAD AND FOREST SERVICE ROAD 359 STATION 0+00 TO STATION 25+00



LAZY Z ROAD STATION 75+00 TO STATION 100+00



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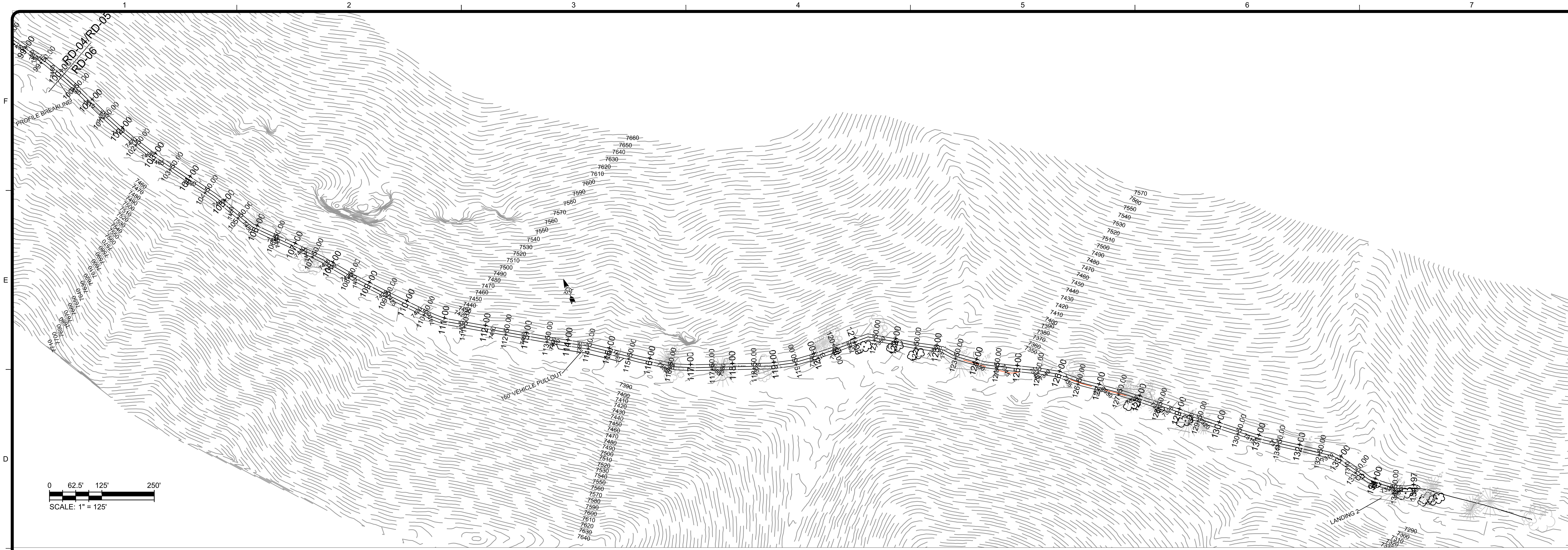
CONCEPTUAL HAUL ROAD DRAWINGS
ROAD LAYOUT PLAN AND PROFILE (SHEET 5 OF 9)

PROJ:	194-6713
DESN:	AML
DRWN:	ENM
CHKD:	JPP

RD-05

Bar Measures 1 inch, otherwise drawing not to scale



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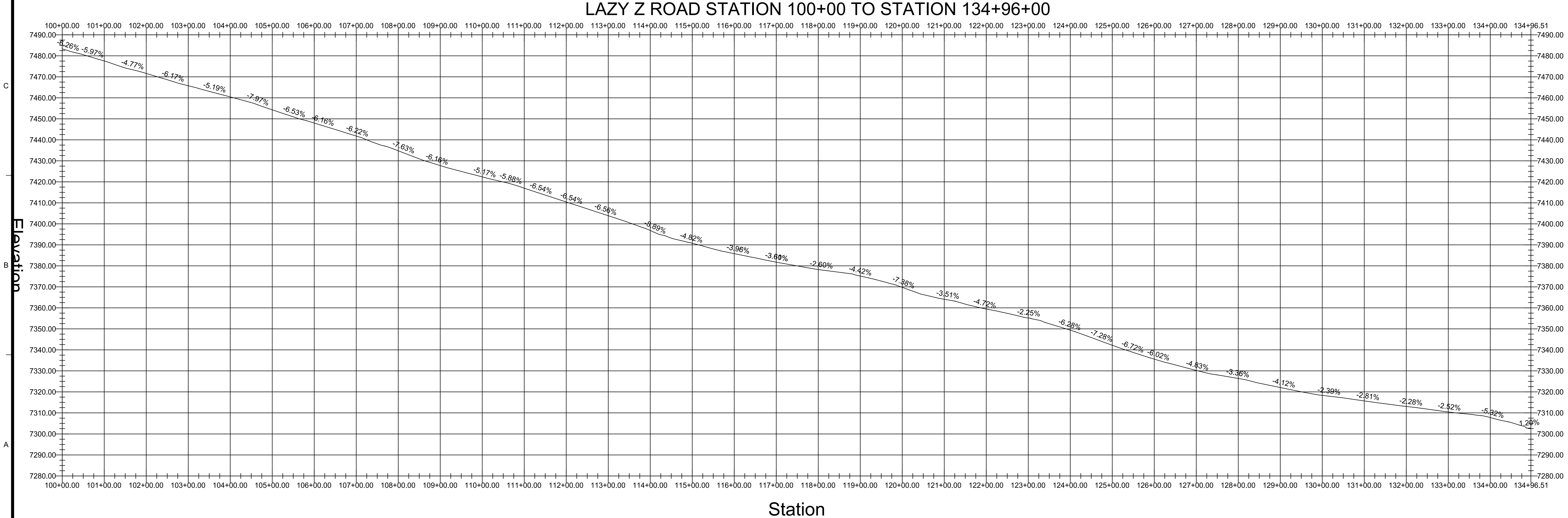

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CONCEPTUAL HAUL ROAD DRAWINGS
ROAD LAYOUT PLAN AND PROFILE (SHEET 6 OF 9)

PROJ:	194-6713
DESN:	AML
DRWN:	ENM
CHKD:	JPP

RD-06

Bar Measures 1 inch, otherwise drawing not to scale

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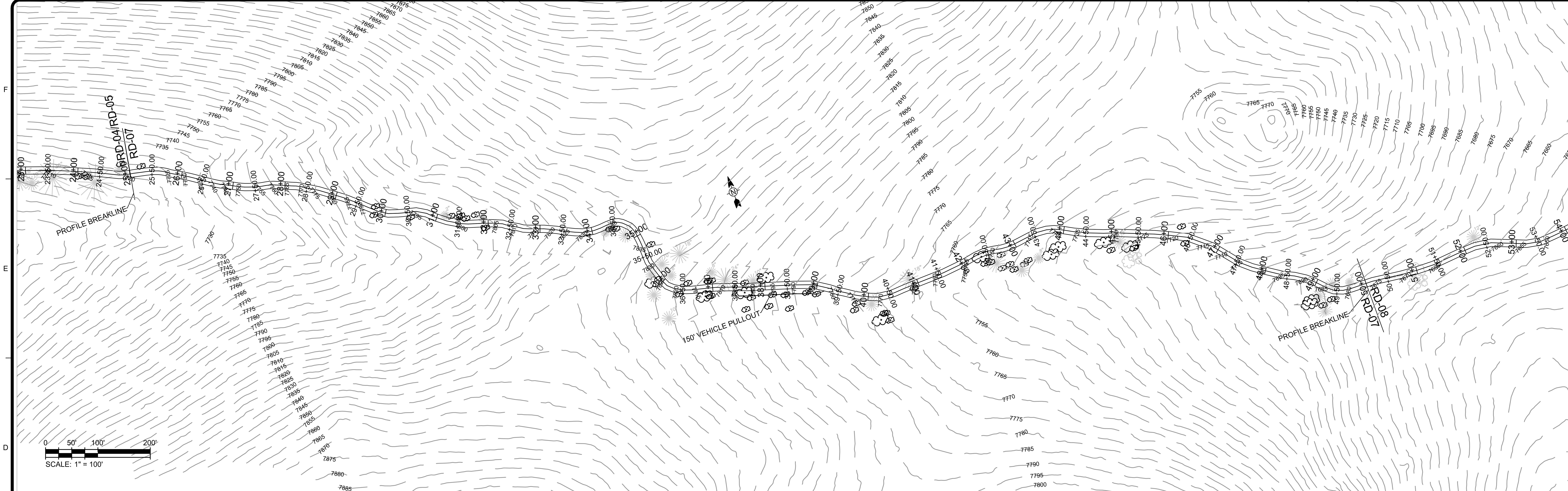
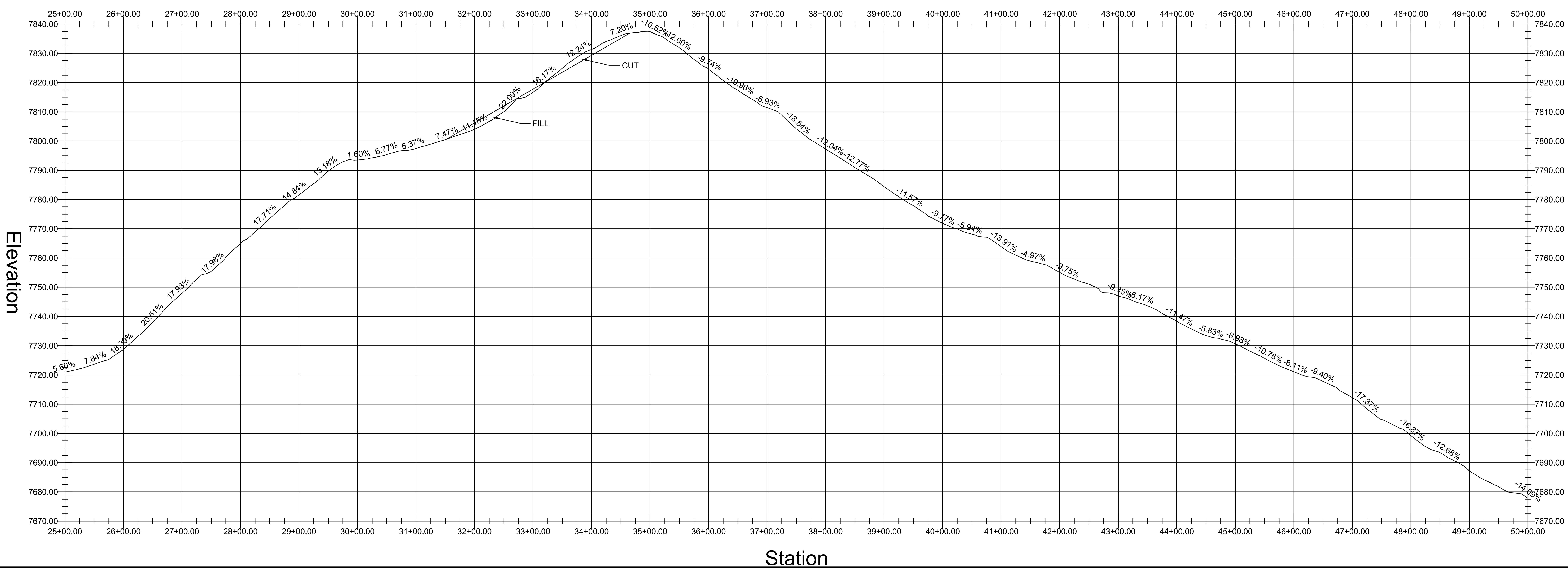


FOREST SERVICE ROAD 359 STATION 25+00 TO STATION 50+00



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GROSS RESERVOIR EXPANSION PROJECT
CONCEPTUAL HAUL ROAD DRAWINGS
ROAD LAYOUT PLAN AND PROFILE (SHEET 7 OF 9)

PROJ:	194-6713
DESN:	AZL
DRWN:	ENM
CHKD:	JPP

RD-07

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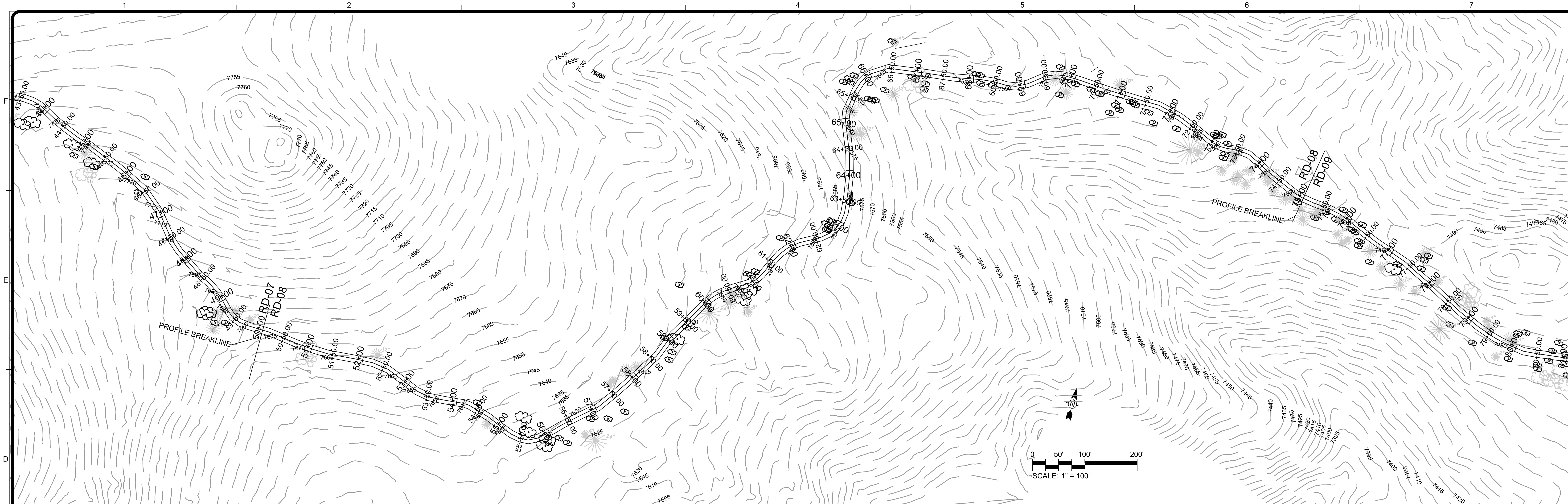
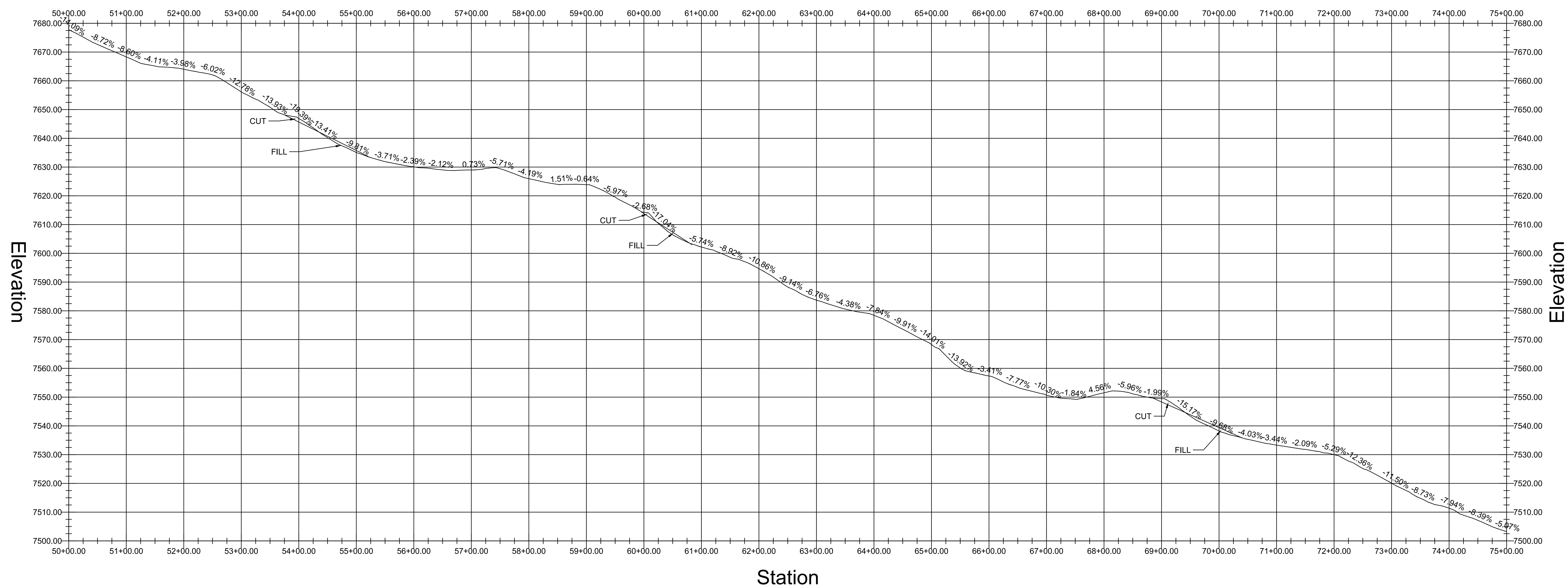


FOREST SERVICE ROAD 359 STATION 50+00 TO STATION 75+00



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CONCEPTUAL HAUL ROAD DRAWINGS
ROAD LAYOUT PLAN AND PROFILE (SHEET 8 OF 9)

PROJ:	194-6713
DESN:	AML
DRWN:	ENM
CHKD:	JPP

RD-08

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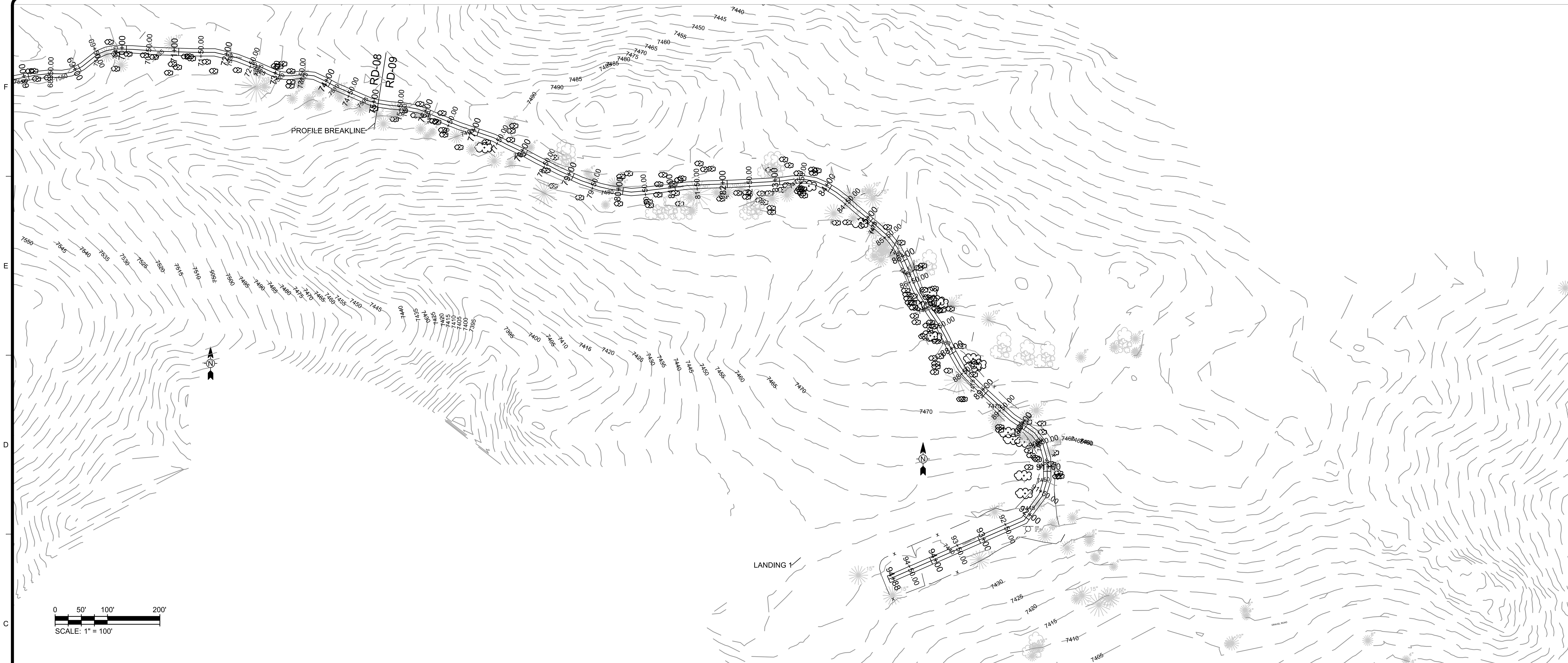
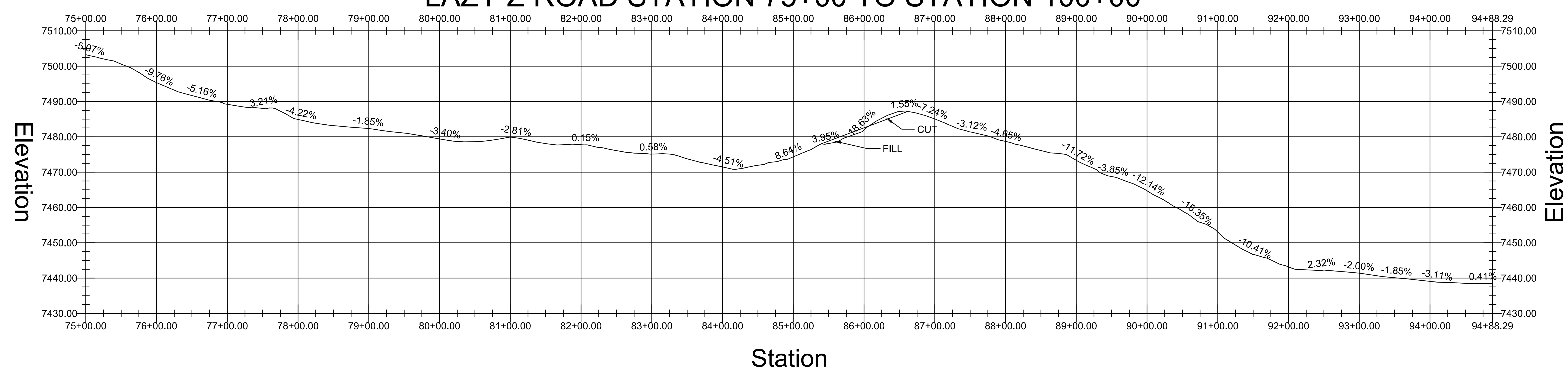


LAZY Z ROAD STATION 75+00 TO STATION 100+00



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CONCEPTUAL HAUL ROAD DRAWINGS
ROAD LAYOUT PLAN AND PROFILE (SHEET 9 OF 9)

PROJ:	194-6713
DESN:	AML
DRWN:	ENM
CHKD:	JPP

RD-09

Bar Measures 1 inch, otherwise drawing not to scale

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Appendix D:
Permissions and Approvals Related to Tree Removal

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Permissions and Approvals Related to Tree Removal

Permission/Approval	Applicable GRE Project Component	Status
Federal		
Corps Section 404 Permit Condition—Tree Removal Plan	The Corps issued a Section 404 Clean Water Act permit for the GRE Project in July 2017. Permit review and authorization includes a process that encourages avoidance of impacts, minimization of impacts, and requires mitigation for unavoidable impacts to the aquatic environment. The Tree Removal Plan will determine preferred removal and disposal methods through consultation with the USFS, the CSFS, Boulder County, Jefferson County and Gilpin County. Denver Water is submitting this Tree Removal Plan document to agencies for input before filing with the FERC for approval prior to land clearing activities.	Denver Water is submitting this Tree Removal Plan to agencies in March 2021. Final to be submitted to FERC in July 2021.
USFS Federal Land Policy and Management Act of 1976	Additional National Forest System lands needed for the GRE Project facilities at Gross Reservoir.	Denver Water and the USFS entered into a Settlement Agreement in September 2016.
Federal Power Act (Section 4e) Authority	Authorizes the USFS to impose conditions within a FERC license. Conditions may be imposed by the USFS to address new GRE Project modifications within the FERC-licensed hydroelectric project boundary at Gross Reservoir.	Section 4e Conditions were part of the September 2016 Off-License Agreement between Denver Water and the USFS; the conditions were included in the FERC hydropower license issued July 16, 2020.
USFS Section 4(e) Conditions 10 (Road Maintenance Plan), 17 (Invasive Species Management), 19 (Erosion Control and Reclamation Plan), 20 (Fire Management and Response Plan), 21 (Raptor Protection Measures), 22 (Special Status Plants Relocation Plan), 23 (Visual Resource Protection Plan), 26 (Pit Development and Reclamation Plan)	Denver Water will develop measures to protect raptors, special status plants and visual resources as appropriate for tree removal activities, which are indicated in the 4(e) Conditions for implementation of the GRE Project. Other required plans per the FERC Order as shown, will be developed as required and incorporated into tree removal activities as applicable.	Denver Water is developing these measures and plans now for submittal to agencies, as appropriate, and to the FERC.

Permission/Approval	Applicable GRE Project Component	Status
USFS Section 4(e) Condition 27 (Tree Removal Plan)	USFS Section 4(e) Condition 27 (Tree Removal Plan) adopting mitigation identified in the 2011 Fish and Wildlife Mitigation Plan developed by Denver Water and approved by CPW and Colorado Water Conservation Board.	Denver Water is submitting this Tree Removal Plan to agencies in March 2021. Final to be submitted to FERC in July 2021.
FERC Hydropower License Amendment	All properties or facilities related to the FERC hydropower license.	FERC issued a Supplemental Environmental Assessment in February 2019 that recommended approval of Denver Water's amendment application. FERC issued its final Order amending the hydropower license in July 2020.
FERC Hydropower License Amendment Article 423 (Tree Removal Plan)	*Article 423 requires additional provisions to be added to the Tree Removal Plan required by USFS 4(e) condition 27: (1) measures to limit travel speeds on logging roads; (2) measures to prevent public use of logging roads during logging operations; (3) measures to limit log removal traffic to daylight hours; (4) measures to ensure logging trucks are appropriately equipped with mufflers to minimize noise; (5) measures to minimize fugitive dust; (6) measures to minimize soil erosion and effects to water quality; and (7) measures to minimize odors and nighttime lighting.[5] In addition, the article requires that the Tree Removal Plan be prepared after consultation with the USFS, CSFS, Boulder County, Jefferson County and Gilpin County.	Denver Water is submitting this Tree Removal Plan to agencies in March 2021. Final to be submitted to FERC in July 2021.

[5] For additional information, see the following sections in this Tree Removal Plan:
Conditions 1, 2, and 3, refer to section 2.3.1
Condition 4, refer to sections 2.3.1 and 2.3.3
Conditions 5 and 6, refer to section 2.3.2
Condition 7 refer to section 2.3.3.

Permission/Approval	Applicable GRE Project Component	Status
FERC Hydropower License Amendment Article 425 (Traffic Management Plan)	Article 425 requires Denver Water to file a Traffic Management Plan with details for minimizing the effects of truck traffic, addressing road damage, meeting county road regulations, reducing disruptions to local traffic and transportation, and minimizing traffic-related noise, light, and obnoxious odors. The Traffic Management Plan must include (1) measures to minimize the number of truck trips needed for GRE Project construction; (2) measures to minimize the effects of construction-related traffic on local traffic patterns, residents, and visitors; (3) measures to minimize noise, dust, and exhaust; (4) measures to encourage and/or require the use of carpools for construction workers; (5) proposed construction traffic routes, time-of-use, traffic control measures, and other restrictions; (6) measures to minimize and repair any road damage; and (7) procedures for complying with county road regulations. The plan must be consistent with traffic control measures needed to comply with USFS 4(e) conditions 10, 26, and 27 as appropriate.	Denver Water is developing this Plan which will incorporate tree removal transportation needs. Denver Water will submit a draft Plan to agencies for input before submitting the final Plan to FERC in July 2021.
State of Colorado		
CDPHE-Air Pollution Control Division Land Development Permit (Fugitive Dust Control Plan)	All ground-disturbing construction activities.	To be obtained prior to construction activities.
CDPHE-Water Quality Control Division General Permit for Stormwater Discharges Associated with Construction Activity	All ground-disturbing construction activities disturbing more than 1 acre.	To be obtained prior to construction activities.
Clean Water Act Section 401 Water Quality Certification	All activities subject to the Section 404 Permit from the Corps. A 401 Certification is required for any federal license or permit that is issued to construct or operate a facility that may result in any fill or discharges into navigable waters. The 401 certification acknowledges that Denver Water will remove trees along the shoreline prior to inundation.	Denver Water was issued the GRE Project 401 Certification in June 2016.
CDOT Access Permit	Modifications to the intersection of SH 72 and Gross Dam Road. Requires Traffic Control Plan.	To be obtained prior to construction activities.

Permission/Approval	Applicable GRE Project Component	Status
CDOT Oversize/Overweight Permit	Oversized and overweight loads on state highways.	To be obtained prior to construction activities.
Programmatic Agreements with the Colorado State Historic Preservation Office issued for the GRE Project	Two known archaeological sites (the resumption flume and Gross Dam) are present in the GRE Project area. In addition, the USFS indicated a third site located on the west side of Gross Reservoir near the Forsythe Falls trailhead would require mitigation if the nearby road is improved for logging. Denver Water will avoid the third site by constructing a short connection between FS 359 to CR 97 for biomass removal.	Denver Water will manage cultural and historic resources in accordance with the two existing Programmatic Agreements issued for the GRE Project. All impacted sites will be mitigated prior to disturbance.
Boulder County		
Areas and Activities of State Interest Permit (1041 Permit)	Boulder County has indicated that the GRE Project requires a 1041 Permit based on Section 8-308.A.2, Major extensions of existing domestic water and sewage treatment systems.	Denver Water submitted a 1041 Permit application in September 2020 and responded to comments on the application in February 2021.
Grading Permit	Movement of greater than 50 cubic yards of material. The permit will include an Erosion Control Plan and BMPs. Final transportation routes will be included as part of Grading Permit application	To be obtained prior to construction activities.
Utility Construction Permit	Construction affecting County rights-of-way requires Traffic Control Plan(s). Traffic control plans will be consistent with available roadways and estimated traffic.	To be obtained prior to construction activities.
Stormwater Quality Permit	Construction projects that disturb 1 acre or more in size.	To be obtained prior to construction activities.
Access Permits	Accesses from SH 72 and Magnolia Drive.	To be obtained prior to construction activities.
Oversize/Overweight Permit	Oversized and overweight loads on County Roads.	To be obtained prior to construction activities.
Building Permit	Temporary construction offices.	To be obtained prior to construction activities.

Appendix E:
Tree Removal Alternatives Considered but Eliminated

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Alternative One: 1 Log Landing

This alternative would make use of one Log Landing on Winiger Ridge for primary processing of all harvested biomass. Table 1 summarizes the advantages and disadvantages associated with Alternative One. This alternative was found to have high costs and high traffic and nuisance factor impacts.

Table 1:

Merits Considered — Alternative One: 1 Log Landing

Advantages	Disadvantages
• Minimum landing construction impacts (one landing) • Minimum service landing construction impacts (one service landing) • Provides multiple biomass disposal options	• Long helicopter round trips for yarding biomass • Minimizes opportunities for cable and ground yarding equipment thereby increases costs • Very labor-intensive biomass treatments on landing area • High haul truck traffic impacts to communities along haul roads on the west side of the reservoir • Susceptible to operational shutdowns from mechanical issues • Second highest stand removal cost alternative

Alternative Two: 2 Log Landings

This alternative included two Log Landings for primary processing of all harvested logs and biomass: Landing one on Winiger Ridge and Landing 2 at the lower terminus of the Winiger Gulch Road. Landing 2 was ground-verified with a local helicopter vendor and selected to use a location that is approximately 2 acres in size in a flat valley bottom at the end of Winger Gulch on CR 97. This Heli-landing site is within the inundation area. The landing site would be pre-logged using tractor-cable yarding and site-graded to prepare the landing site for helicopter activity. Table 2 summarizes the advantages and disadvantages associated with Alternative Two. This alternative was found to have high costs and high traffic and nuisance factor impacts.

Table 2:

Merits Considered — Alternative Two: Two Log Landings

Advantages	Disadvantages
• Reduced helicopter round trips for yarding biomass with two landing areas • Minimum service landing construction impacts (one service landing) • Reduced susceptibility to operational shutdowns from mechanical issues with two landing areas compared to a single landing • Increases opportunities for cable and ground yarding, reducing operating costs • Provides multiple biomass disposal options	• Possibly extends harvesting operating period • Very labor-intensive biomass treatment with two landing areas • High community (west side) haul truck traffic impacts • Third highest stand removal costs

Alternative Four: 1 Log Landing

Alternative Four would make use of one Log Landing located at the junction of Gross Dam Road and Osprey Point Road. Landing 3 would be the primary yarding and processing site for all harvested logs and biomass and would be accessed by Gross Dam Road for removal of material. A backup for Landing 3 would be used as a contingency to support Landing 3. A helicopter service landing is identified as Service (Landing) and uses access by Gross Dam Road. Coordination of tree removal activities and dam construction activities would minimize potential conflicts. Table 3 summarizes the advantages and disadvantages associated with Alternative Four. This alternative was found to have high costs and high traffic impacts.

Table 3:
Merits Considered — Alternative Four: 1 Log Landing

Advantages	Disadvantages
• Minimum landing construction impacts (one landing) • Minimum service landing construction impacts (one service landing) • Potentially reduces road construction costs by using the Gross Dam Road • Reduces west side community impacts • Provides multiple biomass disposal options	• Longest helicopter round trips for yarding biomass • Minimizes opportunities for cable and ground yarding equipment thereby increases costs • Very labor-intensive biomass treatments on landing area • High community haul truck traffic impacts (Gross Dam Road) • Highly congested landing; limited size • Most susceptible to operational shutdowns from mechanical issues (similar to Alternative One) • Highest stand removal cost alternative • Significantly increases biomass disposal costs (increased transportation costs)

Appendix F:
Tree Removal Methods by Stand for Inundation Area Phase

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Summary of Tree Removal Methods by Stand for Inundation Area Phase

Stand	Landing	Acres	Stems	Tons	Stand Removal Method	Biomass Removal Method
1	1	5.6	1,389	194	Hand Felling—Helicopter	Hand work Heli-bucket
2	1	19.7	14,125	1,419	Hand Felling—Helicopter	Hand work Heli-bucket
3	4	12.5	3,838	456	Feller/Buncher/Skidder	Mulcher
3A	4	19.2	5,894	701	Feller/Buncher/Skidder	Mulcher
4	4	5.9	738	126	Feller/Buncher/Skidder	Mulcher
5	4	14.2	3,649	708	Feller/Buncher/Skidder	Mulcher
6	1	19.4	7,488	795	Hand Felling—Helicopter	Hand work Heli-bucket
6A	1	6.3	2,432	258	Hand Felling—Helicopter	Hand work Heli-bucket
7	3	3.7	463	79	Hand Felling—Helicopter	Mulcher
8	3	9.2	2,824	336	Hand Felling—Helicopter	Mulcher
9	3	7.3	1,591	370	Feller/Buncher/Skidder	Mulcher
10	3	5.9	1,664	487	Hand Felling—Helicopter	Mulcher
10A	3	30.9	7,663	1,073	Hand Felling—Helicopter	Mulcher
11	2	13.9	3,920	1,147	Hand Felling—Helicopter	Mulcher
11A	2	6.6	1,861	544	Hand Felling—Helicopter	Hand work Heli-bucket
12	2	16.2	4,018	562	Hand Felling—Helicopter	Hand work Heli-bucket
13	2	33.6	24,091	2,420	Hand Felling—Helicopter	Hand work Heli-bucket
14	2	4.6	6,210	246	Feller/Buncher/Skidder	Mulcher
14A	2	9.3	12,555	498	Cable	Cable Cleanup
15	2	6.1	1,873	223	Feller/Buncher/Skidder	Mulcher
16	2	27.1	19,431	1,952	Hand Felling—Helicopter	Hand work Heli-bucket
16A	2	15.1	10,827	1,088	Hand Felling—Helicopter	Hand work Heli-bucket
17	1	11.7	3,299	965	Feller/Buncher/Skidder	Hand work Heli-bucket
17A	1	8.6	2,425	709	Hand Felling—Helicopter	Hand work Heli-bucket
18	1	14.8	4,544	540	Feller/Buncher/Skidder	Mulcher
19	1	4.4	616	248	Feller/Buncher/Skidder	Mulcher
20	1	7.6	2,333	277	Feller/Buncher/Skidder	Mulcher
20A	1	14.1	4,329	515	Feller/Buncher/Skidder	Mulcher
21	1	5.5	3,944	396	Feller/Buncher/Skidder	Mulcher

Stand	Landing	Acres	Stems	Tons	Stand Removal Method	Biomass Removal Method
22	1	14.7	4,513	537	Feller/Buncher/Skidder	Mulcher
23	1	1.2	1,620	64	Hand Felling—Helicopter	Hand work Heli-bucket
24	1	26.1	30,537	1,630	Cable	Cable Cleanup
24A	1	6.8	7,956	425	Feller/Buncher/Skidder	Mulcher
25	1	3.2	2,294	230	Hand Felling—Helicopter	Hand work Heli-bucket
26	1	4.1	1,017	142	Hand Felling—Helicopter	Hand work Heli-bucket
Surface Fuels				2,035		
Totals		415	207,970	24,398		

Appendix G:
2021 Stakeholder Coordination and Review

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Draft Tree Removal Plan
Agency Comment Matrix

Comment ID	Commenter Section Number	Commenter Page Number (or Figure Number)	Agency Comment	Denver Water Response	Denver Water Edits to Final Tree Removal Plan
USFS					
USFS-1	2.2.4.1	19	Primary haul road that will be used is not represented between FSR 359.1 and County Rd 97.1 (identified on map as FSR 359.1C. That road is too steep to haul in current location. This is noted in comment #18 on p.5 of Responses to Agency Comments Sept. 30, 2019, Appendix A. A more accurate map is presented in the powerpoint presentation slides on Feb. 10, 2021.	The interconnect road between County Road 97.1 (aka NFS 97.1) and NFS 359.1 will be designed to allow passage of logging trucks and other related tree removal equipment. Other improvements to these two roads may be needed as well. A more detailed design will be prepared by the contractor that will be compatible with the equipment intended for use during tree removal operations. The plan will be submitted for agency approval prior to the start of work.	Denver Water will clarify the figure and add text to the document.
USFS-2	2.3.1	23	Ensure what's addressed in the Tree Removal Plan matches what is in the Traffic Management Plan	Agree, the two plans should be consistent with the message and any discrepancies will be corrected.	Denver Water will match the Tree Removal Plan to statements made in the Traffic Management Plan.
USFS-3	2.3.3	24	The gate at Lazy Z and private land, will that remain locked during operations as it crosses private lands or will it remain locked until hauling/ops are commencing. Log haul trucks start early and if they're going to idle to unlock the gate, noise will be an issue too	In Denver Water's site safety plan access to restricted areas will be discussed. Haul trucks will be restricted from excess idling. The gate will be opened for access when crews arrive prior to the planned start of haul operations or keys will be provided to the drivers so disturbance of adjacent property owners is limited.	Denver Water will add clarifying text to the Tree Removal Plan.
USFS-4	App. F	215	See section 2.2.4.1 comment (same map used)	See reply to USFS-1	Figure will be clarified.
USFS-5		221	New Access Road mis-identified on map; CR 97 will need improvements	Denver Water will evaluate CR 97 and perform improvements as needed. Improvements on	Denver Water will add clarifying text. Edits to map?

Comment ID	Commenter Section Number	Commenter Page Number (or Figure Number)	Agency Comment	Denver Water Response	Denver Water Edits to Final Tree Removal Plan
			(widening) to safely get down the road w/ haul trucks and normal traffic	roads owned by USFS (FS Road 97.1) will be done in consultation with USFS.	
USFS-6			Throughout the Draft 2021 Tree Removal Plan, other plans which have not been developed or reviewed by the Forest Service are referenced. Before I approve the Final Tree Removal Plan, I would like an opportunity to review all plans referenced in the 2021 Tree Removal Plan.	Denver Water acknowledges this comment and acknowledges that the USFS' review and approval is required for all 4(e) Condition plans. *Appendix B: Permissions and Approvals Related to Tree Removal* of the Tree Removal Plan contains a list of the approvals needed prior to tree removal, including all other plans that are required by the USFS 4(e) Conditions. The 4(e) Conditions state that the completion dates for the plans are staggered, with some 4(e) Condition plans required to be completed within 1-year of the FERC Order and some plans required within 2-years or 90 days prior to ground disturbance. Denver Water is in the process of developing the 4(e) Condition plans. Denver Water provided a schedule to the USFS depicting the timeline for submittal of plans to the USFS during the Annual Consultation Meeting for Condition 13 held with the USFS on April 8, 2021. As shown in the schedule and explained during the Annual Consultation Meeting, some but not all 4(e) Condition plans will be available for USFS review prior to the deadline of the Tree Removal Plan submission to FERC, which is due July 16, 2021. Denver Water will make every effort to follow this schedule and provide USFS the other 4(e) Condition plans when they are available. List of 4(e) plans related to tree removal currently in preparation: • Invasive Species Management Plan	None

Comment ID	Commenter Section Number	Commenter Page Number (or Figure Number)	Agency Comment	Denver Water Response	Denver Water Edits to Final Tree Removal Plan
				(Condition 17), Delivered to USFS April 15, 2021 • Traffic Management Plan (Article 425), Delivered to USFS May 3, 2021 • Addendum to Visual Resource Protection Plan (Condition 23), in progress (est. October 2021) • Road Management Plan (Condition 28), to be developed	
Boulder County Engineering Development (March 29, 2021) from Amelia Willits					
BC-A-1			The applicant stated intentions to improve County Road 97 for tree removal purposes. Road improvement plans must be made available for staff review and approval prior to the Boulder County Commissioner's meeting.	Denver Water acknowledges that improvements to Boulder County roads will be submitted to Boulder County for review and approval as applicable.	None
BC-A-2			The applicant stated intentions to possibly haul felled trees to a sawmill in Longmont. This option needs to be reflected in haul plans/maps and incorporated into traffic plans.	As stated in the Draft 2021 Tree Removal Plan, at this time Denver Water cannot accurately predict the future market conditions of the timber industry. Denver Water anticipates having this information in 2024 one year prior to start of tree removal activities in the inundation area. Merchantable material will be taken to processing areas and other material will be taken to the nearest landfill.	None
BC-A-3			A new Road Management Plan, with the US Forest Service, is planned. As Boulder County has a shared maintenance agreement with the USFS for certain roads in the area, Boulder County must be included in the new Road Management Plan.	Denver Water will share the final agreement with Boulder County upon request. The agreement between Denver Water and the USFS will include roads owned by the USFS but used to access features of Gross Dam and Reservoir.	None

Comment ID	Commenter Section Number	Commenter Page Number (or Figure Number)	Agency Comment	Denver Water Response	Denver Water Edits to Final Tree Removal Plan
BC-A-4			The applicant must provide a copy of the completed CDPHE Stormwater Management Plan prior to permitting for staff review.	Denver Water will provide a copy of the completed CDPHE Stormwater Management Plan to Boulder County.	None
BC-A-5			To the extent possible, Boulder County would like to see minimal truck traffic to the east.	Denver Water will attempt to minimize truck traffic by using larger trucks and full loads. However, the amount of traffic on each route will depend upon the destination for tree removal material.	None
Boulder County Community Planning and Permitting (April 6, 2021) From Summer Frederick					
BC-B-1			Further, Denver Water submitted a draft Tree Removal Plan, but it did not include any specifics or commitments related to key issues in the 1041 analysis, such as the final destination of felled trees, specific road improvements, and proposed mitigation measures for noise generated by tree removal. Without this information, staff does not know the final haul routes associated with the removal of the felled trees, and, as a result, it cannot assess the potential impacts of the additional heavy truck traffic on county roads. Staff also cannot assess the impact of such a large amount of biomass to various potential final destinations, i.e., sort yards, landfills, or lumbermills.	As stated in the Draft 2021 Tree Removal Plan, at this time Denver Water cannot accurately predict the future market conditions of the timber industry. Denver Water anticipates having this information in 2024 one year prior to start of tree removal activities in the inundation area. Merchantable material will be taken to processing areas and other material will be taken to the nearest landfill. The draft Traffic Management Plan, delivered on May 3, 2021 has estimates on the number of trucks leaving the Gross Reservoir area for tree removal activities. The most recent evaluations have two to three trucks per hour on the road from both the east and west side of the reservoir.	None
Boulder County County Engineer – Mike Thomas –					
BC-C-1			The current draft (March 15, 2021) of the Tree Removal Plan (TRP) states that DWB is waiting for comments from Boulder County and other agencies before proceeding to next level of	The reference provided to 1.3.2.3 should be 1.4.2.3 Preliminary Agency Coordination and Review. This reference will be updated in the final Tree Removal Plan.	Denver Water updated reference to 1.3.2.3 to 1.4.2.3 on Page 5.

Comment ID	Commenter Section Number	Commenter Page Number (or Figure Number)	Agency Comment	Denver Water Response	Denver Water Edits to Final Tree Removal Plan
			completion. This appears to simply acknowledge the requests and observations of the different agencies and that they will be handled at a future time. For example, p. 5 of the plan states, "In addition, FERC Order Article 423 requires that the Tree Removal Plan be prepared after consultation with the USFS, CSFS, Boulder County, Jefferson County, and Gilpin County as discussed in section 1.3.2.3. and summarized in Appendix B." There appears to be more meetings and discussion required in order to finalize the plan.	Based on the extensive outreach performed, detailed in Appendix B, Denver Water does not agree that additional meetings and discussions are required to finalize the plan.	
BC-C-2			On p. 18 of the TRP, there is a statement that a Traffic Management Plan will be prepared by May 2021. This plan is integral to the tree removal on this project and should be completed much sooner in order to provide sufficient time to review and comment.	Denver Water completed the draft Traffic Management Plan and submitted to the agencies on May 3, 2021.	None
BC-C-3			The specific reference to using Gross Dam Road and Crescent Park Drive for tree hauling until the approval and reconfiguration of the intersection of Gross Dam Road and SH 72 requires concurrence from Jefferson County.	Denver Water will confer with CDOT and Jefferson County as needed regarding the use of Crescent Park Drive.	None
BC-C-4			Also, on p. 18 of the TRP, the following statement is made: "The level of use on specific haul routes will depend on the final destinations for biomass materials. Denver Water will minimize impacts to the local community to the	Denver Water will confer with the City of Boulder and Boulder County on the routes used for tree removal activities once the final destination has been determined.	None

Comment ID	Commenter Section Number	Commenter Page Number (or Figure Number)	Agency Comment	Denver Water Response	Denver Water Edits to Final Tree Removal Plan
			extent practicable and will continue coordinating with CDOT, Boulder County, and other local jurisdictions." This does not address the main concerns by Boulder County, pushing to a future date the resolution of such issues as travel through the city of Boulder, potential roadway improvements, and impacts to the greater transportation system.		
BC-C-5			Therefore, to respond to the current draft of the TRP would do nothing but reiterate the needs and concerns of Boulder County. Boulder County will comment to Denver Water on the TRP as submitted on March 15, 2021 but will reserve future comments until after the final TRP is submitted. To restate, the TRP is a required part of the Gross Reservoir Expansion 1041 application and any information that is missing from the TRP will make it harder for the county to be able to conditionally approve the application.	Denver Water will confer with Boulder County on routes used to transport tree removal material once the final destination is determined.	None
Boulder County Long Range Planning (March 25, 2021) from Hannah Hippely					
BC-D-1			Haul route options are discussed on page 20 but no clear commitment or decision is presented.	The final destination will be determined at a later date based on market conditions for tree removal material. See response to comment BC-A-2.	None
BC-D-2			Additionally, the impacts to these rural roads is unknown at this time as the study of these impacts has not been provided.	The draft Traffic Management Plan, delivered on May 3, 2021, has information regarding additional traffic on existing roads.	None

Comment ID	Commenter Section Number	Commenter Page Number (or Figure Number)	Agency Comment	Denver Water Response	Denver Water Edits to Final Tree Removal Plan
BC-D-3			Disposal methods are presented as a menu of options including potential on site cordwood operation, chipping, air burners, etc. but, no commitments regarding disposal are made making impact analysis difficult.	The final destination will be determined at a later date based on market conditions for tree removal material. See response to comment BC-A-2.	None
BC-D-4			Tree removal is anticipated to occur primarily using helicopters and other machinery, the only mitigation for the nuisances created by this activity is that "tree removal activities will cease during non-daylight hours", logging trucks will have mufflers and follow speed limits, and obnoxious odors will be minimized. Without a more detailed plan the impacts of these activities on neighborhood character, community wellbeing, and safety cannot be evaluated.	Denver Water will consider any mitigation and minimization proposed by Boulder County. Based on feedback to date, driving hours, operating hours, mufflers, and speed limits were incorporated into the draft 2021 Tree Removal Plan.	None
Boulder County Parks & Open Space					
BC-E-1			In the Debris Processing and Removal Section on Page 17 the Local Log Yard (referring to our Community Forestry Sort Yard—CFSY) is described (see text below). This statement is not representative of what the yards can handle. The CFSY is not available for this project, it is intended for private, small forestry projects. "Local Log Yard Nederland Community Forestry Sort Yard (CFSY), operated by Boulder County, provides another utilization and disposal option for a portion of the woody material.	Denver Waters contractor will work directly with the Nederland Community Forestry Sort Yard regarding the capacity of the yard. It is not the intention of Denver Water to take all the material from the west side of the reservoir to this facility.	Denver Water added clarifying text to the TRP.

Comment ID	Commenter Section Number	Commenter Page Number (or Figure Number)	Agency Comment	Denver Water Response	Denver Water Edits to Final Tree Removal Plan
			Operationally, the Nederland CFSY could receive both logs and chips. Its tipping fee is approximately $4.00 per cubic yard. The tree removal would produce approximately 24,000 cubic yards. The Nederland CFSY provides the closest offsite disposal location. Disposing saw logs at the sort yard would provide opportunities for local firewood cutters and reduce the trip distance for trucks." The CFSY program is not designed to handle and work with projects of this scale. 24,000 cubic yards can be as much as 5000 tons, and our two yards combined typically process no more than 1600 tons a year. The CFSY is actually a free program that accepts woody biomass from forest health and fire mitigation projects on private lands (and occasional small-scale public projects). The material is sorted to its highest value for utilization purposes. A majority of the material is run through a grinder and sent to facilities for composting purposes. The $4.00 per cubic yard value is an estimate of the costs the County has to pay for tipping fees to these compost facilities, not a charge, and does not include our cost to grind and transport this material. The selected tree removal contractor should work directly with outlets, whether that be composting facilities or firewood contractors/cutters.		

Comment ID	Commenter Section Number	Commenter Page Number (or Figure Number)	Agency Comment	Denver Water Response	Denver Water Edits to Final Tree Removal Plan
BC-E-2			Staff recommends the applicant complete as much product utilization as possible, instead of using Air Curtain Destructors.	Denver Water will use as much product as possible, but much of the material will be slash which has little if any market value.	None
Gilpin County					
GC-1			Based on the current plan and the discussion, the Board strongly opposes the plan as proposed through Gilpin County. Impacts on Gilpin County including the cities of Black Hawk and Central City have not been adequately addressed.	Denver Water is willing to avoid night driving and times when school busses and commuters are using SH 119. The use of the Central City Parkway has also been removed from the plan.	Denver Water added text to clarify time frames to be avoided and remove the use of the Central City Parkway.
GC-2			The Board respectfully requests that the Boulder County Board of County Commissioners and Denver Water abandon plans for Tree Removal routes using Highway 119 through Gilpin County to connect to Interstate I-70.	As stated in the draft 2021 Tree Removal Plan, use of SH 119 and I-70 will depend upon market conditions at the time of tree removal activities. See response to comment BC-A-2.	None
GC-3			State Highway 119 is the one and only north-south thoroughfare through Gilpin County. It is one lane of travel in each direction with no pull-out passing lanes. The added traffic of fully loaded logging or chip box trucks will impede the flow of other vehicles on this route for residents commuting to work or to services below. Should there be an accident involving or resulting from a Project truck, it would likely mean lane or highway closures.	Denver Water anticipates two to three trucks per hour for an eight-hour day during tree removal activates. Additionally, Denver Water will avoid school bus and commuter traffic hours. The transportation of tree removal biomass from the west side of the reservoir is included in the Traffic Impact Study (TIS) boundary. Traffic on SH 119 is being evaluated as part of the TIS. Contractors and their respective hauling subcontractors will be pre-qualified to ensure property maintained equipment and qualified drivers are employed for use in the tree removal operations.	Denver Water added text to clarify what hours will be avoided.
GC-4			Impact on residents living along the proposed route. Many homes are situated less than 70 feet from the highway. The additional noise,	Denver Water agrees that the additional traffic will be observed by people living in close proximity to the highway.	None

Comment ID	Commenter Section Number	Commenter Page Number (or Figure Number)	Agency Comment	Denver Water Response	Denver Water Edits to Final Tree Removal Plan
			pollution, and visual traffic from logging trucks passing by throughout the day from months to years will impact residents' lives and the peaceful enjoyment residents are accustomed to in a rural mountain community.		
GC-5			Impact on business revenue and our county economy. Gilpin County and the cities of Black Hawk and Central are dependent on tourism and casino patrons visiting their businesses contributing to a healthy economy. The cities are in a designated State Historic District. SH 119 serves as a major route for the millions of visitors for the recreation opportunities in Gilpin County, including the casinos, which generate significant revenue for the County and the State. Logging trucks passing through these communities will have a large impact on access for tourists. It is anticipated that significantly fewer tourists will visit these communities once aware of the logging trucks during business hours when one-lane roads are the only paths to, and through, these locations.	Denver Water is willing to schedule trucks associated with tree removal activities around times of high traffic use. For safety reasons, night trucking will not be used, but hours of avoidance consistent with cement and fly ash deliveries will be implemented (school bus).	Denver Water added text to clarify the hours to be avoided to minimize disruption to high commute times, including to school bus traffic.
GC-6			State Highway 119 is Colorado's oldest American Scenic Byway attracting recreational tourists to Gilpin County. Recreationalists depend on access to creeks to fish, to state forest roads and trails, to historic sites, and across Gilpin County to reach local businesses situated along and off the highway. Logging trucks moving along the Scenic	Denver Water will attempt to avoid times of higher recreational usage (weekends) for tree removal trucking activities. See 2.3.1 of the TRP for the following language “To the greatest extent possible, Denver Water will schedule closures to coincide with periods of low recreation use.”	None

Comment ID	Commenter Section Number	Commenter Page Number (or Figure Number)	Agency Comment	Denver Water Response	Denver Water Edits to Final Tree Removal Plan
			Byway will detract from visitors' enjoyment of a rural mountain experience. It will also put wildlife randomly crossing Highway 119 at greater risk of lethal accidents. Gilpin County is home to moose, elk, deer, bears, bobcats, mountain lions, coyotes, nesting raptors, and smaller animals who all would be affected by the logging trucks. There are many motorcyclists who enjoy riding along the Peak to Peak Scenic Byway who would be at greater risk trying to pass the trucks as there are only a few passing lanes on Highway 119. During peak aspen viewing months the tourist traffic spikes with drivers parking and pedestrians walking along the highway right of ways.		
GC-7			Incongruence between the size of logging trucks with the single lane roads in the cities. The narrow, winding roads with sharp turns and multiple stops in historic Black Hawk and Central City to access the Central City Parkway are not suited to large logging trucks. Pedestrians will be at risk as businesses with on-street parking narrow the roads even further. Passenger loading zones and parking entrances are located along these small-town roads.	Denver Water will be staying on highways and will avoid city streets in Blackhawk and Central City.	None
GC-8			Central City Parkway access from the city and mileage is owned by the City of Central which informed Denver Water and the County in the April 6 meeting	Denver Water will not use the Central City Parkway to access I-70. Instead, US 6 will be used.	The tree removal route will no longer depict use

Comment ID	Commenter Section Number	Commenter Page Number (or Figure Number)	Agency Comment	Denver Water Response	Denver Water Edits to Final Tree Removal Plan
			that Central City would need to grant the Project special use permission for truckers to use it as a route to Interstate 70. This application would need to be made to Central City and approved by the City Council. The next portion of the Parkway is under ownership of Clear Creek County. The Parkway is not a state or county road thus has its own rules of use.		of the Central City Parkway.
GC-9			Potential for accidents and increased demands on our local first responders. As a rural mountain county, the two small cities and the county have basic responder services, no urgent care center, and are an hour's distance from a medical facility. With the increase in potential accidents caused by multiple logging trucks a day, the burden on Gilpin County's ambulance, fire and first responders would be taxed. The risk also exists for injuries to the driver and passengers in the logging truck along lengthy routes which the Project proposes.	Denver Water will contract with companies that utilize properly trained drivers and drivers will be required to obey all traffic and safety laws. All trucks will meet DOT requirements.	None
GC-10			We are also concerned about impacts to other roads serving Gilpin County. Coal Creek Canyon (CO 72) is the state highway that serves our residents in northern Gilpin County. Truck traffic will impact traffic flow for commuting residents and tourists, plus pose the aforementioned safety risks to people and wildlife.	A detailed description of how Denver Water will utilize SH 72 is provided in the draft Traffic Management Plan, delivered May 3, 2021.	None

Comment ID	Commenter Section Number	Commenter Page Number (or Figure Number)	Agency Comment	Denver Water Response	Denver Water Edits to Final Tree Removal Plan
GC-11			More direct, safer, less polluting, wider, and more eco-friendly routes are available for transporting tree materials from the Project. We suggest using Landing zone 3 more and barge possibility across the reservoir so traffic would not need to enter Gilpin.	Denver Water is trying to balance impacts to roads and residents associated with tree removal activities and feels removing material from the east and west side of the reservoir is the best way to minimize disruptions to all residents in the area.	None
GC-12			An alternative identified is use of the Union Pacific's Moffat Tunnel Subdivision rail line which travels west from Denver and comes very near Gross Reservoir where it crosses and is accessible from Gross Dam Road. This rail line travels close to SH 72 and SH 93 and crosses those highways at various locations providing access points for loading biomass or equipment for transport south or north on SH 93, or to1-70. As currently proposed, biomass destined for the Longmont area will travel an additional 90 miles, approximately 30 miles of which is through Gilpin County, to avoid a direct route to the north through Boulder, plus using SH 93 to 1-70 is more direct.	As discussed with Gilpin County during the April 6, 2021 meeting, the use of rail has been evaluated and is not a viable option. Listed below are several reasons why. 1. Logistics – Union Pacific cannot guarantee delivery or pickup of material. This is particularly troublesome for activities associated with concrete production and placement. 2. Cost – Trains are designed for long haul transportation. This would require a short train (approximately 15 cars) due to the size of the siding. An engine would have to stay on site for safety purposes (steep grade). Additionally, the material would have to be handled several times to reach a final destination. 3. Gross Dam Road Crossing would be blocked when cars were loaded or unloaded causing roadway disruptions to the public. 4. The land to the north of the tracks would have to be used as a staging area and is currently a State Park.	None

Comment ID	Commenter Section Number	Commenter Page Number (or Figure Number)	Agency Comment	Denver Water Response	Denver Water Edits to Final Tree Removal Plan
GC-13			We understand this proposed Project will impact several communities. We respectfully request that our opposition to the proposed Tree Removal Plan be noted and the proposed route through Gilpin County be abandoned for the reasons outlined above. With alternate routes to the north and east of Gilpin County already identified in the Project we ask that those routes be implemented instead.	Denver Water notes the opposition by Gilpin County. Based on comments from Gilpin County, the proposed route to I-70 was modified to minimize disruption. Additionally, the Traffic Management Plan describes the anticipated truck traffic as two to three trucks per hour for 8-hour days.	None
Boulder County Public Works 3-29-2021					
BC-F-1			The current draft (March 15, 2021) of the Tree Removal Plan (TRP) states that DWB is waiting for comments from Boulder County and other agencies before proceeding to next level of completion. This appears to simply acknowledge the requests and observations of the different agencies and that they will be handled at a future time. For example, p. 5 of the plan states, "In addition, FERC Order Article 423 requires that the Tree Removal Plan be prepared after consultation with the USFS, CSFS, Boulder County, Jefferson County, and Gilpin County as discussed in section 1.3.2.3. and summarized in Appendix B." There appears to be more meetings and discussion required in order to finalize the plan.	No additional meetings are planned with agencies related to the Tree Removal Plan. Denver Water updated the Tree Removal Plan in 2019 and met with several agencies including Boulder County. Two meetings were held, and two drafts were provided for agency review and comment. From the second draft (September 2019), Denver Water prepared the current draft (March 2021) as described in the Tree Removal Plan.	None
BC-F-2			On p. 18 of the TRP, there is a statement that a Traffic Management Plan will be prepared by May 2021.	The Traffic Management Plan was provided for agency review in May 2021 and contains	None

Comment ID	Commenter Section Number	Commenter Page Number (or Figure Number)	Agency Comment	Denver Water Response	Denver Water Edits to Final Tree Removal Plan
			This plan is integral to the tree removal on this project and should be completed much sooner in order to provide sufficient time to review and comment. The specific reference to using Gross Dam Road and Crescent Park Drive for tree hauling until the approval and reconfiguration of the intersection of Gross Dam Road and SH 72 requires concurrence from Jefferson County.	additional information related to traffic associated with tree removal activities. Denver Water will work with other jurisdictions as applicable for areas outside of Boulder County.	
BC-F-3			Also, on p. 18 of the TRP, the following statement is made: "The level of use on specific haul routes will depend on the final destinations for biomass materials. Denver Water will minimize impacts to the local community to the extent practicable and will continue coordinating with CDOT, Boulder County, and other local jurisdictions." This does not address the main concerns by Boulder County, pushing to a future date the resolution of such issues as travel through the city of Boulder, potential roadway improvements, and impacts to the greater transportation system.	As stated in the Draft Tree Removal Plan, at this time Denver Water cannot accurately predict the future market conditions of the timber industry. Denver Water anticipates having this information in 2024 one year prior to start of tree removal activities in the inundation area. Merchantable material will be taken to processing areas and other material will be taken to the nearest landfill. The draft Traffic Management Plan, delivered May 3, 2021, has estimates on the number of trucks leaving the Gross Reservoir area for tree removal activities. The most recent evaluations have two to three trucks per hour on the road from both the east and west side of the reservoir.	None
BC-F-4			Therefore, to respond to the current draft of the TRP would do nothing but reiterate the needs and concerns of Boulder County. Boulder County will comment to Denver Water on the TRP as submitted on March 15, 2021 but will reserve future comments until	Denver Water will not prepare another version of the Tree Removal Plan for agency review. The next version will be submitted directly to FERC for approval on or before July 16, 2021.	None

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			after the final TRP is submitted. To restate, the TRP is a required part of the Gross Reservoir Expansion 1041 application and any information that is missing from the TRP will make it harder for the county to be able to conditionally approve the application.		
BC-F-5			Evaluation of Magnolia and Lazy Z Road after the tree removal plan is submitted is acceptable. However, if the plan shows that improvements must be included on those roads, Boulder County will need to approve the plans, specifications, and implementation of the road improvements, prior to any use of those roads for tree removal.	Denver Water acknowledges that improvements to Boulder County roads will be submitted to Boulder County for review and approval as applicable.	None
BC-F-6			Statement of future incorporation of County comments into the plans is insufficient. Boulder County will need to inspect and approve the work prior to use of the roads for tree removal.	Denver Water acknowledges that improvements to Boulder County roads will be submitted to Boulder County for review and approval as applicable.	None
Boulder County Public Works Department (Comment Matrix)					
BC-G-1			Until final routing is determined, Boulder County cannot approve the plan	Denver Water will submit the plan to FERC for final approval on July 16, 2021.	None
BC-G-2			Traffic Management Plan is due in May, 2021. Further comment will be forthcoming at that time	The draft Traffic Management Plan was submitted to agencies on May 3, 2021 for review.	None
BC-G-3			To approve the TRP any time soon may conflict with possible needs in the future with a new Traffic Management Plan that a future contractor will have to modify, requiring additional review	The timing for development of the Tree Removal Plan is set by FERC's order amending Denver Water's hydropower license. FERC's order requires Denver Water to submit the Tree Removal Plan to FERC for final approval by July 16, 2021.	None

Comment ID	Commenter Section Number	Commenter Page Number (or Figure Number)	Agency Comment	Denver Water Response	Denver Water Edits to Final Tree Removal Plan
			and approval of the overall TRP by Boulder County		
BC-G-4			Designation of DWB as the access permit agent/permittee for realignment of the Gross Dam Road / State Highway 72 intersection may not happen until the 1041 is approved by Boulder County	Denver Water has requested that Boulder County authorize Denver Water to move forward with the access permit application in parallel to the 1041 process so that Denver Water can meet the construction deadlines in FERC's order. If Boulder County delays the access permit application until after the 1041 permit process is complete, it would delay improvements to the intersection of Gross Dam Road and State Highway 72 necessary for construction access and thereby jeopardize Denver Water's ability to comply with the construction deadlines in FERC's order.	None
BC-G-5			It is still expected that DWB explain how avoidance of the city of Boulder will take place if Longmont is the destination	If a business is identified for the disposition of biomass from the tree removal operation that requires transport through the City of Boulder then a route shall be coordinated with the City of Boulder and Boulder County prior to the start of the haul.	None
BC-G-6			Final road improvement drawings for roads under Boulder County jurisdiction need to be provided similar to drawings for Forest Service roads	Denver Water will provide Boulder County with road improvement drawings prior to construction activities.	None
BC-G-7			Road restoration is planned to take place during a 5-month period. There will be liquidated damages imposed if restoration work takes longer than expected	Denver Water will coordinate road restoration activities with Boulder County and will implement repairs in a timely fashion dependent upon weather, season, and other factors as applicable.	None
BC-G-8	2.3.1		8-hour days are stated as the haul duration	Correct, Denver Water does not plan to remove materials from Gross Reservoir for more than 8-hours per day.	None
BC-G-9		22	Plan indicates DWB will maintain GDR during the duration of the project	Correct, Denver Water plans to maintain the entirety of Gross Dam Road (SH 72 to Flagstaff	None

Comment ID	Commenter Section Number	Commenter Page Number (or Figure Number)	Agency Comment	Denver Water Response	Denver Water Edits to Final Tree Removal Plan
				Road) for the duration of the project upon approval from Boulder County.	
Jefferson County					
JC-1			Section 2.2.4. of the March 15th, 2021 draft entitled 2021 Tree Removal Plan states "A draft Traffic Management Plan will be available in May 2021 for agency stakeholder review." Jefferson County will withhold final comments concerning truck routes and their impacts on the community until this traffic management plan is made available for review.	The draft Traffic Management Plan was submitted for agency review on May 3, 2021.	None
NOT REQUIRED AGENCY CONSULTATIONS					
Clear Creek County					
CC-1			Current plans reviewed and discussed with the Gilpin County Board of County Commissioners on April 6 outlined significantly greater truck traffic and related traffic hazards proposed for Colorado Highway 119, the Central City Parkway and Interstate 70 which will occur as a result of the tree removal project.	Denver Water disagrees that significantly greater traffic and hazards will be created by tree removal activities. Current plans estimate an additional 2 to 3 trucks per hour for an eight hour day using SH 119. This equates to a max of 24 trucks a day. After discussions with Gilpin County, the Central City Parkway will not be used for tree removal activities. Instead, I-70 will be access from SH 119 using US 6.	The tree removal route will no longer depict use of the Central City Parkway.
CC-2			Also, the plan' s proposed schedule coincides with CDOT's planned improvement programs on 1- 70, including a major road widening project in the Floyd Hill area which will create traffic - constricting construction zones between Idaho Spring and Floyd Hill.	Denver Water anticipates tree removal activities between 2025 and 2026 and assumes CDOT construction planners will be able to accommodate the truck traffic on an Interstate Highway in a construction zone.	None

Comment ID	Commenter Section Number	Commenter Page Number (or Figure Number)	Agency Comment	Denver Water Response	Denver Water Edits to Final Tree Removal Plan
CC-3			For these reasons, the Clear Creek Board of County Commissioners respectfully requests that as the plan becomes more detailed, we ask that traffic on potential haul routes associated with future construction projects on 1-70 be minimized or the route be eliminated altogether to avoid creating conflicts and congestion.	The use of I-70 will depend on market conditions.	None

Copy of Agency Comments provided to Denver Water

Denver Water provided a template to agencies to aid in the review of agency comments. Some agencies provided comments using the template and some agencies provided Denver Water with comments in either email or letter form. Below are copies of all letters received by required agencies.

One letter was provided directly to Denver Water that was not a FERC review agency. That letter is provided at the end of this document as well.

Tree Removal Plan
Agency Comment Matrix

Please provide your agency's comments in the template provided below. Example entries provided for reference.

Agency/Department: USDA Forest Service/Arapaho-Roosevelt NFs and Pawnee NG/Boulder Ranger District

Date of comments: _________________________

Section Number	Page Number (or Figure Number)	Comment
2.2.4.1	19	Primary haul road that will be used is not represented between FSR 359.1 and County Rd 97.1 (identified on map as FSR 359.1C. That road is too steep to haul in current location. This is noted in comment #18 on p.5 of Responses to Agency Comments Sept. 30, 2019, Appendix A. A more accurate map is presented in the powerpoint presentation slides on Feb. 10, 2021.
2.3.1	23	Ensure what's addressed in the Tree Removal Plan matches what is in the Traffic Management Plan
2.3.3	24	The gate at Lazy Z and private land, will that remain locked during operations as it crosses private lands or will it remain locked until hauling/ops are commencing. Log haul trucks start early and if they're going to idle to unlock the gate, noise will be an issue too
App. F	215	See section 2.2.4.1 comment (same map used)
	221	New Access Road mis-identified on map; CR 97 will need improvements (widening) to safely get down the road w/ haul trucks and normal traffic

March 29, 2021

TO: Summer Frederick, Planning Division Manager; Community Planning & Permitting, Development Review Team - Zoning

FROM: Amelia Willits, Engineering Development Review Planner II; Community Planning & Permitting, Development Review Team – Access & Engineering

SUBJECT: Docket # SI-20-0003: Gross Reservoir & Dam Expansion - Denver Water Board Response to Boulder County November 13, 2020 Referral Comments

3817 Gross Dam Road, at parcel number 1579258000006

The Development Review – Access & Engineering Team has reviewed the February 19, 2021 Denver Water Board (DWB) responses to our comments dated November 13, 2020 and the following comments. Please note, these referral comments are in addition to those provided by Mike Thomas, P.E., County Engineer, under separate cover.

Legal Access

DWB Comment B-2: Portions of private property exist adjacent to Gross Dam Road, along sections that the applicant has identified for road improvements. Denver Water must demonstrate ability to utilize these properties prior to permitting.

Traffic Impacts

DWB Comment B-3: The applicant notes that an updated Traffic Impact Study will be available May 2021. Staff is unable to evaluate the impact of the proposed work to the transportation system and the neighboring communities with the partial data currently provided. The final Traffic Impact Study is required for staff review prior to approval of the 1041 application, which includes the chosen methods of hauling and access, not simply potential options.

DWB Comment B-4: After reviewing the Tree Removal Plan, staff noted the following:

1. The applicant stated intentions to improve County Road 97 for tree removal purposes. Road improvement plans must be made available for staff review and approval prior to the Boulder County Commissioner's meeting.
2. The applicant stated intentions to possibly haul felled trees to a sawmill in Longmont. This option needs to be reflected in haul plans/maps and incorporated into traffic plans.
3. A new Road Management Plan, with the US Forest Service, is planned. As Boulder County has a shared maintenance agreement with the USFS for certain roads in the area, Boulder County must be included in the new Road Management Plan.

4. The applicant must provide a copy of the completed CDPHE Stormwater Management Plan prior to permitting for staff review.
5. To the extent possible, Boulder County would like to see minimal truck traffic to the east.

DWB Comment B-6: Staff requested an amendment to the passenger car equivalency factor, from 3.0 to 2.5. In their comments, DWB has chosen to keep the 3.0 passenger car equivalency factor, which staff acknowledges. The applicant must provide a justification of this number in the updated Traffic Impact Study document.

Plans

DWB Comment B-14 & B-20: Boulder County prefers that all roads for the project be built to the Multimodal Transportation Standards (the Standards). However, staff acknowledges that some of the internal access roads will not be accessible to the public, and as such, will not provide approval of those roads.

Recreational and Public Parking

DWB Comment B-23: The applicant noted that the Recreation Management Plan will be made available to staff by April 15, 2021. Traffic associated with recreation contributes significantly to the numbers during certain seasons. Staff is unable to evaluate the impact of the proposed work to the transportation system, the recreating public, and the neighboring communities without reviewing the Recreation Management Plan.

All other responses satisfy the requirements of the comments as stated. It is our expectation that all comments sent to DWB on December 23, 2020 will stand in full force as part of the conditions of approval if the Board of County Commissioners approves this application.

Community Planning & Permitting
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April 6, 2021

To: Denver Water
From: Summer Frederick, AICP – Planning Division Manager
Re: Docket SI-20-0003: Gross Reservoir & Dam Expansion

Per Article 8-508.C.12 of the Boulder County Land Use Code, the Community Planning & Permitting (formerly Land Use) staff is charged with reviewing application materials required in Article 8-507 for compliance with the Comprehensive Plan, purpose and intent of Article 8, criteria found in Article 8-511, sound planning, and comments from referral agencies and individuals. Community Planning & Permitting (CP&P) staff recognizes that the revised and additional materials submitted in February of 2021 provide responses to specific, individual comments made by CP&P staff. However, staff finds that the submitted response do not adequately address the referral comments, nor provide adequate information as was requested.

As a response to a number of staff's comments, Denver Water refers to information found within application materials submitted for the FERC permitting process and reviewed by various federal agencies. For example, staff commented that data used to establish the need for the proposed project in the Integrated Water Plan is out-of-date and requested recent data. Rather than providing any additional data, Denver Water states, "[b]ecause Denver Water cannot implement an alternative not selected by the Corps and FERC, there is no reason or opportunity to revisit the GRE Project's purpose and need or alternatives to the GRE Project at this stage of the process." Boulder County's Activity and Areas of State Interest (1041) application process is separate from the federal permitting processes Denver Water previously participated in. Therefore, to perform a complete and thorough analysis of the application for compliance with the1041 criteria, information that is additional or different from the information submitted to federal agencies is required. The information submitted for Denver Water's FERC permit provides does not provide the information needed for staff to accurately analyze Denver Water's proposal in the context of the requirements, standards, and intentions found in Article 8 of the Boulder County Land Use Code.

Additionally, Denver Water's response materials indicate that several Plans and Studies required by the FERC permitting process will be provided to Boulder County for review on a timeline that is associated with the FERC permitting requirements. Response materials state that, "Denver Water expects that its preparation of plans will run concurrent with and will not delay, the 1041 process. Pausing the 1041 process until the completed plans are provided to FERC in July 2021 would jeopardize Denver Water's ability to comply with the construction deadlines in the FERC Order." The County's 1041 criteria do not contain provisions that allow an applicant to withhold information based upon the applicant's preferred timeline for providing such information.

Denver Water's representations indicate the Plans and Studies will include information that is directly relevant to the review criteria and will likely influence staff's analysis Denver Water's proposal. For example,

- The Response states thatn updated Traffic Impact Study and a Traffic Management Plan will be available in the coming months. Without these documents, staff cannot adequately assess the potential effects of associated traffic on County roads, how existing transportation patterns may be interrupted, or possible climate change impacts that may result in the form of emissions from additional traffic.
- The Response states that Recreation Management Plan will be available at a later date. Without this Plan, staff does not have a clear understanding of how existing recreation opportunities may be lost or interrupted.
- Denver Water intends to amend/update the current Visual Resource Protection Plan. Without this amendment, staff cannot know the anticipated final visual impacts of the proposed development, nor can staff determine if proposed mitigation measures adequately address issues such as potential impacts to viewsheds, changes in appearance of forest canopies, or change unique landforms.

Further, Denver Water submitted a draft Tree Removal Plan, but it did not include any specifics or commitments related to key issues in the 1041 analysis, such as the final destination of felled trees, specific road improvements, and proposed mitigation measures for noise generated by tree removal. Without this information, staff does not know the final haul routes associated with the removal of the felled trees, and, as a result, it cannot assess the potential impacts of the additional heavy truck traffic on county roads. Staff also cannot assess the impact of such a large amount of biomass to various potential final destinations, i.e., sort yards, landfills, or lumbermills.

For the reasons stated above, staff finds that the current application submittal does not adequately address the identified issues or provide enough information to constitute a complete application. Therefore, staff requests that Denver Water provide complete responses to the second referral and the previously requested additional and up-to-date information.

Thank you and let me know if you have any questions.

Boulder County

Public Works

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March 29, 2021

To: Summer Frederick, Planning Division Manager
Community Planning and Permitting Department

From: Mike Thomas, P.E., County Engineer

Subject: Docket SI-20-0003, Gross Reservoir & Dam Expansion;
Denver Water Board Responses to Boulder County December 23, 2020 Referral Comments

I have reviewed the February 19, 2021 Denver Water Board (DWB) Responses to my comments dated December 23, 2020 and Denver Water's Draft Tree Removal Plan dated March 15, 2021, and have the following reactions to specific DWB Referral Responses below:

DWB Referral Response F-4: The current draft (March 15, 2021) of the Tree Removal Plan (TRP) states that DWB is waiting for comments from Boulder County and other agencies before proceeding to next level of completion. This appears to simply acknowledge the requests and observations of the different agencies and that they will be handled at a future time. For example, p. 5 of the plan states, "In addition, FERC Order Article 423 requires that the Tree Removal Plan be prepared after consultation with the USFS, CSFS, Boulder County, Jefferson County, and Gilpin County as discussed in section 1.3.2.3. and summarized in Appendix B." There appears to be more meetings and discussion required in order to finalize the plan.

On p. 18 of the TRP, there is a statement that a Traffic Management Plan will be prepared by May 2021. This plan is integral to the tree removal on this project and should be completed much sooner in order to provide sufficient time to review and comment. The specific reference to using Gross Dam Road and Crescent Park Drive for tree hauling until the approval and reconfiguration of the intersection of Gross Dam Road and SH 72 requires concurrence from Jefferson County.

Also, on p. 18 of the TRP, the following statement is made: "The level of use on specific haul routes will depend on the final destinations for biomass materials. Denver Water will minimize impacts to the local community to the extent practicable and will continue coordinating with CDOT, Boulder County, and other local jurisdictions." This does not address the main concerns by Boulder County, pushing to a future date the resolution of such issues as travel through the city of Boulder, potential roadway improvements, and impacts to the greater transportation system.

Therefore, to respond to the current draft of the TRP would do nothing but reiterate the needs and concerns of Boulder County. Boulder County will comment to Denver Water on the TRP as submitted on March 15, 2021 but will reserve future comments until after the final TRP is submitted. To restate, the TRP is a required part of the Gross Reservoir Expansion 1041 application and any information that is missing from the TRP will make it harder for the county to be able to conditionally approve the application.

DWB Referral Response F-7: Evaluation of Magnolia and Lazy Z Road after the tree removal plan is submitted is acceptable. However, if the plan shows that improvements must be included on those roads, Boulder County will need to approve the plans, specifications, and implementation of the road improvements, prior to any use of those roads for tree removal.

DWB Referral Response F-8: Statement of future incorporation of County comments into the plans is insufficient. Boulder County will need to inspect and approve the work prior to use of the roads for tree removal.

DWB Referral Response F-9: Statement of inclusion of input from Boulder County on signing proposals and Traffic Control is insufficient. Boulder County requires approval prior to placement.

DWB Referral Response F-11: Consultation with other agencies is accepted, but DWB must provide proof of permit attainment.

DWB Referral Response F-13: The State Highway 72 and Gross Dam Road (CR 77S) intersection improvements are an integral part of the 1041 Application review and therefore cannot be separated from the application because any approval of the 1041 Application may be conditioned on different specifications for the county road at this intersection. As such, Boulder County is not willing to sign the CDOT Access Permit application until the 1041 process has been completed.

DWB Referral Response F-16: The point of the original comment was to ensure that all new access points proposed for this project are temporary, and the approval of this 1041 application does not grant approval for permanent access points, unless DWB specifically requests them as permanent and request is granted by Boulder County.

DWB Referral Response F-17: It is confirmed that DWB will hire all independent inspection services for this project; however, Boulder County must approve the hiring of each individual in the respective areas of need.

All other responses satisfy the requirements of the comments as stated. It is our expectation that all comments sent to DWB on December 23, 2020 will stand in full force as part of the conditions of approval if the Board of County Commissioners approves this application.

Boulder County

Community Planning & Permitting

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TO:	**Summer Frederick, CP&P Development Review**
FROM:	**Hannah Hippely, CP&P Long Range Planning**
RE:	**Re-referral SI-20-0003, Gross Reservoir & Dam Expansion project at 3817 Gross Dam Road, at parcel 157928000006.**
DATE:	**March 25, 2021**

In response to previous referral comments Denver Water submitted additional materials and information for review on February 19, 2021 and March 15, 2021. These re-referral comments address both the responses provided by Denver Water and the new information provided. New comments *italics* follow the comments previously made.

Denver Water's Gross Reservoir Expansion Project application (the application) dated 9/21/20 is a 370 page document which then includes multiple exhibit documents which must be referenced to obtain pieces of information not included in the application. These exhibit documents are each 100s of pages and present different information than is presented in the application. The application should provide complete summary information of the detailed reports provided as exhibits. The application should be amended to provide all relevant information in a complete and consistent manner so that it may be understood when reviewed by agencies, the public, and decisions makers.

The response to this comment from Denver Water was "thank you for your comment" no revision or amendment of the application materials was made to resolve the issue. This comment remains valid.

Denver Water's need for the project is discussed in an 18 year old Integrated Water Resource Plan (2002) referred to as Exhibit 2 and to an extant on page 5 and 6 of the application. In the 2002 plan the Gross Dam and Reservoir Expansion would help address drought concerns at the Moffatt Treatment Plant (MTP) as the plan states "the problem is not lack of overall water supply…but unequal distribution of the available water. That is, Denver Water currently has adequate water supply in its supply systems but not enough water is available for treatment at the Moffat plant". (Figure 7-1 of Exhibit 2 is referenced to show the North and South System however in Exhibit 2 there isn't a Figure 7-1 as the figures are titled using roman numerals.) The Moffatt Treatment Plan is being replaced by a new plant at Ralston Reservoir so the conclusions of the 2002 IWRP which are based on the problems with the MTP are hard to understand given the changes in the Denver Water system.

Contrary to the 2002 IWRP which states that there not a problem of water supply the purpose and need statement of the EIS stats "the purpose of the Moffat Collection System Project is to develop 18,000 acre-feet per year of new, firm yield".
It is understood that the new Ralston Reservoir replaces the Moffatt Treatment Plant (MTP) but does not contribute to the resolution of any the stated water supply issues with the system.

The plan includes adding new water to the system and supporting hydroelectric power development at Gross Dam as benefits. It isn't clear if this document is relevant at this point as the application mentions on page 5 only the need to add storage and supply to the system in addition to adding storage to the north portion of Denver Water's system to balance the system. It isn't clear how the hydroelectric portion of the project has factored into Denver Water's consideration or development of the Gross Dam project. Is hydroelectric generation a primary purpose of this project?

It is understood from the response the hydroelectric component of the project is Federal requirement not part of Denver Water's stated purpose and need nor was it factored into the alternatives analysis.

An updated IWRP would also be useful in understanding Denver Water's current situation as the 2002 plan includes and discussion on conservation and projects that were proposed to be completed by now and to understand if the shortfall described were reduced through the implementation of the Plan's near term "the period up to the year 2030" strategies.

It is understood that the IWRP is outdated and that EIS should be referred to in order to understand Denver Water's current situation. From response comment G14 it is understood that even if the proposed Gross Reservoir expansion is constructed Denver Water expects a substantial supply gap and the need for additional future projects to fill this gap. Denver Water needs the Gross Reservoir expansion to fill the current gap but how does Denver water anticipate filling the additional? At what point does lack of firm water supply result in the curtailment of regional growth? Will Denver Water simply return to the 300+ list of options and select a new project? Without an updated water resource plan it difficult to see how Denver Water has considered the longer term and how this project fits into that more holistic analysis and thus it isn't clear that this project is the least impactful alternative. This project was compared against others to fulfill one set of objectives which precludes the consideration of multiple projects in combination which could lead to different conclusions if a system wide and longer-term need analysis was completed.

The Moffatt System is shown on the Integrated Water Resource Plan (IWRP) table of Long-Term Supply options Table which includes "West Slope Storage; East Slope Storage; Conjunctive Use" as opportunities, is this the portion of the 2002 plan being implemented by the project or is additional expansion of Gross Dam anticipated?

Denver Water states that no additional expansion of Gross Reservoir is planned.

On page 1-16 of the EIS Figure 1-5 shows the 34,000 AF deficit anticipated by the Denver Water in 2032. While conservation measures are anticipated to address 16,000 AF of this deficit a Gross Reservoir expansion of 72,000 AF is to address the remaining 18,000 AF 2032 shortfall. Why is a storage amount four times the identified 18,000 AF shortfall that is needed being proposed?

It is understood that four times the shortfall is needed in order to provide the supply during drought conditions.

Has there been climate change impact analysis which factored into Denver water's needs assessment and the impact analysis of this project?

The response comments indicated that emissions were analyzed in the Appendix I report and Attachment B to the Corp's ROD discusses Green House Gas Emission but, it does not appear that climate impact was a factor in the alternatives analysis.

The provided comments indicate that Denver Water has considered climate change in its needs assessment.

Is the proposed Gross Reservoir expansion anticipated to also play a role in resolving Denver Water's year 2050 89,700 AF shortfall? If not has Denver Water begun planning to address this longer term shortfall?

The response comments indicate that the project does play a role in resolving the longer term 89,700 shortfall by the 18,000 A/F to be stored at Gross Reservoir.

The response comments do not answer the question regarding if and how Denver Water will address the remaining 71,700 A/F shortfall.

Neither the EIS or the 2002 IWRP reflect the new Northwater Treatment Plant next to Ralston Reservoir, the system analysis is out of date. Additionally, much of the analysis and rationale for the project is based on a system analysis where lack of available water at the Moffatt Treatment Plant is the critical flaw being resolved by this project. Updated materials reflecting a more accurate picture of the Denver Water system should be provided.

No new information was provided, the lack of updated information precludes decision makers from understanding how this project fits into Denver Water's long term plans and to understand how the 18,000 A/F short term solution is the best alternative to meet Denver Water's needs

The 2002 IWRP on page 66 notes (as options to solve the water availability problem at the MTP) "other potential solutions – enlarging Gross Reservoir; building a new off-channel reservoir; or recycling water for drinking purposes- would have the additional benefit of adding new water to Denver Water's system to help meet future demand". Though the construction of an off-channel reservoir and water recycling projects were identified as options in 2002 they are not included the alternatives analysis presented in the Environmental Impact Statement. No alternatives analysis was presented in the application. The EIS includes Chapter 2 Proposed Action and Alternatives in which several variations of a Gross Reservoir expansion are discussed. No alternatives to an expansion of Gross Reservoir were considered: why wasn't the construction of an off-channel reservoir(s) examined as suggested in 2002? A new Leyden Gulch Reservoir is considered but no discussion of expanding Ralston Reservoir is mentioned. It is understandable that Denver Water does not see a no action alternative as acceptable but, it isn't clear that any options other than expanding Gross Reservoir have been explored. The alternatives analysis provided in the EIS is unacceptable for the purposes of this 1041 application.

The Alternatives Screening Report was provided. The materials presented analyze only solutions for the small portion of an overwhelming long-term problem, this myopic approach precludes any holistic alternatives analysis as the only solution being searched for is how to locate 18,000 A/F of new water.

In Colorado's Water Plan former Governor Hickenlooper is quoted as saying that "every conversation about water should start with conservation" but conservation efforts are not discussed in any depth in the application, rationalization for the project, and no commitment to conservation projects or programs is made. According to the application "the system capacity of Denver Water's collection system … identified a 34,000 acre-feet per year (AF/yr) deficit in Denver Water's supply compared to projected demand. This shortfall would be met by 16,000 AF/yr of additional conservation and the 18,000 AF/yr Project (72,000 acre-foot [AF] expansion of Gross Reservoir). Denver Water has committed to implement the programs necessary to realize 16,000 AF/yr of conservation savings by 2030. None of the materials provided in the application indicate what these programs are or will be and it isn't clear if these programs could do more to reduce the shortfall and thus reduce the need for new water supplies. How was the conservation portion of the shortfall determined? Of particular concern is that conservation efforts discussed Section V of the 2002 Integrated Water Resource Plan report no new conservation measures implemented after 1998. A 2001 study cited in the IWRP indicated that achieving the goal 29,000 acre foot annual savings by 2050 was not possible given current conservation measures. Following the 2001 study Denver Water staff analyzed additional potential conservation measures but made no commitments to additional conservation efforts. Additionally, the EIS states on page 1-23 "there is no compelling analyses or basis to be confident that these saving will occur." What are the additional conservation methods to be implemented? Since growth in Denver Water service area is a driver of water demand how have water saving actions been incorporated into land use planning within the service area? Water conservation is an aspect the use and development of the water resource in a sustainable manner, sustainability is a cross-cutting theme of the Comprehensive Plan but also a specific goal. How has Denver Water implemented sustainability efforts within their service area and as part of the proposed project?

The resubmittal included Denver Water's conservation plan that was filed with the Colorado Water Conservation Board (CWCB) as well as a summary of activities and awards in the response comments. The provided plan is now 6 years old and no information regarding it achievement of goals was provided. Denver Water needs to implement programs necessary to realize 16,000 AF/yr of conservation savings by 2030 but it is unclear how this plan would achieve that goal. The plan states "Denver Water's conservation goal continues to be to reduce overall water use from pre-2002 drought usage by 22 percent by 2016" how many AF/yr does that statement equate to? The plan also states "a suite of active programs will attain at least 1,000 AF of savings annually" and *"active conservation is defined as permanent water savings achieved through direct intervention from the water provider" the plan provides no details regarding how Denver Water will move from the 1,000 AF/yr active savings goal to 16,000 AF/yr.*

The Additional Countywide Policies portion of the Comprehensive Plan was approved by Planning Commission in 1983. CW 1.04 an CW 1.09 speak to the desirability of reviewing expansions of water systems and assessing the environmental impacts of land use proposals. These long-standing policies remain relevant today as the 1041 process and its environmental impact assessment and alternatives analysis implement these policies. Without a thorough application and critical review of such proposals these Comprehensive Plan policies are disregarded as is the guiding principal which directs direct the County to pursue "goals and polices that achieve significant reductions in our environmental footprint".

These comments remain relevant.

The Environmental Resources Element of the Boulder County Comprehensive Plan (BCCP)identifies a number of resources in the project area including: Winiger Ridge Environmental Conservation Area (ECA), Overland Habitat Connector which links the Winiger Ridge ECA to the Hawking Gulch/Walker Ranch/Upper Eldorado Canyon ECA to the east, an Elk Migration Corridor, Riparian Areas and Wetlands along the creeks flowing into the reservoir, Winiger Gulch a High Biodiversity Significance Area to the southwest of and adjacent to the reservoir, and Winiger Ridge Natural Landmark. These areas are all anticipated to be impacted by the project contrary to the various policies in the element which seek to protect and preserve them. Additionally, the first goal found in the sustainability element directs the County to promote outcomes consistent with the principals of sustainability focusing on the protection of resources.

These comments remain relevant.

The transportation impacts of this project are anticipated to be significant and enduring for years. These impacts are not only traffic related but also result in the emissions of climate impacting greenhouse gasses and impacting local air quality. The Comprehensive Plan Goal 4 of the Sustainability Element directs the County to reduce such emissions. Transportation Element policies direct the County to Design Complete Corridors (TR1.02) , Prioritize Travel Corridors (TR 3.01), Enhance the Bicycle and Pedestrian Network (TR 1.03), Encourage Alternative Transportation (TR2.02), Reduce Single-Occupant-Vehicle Travel (TR 4.01), Minimize reliance on Fossil Fuels (Goal 5), and Promote Public Safety (TR 6.04). Coal Creek Canyon (HWY 72) is a narrow winding corridor that provides one of only a few access points into the region along and beyond the corridor. The anticipated traffic impacts along this corridor conflict with these stated goals and policies. What is Denver Water doing to address the sustainability and traffic impact concerns related to transportation impacts?

Response comments state that Denver Water will address traffic impacts in a final Traffic Management Plan, this plan should be provided now so that it can be used in the evaluation of the project.

New materials provided by Denver Water include a tree removal plan. This plan proposes Various tree and brush removal methods including the use of helicopters and heavy machinery. Materials are to be removed to four landing sites at which they may be treated and from which they will be taken off site. Landing sites 1 and 2 on the west side of the reservoir have trucking routes that use forest service and local rural roads, including Lazy Z and Magnolia Roads, connecting to Hwy 119. According to the plan 18, 024 tons of biomass will be removed from the west area with 81% of biomass is to be removed from the west area with Landing Site 1 being the departing location for 42% of the material and Landing Site 2 being the departing location for 39% of the material. Presuming 25 tons per truck, this equates to 721 trucks (or 1441 trips) through this rural part of the county. Landing sites 3 and 4 will use Gross Dam Road to Hwy 72. Haul route options are discussed on page 20 but no clear commitment or decision is presented. Additionally, the impacts to these rural roads is unknown at this time as the study of these impacts has not been provided. Disposal methods are presented as a menu of options including potential on site cordwood operation, chipping, air burners, etc. but, no commitments regarding disposal are made making impact analysis difficult. Tree removal is anticipated to occur primarily using helicopters and other machinery, the only mitigation for the nuisances created by this activity is that "tree removal activities will cease during non-daylight hours", logging trucks will have mufflers and follow speed limits, and obnoxious odors will be minimized. Without a more detailed plan the impacts of these activities on neighborhood character, community wellbeing, and safety cannot be evaluated.

The project entails a six year long project (operating 24 hours per day at times) to increase the height of the existing dam by 131 feet and thus increasing the reservoir storage capacity inundating additional areas to add 124 feet in elevation to the current water surface elevation achieving 72,000 (77,000 is also stated in the application) acre feet of additional water storage. The project includes an on site quarry and concrete plant and area road improvements. Traffic to the site includes supply trucks, tree hauling, construction equipment and workforce commuting. It is clear that the proposed project will have permanent substantial impacts within Boulder County and significant additional impacts during the six year construction phase.

These comments remain relevant.

As proposed Boulder County bears a significant burden to meet the needs of Denver Water yet the application fails to describe any actions by Denver Water which attempt to relieve this burden and locate the impacts of the water utility needs within the Denver Water service area and require those benefitting from the service to minimize demand through deep and meaningful conservation and land use planning programs. Given the lack of information and the concerns identified it is difficult to find the application on compliance with Comprehensive or the Land Use Code.

These comments remain relevant.

This concludes the Department of Community Planning & Permitting comments at this time.

Boulder County

Parks & Open Space

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TO:	**Summer Frederick, Planning Manager, CPP**
FROM:	Jeff Moline, Resource Planning Manager
RE:	**SU-20-001, Gross Reservoir Expansion Resubmittal**
DATE:	**3-29-21**

Boulder County Parks & Open Space staff has reviewed the applicant's responses to the department's original referral comments. Staff provides the following added comments corresponding to the numbered responses provided by the applicant in Exhibit 19, where warranted. In some of the applicant's responses, they either disagree with or have declined our original request for resource information. Where that information would be critical to assessing the project's impact on 1041 criteria, staff cannot determine if the project will have significant impacts on those particular environmental resources.

S-3. In this response Denver Water notes that Colorado Parks & Wildlife and other state agencies find the proposed mitigation measures of the project sufficient to protect fish and wildlife resources. However, BCPOS does not find the application complete enough with respect to the survey of fish and wildlife species to ensure that 1041 standards are met. BCPOS has provided a list of species of concern for the project location and without field surveys for these resources, cannot assure the project can meet the standards for 1041. BCPOS does not have additional information about which species may or may not occur on the property. Without knowing the impacts to the resources, we cannot determine if the proposed mitigation is suitable, adequate, and appropriate.

S-4. Staff appreciates the additional information on the Toll Property. The site does have important biodiversity values according to the Colorado Natural Heritage Program. Staff has not had an opportunity to visit the property or confirm these values in the field. Additionally, we understand that the U.S. Forest Service (USFS) will have management authority over the parcels in the near future. The site may need considerable management and protection efforts in order to protect the important biodiversity features.

S-5. We appreciate that other agencies have provided comments over the course of the permitting process for the project. Our comments are tailored to the county 1041 regulations; if provided information does not address the 1041 criteria, staff cannot determine project impacts.

S-8, 9, and 58. Staff understands the applicant's response on why wetland impacts cannot be mitigated in the South Boulder Creek drainage—there is not a USACE-accepted wetland bank in the area. Staff remains concerned that impacts to the wetlands in the project area will have impacts to special species, especially plants, and that these impacts will be very challenging to mitigate fully in order to meet 1041 standards.

S-10, S-14. Until the applicant is able to provide the information on the presence of species of concern, county staff can't provide the analysis necessary for the 1041 review of project impacts. Boulder County's Comprehensive Plan included a desktop analysis, therefore Denver Water's analysis, due to be available on March 31, 2021, is not likely to confirm presence or absence of these species. A field survey will still be required to determine project impacts on species of concern.

S-13. Updates should be completed regarding the Aquatic Nuisance Species section:

A. Section 2.5.1 lists these species as "top AIS concerns" by CPW: New Zealand Mudsnail, Rusty Crayfish, **Waterflea**, Zebra and Quagga Mussels.
    a. Unclear what CPW guidance was cited. Provide citation.
B. Appendix 5.1.1.1.3 "List of Aquatic Invasive Species" are taken from "USDA 2017".
    a. A note about "Colorado species of concern" is provided, however, **spiny water flea** was not included.
C. A new reference from CPW should be included, and "Priority" animal and plant species in this document should be reviewed for inclusion in this management plan.
    a. 2020 State of Colorado Aquatic Nuisance Species Management Plan, https://cpw.state.co.us/Documents/ANS/CO-ANS-Management-Plan.pdf
    b. Significant changes and additions were made to the Colorado list of priority aquatic nuisance animal and plant species of concern.
    c. There are two species of water fleas that should be called out.
    d. The primary animal species remain nearly the same, but there are many secondary species we request you consider.
    e. There are many priority aquatic plant species, but none were called out as "top" aquatic invasive species for introduction potential.
    f. Applicant should refer to Tables on pages 29-32.
D. 5.1.1.1.4 ANS Inspection Checklists – appears dated, from CDOW 2009.
    a. There might be a new version; we request you investigate and use if available: Source: CDOW. 2009. https://cpw.state.co.us/Documents/ANS/COANSInspectionHandbook.pdf

S-18, S-19. Staff members' experience with the Federally Listed Threatened Species Preble's meadow jumping mouse (PMJM), captured on adjacent BCPOS properties, causes us to continue to recommend that the applicant survey for the species in order to comply with the 1041 regulations that require this information. Staff's assessment is that suitable habitat is present in the project area. In addition, in the 2006 USFWS letter they state, "Should additional information regarding listed or proposed species become available, this determination may be reconsidered under the ESA." Recent Boulder County captures of Preble's is additional information and warrants further investigation.

S-23. Staff remains concerned that some of the resource studies and surveys are now old enough that the project's potential impacts (to be reviewed through the 1041 process) are not as accurate as more recent surveys.

S-25, S-43, S-61. Staff understands that CPW has commented on the 1041 application and confirms that the Fish and Wildlife Mitigation Plan for the project addresses their concerns, including those pertaining to elk and Environmental Conservation Areas. BCPOS remains concerned about impacts to elk in the area and is concerned about increased conflicts with elk. CPW is embarking on a collaring study (started in 2019/20) to get current information on this herd. High Biodiversity Areas and the ECA are not their purview. staff still concludes that these resources would be significantly impacted by the proposal.

S-27. This response was based on staff's request for more information and exhibits on visual impacts to the area by the proposal. The applicant indicates that the existing material satisfied the U.S. Army Corps of Engineers (USACE), USFS, and Federal Energy Regulatory Commission (FERC). Per the FERC order, Denver Water is required to prepare an addendum to the current Visual Resource Protection Plan which will be focused on USFS impacts and mitigation thereof. Staff believes more information is necessary to address 1041 criteria pertaining to visual impacts.

S-28. This response is related to staff's request to update the Recreation Management Plan. The applicant indicates this plan will be updated by April 15, 2021. Staff will review it once it is available.

S-32. Staff has reviewed the Tree Removal Plan and has these comments:

A. In the Debris Processing and Removal Section on Page 17 the Local Log Yard (referring to our Community Forestry Sort Yard—CFSY) is described (see text below). This statement is not representative of what the yards can handle. The CFSY is not available for this project, it is intended for private, small forestry projects.

"Local Log Yard

Nederland Community Forestry Sort Yard (CFSY), operated by Boulder County, provides another utilization and disposal option for a portion of the woody material. Operationally, the Nederland CFSY could receive both logs and chips. Its tipping fee is approximately $4.00 per cubic yard. The tree removal would produce approximately 24,000 cubic yards. The Nederland CFSY provides the closest offsite disposal location. Disposing saw logs at the sort yard would provide opportunities for local firewood cutters and reduce the trip distance for trucks."

The CFSY program is not designed to handle and work with projects of this scale. 24,000 cubic yards can be as much as 5000 tons, and our two yards combined typically process no more than 1600 tons a year. The CFSY is actually a free program that accepts woody biomass from forest health and fire mitigation projects on private lands (and occasional small-scale public projects). The material is sorted to its highest value for utilization purposes. A majority of the material is run through a grinder and sent to facilities for composting purposes. The $4.00 per cubic yard value is an estimate of the costs the County has to pay for tipping fees to these compost facilities, not a charge, and does not include our cost to grind and transport this material. The selected tree removal contractor should work directly with outlets, whether that be composting facilities or firewood contractors/cutters.

B. Staff recommends the applicant complete as much product utilization as possible, instead of using Air Curtain Destructors.

S-39. If the project is approved, staff will work with the applicant to coordinate the review and monitoring of the implementation of mitigation measures along with the other permitting agencies

Gilpin County Colorado

Commissioners
Web Sill, District 1
Linda Isenhart, District 2
Sandy Hollingsworth, District 3

County Manager
Abel Montoya

County Attorney
Bradford Benning

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April 12, 2021

TO: Denver Water, Boulder County Board of County Commissioners,

CC: Summer Laws and Dale Case, City of Boulder Community Planning and Permitting; Town of Nederland, Jefferson County Board of County Commissioners; Clear Creek Board of County Commissioners, City of Black Hawk, City of Central, Golden; and CDOT.

RE: Gross Reservoir Expansion Tree Removal Route Project ("Project")

The Gilpin County Board of County Commissioners ("Board") expresses their appreciation for meeting with us on April 6 to discuss the revised Gross Reservoir Expansion Project proposed Tree Removal Routes. Based on the current plan and the discussion, the Board strongly opposes the plan as proposed through Gilpin County. Impacts on Gilpin County including the cities of Black Hawk and Central City have not been adequately addressed. The new plan actually presents more impact and safety concerns than the previous version. The Board respectfully requests that the Boulder County Board of County Commissioners and Denver Water abandon plans for Tree Removal Routes using Highway 119 through Gilpin County to connect to Interstate I-70.

On February 17, Gilpin County Commissioners Isenhart and Hollingsworth and County Manager Montoya met with representatives from Denver Water to discuss the previous proposed routes, tree removal methods, and timelines of the Project. This discussion focused on the negative impacts to Gilpin County and there being no benefits to Gilpin County and its residents. We requested a fair and objective review and resolution of the concerns Gilpin County and other impacted communities have expressed related to this Project. Here are a some of the Project impacts that the route through Gilpin County has not yet addressed:

<u>State Highway 119 is the one and only north-south thoroughfare through Gilpin County</u>. It is one lane of travel in each direction with no pull-out passing lanes. The added traffic of fully loaded logging or chip box trucks will impede the flow of other vehicles on this route for residents commuting to work or to services below. Should there be an accident involving or resulting from a Project truck, it would likely mean lane or highway closures.

<u>Impact on residents living along the proposed route.</u> Many homes are situated less than 70 feet from the highway. The additional noise, pollution, and visual traffic from logging trucks passing by throughout the day from months to years will impact residents' lives and the peaceful enjoyment residents are accustomed to in a rural mountain community.

<u>Impact on business revenue and our county economy.</u> Gilpin County and the cities of Black Hawk and Central are dependent on tourism and casino patrons visiting their businesses contributing to a healthy economy. The cities are in a designated State Historic District. SH 119 serves as a major route for the millions of visitors for the recreation opportunities in Gilpin County, including the casinos, which generate significant revenue for the County and the State. Logging trucks passing through these communities will have a large impact on access for tourists. It is anticipated that significantly fewer tourists will visit these communities once aware of the logging trucks during business hours when one-lane roads are the only paths to, and through, these locations.

State Highway 119 is Colorado's oldest American Scenic Byway attracting recreational tourists to Gilpin County. Recreationalists depend on access to creeks to fish, to state forest roads and trails, to historic sites, and across Gilpin County to reach local businesses situated along and off the highway. Logging trucks moving along the Scenic Byway will detract from visitors' enjoyment of a rural mountain experience. It will also put wildlife randomly crossing Highway 119 at greater risk of lethal accidents. Gilpin County is home to moose, elk, deer, bears, bobcats, mountain lions, coyotes, nesting raptors, and smaller animals who all would be affected by the logging trucks. There are many motorcyclists who enjoy riding along the Peak to Peak Scenic Byway who would be at greater risk trying to pass the trucks as there are only a few passing lanes on Highway 119. During peak aspen viewing months the tourist traffic spikes with drivers parking and pedestrians walking along the highway right of ways.

Incongruence between the size of logging trucks with the single lane roads in the cities. The narrow, winding roads with sharp turns and multiple stops in historic Black Hawk and Central City to access the Central City Parkway are not suited to large logging trucks. Pedestrians will be at risk as businesses with on-street parking narrow the roads even further. Passenger loading zones and parking entrances are located along these small-town roads.

Central City Parkway access from the city and mileage is owned by the City of Central which informed Denver Water and the County in the April 6 meeting that Central City would need to grant the Project special use permission for truckers to use it as a route to Interstate 70. This application would need to be made to Central City and approved by the City Council. The next portion of the Parkway is under ownership of Clear Creek County. The Parkway is not a state or county road thus has its own rules of use.

Potential for accidents and increased demands on our local first responders. As a rural mountain county, the two small cities and the county have basic responder services, no urgent care center, and are an hour's distance from a medical facility. With the increase in potential accidents caused by multiple logging trucks a day, the burden on Gilpin County's ambulance, fire and first responders would be taxed. The risk also exists for injuries to the driver and passengers in the logging truck along lengthy routes which the Project proposes.

We are also concerned about impacts to other roads serving Gilpin County. Coal Creek Canyon (CO 72) is the state highway that serves our residents in northern Gilpin County. Truck traffic will impact traffic flow for commuting residents and tourists, plus pose the aforementioned safety risks to people and wildlife.

Gilpin County submitted a letter of concern in December 2020 regarding environmental, wildlife, and residential impacts. More direct, safer, less polluting, wider, and more eco-friendly routes are available for transporting tree materials from the Project. We suggest using Landing zone 3 more and barge possibility across the reservoir so traffic would not need to enter Gilpin. An alternative identified is use of the Union Pacific's Moffat Tunnel Subdivision rail line which travels west from Denver and comes very near Gross Reservoir where it crosses and is accessible from Gross Dam Road. This rail line travels close to SH 72 and SH 93 and crosses those highways at various locations providing access points for loading biomass or equipment for transport south or north on SH 93, or to I-70. As currently proposed, biomass destined for the Longmont area will travel an additional 90 miles, approximately 30 miles of which is through Gilpin County, to avoid a direct route to the north through Boulder, plus using SH 93 to I-70 is more direct.

We understand this proposed Project will impact several communities. We respectfully request that our opposition to the proposed Tree Removal Plan be noted and the proposed route through Gilpin County be abandoned for the reasons outlined above. With alternate routes to the north and east of Gilpin County already identified in the Project we ask that those routes be implemented instead.

Sincerely,

Gilpin County Board of County Commissioners

Linda Isenhart

Linda Isenhart, Chair,
Commissioner, District 2

Web Still
Commissioner, District 1

Sandy Hollingsworth
Commissioner, District 3

Boulder County

Public Works

2525 13th Street • Boulder, Colorado 80304 • Tel: 303-441-3900
Mailing Address: P.O. Box 471 • Boulder, Colorado 80306 • **www.BoulderCounty.org**

March 29, 2021

To: Summer Frederick, Planning Division Manager
Community Planning and Permitting Department

From: Mike Thomas, P.E., County Engineer

Subject: Docket SI-20-0003, Gross Reservoir & Dam Expansion; Denver Water Board Responses to Boulder County December 23, 2020 Referral Comments

I have reviewed the February 19, 2021 Denver Water Board (DWB) Responses to my comments dated December 23, 2020 and Denver Water's Draft Tree Removal Plan dated March 15, 2021, and have the following reactions to specific DWB Referral Responses below:

DWB Referral Response F-4: The current draft (March 15, 2021) of the Tree Removal Plan (TRP) states that DWB is waiting for comments from Boulder County and other agencies before proceeding to next level of completion. This appears to simply acknowledge the requests and observations of the different agencies and that they will be handled at a future time. For example, p. 5 of the plan states, "In addition, FERC Order Article 423 requires that the Tree Removal Plan be prepared after consultation with the USFS, CSFS, Boulder County, Jefferson County, and Gilpin County as discussed in section 1.3.2.3. and summarized in Appendix B." There appears to be more meetings and discussion required in order to finalize the plan.

On p. 18 of the TRP, there is a statement that a Traffic Management Plan will be prepared by May 2021. This plan is integral to the tree removal on this project and should be completed much sooner in order to provide sufficient time to review and comment. The specific reference to using Gross Dam Road and Crescent Park Drive for tree hauling until the approval and reconfiguration of the intersection of Gross Dam Road and SH 72 requires concurrence from Jefferson County.

Also, on p. 18 of the TRP, the following statement is made: "The level of use on specific haul routes will depend on the final destinations for biomass materials. Denver Water will minimize impacts to the local community to the extent practicable and will continue coordinating with CDOT, Boulder County, and other local jurisdictions." This does not address the main concerns by Boulder County, pushing to a future date the resolution of such issues as travel through the city of Boulder, potential roadway improvements, and impacts to the greater transportation system.

Therefore, to respond to the current draft of the TRP would do nothing but reiterate the needs and concerns of Boulder County. Boulder County will comment to Denver Water on the TRP as submitted on March 15, 2021 but will reserve future comments until after the final TRP is submitted. To restate, the TRP is a required part of the Gross Reservoir Expansion 1041 application and any information that is missing from the TRP will make it harder for the county to be able to conditionally approve the application.

DWB Referral Response F-7: Evaluation of Magnolia and Lazy Z Road after the tree removal plan is submitted is acceptable. However, if the plan shows that improvements must be included on those roads, Boulder County will need to approve the plans, specifications, and implementation of the road improvements, prior to any use of those roads for tree removal.

DWB Referral Response F-8: Statement of future incorporation of County comments into the plans is insufficient. Boulder County will need to inspect and approve the work prior to use of the roads for tree removal.

DWB Referral Response F-9: Statement of inclusion of input from Boulder County on signing proposals and Traffic Control is insufficient. Boulder County requires approval prior to placement.

DWB Referral Response F-11: Consultation with other agencies is accepted, but DWB must provide proof of permit attainment.

DWB Referral Response F-13: The State Highway 72 and Gross Dam Road (CR 77S) intersection improvements are an integral part of the 1041 Application review and therefore cannot be separated from the application because any approval of the 1041 Application may be conditioned on different specifications for the county road at this intersection. As such, Boulder County is not willing to sign the CDOT Access Permit application until the 1041 process has been completed.

DWB Referral Response F-16: The point of the original comment was to ensure that all new access points proposed for this project are temporary, and the approval of this 1041 application does not grant approval for permanent access points, unless DWB specifically requests them as permanent and request is granted by Boulder County.

DWB Referral Response F-17: It is confirmed that DWB will hire all independent inspection services for this project; however, Boulder County must approve the hiring of each individual in the respective areas of need.

All other responses satisfy the requirements of the comments as stated. It is our expectation that all comments sent to DWB on December 23, 2020 will stand in full force as part of the conditions of approval if the Board of County Commissioners approves this application.

Tree Removal Plan
Agency Comment Matrix

Please provide your agency's comments in the template provided below. Example entries provided for reference.

Agency/Department: ____Boulder County Public Works Department___________________________________

Date of comments: ___April 14, 2021_____________________

Section Number	Page Number (or Figure Number)	Comment
		Until final routing is determined, Boulder County cannot approve the plan
		Traffic Management Plan is due in May, 2021. Further comment will be forthcoming at that time
		To approve the TRP any time soon may conflict with possible needs in the future with a new Traffic Management Plan that a future contractor will have to modify, requiring additional review and approval of the overall TRP by Boulder County
		Designation of DWB as the access permit agent/permittee for realignment of the Gross Dam Road / State Highway 72 intersection may not happen until the 1041 is approved by Boulder County
		It is still expected that DWB explain how avoidance of the city of Boulder will take place if Longmont is the destination
		Final road improvement drawings for roads under Boulder County jurisdiction need to be provided similar to drawings for Forest Service roads
		Road restoration is planned to take place during a 5-month period. There will be liquidated damages imposed if restoration work takes longer than expected
2.3.1		*8-hour days are stated as the haul duration*
	22	*Plan indicates DWB will maintain GDR during the duration of the project*

Brasfield, Melissa

From:	Steve Durian <sdurian@co.jefferson.co.us>
Sent:	Tuesday, April 13, 2021 11:31 AM
To:	Brasfield, Melissa
Subject:	RE: Gross Reservoir Expansion Project Tree Removal Plan

Melissa,

I have only one comment for now:

Section 2.2.4. of the March 15th, 2021 draft entitled *2021 Tree Removal Plan* states "A draft Traffic Management Plan will be available in May 2021 for agency stakeholder review." Jefferson County will withhold final comments concerning truck routes and their impacts on the community until this traffic management plan is made available for review.

Steve Durian
Director, Transportation and Engineering Division

Jefferson County
100 Jefferson County Parkway, Suite 3500
Golden, CO 80419
(303) 271-8498

From: Brasfield, Melissa <Melissa.Brasfield@denverwater.org>
Sent: Monday, March 15, 2021 6:55 PM
To: Steve Durian <sdurian@co.jefferson.co.us>
Subject: Gross Reservoir Expansion Project Tree Removal Plan

Dear Mr. Durian,

Please find attached Denver Water's Draft Tree Removal Plan (March 15, 2021) for the Gross Reservoir Expansion Project (GRE Project) for your agency's review. The deadline for your agency's comments on this plan is **April 14, 2021**. The final plan will be submitted to FERC, per Article 423, for review and approval on or before July 16, 2021.

Due to the size of the file, you should be receiving a separate email through OneDrive (additional access link here). Please confirm receipt of this message as well as receipt of the full plan through the file transfer program. The file attached is a smaller file size with lower figure resolution.

If you have any questions on this letter, please contact me directly. Thank you again to you and your colleagues for your feedback on Denver Water's Draft 2021 Tree Removal Plan.

Melissa

Melissa Brasfield | Communications Specialist
Gross Reservoir Expansion Project
Denver Water | t: 303-628-6348 | d: 303-628-6664
denverwater.org | denverwaterTAP.org

DENVER WATER

Clear Creek County

POST OFFICE BOX 2000
GEORGETOWN, COLORADO 80444

TELEPHONE: (303) 679-2300

April 16, 2021

TO: Denver Water, Boulder County Board of County Commissioners

CC: Summer Laws and Dale Case, City of Boulder Community Planning and Permitting; Gilpin County Board of County Commissioners; and CDOT

RE: Gross Reservoir Expansion Tree Removal Plan

The Clear Creek County Board of County Commissioners wishes to express concern regarding the Gross Reservoir Expansion Project's proposed tree removal routes. Current plans reviewed and discussed with the Gilpin County Board of County Commissioners on April 6 outlined significantly greater truck traffic and related traffic hazards proposed for Colorado Highway 119, the Central City Parkway and Interstate 70 which will occur as a result of the tree removal project.

Also, the plan's proposed schedule coincides with CDOT's planned improvement programs on I-70, including a major road widening project in the Floyd Hill area which will create traffic-constricting construction zones between Idaho Springs and Floyd Hill.

For these reasons, the Clear Creek Board of County Commissioners respectfully requests that as the plan becomes more detailed, we ask that traffic on potential haul routes associated with future construction projects on I-70 be minimized or the route be eliminated altogether to avoid creating conflicts and congestion. We also acknowledge and have concerns about the impacts to Gilpin County, Black Hawk and Central City associated with this route.

Thank you for your consideration.

CLEAR CREEK BOARD OF COUNTY COMMISSIONERS

George Marlin
by nar

Randall Wheelock
by nar

George Marlin, Chairman | Randall Wheelock, Commissioner | Sean Wood, Commissioner

Appendix H:
Tree Removal and Disposal Methods

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1.0 Tree Removal and Disposal Methods

Described below are the tree removal and disposal methods that will be used for the Selected Alternative identified in section 1.4.2.1 of the Tree Removal Plan that has been developed for the Gross Reservoir Expansion Project.

1.1 Tree Removal Systems Descriptions

1.1.1 Helicopter

Helicopter Logging (HL) is a method of logging that can be used where stands are inaccessible. Cables are dropped from the helicopter and used to remove cut trees and woody biomass. The use of helicopters reduces the infrastructure required to log a specific stand and greatly reduces the schedule and timing of operations. It also can increase the operational productivity in remote stands with limited access.

Courtesy of Columbia Helicopters Model 107-II Vertol

HL can vary given size of the helicopter-based pay load capacity and flight times and capacities. The Columbia model 107-II Vertol helicopter is often selected for HL and can extract 20,000 cubic feet (about 660 tons) of woody biomass per 9-hour day. The Vertol has a lift capacity of 6,200 pounds at an elevation of 5,000 feet. This double-rotor helicopter provides flexibility and increased stability in cross winds to log and deliver woody biomass at precise sites.

HL is accomplished by suspending a long line of wire below the aircraft with chokers attached. In some operations, a grapple may be used instead of chokers. The long line is typically between 90 and 300 feet in length, depending upon topography and the height of trees above which the helicopter must hover. Long chokers may be used and are pre-set on trees in the stand. The choker ends are then brought together to make up loads that are estimated as being slightly less than the helicopter's lifting capacity.

Courtesy of Market-it Forestry and R&R Conner's Heli-Logging, image of a Heli- bucket

HL ground personnel will hand cut and bunch tree and woody biomass with chokers before the helicopter starts to work. A one-person faller can hand fell about one-third acre per day. Logs and biomass must be bucked so individual logs and biomass do not exceed the net lifting capability of the helicopter. Tree cuts must be complete so that each log is free of the adjacent trees. All trees, brush (dead or alive) and biomass are cut within 6 inches of the ground on uphill side of the slope or obstruction and removed from the stand. All limbs attached to trees are airlifted and processed at the log landing zone. Old remnant tree stumps from the historical wildfires must be cut at ground level for HL removal.

Logs and biomass are connected to chokers and bunched and then connected to the hook at the end of the helicopter's long line. The helicopter then climbs vertically to lift the logs off the ground and clear the forest canopy. Woody biomass that cannot be bunched or yarded by chokers are collected and placed in a Heli-bucket or Heli-cargo nets to be airlifted with other woody material and processed on the landing.

Courtesy of John Deere Feller Buncher Yarder

The inhaul element involves flying the load of logs from the hooking point to the landing. At the landing, the pilot sets the log biomass and Heli buckets on the ground in the drop zone and releases the chokers from the hook. With the load released, the pilot clears the log landing and enters the outhaul element to return to the stands for another load of logs. The entire process, outhaul, hook, inhaul, and unhook, is commonly referred to as a turn.[6]

1.1.2 Ground-Based

Feller Buncher. A feller buncher is a self-propelled machine with a cutting head that can hold more than one woody stem at a time. The cutting head is used strictly for cutting, holding, and placing the stems on the ground. Feller bunchers do not have processing capabilities.

Tracked machines with self-leveling cabs can operate on slopes up to 50%. Tracked machines without self-leveling cabs can operate on slopes up to 40%. For safety, wheeled feller bunchers should be restricted to slopes below 40%. Ground and tree conditions affect the slope at which the equipment can operate. Rough, broken ground or many ground obstructions limit the slopes to less than the maximum. A swing boom feller buncher is a tracked machine with the cutting head mounted on a boom. The machine does not have to drive up to each tree to cut it. Larger

[6] U.S. Forest Service. 2019. Forest Management Operations General Forest Management Information, Washington D.C. www.fs.fed.us/forestmanagement/index.shtml.

trees also reduce the feasible operating slope because of the mass that can be handled safely (USFS 2019).

Ground Skidders: Wheeled or track skidders are built on an articulated chassis with the cab and engine mounted on the forward articulation, and either a cable drum and arch or grapple is mounted on the rear articulation. Many modern skidders include both a cable drum and a grapple. Wheeled skidders typically have a small blade mounted on the front that can be used to push material out of the way and level small ground obstructions. A grapple can pick up more than one woody stem at a time. A cable skidder has a skid line with chokers attached. The number of chokers used depends on the size of trees being extracted. Cable skidders have a fixed arch over which the cable runs through a fairlead. The arch provides lift to the large ends of the logs and can be used as forwarders transporting logs to landings.

Courtesy of Caterpillar a wheeled skidder with the arch grapple transporting logs

Mulchers Masticators: Mulchers chop and grind vegetation into small particles that become native forest surface soil duff material. Mulchers may be used to clean up a stand following conventional timber or felling operations. Mulchers can reduce limbs, tops, and cull material to shredded particles on the forest floor and that degrade more quickly back into the soil.[7] Track-driven mulchers can be used very effectively on slopes up to 40% with extremely low ground pressure required.

Courtesy of Tiger Equipment Model 470 Tiger Mulcher

[7] U.S. Forest Service. 2019. Forest Management Operations General Forest Management Information, Washington D.C. www.fs.fed.us/forestmanagement/index.shtml.

Forwarders are articulated machines consisting of an operator's cab and a log bunk. They are basically tractors pulling a wagon load of wood. Forwarders currently exist that have up to eight wheels. The cab may be fixed or capable of rotating on the chassis. Many forwarders have a boom-mounted grapple for loading and unloading material.

Traction and flotation can be increased by adding tracks that slide on over the dual wheels or by opting for wider tires. Tire chains may also be applied for additional traction in snow or mud.

Forwarders are limited to extracting processed material. They are typically operated with a harvester capable of producing cut to length material. The harvester is also capable of stacking the processed logs near a skid trail accessible to the forwarder. Manual felling and processing do not have this capability, limiting the productivity of the forwarder.

Courtesy of John Deere- single bunk forwarder

Compared to skidders, forwarders cost more to purchase and so require a higher rate of productivity to justify the cost.

A typical cut-to-length system uses either self-loading trucks or a forwarder that loads the log trucks. Roadside landings can be used since there are no space requirements for a loader or processor. The forwarder can simply unload into decks at the roadside, facilitating subsequent loading of the log trucks.

Air curtain destructors (ACDs) are skid-mounted systems designed and constructed to optimize the air curtain concept. High velocity air is blown across and down at an optimum angle into the pit creating the air curtain on top and a rotational turbulence within the firebox. The high velocity air creates the rotational turbulence providing an oxygen-enriched environment in the combustion zone that accelerates the combustion process (like the effect of fanning a fire). The temperature within the firebox is usually above 2,000°F. The high velocity air over the firebox creates an air curtain that traps unburned particulate

Courtesy of U.S. Forest Service San Dimas Experiment Station, Air Curtain Burner until it is completely consumed. Nearly complete combustion is achieved with minimal amounts of escaped particulates, virtually eliminating smoke.

Vertical refractory walls aid in the combustion process by retaining and reflecting the high temperatures generated within the firebox. The combustion process reduces the wood waste to usable biochar and carbon ash by approximately 98%, leaving about 2% in volume (100 tons of wood, or two to four tons of ash and biochar). Twin refractory-lined panel doors at the rear of the firebox allow for ash removal. The unit has no bottom and can be dragged on its skids and its rear door panels open to dump ash.

The skids and durability of the unit allow it to be dragged around the site for repositioning or from site to site depending upon the terrain and distance to be moved. The ash may be left in place, disposed of, or used as a soil amendment by mixing it with the soil at the site or other locations.[8]

Air Burners, LLC manufactures several skid-mounted systems with burn rates ranging from one to 15 tons per hour. The larger units are more difficult to transport or move around the site. Due to their size, special permits are required for transporting over roads. Systems can be customized to meet specific needs. The standard units can also be leased.

Personal communication with Air Burners North American Sale representative confirmed the S-330 Air Burner production rates of 10 to 12 tons per hour are appropriate. Boulder County has an S-220 that has a production capacity of seven ton per hour, a production rate approximately 30% less than the S-330.

1.1.3 Cable Based

Cable Yarder. A cable yarder is ground-based rubber tire or track equipment that uses a system of cables to pull or fly logs from the stump to the landing. It generally consists of an engine, drums, and spar, but it has a range of configurations and variations such as the Yoder yarder. The Yoder can be configured to function as a shovel logger, a cable line logger, standing skyline, or swing yarder. The Yoder is very versatile in logging performance. Yoder yarders have a short-span cable that reaches out 600 feet and a long-span

Courtesy of R&R Conner's Logging with a Yoder Yarder

[8] U.S. Forest Service. 2002. The Use of Air Curtain Destructors for Fuel Reduction; San Dimas Technology and Development Center. San Dimas, CA 8pp.

cable that reaches out to 1,000 feet depending on equipment model. The Yoder yarder is most suitable for steep slopes where it is difficult to access the logs with other machinery. It can be used as a Swing yarder on flatter areas with lighter loads. The basic cable Yoder yarding system is recommended for use.

1.1.4 Hand Felling

Chainsaw felling and processing is generally considered feasible for any type of treatment. However, its major disadvantage is the decreased productivity compared to mechanical options. This decreased productivity may translate into increased treatment costs.[9]

1.1.5 Landings

On the landing zone, there is typically a grapple loader moving material from the drop zone to the processing or decking area. The mechanical processing equipment provides for a variety of outputs; may include sawlogs, cordwood, chipping, grinding and biochar log shredder at the landing.[10] A second loader may be involved in loading trucks to transport processed biomass and biochar, which is loaded onto dump trucks or truck and trailers for transportation to potential markets (Gaspard 2019). The amount of processed biochar that is stored and later loaded into cubic yard bags varies depending on size fraction of the biochar from 250 to 600 pounds. A second loader may be involved to transport processed biomass and biochar, which would be loaded onto dump trucks or truck and trailers for transportation to potential markets.

Courtesy of BCN, Log Shredder Loading a Kiln

–Courtesy of Biochar Now! — Processed Biochar in Cubic Yard Bags Stored on Landing zone for Shipping

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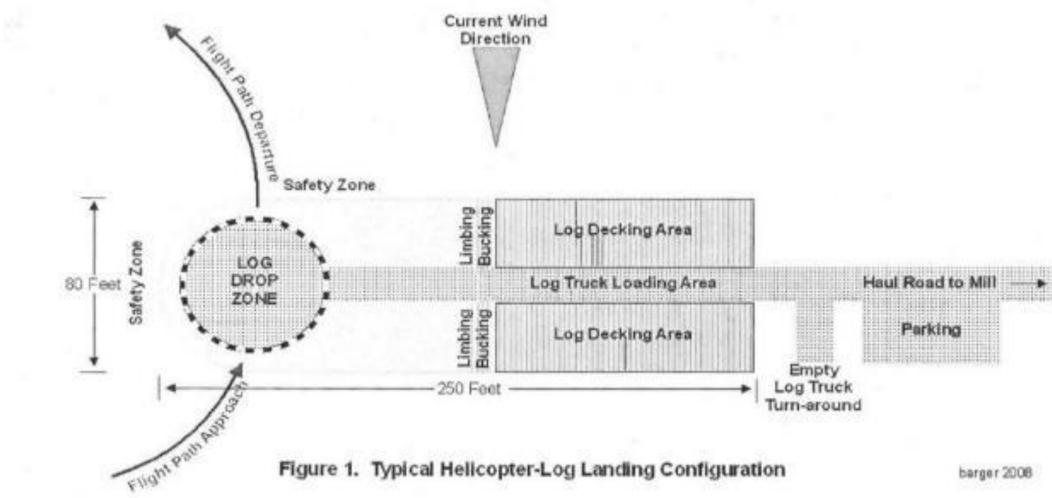
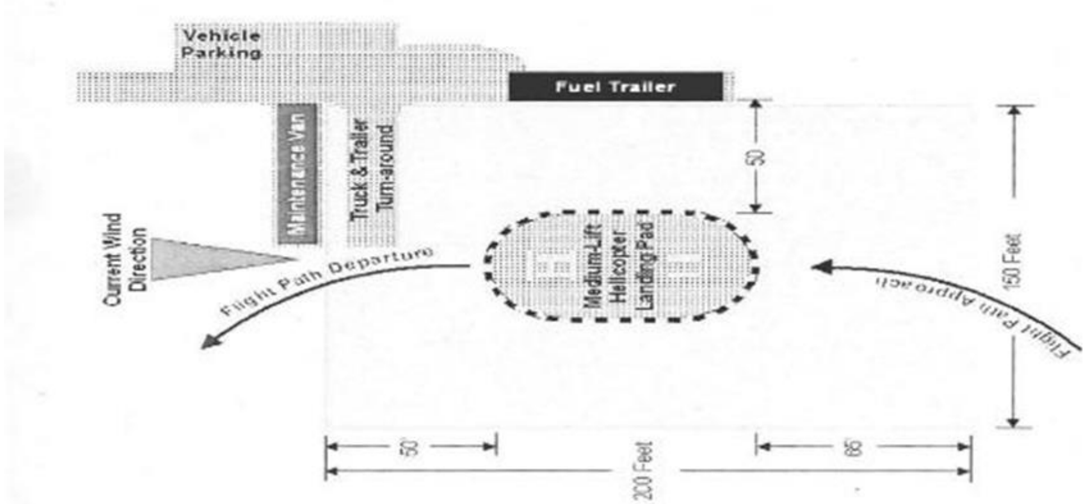
9 U.S. Forest Service. 2019. Forest Management Operations General Forest Management Information, Washington D.C. www.fs.fed.us/forestmanagement/index.shtml.

10 J. Gaspard. 2019.Biochar Now Technology, Berthoud, CO, 4 pp.

Planning for helicopter logging and landing areas is critical. It is important that enough space and support are available at each landing site to support the functionality of log dropping and processing biomass, to include having enough transportation available to remove the large volumes of timber and biomass from the landing area. Helicopter logging typically requires two landings, a service landing for refueling and one for dropping off the extracted timber. The following diagrams illustrate the general dimensions and support space needed for adequate HL sites. Typical Heli-log landing zones and service pads are illustrated below.



Heli-Log and Processing Landing



Landing Heli-Service Pad

Courtesy of Markit! Forestry, Heli landing and processing site*

* This image captures the complete Heli-landing zone operation. The landing area displays a hot active helicopter yarding area with, log processor de-limber, grapple loader, grapple sort loader, front end loader with extended scoop for loading chip trucks, and horizontal wood-chip grinder.

1.2 Tree and Debris Disposal

1.2.1 Process and Utilize Chips

Grinding whole trees and hauling to biomass utilization facilities is an option for debris disposal. Large grinders are used to convert entire trees into rough chips. These chips can be used as fuel for steam generation or compost or simply dumped in a landfill. Several utilization facilities operate in the greater GRE Project working area. Eagle Valley Green Energy in Gypsum and Confluence Energy in Kremmling are potential purchasers of biomass for energy production. A1 Organics in Commerce City and Renewable Fiber Inc. in Fort Lupton provide disposal locations.

Grinder operations are straightforward. Slash is decked in large piles and fed through the grinder with a track hoe or loader, the grinder blows chips into a pile or a truck and the chips are hauled to a utilization facility. The Morbark 4600XL Wood Hog can process debris at the rate of 100 tons per hour. Given the production capacity of this grinder, 1,000 tons of debris could be processed during a 10-hour day. At this rate, it would take approximately 24 days to grind the slash and debris generated by the GRE Project. Chip vans capable of holding approximately 100 cubic yards of chips would carry approximately 23 to 27 tons per load. Given the estimated 24,000 tons of debris, approximately 1,000 truckloads of chips would be generated.

1.2.2 Biochar

Biochar production provides an option to utilize all the biomass and tree removal debris from the GRE Project.

Biochar Now! (BCN) uses a slow-pyrolysis technology (slow burning/cooking in an enclosed kiln) to make its biochar. In general, each kiln burns about 2,000 pounds of wood and would produce approximately 600 pounds of biochar in 24 hours. BCN would pay $60 per dry ton for the feedstock delivered whole tree to the shredder location. BCN would need about $5 million upfront to purchase the biochar equipment needed for the tree removal. BCN would take care of all the processing (shredding) and haul the shredded material offsite. The production of the biochar in the local area would provide local jobs, and processing of the biomass by BCN would reduce the woody material by 80%. The processed biochar can then be transported via dump trucks to markets.[11]

1.2.3 Sawlogs

Most of the trees to be removed under the Tree Removal Plan in the GRE Project area are not highly desired by the timber industry because of their relatively short height and number of limbs (knots). Conventional logging truck access to most of the wood is restrictive and very expensive. One operator (Carl Spaulding, VP and General Manager, Renewable Fiber Inc., Fort Lupton,

[11] J. Gaspard. 2019.Biochar Now Technology, Berthoud, CO, 4 pp.

Colorado) indicated there is “no merchantable material” in the GRE Project area. Accordingly, the focus of the Tree Removal Plan is to treat GRE Project material as debris.

1.2.4 Pellets

Material from the tree removal activities could be utilized as pellets. Confluence Energy in Kremmling, Colorado, would purchase biomass at $35 to $40 per ton delivered at the Kremmling facility as quoted in 2019.

1.2.5 Cordwood

Cordwood production may be possible by selecting a producer such as Sweetman Enterprises Inc. The cordwood firm expressed interest in contracting the entire 24,000 tons of woody material to convert to cordwood and chips at the landing locations. Sweetman Enterprises Inc. did not provide pricing information; however, there is interest in developing a business partnership with Denver Water on the tree removal program.

JCK Corporation, a firewood supplier, confirmed that they chiefly procure dry, dead wood for cordwood production. They will not pay for dead or green wood. JCK may be interested in receiving green wood at a storage area on Denver Water lands for year-long processing of green wood to dry wood but will not receive green wood at its Henderson facility. Since 90% of the wood that is removed will be green, JCK is not a viable alternative for disposal of cordwood.

Nederland Community, Colorado, is a firewood-dependent community for home heating. There may be an opportunity to provide cordwood through vendors such as Sweetman Enterprises Inc. or others. It will be important to balance “free use” firewood with the existing commercial market in the area.

1.2.6 Ethanol

Ethanol production from biomass is possible; however, according to Scott Haase, Renewable Energy Scientist, of the National Renewable Energy Laboratory in Lakewood, Colorado, “the markets have deteriorated significantly and are currently not an economically viable option in Colorado.”

1.2.7 Boulder Log Yard

Nederland Community Forestry Sort Yard (CFSY) provides another utilization and disposal option. Operationally, the Nederland CFSY could receive both logs and chips. Its tipping fee is approximately $4.00 per cubic yard. The GRE Project would produce approximately 24,000 cubic yards. The Nederland CFSY, operated by Boulder County, is the closest offsite disposal location. Disposing saw logs at the sort yard would provide opportunities for local firewood cutters and could generate community goodwill.

1.2.8 Air Curtain Destructor

ACDs or burners are widely used in land clearing projects throughout the world. An ACD is a simple machine that is, in fact, a large mobile incinerator. Combustible material is loaded into the large bin and a fan blows a high-pressure curtain of air across the top of the bin. The curtain recirculates combustible gases and smoke until only heat and a minimum of pollutants escape from the bin. ACDs have a 96 to 98% reduction rate, so 2,000 pounds of slash turns into 40 to 80 pounds of ash and a limited amount of biochar. ACDs provide an efficient, environmentally friendly feasible option for debris disposal. A USFS San Dimas Technology and Development Center evaluation of ACDs, indicated ACDs efficiently disposed of large quantities of fuels while releasing very little emission particulate matter.[12] Residual ash and biochar have beneficial use and can be applied to disturbed areas during restoration activities. A larger FireBox can eliminate 10 to 12 tons of woody debris per hour, reducing approximately 100 tons during a 10-hour day. A single operator can support three ACDs on a single landing. Three ACDs working in combination could eliminate 24,000 tons of debris in 80 burning days. Additional burners would reduce disposal times. Using ACDs essentially eliminates product removal traffic from local and state highways. Environmental impacts are minimal as near complete combustion is achieved with minimal amounts of escaped particulates, virtually eliminating smoke. Ash and biochar can be stored onsite to be used for site restoration.

Results of real-time ambient air testing by Lockheed Martin Technology Service for the United States EPA/Environmental Response Team in Puerto Rico showed that “there were no significant emission releases during debris burning.”[13] The ambient air monitoring and sampling was conducted at the request of the EPA and the Corps to evaluate air emissions during ongoing burns destroy all burnable woody debris generated by Hurricane Jeanne.

Use of ACDs would require coordination with USFS, Boulder County Sheriff, CDPHE, and local fire districts.

1.2.9 Foothills Landfill

Loading and hauling chips to a landfill is the most expensive disposal option based on haul costs and tipping fees. Haul costs were determined using Landing Sites 1, 2, and 3 as starting areas for chip trucks. Foothills Landfill is located at 8900 Highway 93 near Golden and is the closest landfill to the GRE Project area. Quoted tipping fees at Foothills Landfill are $22.80 per ton.

[12] U.S. Forest Service. 2005. The Use of Air Curtain Destructors for Fuel Reduction and Disposal; San Dimas Technology and Development Center. San Dimas, CA 5pp.
[13] Lockheed Martin Technology Services. 2005. Ambient Air Monitoring and Sampling at the Toa Baja Landfill Site, Toa Baja, Puerto Rico. WA #0-112-Trip Report. 205pp.

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Appendix I:
Access Roads and Haul Route Conceptual Design

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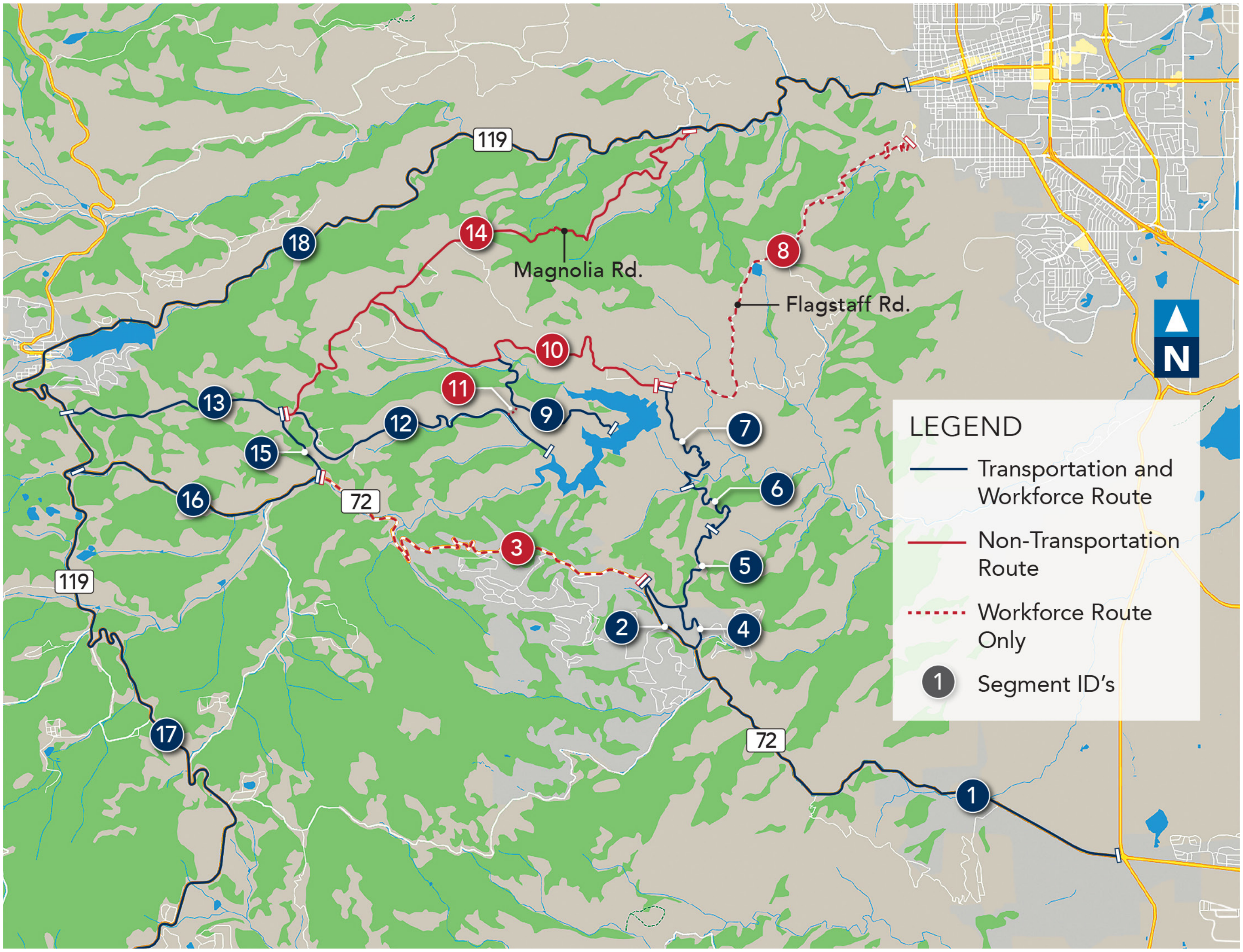
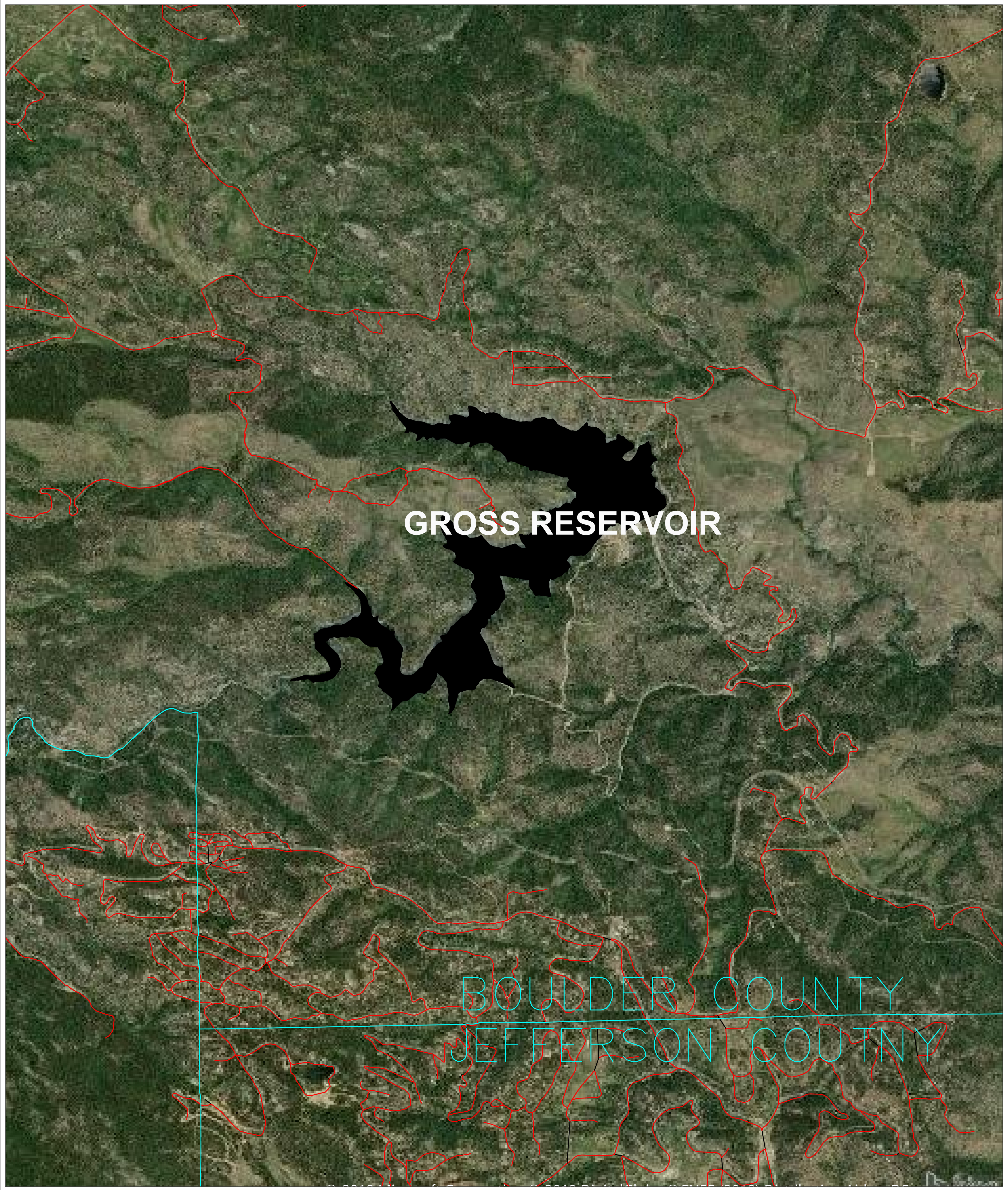
14
Magnolia Rd.
13
10
FS 359
8
Flagstaff Rd.
11
9
12
7
15
16
72
6
3
5
2
4
1
72
LEGEND
Transportation and Workforce Route
Non-Transportation Route
Workforce Route Only
Non-public Access Roads
1 Segment ID's
N



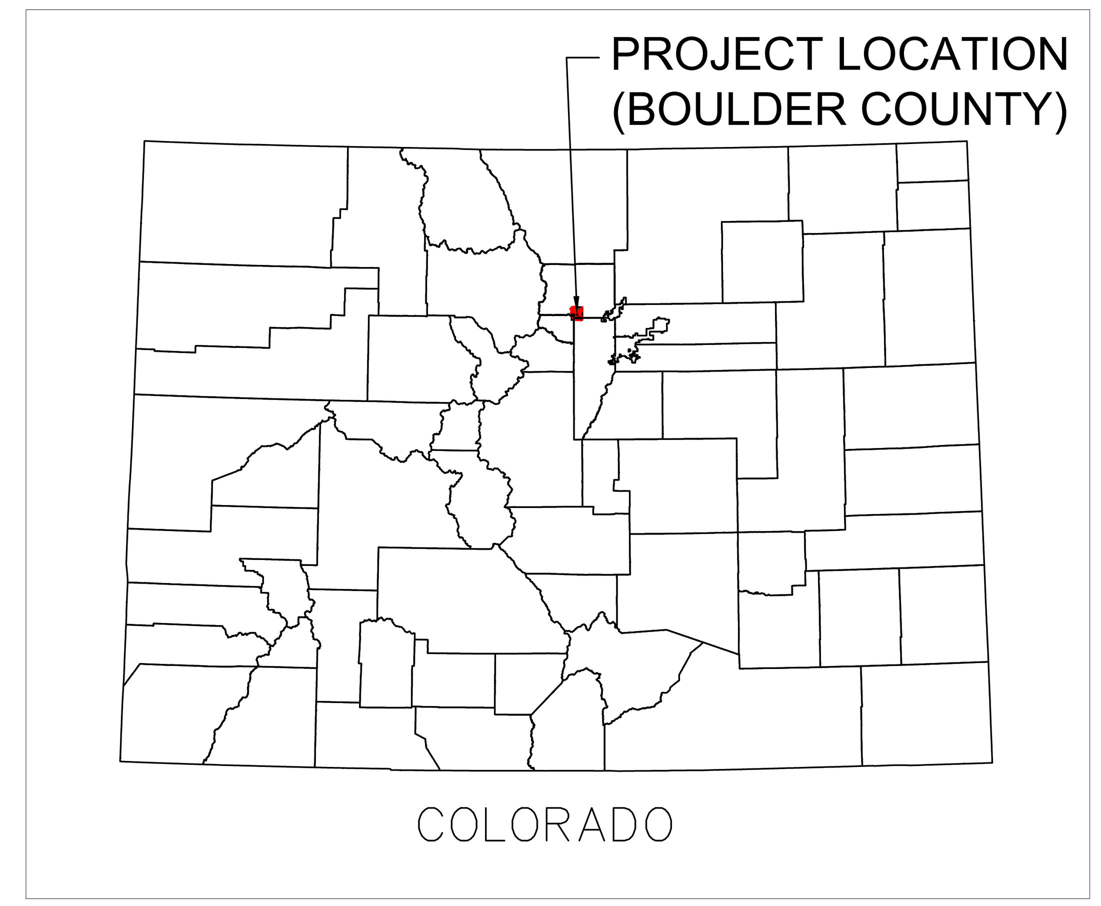
119
72
Magnolia Rd.
Flagstaff Rd.
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
N
LEGEND
Transportation and Workforce Route
Non-Transportation Route
Workforce Route Only
Segment ID's

DENVER WATER - GROSS RESERVOIR EXPANSION PROJECT
CONCEPTUAL HAUL ROAD DRAWINGS
BOULDER COUNTY, CO



VICINITY MAP

0 1000' 2000' 4000'
SCALE: 1"=2000'



LOCATION MAP (N.T.S.)

Sheet	Title	Rev. No	Date
G-01	COVER SHEET	A	9/25/2019
G-02	GENERAL CONSTRUCTION NOTES	A	9/25/2019
C-01	KEY MAP/TRANSPORTATION PLAN	A	9/25/2019
C-02	ROAD SECTIONS AND DETAILS	A	9/25/2019
RD-01	ROAD LAYOUT PLAN AND PROFILE (SHEET 1 OF 9)	A	9/25/2019
RD-02	ROAD LAYOUT PLAN AND PROFILE (SHEET 2 OF 9)	A	9/25/2019
RD-03	ROAD LAYOUT PLAN AND PROFILE (SHEET 3 OF 9)	A	9/25/2019
RD-04	ROAD LAYOUT PLAN AND PROFILE (SHEET 4 OF 9)	A	9/25/2019
RD-05	ROAD LAYOUT PLAN AND PROFILE (SHEET 5 OF 9)	A	9/25/2019
RD-06	ROAD LAYOUT PLAN AND PROFILE (SHEET 6 OF 9)	A	9/25/2019
RD-07	ROAD LAYOUT PLAN AND PROFILE (SHEET 7 OF 9)	A	9/25/2019
RD-08	ROAD LAYOUT PLAN AND PROFILE (SHEET 8 OF 9)	A	9/25/2019
RD-09	ROAD LAYOUT PLAN AND PROFILE (SHEET 9 OF 9)	A	9/25/2019

ACCESS ROAD SURVEY CONDUCTED BY SHORT ELLIOT HENDRICKSON INC. BETWEEN JUNE 1ST AND JUNE 20TH, 2019.

HORIZONTAL DATUM:

THIS PROJECT DATUM IS COLORADO STATE PLANE NORTH ZONE. NGS CONTROL POINT MAGNOLIA WAS UTILIZED.

(US SURVEY FEET) = 1,236,991.16' NORTH 3,025,807.55' EAST

VERTICAL DATUM

NGS MAGNOLIA (NAVD88)= 8094.28'

CONTROL POINT TABLE

PNT NO.	NORTH	EAST	ELEV	DESCRIPTION
1	1236991.16	3025807.55	8094.28	NGS MAGNOLIA
300	1224773.22	3022400.14	8043.05	SEH RPC NO.5 REBAR
301	1228852.06	3028500.16	7758.16	SEH RPC NO.5 REBAR
302	1224362.40	3035802.46	7442.52	SEH RPC NO.5 REBAR

ADDITIONAL TOPOGRAPHIC SURVEY DATA PROVIDED BY DENVER WATER FROM UNKNOWN ORIGINAL SOURCE.

LEGEND

- 80 — EXISTING TOPOGRAPHIC CONTOUR–MAJOR
- EDGE OF ROAD
- 24+00 24+50 25+00 25+50 26+00 26+50 — CENTERLINE OF ROAD WITH STATION MARKS
- SURVEYED TREE LOCATION
- OH — EXISTING OVERHEAD ELECTRIC
- STM — CULVERT
- x — EXISTING FENCELINE

TETRA TECH
www.tetratech.com
350 INDIANA ST #500
GOLDEN, CO, 80401
PHONE: 303-217-5700

DENVER WATER
GROSS RESERVOIR EXPANSION PROJECT
TREE REMOVAL HAUL ROADS
COVER SHEET

PROJ: 194-6713
DESN: AMI
DRWN: AMI
CHKD: JPF

G-01

9/25/2019 11:27:50 AM - P:\DENVER WATER\GROSS RESERVOIR EXPANSION\ENGINEERING\ACCESS ROADS\COVER SHEET.DWG - MATHERS, ERIC

Bar Measures 1 inch, otherwise drawing not to scale

CONSTRUCTION DRAWING NOTES:

1. THE CONTRACTOR SHALL HAVE KNOWLEDGE OF, AND WILL WORK IN COMPLIANCE WITH, THE TERMS AND CONDITIONS STATED IN THE PERMITS ISSUED BY OR TO DENVER WATER, AND IS SUBJECT TO THE SAME SANCTIONS FOR VIOLATIONS OF SUCH PERMITS.
2. ALL ACTIVITIES AUTHORIZED UNDER THE PERMITS ISSUED MUST BE IN STRICT CONFORMANCE WITH THE SPECIFICATIONS AND DETAILS DEPICTED ON THE CONSTRUCTION DRAWINGS.
3. NONE OF THE ISSUED PERMITS ALLOW FOR THE RIGHT TO TRESPASS UPON THE LANDS OR INTERFERE WITH THE PROPERTY AND/OR RIPARIAN RIGHTS OF LANDOWNERS NOT PARTICIPATING IN THE PROJECT.
4. ALL CONSTRUCTION ACTIVITY, INCLUDING OPERATION OF MACHINERY, EXCAVATION, FILLING, GRADING, CLEARING OF VEGETATION, DISPOSAL OF WASTE, AND STOCKPILING OF MATERIAL WILL TAKE PLACE WITHIN THE LAYDOWN OR ACCESS ROADS.
5. EQUIPMENT SHALL UTILIZE THE INTERSECTION OF ACCESS ROADS AND EXISTING ROADS FOR TURNING. WORK AREAS FOR TREE CLEARING WILL ALSO PROVIDE AREAS FOR EQUIPMENT TURNING AND PARKING.
6. FUGITIVE DUST RESULTING FROM CONSTRUCTION ACTIVITIES SHALL BE MINIMIZED TO THE MAXIMUM EXTENT PRACTICABLE BY IMPLEMENTING APPROPRIATE CONTROL MEASURES. A WATERING VEHICLE SHALL BE AVAILABLE FOR THE DURATION OF PROJECT ACTIVITIES, INCLUDING THROUGHOUT RESTORATION.

EXCAVATION, BACKFILL, COMPACTION

THIS SECTION SPECIFIES THE TECHNICAL AND CONSTRUCTION REQUIREMENTS FOR EXCAVATION, BACKFILL, COMPACTION, AND SURFACE AGGREGATE PLACEMENT FOR THE PROJECT.

PART 1 GENERAL

SUBMITTALS

1. ALL SUBMITTALS SHALL BE APPROVED BY CONTRACTOR QC MANAGER WITH CONCURRENCE BY DENVER WATER REPRESENTATIVE PRIOR TO START OF WORK.
2. SURFACE AGGREGATE: SUBMIT DOCUMENTATION INDICATING THAT SELECTED AGGREGATE MEETS THE REQUIREMENTS FOR AGGREGATE STATED ON THIS DRAWING.
3. SUBMIT FIELD COMPACTION TEST REPORTS FOR SUBGRADE FILL, SUBGRADE SOIL, AND SURFACE AGGREGATE.
4. GEOTEXTILE: SUBMIT LABORATORY TEST RESULTS DOCUMENTING GEOTEXTILE ENGINEERING PROPERTIES. THIS DOCUMENT SHALL INCLUDE GRAB STRENGTH, SEWN SEAM STRENGTH, TEAR STRENGTH, ULTRAVIOLET STABILITY, APPARENT OPENING SIZE, PERMITIVITY, AND OTHER PROPERTIES AS REPORTED BY THE MANUFACTURER.

PART 2 PRODUCTS

2.1 EXCAVATED SUITABLE MATERIALS

AT MINIMUM, EXCAVATED SUITABLE MATERIALS SHALL BE:

- FREE OF DEBRIS, SNOW, ICE, FROZEN SOIL OR MUD.
- FREE OF VISIBLE OR KNOWN CONTAMINATION.
- FREE OF LUMPS AND ROCKS LARGER THAN ½ THE LIFT THICKNESS WITH A MAXIMUM SIZE OF 6 INCHES.
- FREE OF VEGETATION, WASTE, AND ANY OTHER DELETERIOUS MATTER.

ALL EXCAVATED SUITABLE MATERIALS WILL BE SUBJECT TO APPROVAL BY THE FIELD ENGINEER WITH CONCURRENCE BY DENVER WATER REPRESENTATIVE.

2.2 BACKFILL MATERIAL

FILL MATERIAL CONSISTS OF EXCAVATED SUITABLE MATERIALS FREE OF CONTAMINANTS AS DETERMINED BY THE FIELD ENGINEER WITH CONCURRENCE BY DENVER WATER REPRESENTATIVE. THE FILL WILL BE UTILIZED TO RAISE THE EXISTING GRADE AND CONSTRUCT SLOPES.

2.3 SUBGRADE SOIL

SUBGRADE SOIL IS THE COMPACTED NATIVE SOIL THAT IS OBTAINED AFTER STRIPPING TOPSOIL, MOISTURE CONDITIONED TO NEAR THE OPTIMUM MOISTURE CONTENT, AND COMPACTED TO 95% OF MAXIMUM DRY DENSITY IN ACCORDANCE WITH ASTM D698. THE PREPARED SUBGRADE SHOULD BE INSPECTED FOR SOFT OR LOOSE AREAS BY PROOF-ROLLING IN ACCORDANCE WITH SECTION 3.5. SOFT OR LOOSE AREAS SHALL BE OVER-EXCAVATED AND BACKFILLED WITH SUITABLE FILL AND COMPACTED IN ACCORDANCE WITH SECTION 3.5 AND 3.6 OR AS DIRECTED BY THE FIELD ENGINEER WITH CONCURRENCE BY DENVER WATER REPRESENTATIVE. THE COMPACTED SUBGRADE WILL BE TESTED IN ACCORDANCE WITH SECTION 3.8.

2.4 SURFACE AGGREGATE

ROAD SURFACE, SHALL CONSIST OF 4 to 6-INCHES THICK COMPACTED LAYER OF SURFACE AGGREGATE THAT SHALL MEET COLORADO DEPARTMENT OF TRANSPORTATION STANDARD SPECIFICATIONS FOR HIGHWAY CONSTRUCTION, SECTION 703 SURFACE COURSE AGGREGATE AS SHOWN IN TABLE BELOW. (SEE DETAIL 1 AND 2 ON SHEET C-11 FOR ROAD SECTION DETAILS). ANY MODIFICATION TO THIS SPECIFICATION NEEDS TO BE APPROVED BY THE FIELD ENGINEER WITH CONCURRENCE BY DENVER WATER REPRESENTATIVE.

SIEVE	GRADATION (PERCENT PASSING BY WEIGHT)	
	SURFACE COURSE	
	CLASS 5	CLASS 6
1-1/2 IN.	100	
1 IN.	95-100	100
3/4 IN.		95-100
NO. 4	30-70	30-65
NO. 8		25-55
NO. 200	3-15	3-12

2.5 GEOTEXTILE

GEOTEXTILE IF REQUIRED SHALL BE TENCATE MIRAFI HP270 OR AN APPROVED EQUIVALENT, WHICH SHALL HAVE EITHER EQUAL OR SUPERIOR ENGINEERING PROPERTIES. EQUIVALENT SUBSTITUTIONS SHALL BE APPROVED BY THE FIELD ENGINEER WITH CONCURRENCE BY DENVER WATER REPRESENTATIVE.

2.6 PIPE MATERIALS

PIPE SHALL BE GALVANIZED STEEL CORRUGATED METAL PIPE OR ENGINEER APPROVED EQUIVALENT.

PART 3 EXECUTION

3.1 PREPARATION

1. IDENTIFY THE REQUIRED LINES, LEVELS, CONTOURS, AND DATUM.
2. THE CONTRACTOR SHALL CONTACT THE COLORADO UTILITY CALL CENTER (COLORADO 811) FOR DELINEATION OF UTILITIES PRIOR TO START OF EARTH WORK.
3. NOTIFY UTILITY COMPANIES TO REMOVE AND/OR RELOCATE UTILITIES.
4. PROTECT UTILITIES FROM DAMAGE DURING THE PERFORMANCE OF ANY EARTH WORK.

3.2 CLEARING

1. REMOVE VEGETATION, TRASH, DEBRIS, AND OTHER UNDESIRABLE MATERIALS SUCH AS ROCK (LARGER THAN 6 INCHES) AND OBSTRUCTIONS FROM THE CONSTRUCTION AREAS. LIMIT STUMP REMOVAL TO IMPACTED AREAS.

3.3 EXCAVATION

1. EXCAVATE ON-SITE SOIL TO THE INDICATED ELEVATION AND DIMENSION AS SHOWN ON THE CONSTRUCTION DRAWINGS.
2. CUT SLOPES SHALL NOT EXCEED 2H:1V.
3. MAINTAIN STABLE SLOPES AT ALL TIMES.
4. GRADE THE TOP PERIMETER OF THE EXCAVATION AREAS TO PREVENT SURFACE WATER FROM DRAINING INTO EXCAVATED AREAS, OR UNPROTECTED SLOPES.
5. THE EXCAVATED SOILS SHOULD BE SUITABLE FOR RE-USE AS EMBANKMENT OR MISCELLANEOUS FILL PROVIDED THE BACKFILL DENSITY CAN BE ACHIEVED.
6. NOTIFY FIELD ENGINEER OF UNEXPECTED SUBSURFACE CONDITIONS (I.E., UNCOMPACTABLE, UNSUITABLE, OR BEDROCK) AND DISCONTINUE AFFECTED WORK IN THE AREA UNTIL NOTIFIED TO RESUME WORK.

3.4 STOCKPILING

1. STOCKPILE MATERIAL ON-SITE AT THE LOCATION(S) INDICATED BY THE FIELD ENGINEER WITH CONCURRENCE BY DENVER WATER REPRESENTATIVE.
2. HEIGHT OF STOCKPILES SHOULD BE DETERMINED BY FIELD ENGINEER WITH CONCURRENCE BY DENVER WATER REPRESENTATIVE TO PREVENT EXCESS WIND AND WATER EROSION.
3. DIFFERENT MATERIAL SHALL BE STOCKPILED SEPARATELY FROM EACH OTHER TO PREVENT INTERMIXING.
4. DIRECT SURFACE WATER AWAY FROM ALL STOCKPILE LOCATIONS TO PREVENT EROSION OR DETERIORATION OF MATERIALS.
5. ALL STOCKPILES SHALL HAVE SILT FENCE OR APPROVED ALTERNATE INSTALLED AROUND THE BASE TO PREVENT OFFSITE MIGRATION OF SEDIMENT. THE ENVIRONMENTAL SITE MANAGER WILL SELECT APPROPRIATE MEANS WITH CONCURRENCE OF DENVER WATER REPRESENTATIVE.

3.5 FILL PLACEMENT

1. ALL FILL SHOULD BE APPROVED BY THE FIELD ENGINEER WITH CONCURRENCE BY DENVER WATER REPRESENTATIVE PRIOR TO PLACEMENT.
2. FILL REQUIRED TO OBTAIN THE DESIRED FINISH GROUND SURFACE ELEVATION SHOULD BE PLACED IN UNIFORM TWELVE (12) INCH OR THINNER LOOSE LIFTS AND COMPACTED TO 95% OF MINIMUM DRY DENSITY IN ACCORDANCE WITH ASTM D698.
3. GRADE THE FILL SLOPES TO 2H:1V OR FLATTER.
4. GRADE SUBGRADES TO DRAIN AND PREVENT WATER PONDING
5. COMPACTION SHALL BE OBTAINED BY THE USE OF MULTIPLE-WHEEL PNEUMATIC-TIRED ROLLERS, OR OTHER EQUIPMENT APPROVED BY THE FIELD ENGINEER WITH CONCURRENCE BY DENVER WATER REPRESENTATIVE FOR BACKFILL SOILS. GRANULAR FILL SHALL BE COMPACTED USING VIBRATORY EQUIPMENT OR OTHER EQUIPMENT APPROVED BY THE CONTRACTOR. COMPACTION SHALL BE ACCOMPLISHED WHILE THE FILL MATERIAL IS AT THE SPECIFIED MOISTURE CONTENT. COMPACTION OF EACH LAYER SHALL BE CONTINUOUS OVER THE ENTIRE AREA.
6. PROOF-ROLLING: PERFORM AS DIRECTED BY THE FIELD ENGINEER WITH CONCURRENCE BY DENVER WATER REPRESENTATIVE TO DETERMINE LOCATION OF UNACCEPTABLE SOFT AREAS. PROOF-ROLLING SHALL BE PERFORMED USING A HEAVY OR FULLY LOADED PNEUMATIC TIRE DUMP TRUCK. UNACCEPTABLE AREAS SHALL BE STABILIZED IN ACCORDANCE WITH THIS SPECIFICATION.

3.6 ROADWAYS

1. ALL PROJECT ROADS WILL BE CROSS-SLOPED AT 1% TO ALLOW FOR STORM WATER FLOW OVER THE ROADWAY.
2. THE DIRECTION OF THE CROSS-SLOPE FOR THE ROADS WILL BE DETERMINED BY THE FIELD ENGINEER WITH CONCURRENCE BY DENVER WATER REPRESENTATIVE DURING CONSTRUCTION.
3. SUBGRADE INSPECTION: INSPECT THE COMPACTED SUBGRADE FOR DETERMINATION OF SOIL-TYPE AND THE NEED FOR GEOTEXTILE PLACEMENT.
4. GEOTEXTILE INSTALLATION: INSTALL THE GEOTEXTILE FOR ROADWAYS ON UNSUITABLE SOIL SUBGRADES. THE FIELD ENGINEER WITH CONCURRENCE BY DENVER WATER REPRESENTATIVE WILL DESIGNATE LOCATIONS WHERE THE GEOTEXTILE IS REQUIRED. ALL GEOTEXTILES SHALL BE INSTALLED IN ACCORDANCE WITH MANUFACTURERS INSTRUCTIONS.
5. SURFACE AGGREGATE
   - 5.1. PLACE SURFACE AGGREGATE BY END-DUMPING ON THE PREVIOUSLY PLACED AGGREGATE OR COMPACTED SUBGRADE.
   - 5.2. PROVIDE A MINIMUM 4 INCH LAYER OF SURFACE AGGREGATE (OVER THE GEOTEXTILE, IF REQUIRED BY THE FIELD ENGINEER WITH CONCURRENCE BY DENVER WATER REPRESENTATIVE) FOR ACCESS ROADS BEFORE PERMITTING ANY TRAFFIC.
   - 5.3. ALL SURFACE AGGREGATE SHOULD BE COMPACTED WITH A SMOOTH DRUM VIBRATORY ROLLER TO OBTAIN 98 % OF THE MAXIMUM DRY DENSITY AS DETERMINED BY ASTM D698, STANDARD PROCTOR. AS AN ALTERNATIVE, A TEST FILL METHOD IN LIEU OF ASTM D698 AND AS APPROVED BY THE FIELD ENGINEER WITH CONCURRENCE BY DENVER WATER REPRESENTATIVE, MAY BE USED FOR CONTROL OF COMPACTION.
   - 5.4. REPLACE TOPSOIL IN DISTURBED AREAS AS INDICATED ON THE DRAWINGS.
   - 5.5. REVEGETATE IN ACCORDANCE WITH THE APPROVED STORMWATER POLLUTION PREVENTION PLAN.
6. TRUCK TURNAROUNDS WILL BE LOCATED BY CONTRACTOR WITH CONCURRENCE OF DENVER WATER REPRESENTATIVE.
7. IF ROCK IS PRESENT ON EXISTING ROAD CHECK WITH DENVER WATER REPRESENTATIVE FOR DEPTH AND PLACEMENT OF AGGREGATE BASE.

3.7 CLEANUP AND SITE RESTORATION

1. REMOVE STOCKPILE: LEAVE AREA IN A CLEAN AND NEAT CONDITION. GRADE THE SURFACE IN ACCORDANCE WITH THE CONSTRUCTION DRAWINGS.
2. MISCELLANEOUS FILL MUST BE TRACKED OR TAMPED IN PLACE TO ACHIEVE UNYIELDING SURFACE.
3. GRADE MISCELLANEOUS FILL AS OUTLINED ON THE DRAWINGS OR AS DESIRED BY THE FIELD ENGINEER WITH CONCURRENCE BY DENVER WATER REPRESENTATIVE TO RESEMBLE THE NATURAL GROUND SURFACE.
4. UPON COMPLETION OF TREE REMOVAL WORK THE CONTRACTOR SHALL RESTORE THE HAUL ROADS TO THE ORIGINAL CONDITION AS DIRECTED BY DENVER WATER. THE CONNECTOR ROAD BETWEEN FS 359 AND CR 97E SHALL BE OBLITERATED AND THE HAUL ROAD REVEGETATED IN ACCORDANCE WITH THE DIRECTIONS OF DENVER WATER.

3.8 FIELD QUALITY CONTROL TESTING

1. ALLOW THE FIELD ENGINEER AND DENVER WATER REPRESENTATIVE (IF DEEMED NECESSARY BY OWNER) TO INSPECT AND APPROVE SUBGRADES AND FILL LAYERS BEFORE CONSTRUCTION WORK IS PERFORMED.
2. THE FIELD ENGINEER WITH CONCURRENCE BY DENVER WATER REPRESENTATIVE SHALL APPROVE ALL MATERIAL USED FOR FILL. APPROVAL SHALL BE OBTAINED BEFORE USE OF MATERIAL ON THE SITE BY THE CONTRACTOR.
3. THE FIELD ENGINEER AND DENVER WATER REPRESENTATIVE (IF DEEMED NECESSARY BY OWNER) SHALL BE PRESENT TO OBSERVE ALL FILL PLACEMENT AND COMPACTION OPERATIONS.
4. MATERIAL GRADATION (PARTICLE SIZE ANALYSIS) SHALL BE PERFORMED AT 1 TEST PER 5,000 CY OR MINIMUM OF 1 PER DAY PER SECTION.
5. FIELD DENSITY TESTS AND IN-PLACE MOISTURE SHALL BE PERFORMED BY THE CONTRACTOR IN ACCORDANCE WITH THE CRITERIA BELOW:
   - ROADWAY: PERFORM AT LEAST ONE FIELD TEST OF SUBGRADE AND FILL MATERIAL FOR EVERY 500 LINEAR FEET OR AS DIRECTED BY THE FIELD ENGINEER WITH CONCURRENCE BY DENVER WATER REPRESENTATIVE, BUT IN NO CASE LESS THAN ONE (1) TEST PER LIFT OF FILL.
   - OTHER UNPAVED AREAS: PERFORM AT LEAST ONE FIELD TEST OF SUBGRADE AND FILL MATERIAL FOR EVERY 10,000 SQ. FT. OR AS DIRECTED BY THE FIELD ENGINEER WITH CONCURRENCE BY DENVER WATER REPRESENTATIVE, BUT IN NO CASE LESS THAN ONE (1) TEST PER LIFT OF FILL.
   - TRENCHES/OUTLET PIPE: PERFORM AT LEAST ONE FIELD TEST OF SUBGRADE AND FILL MATERIAL FOR EVERY 100 LINEAR FEET OR AS DIRECTED BY THE FIELD ENGINEER WITH CONCURRENCE BY DENVER WATER REPRESENTATIVE, BUT IN NO CASE LESS THAN ONE (1) TEST PER LIFT OF FILL.

REFERENCE:

IN-PLACE DENSITY TEST: ASTM D1556, ASTM D2922, ASTM D2167, ASTM D6938.

IN-PLACE MOISTURE TEST: ASTM D6938

MOISTURE DENSITY RELATIONSHIP: ASTM D698

PARTICLE SIZE ANALYSIS: ASTM C136 / D422

STORMWATER POLLUTION PREVENTION PLAN

THE CONTRACTOR SHALL COMPLY WITH THE COLORADO DEPARTMENT OF PUBLIC HEALTH AND ENVIRONMENT (CDPHE) APPROVED SWPPP, ITEMS LISTED BELOW.

SPILL PREVENTION, CONTAINMENT, AND COUNTERMEASURES NOTES

GENERAL

SPILLS WILL BE IMMEDIATELY REPORTED TO DENVER WATER, BY THE PRIME CONTRACTOR. DENVER WATER WILL KEEP AN UP-TO-DATE LIST OF QUALIFIED EMERGENCY RESPONSE CONTRACTORS WITH THE CAPABILITY OF REACHING THE PROJECT SITE QUICKLY.

IN THE EVENT THAT A SPILL OCCURS ON THE SITE, THE FOLLOWING NOTIFICATION PROCEDURE WILL BE FOLLOWED:

1. SUBCONTRACTOR NOTIFIES THE DENVER WATER CONSTRUCTION MANAGER.
2. THE CONSTRUCTION MANAGER NOTIFIES THE SUPERINTENDENT, PROJECT MANAGER AND THE DENVER WATER CONSTRUCTION MANAGER.
3. DENVER WATER REPORTS THE SPILL TO THE CDPHE DIVISION FOR SPILL PREVENTION AND RESPONSE.

ESTIMATED CUT AND FILL TOTALS			
LOCATION	CUT	FILL	NET
NEW CONNECTOR ROAD	5197 CU. YD.	4666 CU. YD.	531 CU. YD CUT

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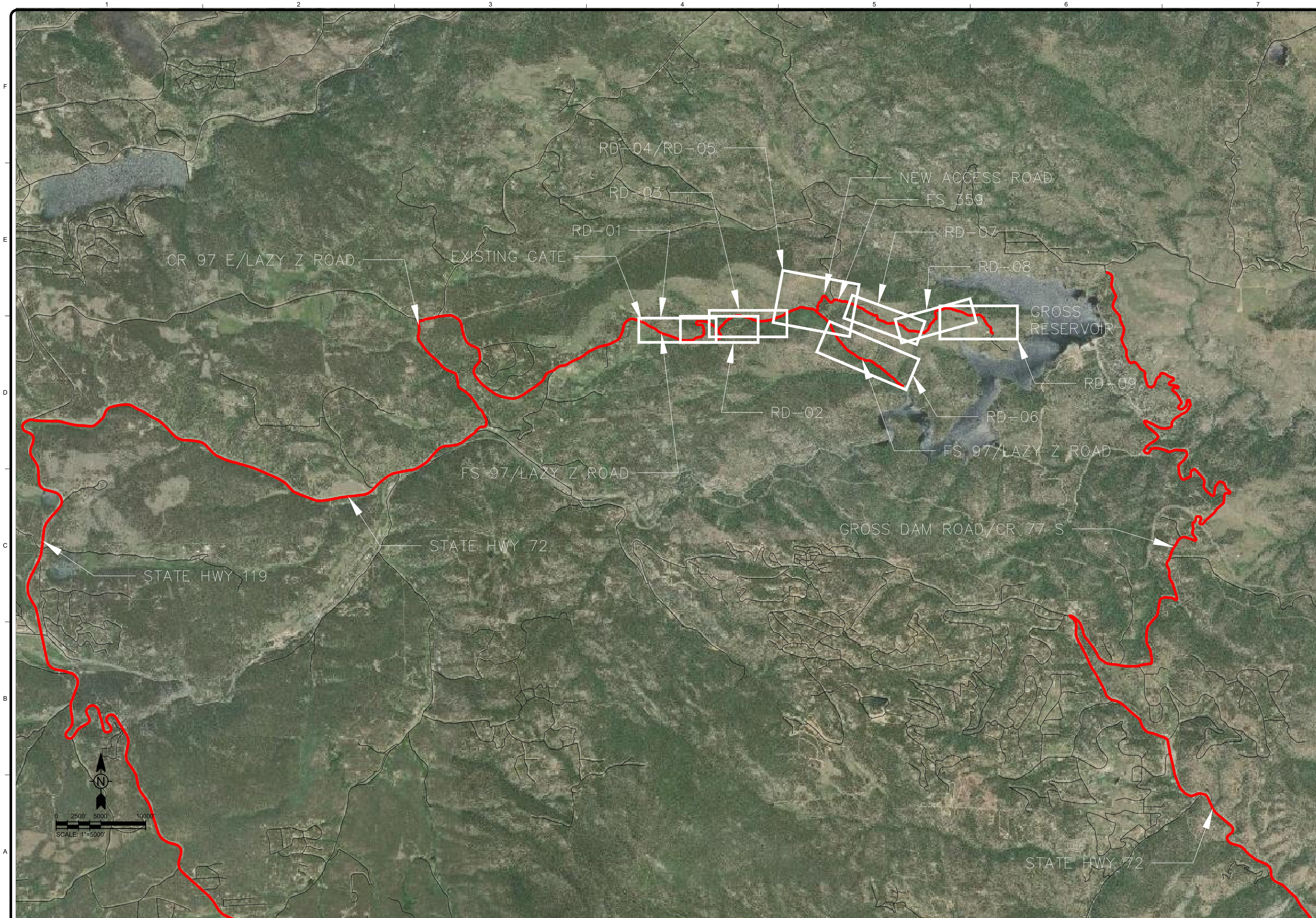
DENVER WATER
GROSS RESERVOIR EXPANSION PROJECT
CONCEPTUAL HAUL ROAD DRAWINGS
CONSTRUCTION GENERAL NOTES

PROJ:	194-6713
DESN:	AML
DRWN:	AML
CHKD:	JPP

G-02



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DENVER WATER
GROSS RESERVOIR EXPANSION PROJECT
KEY MAP AND TRANSPORTATION PLAN

PROJ:	194-6713
DESN:	AML
DRWN:	ENM
CHKD:	JPP

C-01

Bar Measures 1 inch, otherwise drawing not to scale

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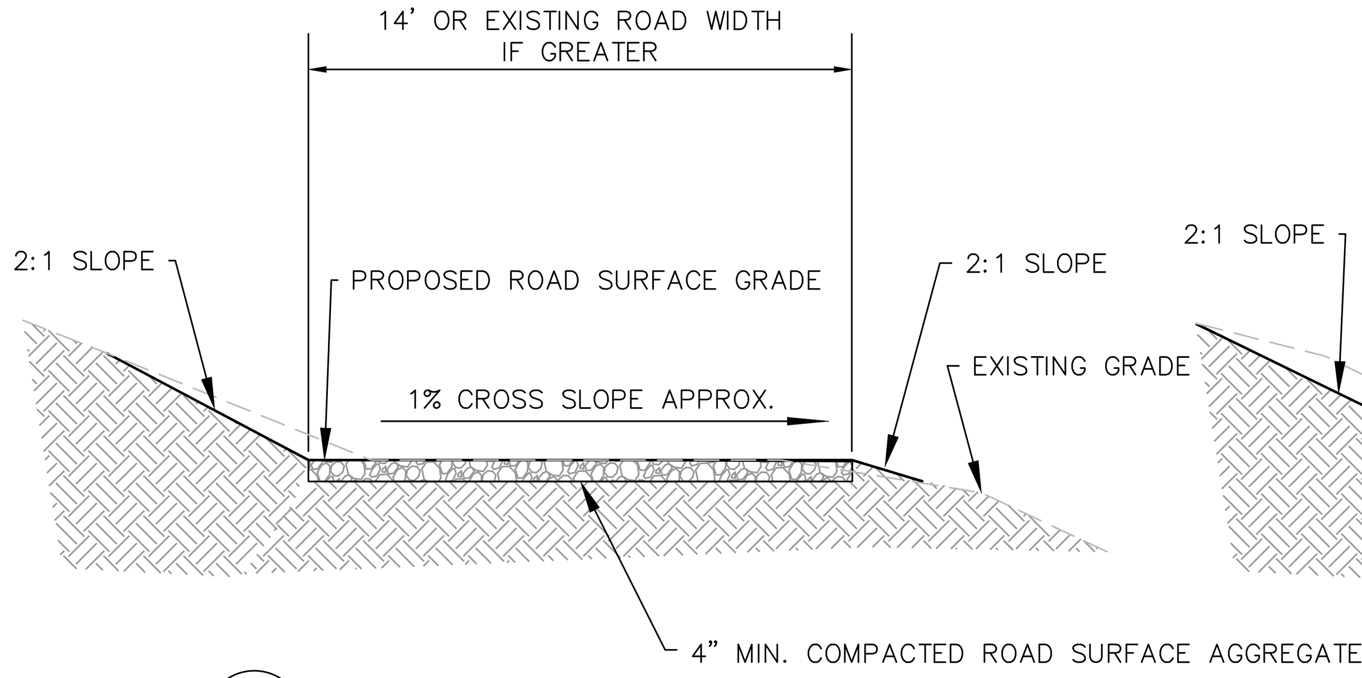
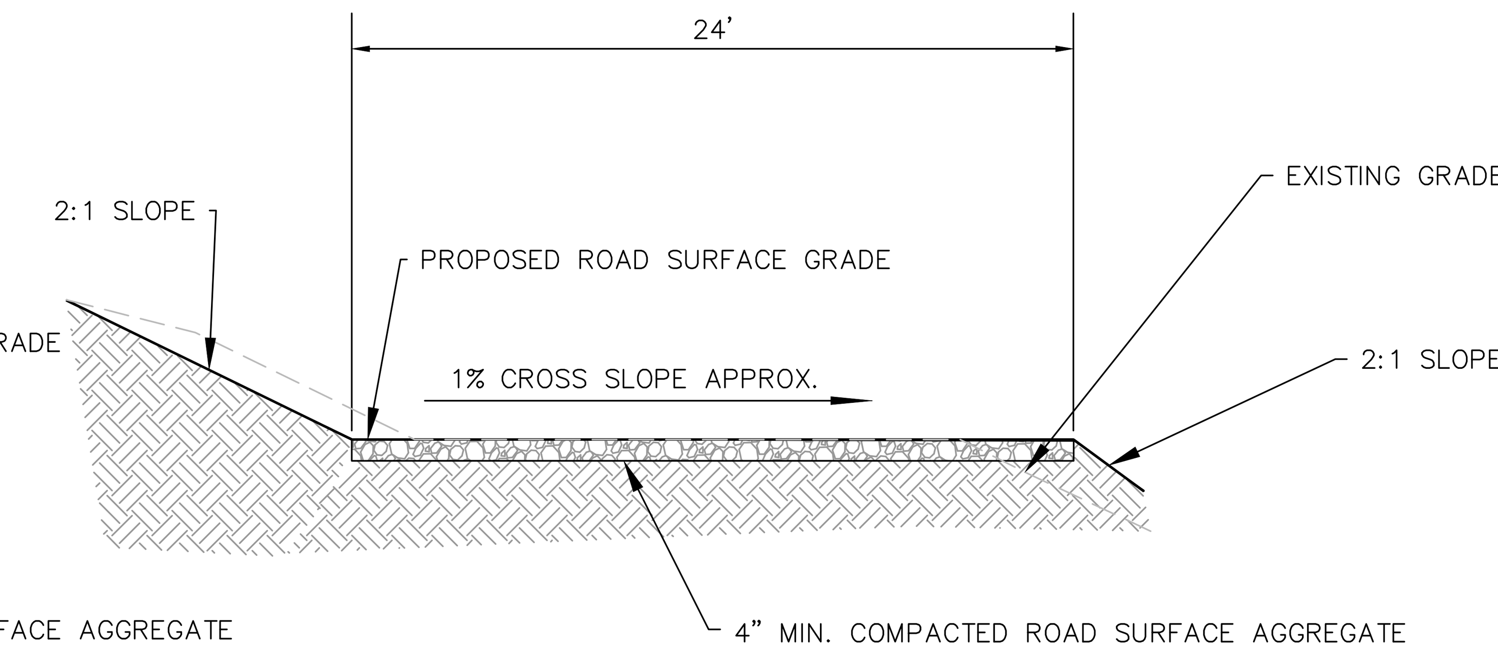


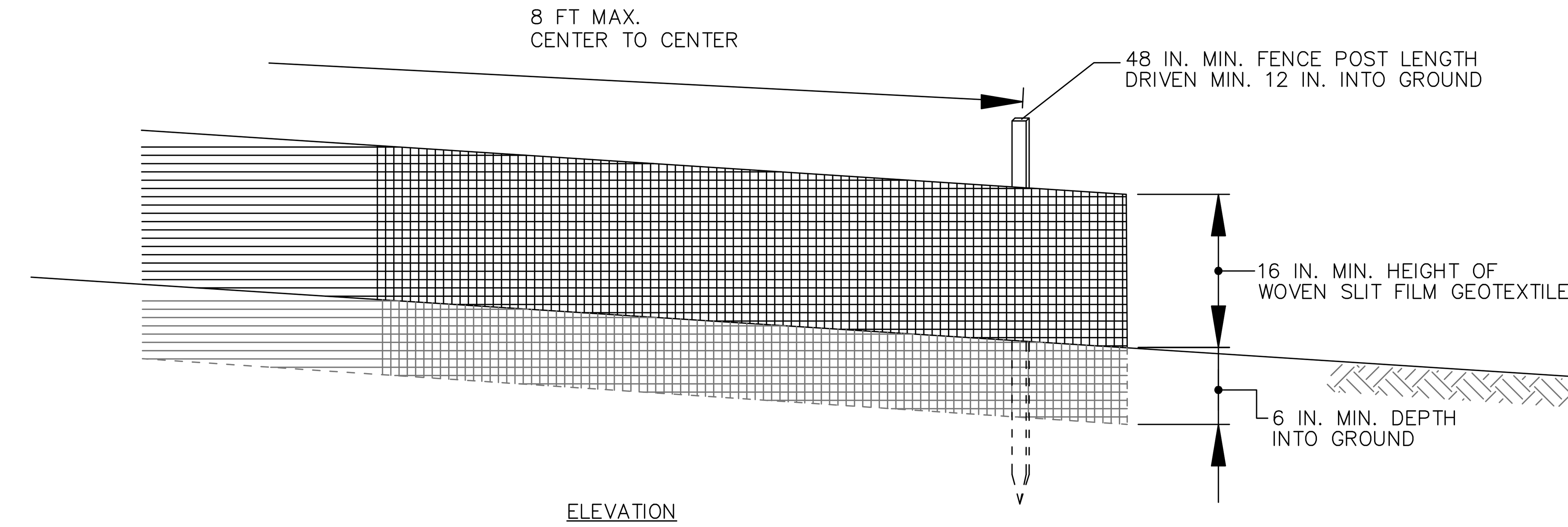
1 TYP ACCESS ROAD CROSS SECTION TYP.
NOT TO SCALE



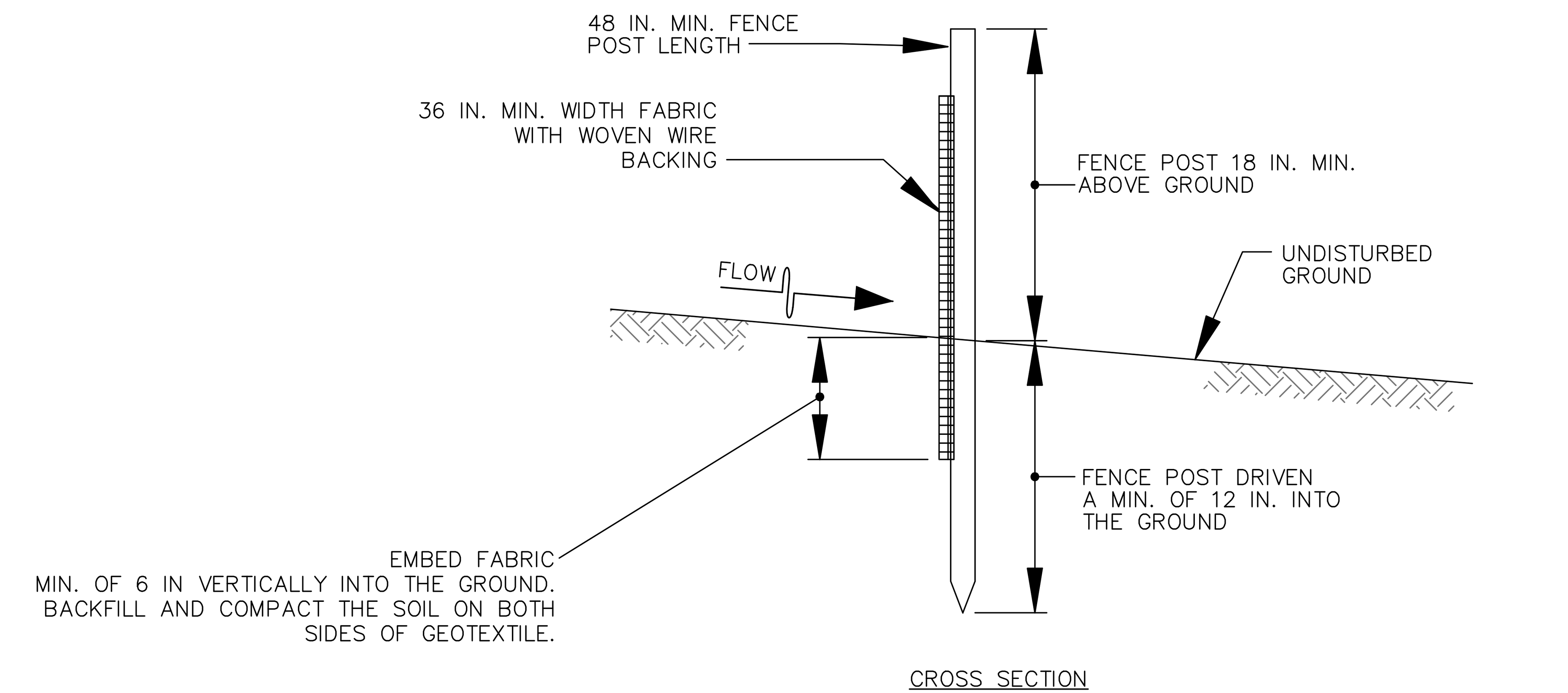
2 TYP PASSING/PULL OUT LANE CROSS SECTION TYP.
NOT TO SCALE

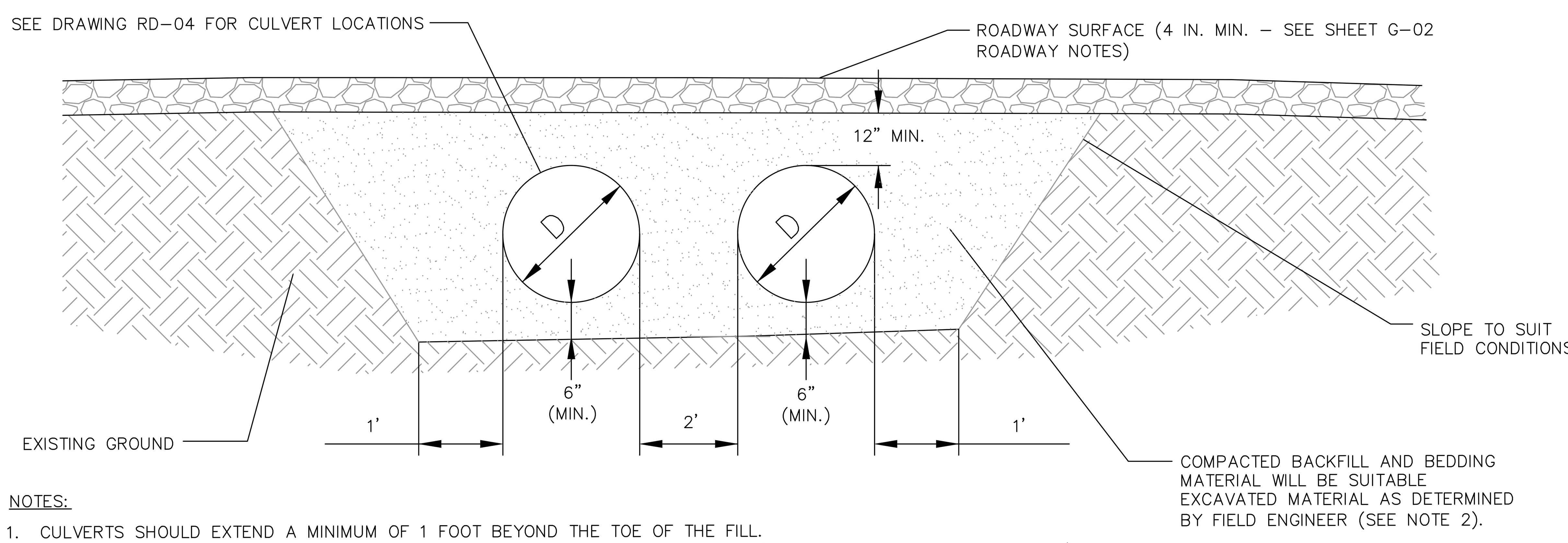
CONSTRUCTION SPECIFICATIONS

1. SIDE SLOPES IN CUT AND FILL AREAS SHALL BE 2:1 (H:V) UNLESS OTHERWISE DESIGNATED ON DRAWINGS.



3 TYP SILT FENCE DETAIL
NOT TO SCALE





NOTES:

1. CULVERTS SHOULD EXTEND A MINIMUM OF 1 FOOT BEYOND THE TOE OF THE FILL.
2. CULVERT BACKFILL WILL BE COMPACTED TO 95% OF THE MAXIMUM DRY DENSITY (±4% OPTIMUM MOISTURE CONTENT).

CULVERT CROSSINGS SCHEDULE EXISTING CULVERTS

CULVERT	DIAMETER (IN.)	# OF PIPES	MATERIAL	START INVERT (FT)	END INVERT (FT)	PROPOSED TEMPORARY LENGTH (FT)
C–1	36"	2	CMP	7674	7654	100
C–2	24"	1	CMP	7654	7642	50

SILT FENCE SPECIFICATIONS

1. FENCE POST SHALL BE MADE OF EITHER HOT ROLLED STEEL, AT LEAST 4 FEET LONG WITH TEE OR Y–BAR CROSS SECTION, SURFACE PAINTED OF GALVANIZED, MINIMUM NOMINAL WEIGHT 1.25 LB/FT^2, AND BRINDELL HARDNESS EXCEEDING 140, OR WOOD.
2. SILT FENCE MATERIAL SHALL BE POLYPROPYLENE, POLYETHYLENE, OR POLYAMIDE WOVEN OR NON WOVEN FABRIC. THE FABRIC WIDTH SHOULD BE 36 INCHES, WITH A MINIMUM UNIT WEIGHT OF 4.5 OZ/YD, MULLEN BURST STRENGTH EXCEEDING 190 LB/IN.^{2}, ULTRAVIOLET STABILITY EXCEEDING 70%, AND MINIMUM APPARENT OPENING SIZE OF U.S. SIEVE NO. 30.
3. WOVEN WIRE BACKING TO SUPPORT THE FABRIC SHALL BE GALVANIZED 2"X4" WELDED WIRE, 12 GAUGE MINIMUM.
4. POSTS, WHICH SUPPORT THE SILT FENCE, SHALL BE INSTALLED ON A SLIGHT ANGLE TOWARD THE ANTICIPATED RUNOFF SOURCE. POST MUST BE EMBEDDED A MINIMUM OF 1 FOOT DEEP AND SPACED NOT MORE THAN 8 FEET ON CENTER. WHERE WATER CONCENTRATES, THE MAXIMUM SPACING SHALL BE 6 FEET.
5. LAY OUT FENCING DOWN–SLOPE OF DISTURBED AREA, FOLLOWING THE CONTOUR AS CLOSELY AS POSSIBLE. THE FENCE SHALL BE SITED SO THAT THE MAXIMUM DRAINAGE AREA IS $\frac{1}{4}$ ACRE/100 FEET OF FENCE.
6. THE TOE OF THE SILT FENCE SHALL BE TRENCHED IN WITH A SPADE OR MECHANICAL TRENCHER, SO THAT THE DOWN–SLOPE FACE OF THE TRENCH IS FLAT AND PERPENDICULAR TO THE LINE OF FLOW. WHERE FENCE CANNOT BE TRENCHED IN (E.G., PAVEMENT OR ROCK OUTCROP), WEIGHT FABRIC FLAP WITH 3 INCHES OF PEA GRAVEL ON UPHILL SIDE TO PREVENT FLOW FROM SEEPING UNDER FENCE.
7. THE TRENCH MUST BE A MINIMUM OF 6 INCHES DEEP AND 6 INCHES WIDE TO ALLOW FOR THE SILT FENCE FABRIC TO BE LAID IN THE GROUND AND BACKFILLED WITH COMPACTED MATERIAL.
8. SILT FENCE SHALL BE SECURELY FASTENED TO EACH SUPPORT POST OR TO WOVEN WIRE, WHICH IS IN TURN ATTACHED TO THE STEEL FENCE POST. THERE SHALL BE A 3–FOOT OVERLAP, SECURELY FASTENED WHERE ENDS OF FABRIC MEET.
9. REMOVE ACCUMULATED SEDIMENT AND DEBRIS WHEN BULGES DEVELOP IN SILT FENCE OR WHEN SEDIMENT REACHES 50% OF FENCE HEIGHT. REPLACE GEOTEXTILE IF TORN. IF UNDERMINING OCCURS, REINSTALL FENCE.

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DENVER WATER
GROSS RESERVOIR EXPANSION PROJECT
CONCEPTUAL HAUL ROAD DRAWINGS
ESC AND ROAD DETAILS (SHEET 1 OF 1)

PROJ:	194-6713
DESN:	AML
DRWN:	ENM
CHKD:	JPP

C-02

Bar Measures 1 inch, otherwise drawing not to scale

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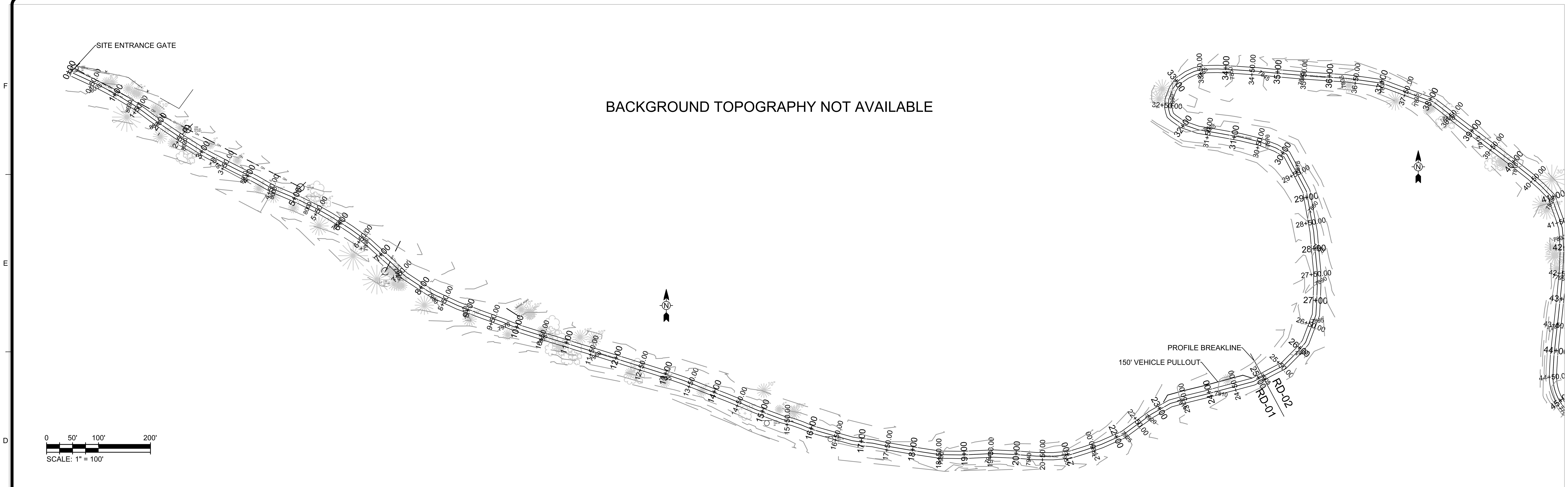
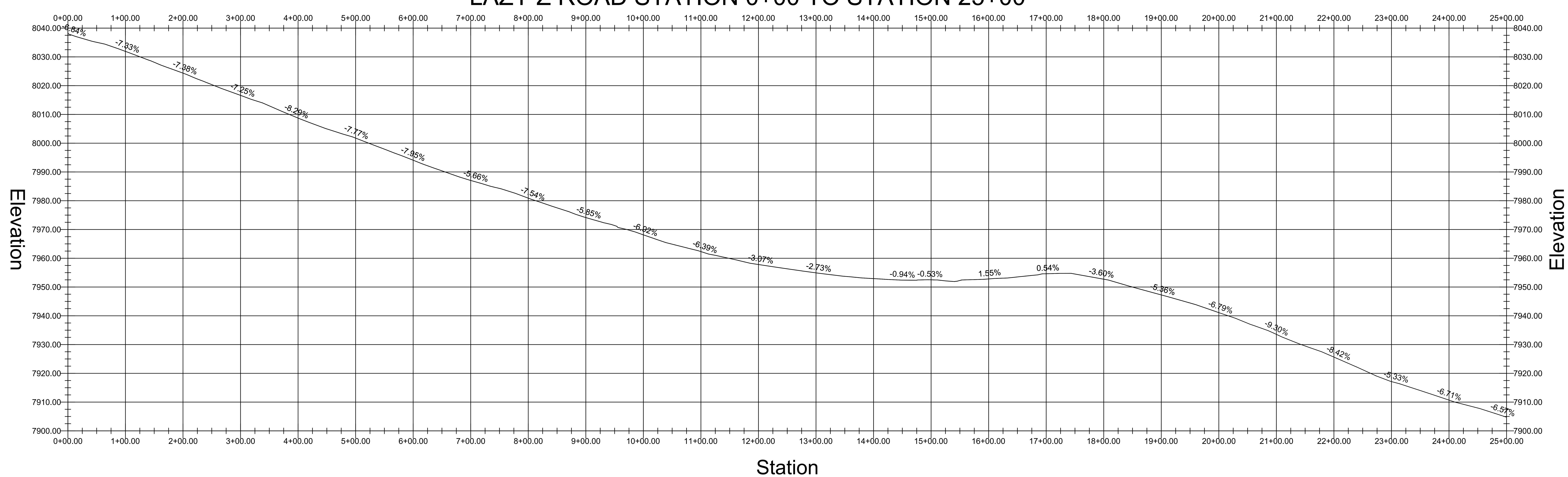


LAZY Z ROAD STATION 0+00 TO STATION 25+00



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DENVER WATER
GROSS RESERVOIR EXPANSION PROJECT
CONCEPTUAL HAUL ROAD DRAWINGS
ROAD LAYOUT PLAN AND PROFILE (SHEET 1 OF 9)

PROJ:	194-6713
DESN:	AML
DRWN:	ENM
CHKD:	JPP

RD-01

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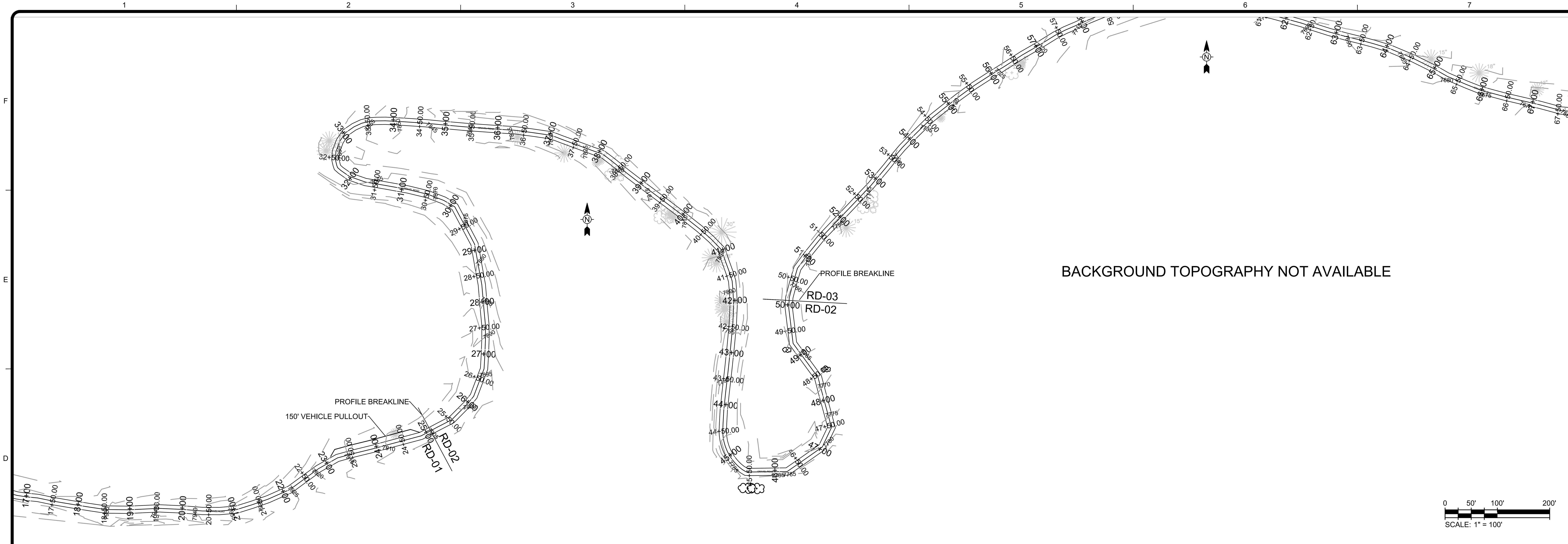

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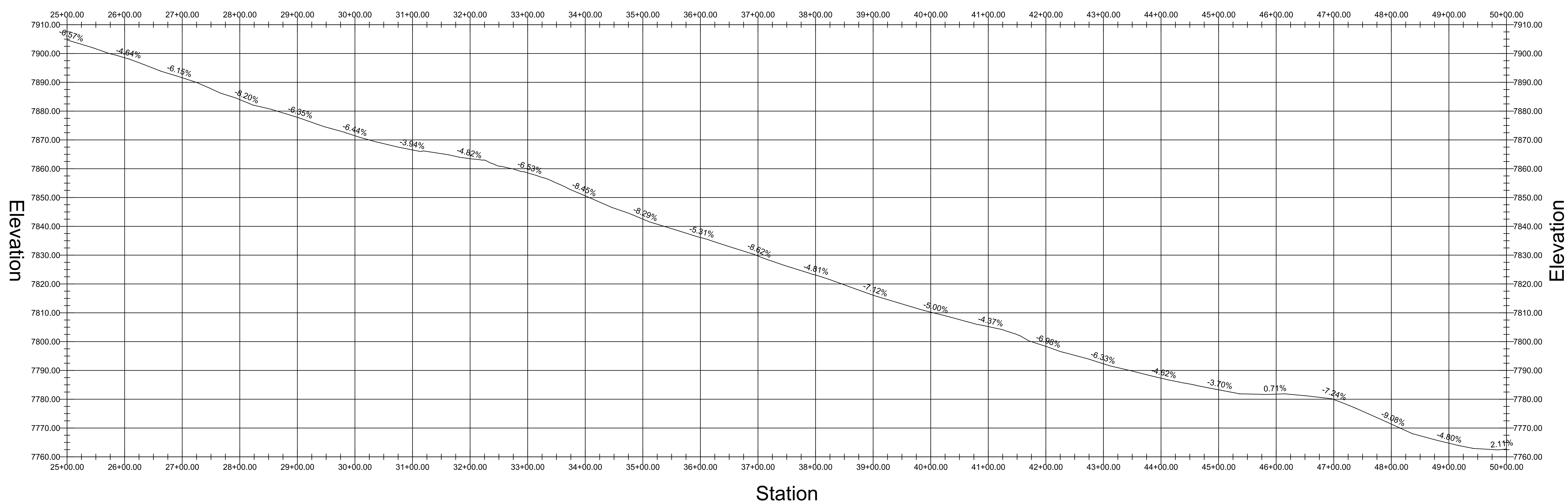

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CONCEPTUAL HAUL ROAD DRAWINGS
ROAD LAYOUT PLAN AND PROFILE (SHEET 2 OF 9)

PROJ:	194-6713
DESN:	AML
DRWN:	ENM
CHKD:	JPP

RD-02

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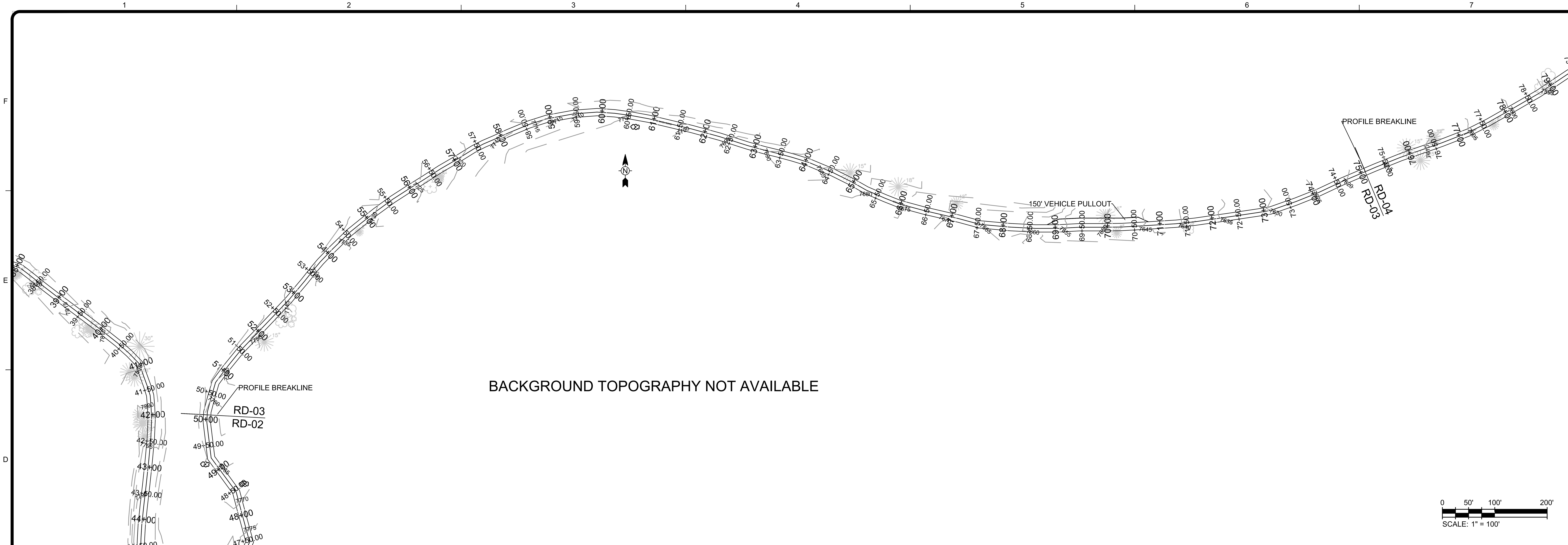
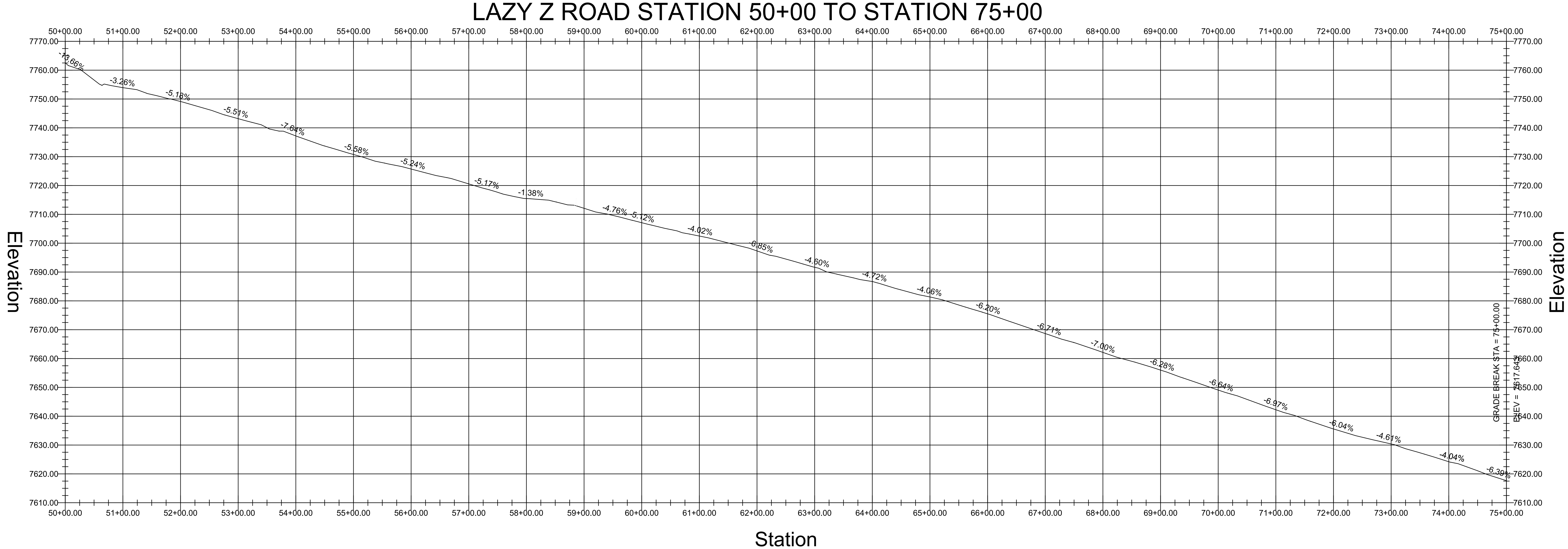


LAZY Z ROAD STATION 50+00 TO STATION 75+00



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DENVER WATER
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CONCEPTUAL HAUL ROAD DRAWINGS
ROAD LAYOUT PLAN AND PROFILE (SHEET 3 OF 9)

PROJ:	194-6713
DESN:	AML
DRWN:	ENM
CHKD:	JPP

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ROAD LAYOUT PLAN AND PROFILE (SHEET 4 OF 9)

PROJ:	194-6713
DESN:	AML
DRWN:	ENM
CHKD:	JPP

RD-04

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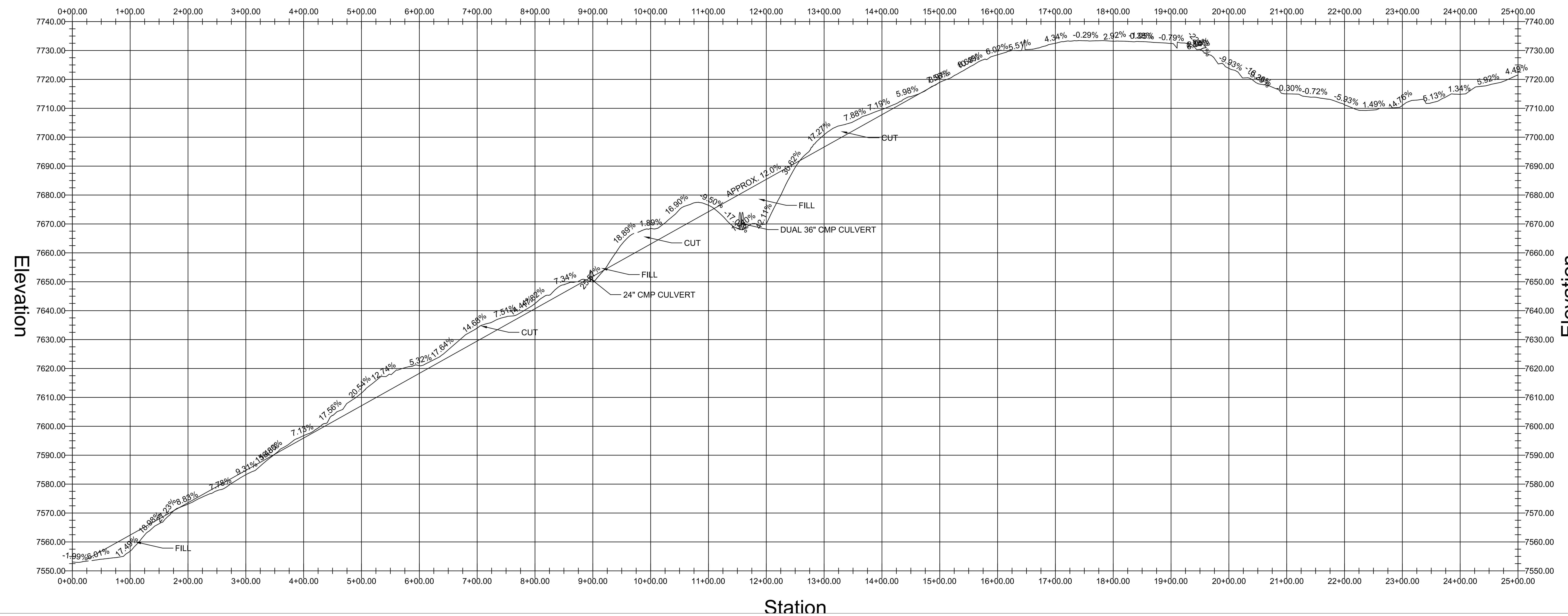
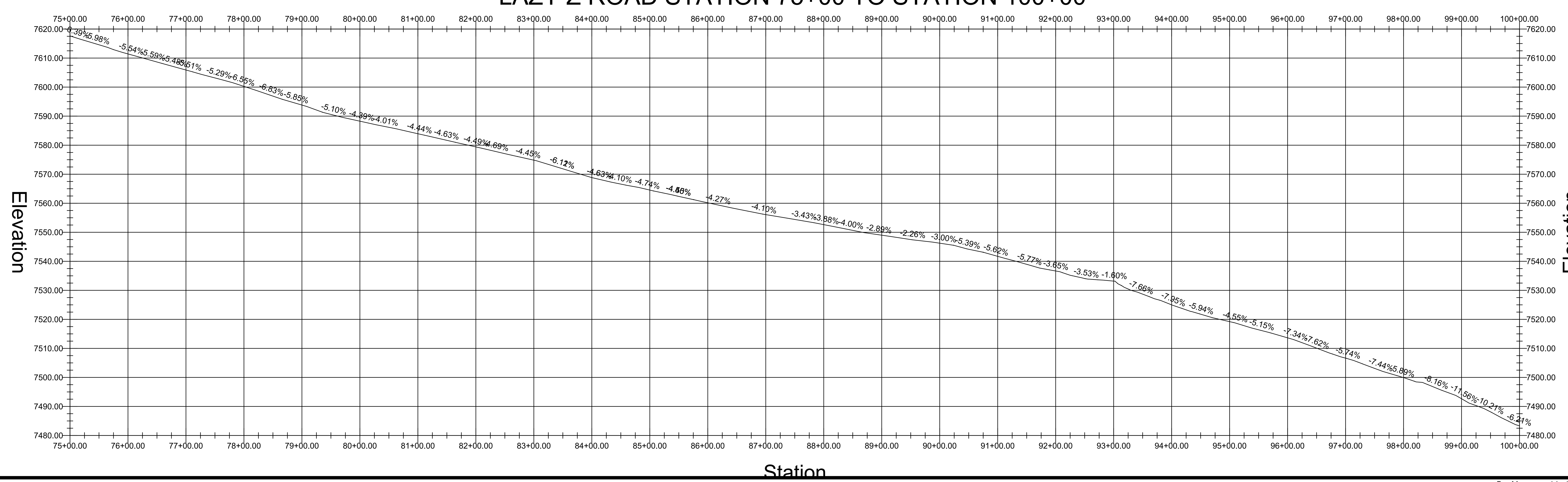
CONNECTOR ROAD AND FOREST SERVICE ROAD 359 STATION 0+00 TO STATION 25+00



LAZY Z ROAD STATION 75+00 TO STATION 100+00



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CONCEPTUAL HAUL ROAD DRAWINGS
ROAD LAYOUT PLAN AND PROFILE (SHEET 5 OF 9)

PROJ:	194-6713
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CHKD:	JPP

RD-05

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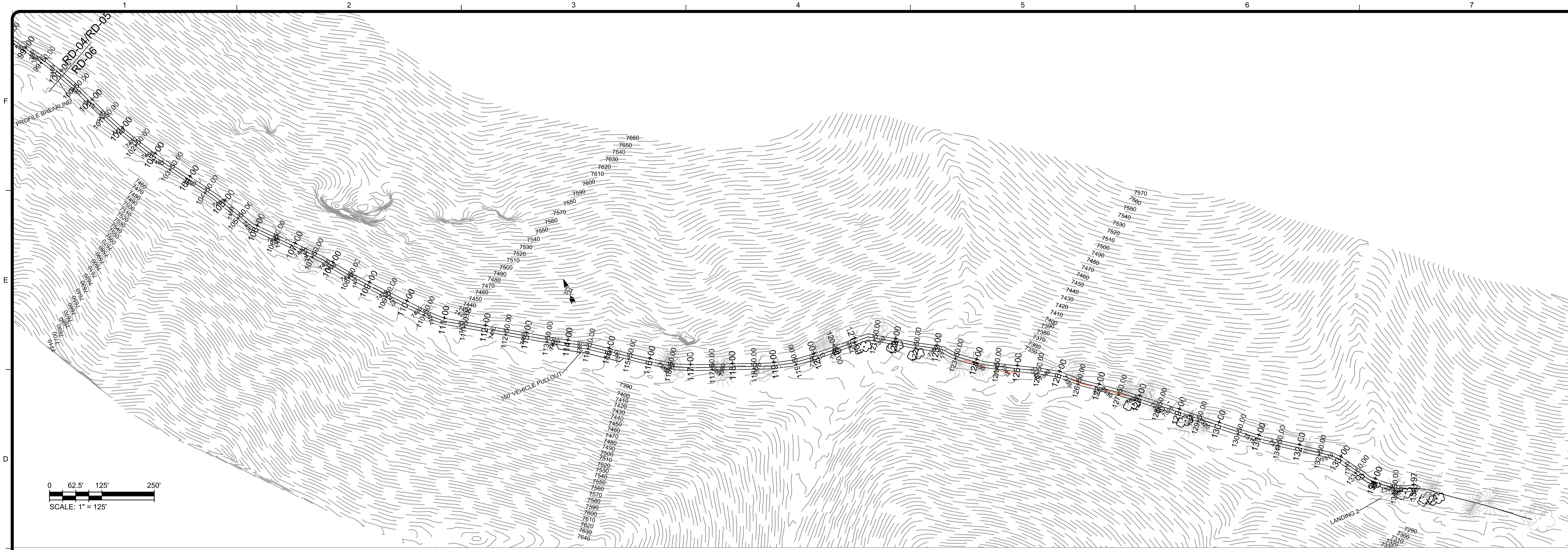

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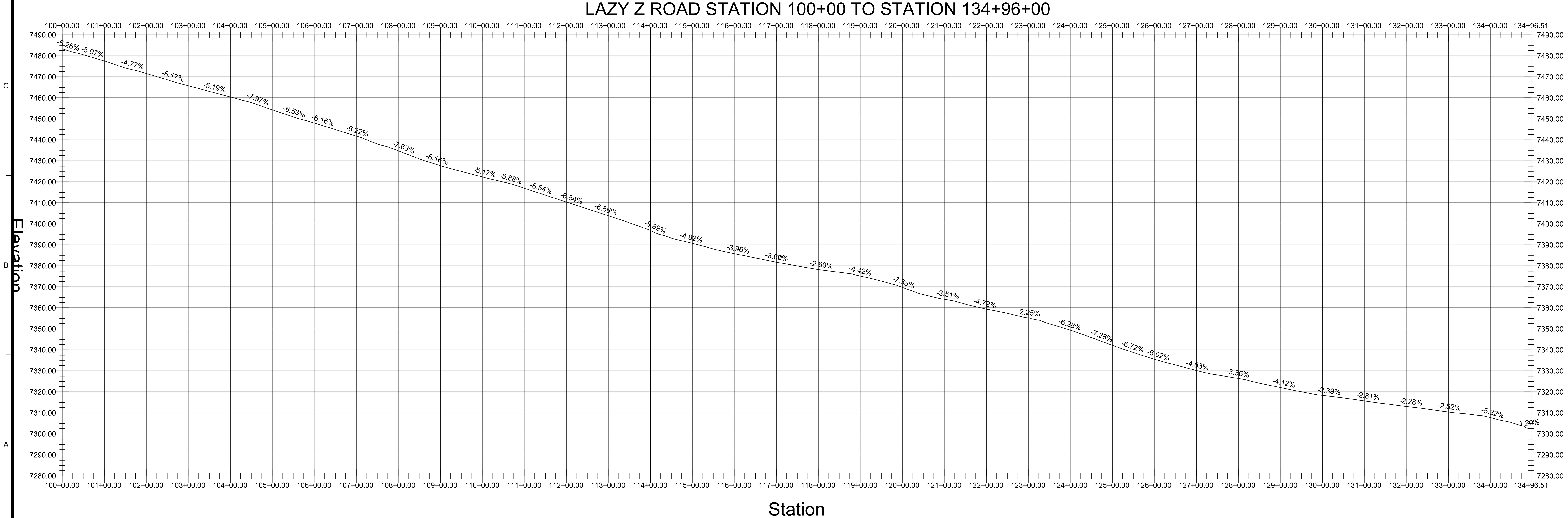

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CONCEPTUAL HAUL ROAD DRAWINGS
ROAD LAYOUT PLAN AND PROFILE (SHEET 6 OF 9)

PROJ:	194-6713
DESN:	AML
DRWN:	ENM
CHKD:	JPP

RD-06

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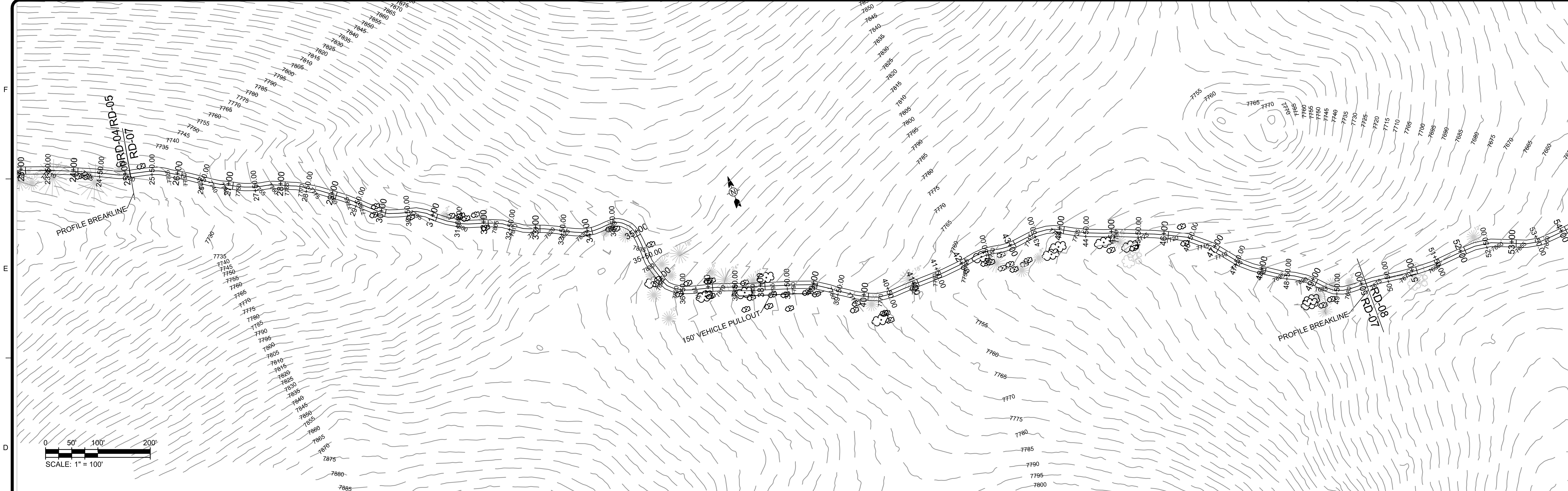

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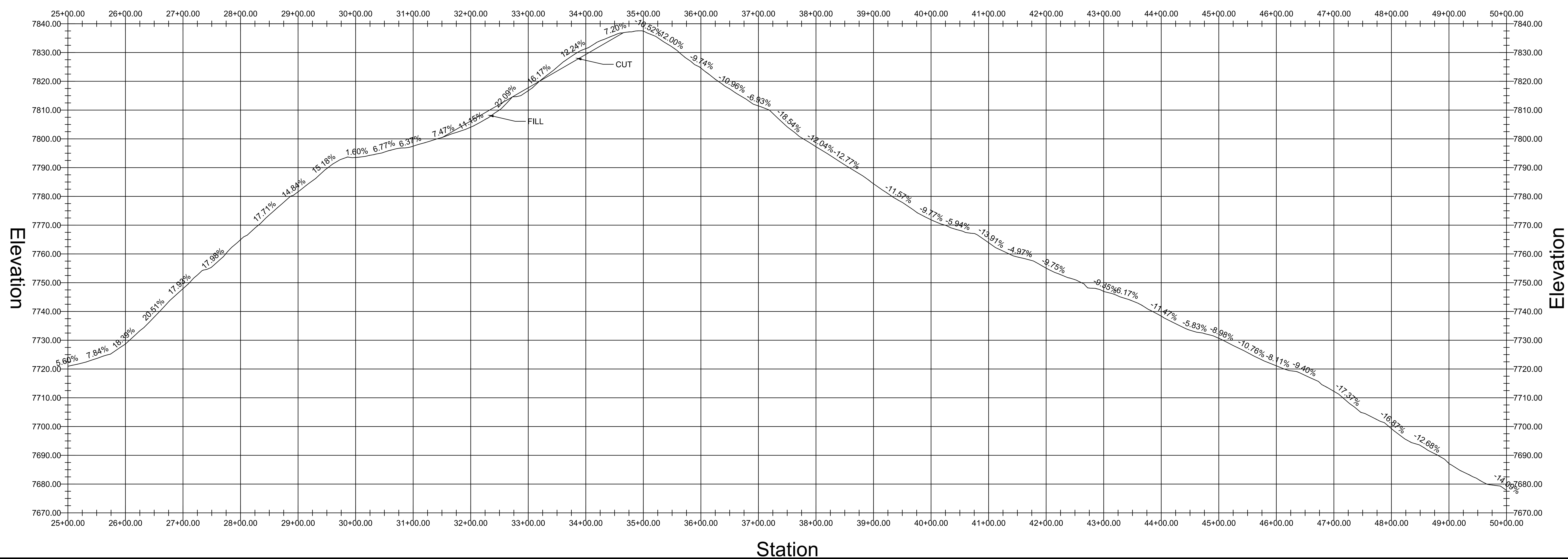

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GROSS RESERVOIR EXPANSION PROJECT
CONCEPTUAL HAUL ROAD DRAWINGS
ROAD LAYOUT PLAN AND PROFILE (SHEET 7 OF 9)

PROJ:	194-6713
DESN:	AZL
DRWN:	ENM
CHKD:	JPP

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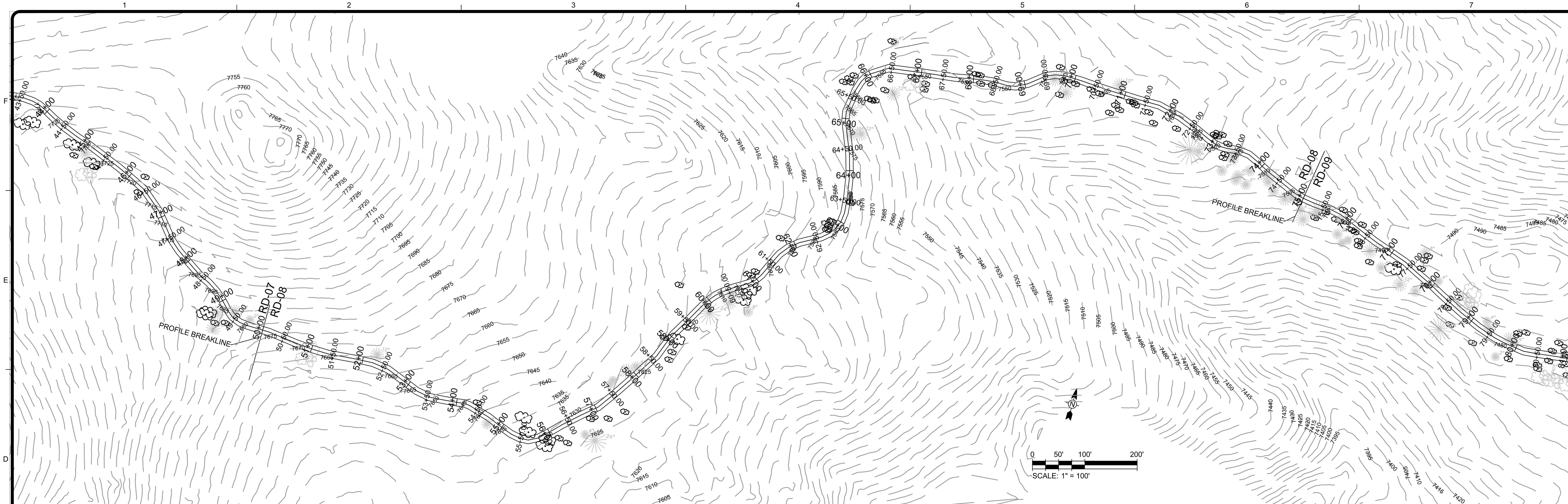
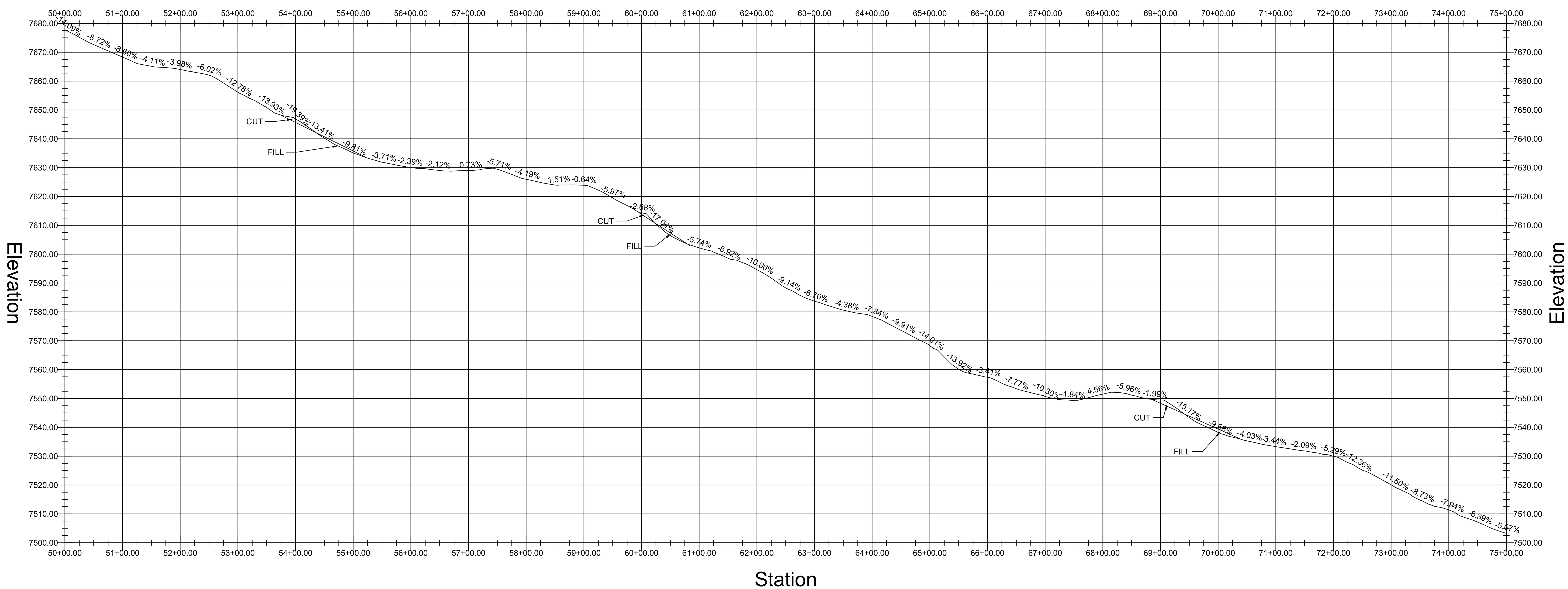


FOREST SERVICE ROAD 359 STATION 50+00 TO STATION 75+00



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ROAD LAYOUT PLAN AND PROFILE (SHEET 8 OF 9)

PROJ:	194-6713
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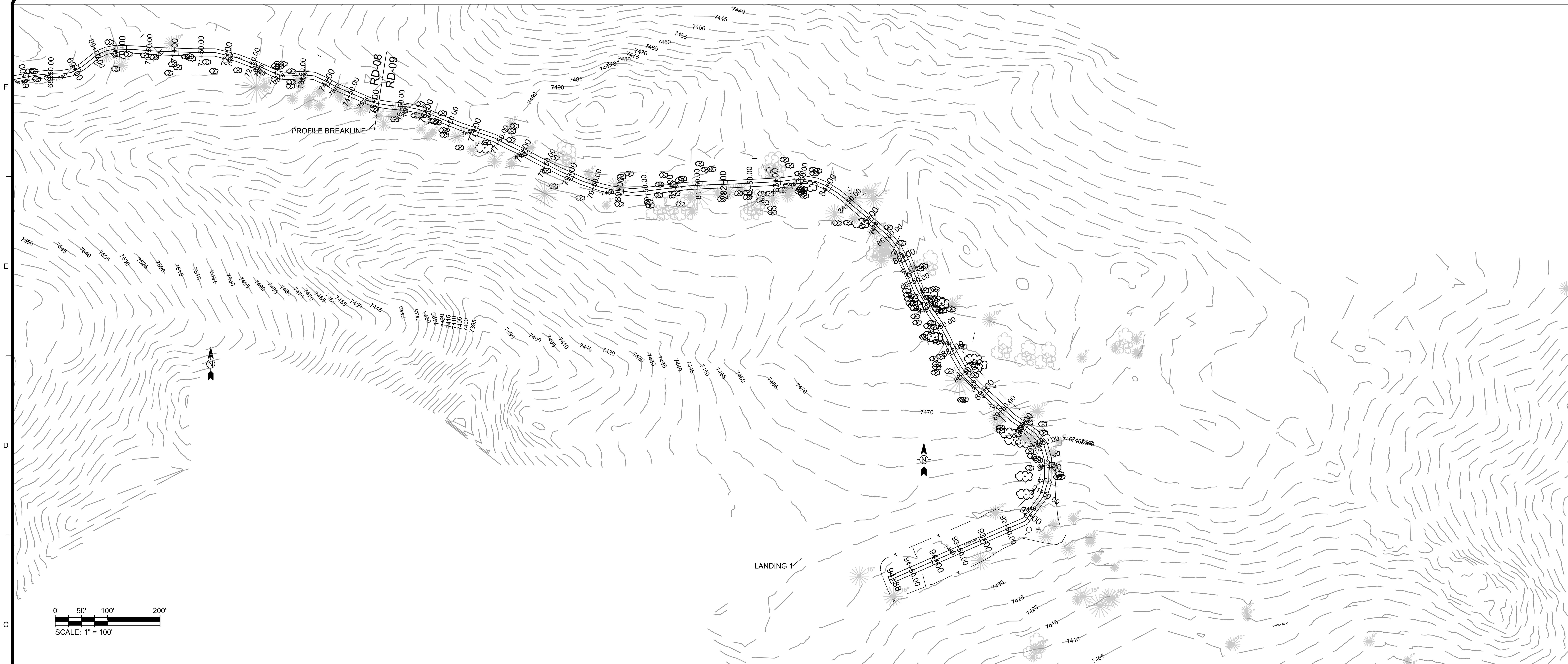
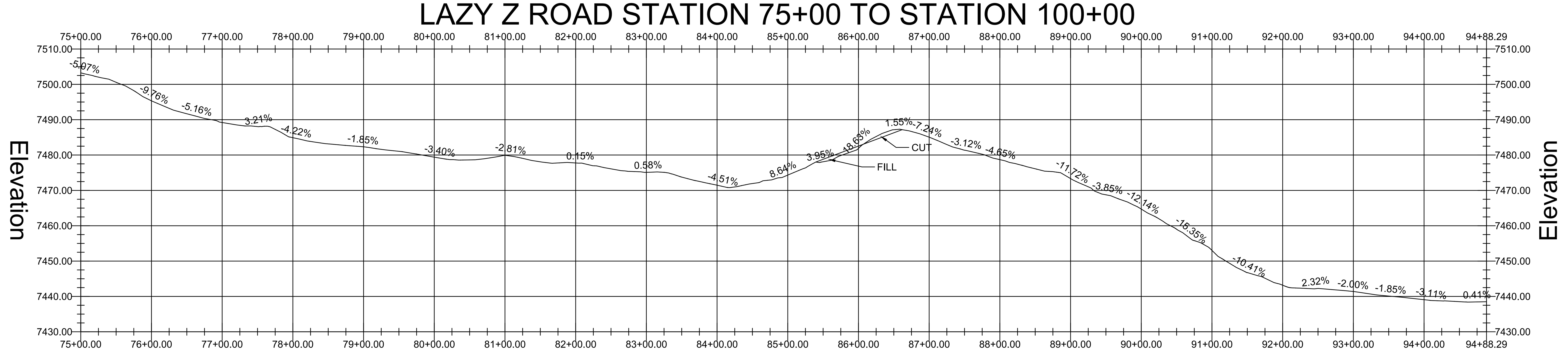


LAZY Z ROAD STATION 75+00 TO STATION 100+00



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CONCEPTUAL HAUL ROAD DRAWINGS
ROAD LAYOUT PLAN AND PROFILE (SHEET 9 OF 9)

PROJ:	194-6713
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DRWN:	ENM
CHKD:	JPP

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