TRI-STATE

June 29, 2021

Mr. Zach Trujillo
Environmental Protection Specialist
Colorado Division of Reclamation, Mining & Safety
Department of Natural Resources
1313 Sherman Street, Room 215
Denver, CO 80203

RE: Colowyo Coal Company L.P.
Permit No. C-1981-019
Technical Revision 149 (TR-149)
Collom Haul Road Storm Water Runoff Control Structures

Dear Mr. Trujillo,

Tri-State Generation and Transmission Association Inc. (Tri-State), is the parent company to Axial Basin Coal Company, which is the general partner to Colowyo Coal Company L.P. (Colowyo). Therefore, Tri-State on behalf of Colowyo is submitting technical revision 149 (TR-149) to Permit No. C-1981-019.

TR-149 propose a series of small channels and small sediment sumps to manage storm water runoff from the Collom Haul Road. TR-149 also proposes to abandoned several culverts in the lower portion of the Collom Haul Road. The small channels proposed will direct surface water flows to small sediment sumps where water will be allowed some settling time prior to discharge, or the storm water will be allowed to infiltrate.

Included in this technical revision is a change of index sheet to ease incorporation of this technical revision into the permit document, and a public notice for the Division's review. If you should have any additional questions or concerns, please feel free to contact Tony Tennyson at (970) 326-3560 at your convenience.

Sincerely,

DocuSigned by:
Chris Gilbreath
D250C711D0BF450...

Chris Gilbreath
Senior Manager
Remediation and Reclamation

CG:TT:der

Enclosure

cc: Jennifer Maiolo (BLM-LSFO)
Tony Tennyson (via email)
Angela Aalbers (via email)
File: C. F. 1.1.2.138 - G471-11.3(21)d

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CHANGE SHEET FOR PERMIT REVISIONS, TECHNICAL REVISION, AND MINOR REVISIONS

Mine Company Name: **Colowyo Coal Company**

Permit Number: **C-1981-019**

Date: **June 16, 2021**

Revision Description: **TR-149 Collom Haul Road BMPs**

Volume Number	Page, Map or other Permit Entry to be REMOVED		Page, Map or other Permit Entry to be ADDED		Description of Change
1					No Change
2A					No Change
2B					No Change
2C					No Change
2D					No Change
2E					No Change
3					No Change
4					No Change
4					No Change
5A					No Change
5B					No Change
6					No Change
7					No Change
8					No Change
9					No Change
10					No Change
12					No Change
13					No Change
14					No Change
15	List of Exhibits pages ix and x (2 pages)		List of Exhibits pages ix and x (2 pages)		List of Exhibits has been updated.
15	Rule 2, Page 74 (1 page)		Rule 2, Page 74 (1 page)		Citations for Volume 18C Exhibit 7, Item 25F have been inserted.
15	Rule 4, Page 2 through Rule 4, Page 7 (6 pages)		Rule 4, Page 2 through Rule 4, Page 7 (6 pages)		Section 4.03.1 has been updated which caused a short pagination shift.
16					No Change
17					No Change

CHANGE SHEET FOR PERMIT REVISIONS, TECHNICAL REVISION, AND MINOR REVISIONS

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Revision Description: **TR-149 Collom Haul Road BMPs**

Volume Number	Page, Map or other Permit Entry to be REMOVED		Page, Map or other Permit Entry to be ADDED		Description of Change
18A					No Change
18B					No Change
18C	Volume 18 C Table of Contents (1 page)		Volume 18 C Table of Contents (1 page)		Volume 18C table of contents has been updated.
18C			Page Exh. 7-25E-1, Figures Exh. 7-25E-1 through 7-25E-5 and 42 pages SEDCAD Outputs		Exhibit 7, Item 25E has been inserted into the permit.
18C			Pages Exh. 25F-1 through Exh. 25F-8 (8 pages), Figure Exh. 7-25F-1 (1 page), and SEDCAD outputs (7 pages)		Exhibit 7, Item 25F has been inserted. This Exhibit used to be in Volume 20.
18D					No Change
19					No Change
20	Volume 20 List of Exhibits (2 pages)		Volume 20 List of Exhibits (1 page)		Volume 20 List of Exhibits has been updated.
20	Exhibit 13C Pages 2 and 3 (2 pages)		Exhibit 13C Pages 2 and 3 (2 pages)		Exhibit 13C Table of Contents has been updated.
20	Exhibit 13C Page 5 (1 page)		Exhibit 13C Page 5 (1 page)		Table 13C-3C has been inserted.
20	Exhibit 13C Page 7 (1 page)		Exhibit 13C Page 7 (1 page)		Table 13C-6C has been inserted.
20	Map 13C-1 Sheet 2		Map 13C-1 Sheet 2		Map 13C-1 Sheet 2 has been updated.
20	Exhibit 24, Item 1 All pages (17 pages)				Exhibit 24, Item 1 has been renamed and moved to Volume 18C.
21					No Change
22	Map 25E Sheets 1 and 2		Map 25E Sheets 1 and 2		Map 25E Sheets 1 and 2 have been updated.

LIST OF EXHIBITS

Volume 18C

Exhibit 7, Item 23 Sediment Control Plan Parts J – M

Exhibit 7, Item 25 Collom Post Mine Channel Design

Exhibit 7, Item 25A Collom In Pit Drilling Small Area Exemption

Exhibit 7, Item 25B Collom Topsoil Depth Testing Small Area Exemption

Exhibit 7, Item 25C Temporary Access Road Small Area Exemption

Exhibit 7, Item 25D Power Line Light-Use Road Small Area Exemption

Exhibit 7, Item 25E Collom Haul Road Channels

Exhibit 7, Item 25F Collom Haul Road Culverts

Volume 18D

Exhibit 7, Item 26 Collom Pond As-Builts

Volume 19

Exhibit 9, Item 8 Baseline Survey of Soil Resources Collom Mining Area, Tetra Tech, July 2006

Exhibit 9, Item 9 Prime Farmland Determination Documentation

Volume 20

Exhibit 10, Item 6 Proposed Collom Coal Mine Project Baseline Vegetation Survey, May 2006, Cedar Creek Associates, Inc.

Exhibit 10, Item 7 Wetlands and Waters of the US Delineation for Collom Project, May 2006, Cedar Creek Associates, Inc.

Exhibit 11, Item 1 Wildlife Survey Report for the Collom Permit Study Area, August 25, 2006, Cedar Creek Associates, Inc.

Exhibit 11, Item 2 2007 Wildlife Monitoring Report for the Collom Permit Study Area, December 20, 2007, Cedar Creek Associates, Inc.

Exhibit 13C Cumulative Bond ScheduleExhibit 14, Item 7 Pre-Blast Survey – Structures within ½ Mile of Collom Mining Area
(Pending)

Exhibit 14, Item 8 Pre-Blast Survey – Offering Letters (Pending)
Pre-Blast Structure Locations Drawing (Pending)

LIST OF EXHIBITS

LIST OF EXHIBITS – VOLUME 18C

Exhibit 7, Item 23	Sediment Control Plan Parts J - M
Exhibit 7, Item 25	Post Mine Channel Design
Exhibit 7, Item 25A	Collom In Pit Drilling Small Area Exemption
Exhibit 7, Item 25B	Collom Topsoil Depth Testing Small Area Exemption
Exhibit 7, Item 25C	Temporary Access Road SAE
Exhibit 7, Item 25D	Power Line Road SAE
Exhibit 7, Item 25E	Collom Haul Road Channels
Exhibit 7, Item 25F	Collom Haul Road Culverts

surrounding areas, and all culverts are designed to safely pass peak runoff from a 10 year, 24 hour precipitation event (Please see Volume 18C Exhibit 7, Item 25F).

The Collom Haul Road has constructed to meet the applicable haul road regulations as well as internal road design guidelines while minimizing additional disturbed area and preventing environmental damage. The as-built configuration can be found on Map 25E Sheets 1 through 4. The Collom Haul Road has an overall width of approximately 100 feet, with a 28-foot asphalt-running surface as shown on (Map 25E Sheet 1).

Asphalt pavement specifications were based on a 30 year design life with an 18" thick base course (gravel) and 7.0" asphalt thickness. The asphalt installed will support a 50 ton coal haul trucks with axle loads of about 81 psi. Cut slopes have been completed at 0.25H: 1V or less when completed in competent rock. Elsewhere, cut slopes in unconsolidated materials were typically laid back at 2H:1V; however some areas are steeper or shallower based on field conditions encountered during construction (please see Map 25E Sheet 3).

There are two main haul roads that will be built to haul overburden materials from the pit to the temporary overburden stockpile. These are shown on Map 25D and are designated as the East and West Haul Roads. Please see section 4.03.1 for details pertaining to these two haul roads and haul roads that will be constructed within the mining area.

Several access roads have been constructed to support mining operations at the Collom mine. Two access roads were constructed to the Section 25 and 26 sediment ponds, an access road was constructed to access the Collom Haul Road from the Jubb Creek entrance off of Moffat County Road 32, and several temporary access roads were established to support intial mining operations. The locations and as-built configurations for these access roads are provided in Volume 18B, Exhibit 7-23, Part D, Figures D1 through Figure D4.

2.05.3 (4) Operation Plan – Ponds, Impoundments, and Diversions

To control runoff, and protect surface and ground water quality, Colowyo will construct several new sedimentation structures and diversion ditches. All ponds, impoundments, and diversions are designed to meet or exceed the requirements of 2.05.3(4) and 4.05.6. All sediment ponds will be constructed and maintained in accordance with the parameters mentioned in Volume 1, Section 2.05. Impoundments will be inspected quarterly as discussed in Section 4.05.6. Please see Exhibit 23, Item 1 – Geotechnical Report Collom Temporary Spoil Pile and Pond and Exhibit 23, Item 2. Also refer to Exhibit 7, Item 25 – Collom Post Mine Channel Design; Exhibit 7, Item 23, Part C – Collom Pond Design Maps; and Exhibit 7, Item 23 (for information pertaining to diversion channels during mining) for specific designs and locations of these structures.

During the initial facitlites development a stage development of the Section 36, Middle Pond, and Section 25 Pond will occur to avoid the brooding and lekking season for Greater Sage Grouse. This plan can be seen in Exhibit 7, Item 23, Part J.

The sediment ponds will remain in place until such time as the entire disturbance footprint area reporting to these structures is reclaimed and the requirements of Rule 4.05.2(2) are met. The best case scenario for this would be a minimum of 2 years after the last seeding occurs within the affected contributing watershed. Therefore, the earliest anticipated removal of these structures is approxiamtely 2035.

One containment pond (Wilson Storage Pond) is utilized to store water during the initial construction of the Collom Haul Road and Collom Facilities Area. Water is pumped or trucked in from an exisisting

a manner to safely pass peak runoff from a 10 year, 24 hour precipitation event (Please see Volume 18C Exhibit 7, Item 25F). During construction of the Collom Haul Road, the field engineer shall determine the need for control measures during construction. Such temporary and permanent control measures would include silt fences, S-fence, straw bales, straw wattles, rock check dams, or other measures such as downstream sediment ponds.

A network of temporary channels and small sediment sumps will be utilized to management stormwater runoff from the Collom Haul Road. The location of these channels and small sediment sumps are shown on Map 25E. Sheet1. The channel configuration details including reporting watershed delineations for these channels can be found in Volume 18C Exhibit 7, Item 25E.

At the request of Moffat County an elevated roadway crossing will be installed where the Collom haul road crosses Moffat County Road 51 (CR-51). Once the elevated crossing is installed, CR-51 will allow public traffic to cross over the top of the Collom Haul Road. An equipment corrider will be installed adjacent to the elevated crossing to provide large equipment access from the exisiting mining areas to the Collom mine. Design details for this elvated crossing can be found on Map 25F.

The Collom Haul Road heavy equipment traffic will cross CR-51 at grade. Only non-production mine traffic will utilize the at grade crossing. All normal light vehicle and coal haul traffic will be separated from CR-51 by an overpass. The at grade crossing will employ typical signage as well as visual indication on the CR-51 approach to the intersection at adequate distance to warn the public of the intersection and potential interaction with mine equipment. Crossing gates to the haul road will be kept in the closed position preventing access to the Collom Haul Road by non-authorized personnel to restrict access onto the Collom Haul Road. When the Colowyo Mine vehicles approach to cross CR-51, gate(s) will close to the CR-51 traffic, then gate(s) will open to the haul road allowing the mine vehicles to pass. Access to the haul road gates will be through authorized Colowyo staff only with appropriate measures to ensure that the public cannot readily open the gates.

For wildlife protection measures on the Collom Haul Road, Colowyo limit's vehicle speed limits to 50 mph at the locations where the Collom Haul Road to the Gossard Loadout intersects established wildlife travel/migration corridors. These areas also have supplemental lightening installed to improve wildlife visibility and to assist in minimizing wildlife/vehicle collisions. Colowyo maintains a record of all wildlife/vehicle collisions if they occur that includes date, time, location, and species involved in the collision.

There is one haul road that will be constructed outside of the Collom Pit to haul coal to the coal stockpile area and primary crusher (please see Map 22B for stockpile and crusher locations). This haul road is shown Map 25D and is designated as the Collom Coal Haul Road. The Collom Coal Haul Road is designed to allow large mining equipment access and egress to and from the pit area to the coal stockpile and coal crushing faciltiy. Once this haul road intercept the crest of the mining limit, within the Collom Pit, it will be exempt from any construction specifications, since roadways within the immediate mining pit area are exempt for construction specifications in accordance with Rule 1.04(111). The Collom Coal Haul Road will be designed and constructed in accordance with Rule 4.03.1 as shown on Map 25D.

Temporary haul roads and in-pit haul road will be utilized to support mining will be developed within the Collom Pit and the Temporary Spoil Pile area. These roads will constantly be changing and moving as the Collom pit advances and as the Temporary Spoil Pile is constructed. In accordance with Rule 1.04(111) these roads will be exempt from design specification required under Rule 4.03.1. They will be designed to Colowyo's internal haul road design standards for the equipment that will be operating on them.

4.03.2 Access Roads

In order to obtain access to the Section 26, Section 25, Section 36, and Middle sediment ponds, access roads will be constructed as shown in Volume 18B, Exhibit 7, Item 23.

Use of these access roads will be for routine environmental monitoring and maintenance activities. Typical road use would consist of several trips per week by a light use vehicle using one way travel and low speed. For design information of the access roads please see Exhibit 7-23 Figures D1 and D2. Any outslopes created from the construction of this access road will be seeded with the mix listed below, post construction.

Several temporary access roads will be constructed to allow access to construct the west side sediment control system and to temporarily haul topsoil to a stockpile. These temporary access roads will be constructed in accordinace with Volume 18B, Exhibit 7, Item 23, Part D. Any outslopes created from the construction of this access road will be seeded with the mix listed below, post construction.

At the entrance to Jubb Creek off Moffat County Road 32, an access road will be established from the temporary facities area to where it ties into the Collom haul road. This access road will allow equipment, supplies, and man power to access and egress during the development of the Collom haul road and Collom factilites area. The Jubb Creek access road will be constructed in accordance with Volume 18B, Exhibit 7, Item 23, Part D. Any outslopes created from the construction of this access road will be seeded with the mix listed below, post construction.

All access roads are designed to meet the standards of Rule 4.03.2 for Access Roads. They are specifically designed to meet the minimum design requirements while minimizing additional disturbed area and preventing environmental damage. Additional discussions of these access roads may be found under Section 2.05.3(3).

The access road cut/fill stabilization seed mix is as follows:

Western wheatgrass @	4 Lbs PLS/Acre
Mountain Brome @	4 Lbs PLS/Acre
Kentucky Bluegrass @	2 Lbs PLS/Acre
Sanfoin @	2 Lbs PLS/Acre
Total	12 Lbs PLS/Acre

Following construction, a report by a registered professional engineer shall be provided to the Division indicating that the roads have been built as designed. Following mining activities, the access roads may be request to remain in place as a private ranch road and therefore would not be reclaimed. Should the access roads be requested to remain post-mining, the applicable surface owner and Colowyo will provide the Division with a letter documenting this request at the appropriate time.

4.03.3 Light-Use Roads

Light roads may be used in portions of the Collom permit expansion area. Typically, these roads are existing ranch or two track roads that were exisiting prior to the development of the Collom operation. Construction and maintenance of these roads are discussed in the Volume 1, Section 4.03.3.

Several light-use road will be utilized to support construction and long-term access to the power line that will provide power to electrical powered equipment in the Collom Pit. The light use road located in the

southern portion of Section 36 (T4N, R93W) and the northern portion of Section 1 (T3N, R94W) follows the power line to where it intersects the eastern portion of the Collom Pit and the road will follow the power line out into the future mining areas of the Collom Pit. Other sections of the light use raod will be within the Collom Pit footprint adjacent to the power line itself. Once mining progess to this power line location, the power line will be moved to the south, and the only portion of the light use road that will reamin is in the southern portion of Section 36 and norther portion of Section 1.

In accordance with Rule 4.03.3 (3), a field-design method will be utilized to construct the light-use road. Topsoil will be removed and windrowed adjacent to the road. Sediment control for the portion of the road that is outside of the Section 25 Pond watershed is described in Volume 18B, Exihibit 7-25D.

4.04 SUPPORT FACILITIES

The original support facilities used at the mining operation, including the office, shop and warehouse complex, and the coal handling and loadout facilities may continue to serve as minor support facilities for this expansion and are shown within the original Colowyo Permit Map 21 and Map 22, Volume 8. Many of the support structures were constructed at the mine start-up in 1976-1977. The complete discussion on all the original support facilities is found under Sections 2.05.3 and 4.04 in Volume 1.

The Collom area facilities will include an administration building, shop and warehouse facility, coal crushing, explosives bunker, sedimentation ponds, utility lines, water lines, and haul roads that will be constructed near the Collom Pit area. These facilities are detailed in the Structure and Facilities Map 22B.

4.05 HYDROLOGIC BALANCE

4.05.1 General Requirements

Please see Section 4.05.1 in Volume 1.

In addition to the mining, reclamation, and treatment methods referenced in this section, further protection of the hydrologic balance will be established by an on-going plan for monitoring potential changes in surface water quality and quantity and valley fill groundwater quality. This monitoring plan is described under Section 4.05.13 and the monitoring locations are graphically shown on Map 10B.

4.05.2 Water Quality Standards and Effluent Limitations

Please see Section 4.05.2 in Volume 1.

4.05.3 Diversions and Conveyance of a Watershed Less than One Square Mile

The drainage and sediment control measures described under Section 2.05.6 and presented in the Erosion and Sedimentation Control Plan will provide for clean water diversion of surface drainages within the Collom Pit area, as needed for mine operations (please see Exhibit 7, Item 23, Part A) . A system of clean water diversion ditches upslope from the mining activities will be constructed to divert surface runoff away from the disturbed areas (Collom Pit). These temporary diversions will be constructed to pass at a minimum the runoff from the precipitation event with a two-year recurrence interval.

Any topsoil stockpile areas that may be constructed outside the confines of engineered sediment control structures will be required to have a perimeter ditch and berm constructed around the entire footprint of the stockpile sufficient to capture and retain any rainwater/snowmelt that may be generated from the

stockpile area to preclude loss and/or contamination of the topsoil resource. A demonstration of the effectiveness of sediment control structures to be constructed around several topsoil stockpiles planned outside of primary sediment control may be found under Exhibit 7, Item 23, Part D.

4.05.4 Stream Channel Diversions (Relocation of Streams)

The drainage and sediment control measures described under Section 2.05.6 and presented in the Erosion and Sedimentation Control Plan (Exhibit 7, Item 23) will provide for temporary diversion of surface drainages within the permit area, as needed for mine operations. A system of temporary ditches will be used to divert runoff from disturbed areas to sediment ponds. The natural drainage systems will be restored to historic drainage patterns once diversion ditches are removed; therefore, there will be no permanent diversions of these channels.

The only stream channel that will be impacted by the Collom Pit is the main stream of Little Collom Gulch, an ephemeral stream draining less than one square mile at the upstream pit boundary. Clean water diversions will be installed above the Collom Pit (Exhibit 7, Item 23, Part A) and will be removed as mining progresses. It will also be channelized further downstream, alongside the haul road leading from the Collom Pit to the spoil pile, where it drains greater than one square mile (Exhibit 7, Item 2, Part B).

4.05.5 Sediment Control Measures

Sediment control measures to be implemented are shown in Exhibit 7, Item 23 Erosion and Sedimentation Control Plan, and postmining channels are shown on Map 41B. These facilities, consisting primarily of diversion ditches and sedimentation ponds, will be located, constructed and maintained to avoid erosion and increased contribution of sediment load to runoff.

Facilities to control sediment are typically installed in areas above and/or below the planned sites of disturbance. “Upstream” facilities, such as clean water diversion ditches upslope from the mining activities, serve to divert runoff away from the disturbed areas. Temporary diversion ditches below the disturbed area of the pit will help collect runoff from disturbed areas and route it into the sedimentation ponds. During active mining, the mining areas will aid in retaining sediment within the disturbed areas by catching water in pits, small depressions and dozer basins, etc. Once reclaimed, the basins will drain as they did prior to mining activities (i.e., historic drainage patterns will be re-established).

All temporary diversions will be removed and reclaimed when no longer needed for sediment control in accordance with Rule 4.05.2(2)

Channel lining rock riprap and energy dissipaters will be used when necessary. As stated above, all temporary diversion structures will be seeded and revegetated after removal. Colowyo does not anticipate that there will be any significant excess material resulting from the construction of diversion ditches.

None of the diversions will drain into underground mines.

4.05.6 Sedimentation Ponds

The location, design parameters, and detailed sedimentation calculations of all planned sedimentation ponds are presented in Erosion and Sedimentation Control Plan (Exhibit 7, Item 23). The design plans and specifications for the sedimentation ponds are described in this section (Part C). All sedimentation ponds will be located as close as practical to the areas to be disturbed. Steep terrain in the upper basins precludes location of the ponds at the Collom Pit disturbance boundaries during the critical early phase of operations, necessitating down-valley locations downstream of the Collom Pit and temporary spoil pile

footprint. Other methods of sediment control will be located on the reclaimed areas; these methods include the use of contour furrowing, contour drainage ditches, chisel plowing, and revegetation.

Colowyo has specificially provided information regarding Rule 4.05.9(7)(a-e) with respect to the construction of sediment ponds on the design drawings. Please see Exhibit 7-23C, Table 1 and Exh. 7-23 Figures C5 through C9.

Exhibit 7, Item 23, Part C contains calculations used to determine runoff volumes and flow rates for the theoretical 10-year, 25-year, and 100-year, 24-hour precipitation events, as well as annual sediment volumes. The precipitation data were obtained from the NOAA Atlas 2, Volume 3 for Colorado; soil types were obtained from the Soil Conservation Service, and are shown on the soils survey map (Map 5D).

The ongoing mining activities within each watershed of the permit area will create constantly changing hydrologic conditions. The design models are generally based on a static, theoretical scenario, utilizing SEDCAD 4. Please refer to Exhibit 7, Item 23 for a delineation of the areas used for these modeling purposes, the presentation of the assumed worse case scenario, as well as the maps associated with the SEDCAD runs.

The scenario used for the sedimentation ponds corresponds to an active, disturbed operation. In terms of groundwater, Colowyo's pits have remained essentially dry. Discharges from the ponds will remain in compliance with Colowyo's CDPS Discharge Permit. The use of flocculants in sedimentation ponds may also be used in accordance with the provisions of the CDPS Permit.

Sediment will be removed from all sedimentation ponds on an as needed basis or when the sediment level will not allow effective treatment of the runoff resulting from the 10-year, 24-hour precipitation event in accordance with Rule 4.05.2. Quarterly inspections will note the level of sediment in each pond. Ponds will typically be cleaned of sediment when water levels are lowest, and the least amount of precipitation is expected. The removed sediment may be used as topsoil or subsoil if it meets the suitability criteria discussed under Section 2.04.9 or placed in the backfill of the pits. The Division will be notified of this determination if the material is selected as overburden material that can be substituted for or as a supplement to topsoil.

All sedimentation ponds will be designed so that the minimum elevation at the top of the settled embankment is at least one foot above the elevation of the water surface in the pond with the emergency spillway flowing at design depth.

Colowyo will design, construct, and maintain the sedimentation ponds to prevent short-circuiting to the extent possible. As a general rule, the inflow to the ponds will be at the opposite end from the outflow area. The constructed height of the sedimentation pond embankment will be designed to allow for settling. During construction, a registered professional engineer will ensure that the appropriate embankment height is accomplished. For all sedimentation ponds, the entire embankment, including the surrounding areas disturbed by construction, will be seeded after the embankment is completed, using the Topsoil Stockpile/Pond Embankment seed mix described below. The active upstream side of the embankment where water will be impounded will be stabilized, where necessary. Areas in which revegetation is not successful or, where rills and gullies develop, will be repaired and revegetated.

Colowyo will inspect the condition of each sediment pond, sediment trap, or future post-mining stock reservoir on a quarterly basis. All of these types of structures meet the requirements of an impoundment, and the inspection procedures will meet the requirements under Rule 4.05.9 (17). Previously, Colowyo has received a waiver from quarterly inspections for several existing stock reservoirs within the current

permit area as described under Section 4.05.9. This waiver changed the inspection frequency to annual. Following construction of any future post-mining stock reservoir in the Collom permit expansion area, Colowyo may request a similar waiver but until that is approved, the quarterly frequency would apply. Results of all impoundment inspections will be submitted quarterly.

Topsoil Stockpile/Pond Embankment Seed Mix*

Western wheatgrass @ 4 Lbs PLS/Acre
Thickspike wheatgrass** @ 4 Lbs PLS/Acre
Yarrow*** @ 0.15 Lbs PLS/Acre

*mix may be modified as a result of an updated Reclamation Plan, currently under review.
**option to replace Thickspike wheatgrass with Beardless bluebunch wheatgrass or Sheep fescue
***option to replace Yarrow with Cicer milkvetch

4.05.7 Discharge Structures

Please see Section 4.05.7 in Volume 1.

The design requirements for sediment ponds for the existing operation can be found in Volumes 2D, 2E, or in Exhibit 7, Item 15, in Volume 13

Design requirements for all sediment ponds associate with the Collom Pit can be found in Exhibit 7, Item 23.

4.05.8 Acid-forming and Toxic-Forming Spoil

Acid forming materials do not exist in significant quantities within the overburden to be removed by the mining operations. A discussion on the overburden at the Colowyo operation has been conducted as set forth in Section 2.04.6. A discussion of the overburden monitoring plan is set forth in Section 2.05. Acid-Base Accounting shows that 19 feet out of 4,212 feet of analyzed over- and inter -burden has a net acid-generating potential, and the average acid-neutralizing potential to acid-generating potential ratio is strongly weighted toward acid-neutralizing in each borehole (Exhibit 6, Item 9).

4.05.9 Post-Mining Impoundments

Please see Section 4.05.9 in Volume 1.

4.05.10 Underground Mine Entry and Access Discharges

Colowyo currently conducts surface coal mining exclusively.

4.05.11 Groundwater Protection

Please see Section 4.05.11 in Volume 1.

4.05.12 Protection of Groundwater Recharge Capacity

Please see Section 4.05.11 in Volume 1.

Exhibit 7, Item 25E
Collom Haul Road Channel Configurations

Several channels will be utilized to manage storm water runoff from undisturbed and disturbed areas on and along the Collom Haul Road. These channels will route water from culvert outlets and road cutouts to small sumps (best management practice structures for storm water), to allow sediment to settle out and to decrease peak flows prior to discharge. This section addresses the configuration of these channels along the Collom Haul Road.

Exhibit 7, Item 14 in Volume 2D describes the hydrologic methodology used for channel assumptions. Runoff curve numbers assigned to the undisturbed and disturbed lands have been selected in accordance with Table 1 in the Introductory Text for Exhibit 7 in Volume 2D. For channels protected by a riprap liner, selection of minimum riprap size is done using the Simons/OSM method in SEDCAD^{TM}.

The following pages present the results of the SEDCAD^{TM} models for channels C-1 through C-9. A SEDCAD^{TM} model for channel C-2 is not included as C-2 is a native channel that is stable and will not have a formal channel constructed in it. It will have some small rock check dams installed to slow down flows down gradient of the Collom Haul Road in that corresponding drainage.

Location, contributing watersheds, and on the ground hydrologic conditions for these channels are reflected on Figures Exh. 7-25E-1 through Exh. 7-25E-5. The dimensions, lining type, and flow characteristics all the channel configurations are included in the SEDCAD^{TM} attached outputs for each specific channel. A summary of the channel configurations and minimum construction specifications are summarized on the table below.

Channel	Lining Type	Specified Depth	Bottom Width	Side Slope, 1H:1V	Minimum Rip Rap, D50 (in)
C-1	Riprap	3.0	10.0	2:1	6.0
C-2*	-	-	-	-	-
C-3	Riprap	3.0	5.0	2:1	9.0
C-4	Riprap	3.0	5.0	2:1	3.0
C-5	Riprap	3.0	5.0	2:1	6.0
C-6	Riprap	3.0	5.0	2:1	3.0
C-7	Erodible	3.0	2.0	2:1	NA
C-8	Erodible	3.0	Triangular	2:1	NA
C-9	Erodible	3.0	Triangular	2:1	NA

*C-2 Channel is the pre-mine natural grass channel and will have several small rock check dams installed only due to the minimal watershed reporting.

30A

38

1.4 Ac

40A

2.1 Ac

C-1

CS-1

1.4 Ac

7.1 Ac

7100

7000

Jubb Fork

West

Legend

- Channel
- Sub-Watershed Boundaries
- Streams
- BMP Sump Location
- Roads
- Paved Road
- Culvert
- Topsoil Pile
- CN47 Undisturbed (Sagebrush)
- CN85 Disturbed - Bare Ground

N W E S

0' 300' 600'

CONTOUR INTERVAL 25 FT.
June 2020 Topography

Collom Haul Road

C-1 Channel Watersheds

Colowyo Coal Company
5731 State Highway 13
Meeker, Colorado 81641

SCALE: 1" = 300'
DATE: 6/16/21
DRWG. BY: Tony
APPROVED BY: AA

DRWG NO.
Figure Exh. 7-25E-1

No.	REVISION	DATE	BY	CHK

28.0 Ac

17.8 Ac

0.3 Ac

0.4 Ac

0.4 Ac

36

35

0.5 Ac

36A

C-4

C-3

2.3 Ac

38

CS-3

1.2 Ac

4.1 Ac

C-2

40A

CS-2

C-1

CS-1

Creek

bb

Legend

- Channel
- Sub-Watershed Boundaries
- Streams
- BMP Sump Location
- Roads
- Paved Road
- Culvert
- CN47 Undisturbed (Sagebrush)
- CN85 Disturbed - Bare Ground

N W E S

0' 300' 600'

CONTOUR INTERVAL 25 FT.
June 2020 Topography

Collom Haul Road

C-3 & C-4 Channel Watersheds

Colowyo Coal Company
5731 State Highway 13
Meeker, Colorado 81641

SCALE: 1" = 300'
DATE: 6/16/21
DRWG. BY: Tony
APPROVED BY: AA

DRWG NO.
Figure Exh. 7-25E-2

No.	REVISION	DATE	BY	CHK

87.1 Ac

34

0.5 Ac

1.0 Ac

C-6

0.4 Ac

0.2 Ac

4.2 Ac

C-5

34A

0.7 Ac

CS-4

36

35

36A

C-4

C-3

38

CS-3

Legend

- Channel
- Sub-Watershed Boundaries
- Streams
- BMP Sump Location
- Roads
- Paved Road
- Culvert

- CN47 Undisturbed (Sagebrush)
- CN85 Disturbed - Bare Ground
- Topsoil Pile

N

W E

S

0' 300' 600'

CONTOUR INTERVAL 25 FT.
June 2020 Topography

Collom Haul Road

C-5 & C-6 Channel Watersheds

Colowyo Coal Company
5731 State Highway 13
Meeker, Colorado 81641

SCALE: 1" = 300'
DATE: 6/16/21
DRWG. BY: Tony
APPROVED BY: AA

DRWG NO.
Figure Exh. 7-25E-3

No.	REVISION	DATE	BY	CHK

34.2 Ac

0.8 Ac

0.4 Ac

CS-5

C-7

30

4.9 Ac

34

C-6

C-5

34A

CS-4

Legend

- Channel
- Sub-Watershed Boundaries
- Streams
- BMP Sump Location
- Roads
- Paved Road
- Culvert
- CN47 Undisturbed (Sagebrush)
- CN85 Disturbed - Bare Ground
- Topsoil Pile

N

W E

S

0' 300' 600'

CONTOUR INTERVAL 25 FT.
June 2020 Topography

Collom Haul Road

C-7 Channel Watersheds

Colowyo Coal Company
5731 State Highway 13
Meeker, Colorado 81641

SCALE: 1" = 300'
DATE: 6/16/21
DRWG. BY: Tony
APPROVED BY: AA

DRWG NO.
Figure Exh. 7-25E-4

No.	REVISION	DATE	BY	CHK

17.5 Ac

20.8 Ac

2.3 Ac

0.2 Ac

C-9

0.5 Ac

CS-6

26

28

C-8

0.5 Ac

1.0 Ac

3.6 Ac

CS-5

C-7

30

Legend

- Channel
- Sub-Watershed Boundaries
- Streams
- BMP Sump Location
- Roads
- Paved Road
- Culvert
- CN47 Undisturbed (Sagebrush)
- CN85 Disturbed - Bare Ground
- Topsoil Pile

N

W E

S

0' 300' 600'

CONTOUR INTERVAL 25 FT.
June 2020 Topography

Collom Haul Road

C-8 & C-9 Channels Watersheds

Colowyo Coal Company
5731 State Highway 13
Meeker, Colorado 81641

SCALE: 1" = 300'
DATE: 6/16/21
DRWG. BY: Tony
APPROVED BY: AA

DRWG NO.
Figure Exh. 7-25E-5

No.	REVISION	DATE	BY	CHK

C-1 Channel Configuration

10-Year 24-Hour Storm Event

Tony Tennyson

Tri-State Generation & Transmission Assoication, Inc.
1100 West 116th Avenue
Westminster, CO 80234

Phone: (970) 326-3560
Email: ttennyson@tristategt.org

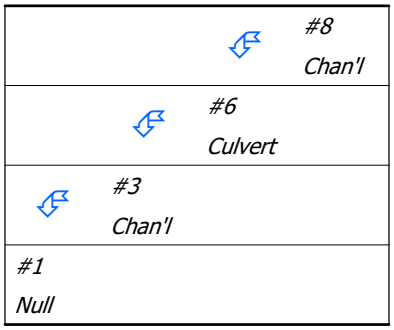
General Information

Storm Information:

Storm Type:	NRCS Type II
Design Storm:	10 yr - 24 hr
Rainfall Depth:	1.800 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Null	#1	==>	End	0.000	0.000	Null At End of C-1 Ditch
Channel	#3	==>	#1	0.000	0.000	C-1 Channel
Culvert	#6	==>	#3	0.000	0.000	Culvert 40A - Half Culvert
Channel	#8	==>	#6	0.000	0.000	Collom Haul Road Ditch South



Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#8	7.100	7.100	6.55	0.51
#6	0.000	7.100	6.55	0.51
#3	4.600	11.700	7.35	0.57
#1	0.000	11.700	7.35	0.57

Structure Detail:

Structure #8 (Erodible Channel)

Collom Haul Road Ditch South

Triangular Erodible Channel Inputs:

Material: Shales and hardpans

Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Manning's n	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
7.0:1	1.5:1	5.9	0.0250				6.0

Erodible Channel Results:

	w/o Freeboard	w/ Freeboard
Design Discharge:	6.55 cfs	
Depth:	0.52 ft	
Top Width:	4.39 ft	
Velocity:	5.77 fps	
X-Section Area:	1.13 sq ft	
Hydraulic Radius:	0.251 ft	
Froude Number:	2.00	

Structure #6 (Culvert)

Culvert 40A - Half Culvert

Culvert Inputs:

Length (ft)	Slope (%)	Manning's n	Max. Headwater (ft)	Tailwater (ft)	Entrance Loss Coef. (Ke)
300.00	52.00	0.0150	2.00	0.00	0.90

Culvert Results:

Design Discharge = 6.55 cfs

Minimum pipe diameter: 1 - 18 inch pipe(s) required

Structure #3 (Riprap Channel)

C-1 Channel

Trapezoidal Riprap Channel Inputs:

Material: Riprap

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)
10.00	2.0:1	2.0:1	10.0	2.87		

Riprap Channel Results:

Simons/OSM Method - Steep Slope Design

	w/o Freeboard	w/ Freeboard
Design Discharge:	7.35 cfs	
Depth:	0.11 ft	2.98 ft
Top Width:	10.44 ft	21.92 ft
Velocity*:		
X-Section Area:	1.13 sq ft	
Hydraulic Radius:	0.108 ft	
Froude Number*:		
Manning's n*:		
Dmin:	1.00 in	
D50:	3.00 in	
Dmax:	3.75 in	

Velocity and Manning's n calculations may not apply for this method.

Structure #1 (Null)

Null At End of C-1 Ditch

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#8	1	7.100	0.121	0.000	0.000	89.000	F	6.55	0.511
	Σ	**7.100**						**6.55**	**0.511**
#6	Σ	**7.100**						**6.55**	**0.511**
#3	1	1.100	0.005	0.000	0.000	85.000	F	0.80	0.059
	2	1.400	0.024	0.000	0.000	47.000	S	0.00	0.000
	3	2.100	0.044	0.000	0.000	47.000	S	0.00	0.000
	Σ	**11.700**						**7.35**	**0.570**
#1	Σ	**11.700**						**7.35**	**0.570**

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#3	1	5. Nearly bare and untilled, and alluvial valley fans	52.00	74.36	143.00	7.210	0.005
#3	**1**	**Time of Concentration:**					**0.005**
#3	2	3. Short grass pasture	22.00	71.94	327.00	3.750	0.024
#3	**2**	**Time of Concentration:**					**0.024**
#3	3	3. Short grass pasture	11.00	46.97	427.00	2.650	0.044
#3	**3**	**Time of Concentration:**					**0.044**
#8	1	7. Paved area and small upland gullies	5.90	125.72	2,131.00	4.880	0.121
#8	**1**	**Time of Concentration:**					**0.121**

C-3 and C-4 Channel Configurations

10-Year 24-Hour Storm Event

Tri-State Generation & Transmission Assoication, Inc.
1100 West 116th Avenue
Westminster, CO 80234

Phone: (970) 326-3560
Email: ttennyson@tristategt.org

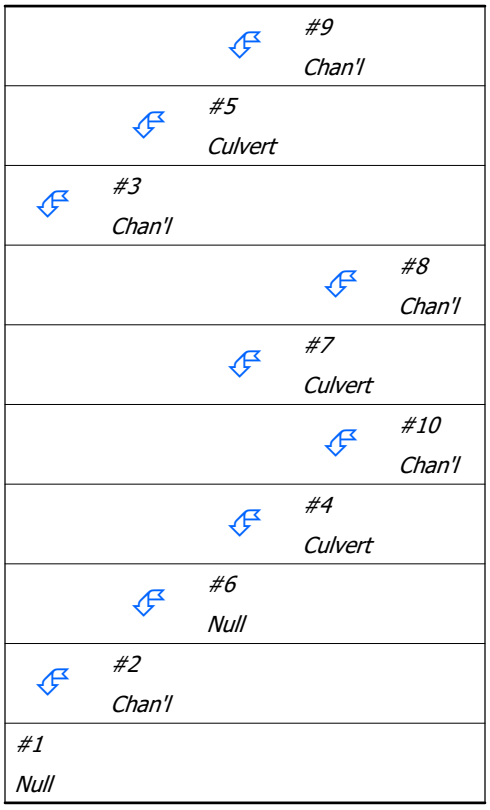
General Information

Storm Information:

Storm Type:	NRCS Type II
Design Storm:	10 yr - 24 hr
Rainfall Depth:	1.800 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Null	#1	==>	End	0.000	0.000	Null at Confluecne of C-3 & C-4 Channels
Channel	#2	==>	#1	0.000	0.000	C-3 Channel
Channel	#3	==>	#1	0.000	0.000	C-4 Channel
Culvert	#4	==>	#6	0.000	0.000	Culvert 36
Culvert	#5	==>	#3	0.000	0.000	Culvert 35
Null	#6	==>	#2	0.000	0.000	Null at Culvert 36 & 36A Confluence
Culvert	#7	==>	#6	0.000	0.000	Culvert 36A
Channel	#8	==>	#7	0.000	0.000	Collom Haul Road South Ditch
Channel	#9	==>	#5	0.000	0.000	Collom Haul Road North Ditch to Culvert 35
Channel	#10	==>	#4	0.000	0.000	Collom Haul Road North Ditch to Culvert 36



Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#9	28.300	28.300	0.22	0.01
#5	0.000	28.300	0.22	0.01
#3	2.800	31.100	0.58	0.03
#8	4.100	4.100	2.99	0.22
#7	0.000	4.100	2.99	0.22
#10	18.200	18.200	0.29	0.02
#4	0.000	18.200	0.29	0.02
#6	0.000	22.300	3.28	0.24
#2	1.600	23.900	3.57	0.26
#1	0.000	55.000	4.16	0.29

Structure Detail:

Structure #9 (Erodible Channel)

Collom Haul Road North Ditch to Culvert 35

Triangular Erodible Channel Inputs:

Material: Shales and hardpans

Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Manning's n	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
1.5:1	7.0:1	6.4	0.0250				6.0

Erodible Channel Results:

	w/o Freeboard	w/ Freeboard
Design Discharge:	0.22 cfs	
Depth:	0.14 ft	
Top Width:	1.21 ft	
Velocity:	2.55 fps	
X-Section Area:	0.09 sq ft	
Hydraulic Radius:	0.070 ft	
Froude Number:	1.68	

Structure #5 (Culvert)

Culvert 35

Culvert Inputs:

Length (ft)	Slope (%)	Manning's n	Max. Headwater (ft)	Tailwater (ft)	Entrance Loss Coef. (Ke)
273.00	13.00	0.0150	1.00	0.00	0.90

Culvert Results:

Design Discharge = 0.22 cfs

Minimum pipe diameter: 1 - 4 inch pipe(s) required

Structure #3 (Riprap Channel)

C-4 Channel

Trapezoidal Riprap Channel Inputs:

Material: Riprap

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)
5.00	2.0:1	2.0:1	5.0	2.90		

Riprap Channel Results:

Simons/OSM Method - Mild Slope Design

	w/o Freeboard	w/ Freeboard
Design Discharge:	0.58 cfs	
Depth:	0.10 ft	3.00 ft
Top Width:	5.42 ft	17.02 ft
Velocity:	1.07 fps	
X-Section Area:	0.55 sq ft	
Hydraulic Radius:	0.100 ft	
Froude Number:	0.59	
Manning's n:	0.0288	
Dmin:	0.00 in	
D50:	3.00 in	
Dmax:	0.00 in	

Structure #8 (Erodible Channel)

Collom Haul Road South Ditch

Triangular Erodible Channel Inputs:

Material: Shales and hardpans

Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Manning's n	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
7.0:1	1.5:1	8.3	0.0250				6.0

Erodible Channel Results:

	w/o Freeboard	w/ Freeboard
Design Discharge:	2.99 cfs	
Depth:	0.36 ft	
Top Width:	3.07 ft	
Velocity:	5.39 fps	
X-Section Area:	0.55 sq ft	
Hydraulic Radius:	0.176 ft	
Froude Number:	2.23	

Structure #7 (Culvert)

Culvert 36A

Culvert Inputs:

Length (ft)	Slope (%)	Manning's n	Max. Headwater (ft)	Tailwater (ft)	Entrance Loss Coef. (Ke)
150.00	33.00	0.0150	1.00	0.00	0.90

Culvert Results:

Design Discharge = 2.99 cfs

Minimum pipe diameter: 1 - 18 inch pipe(s) required

Structure #10 (Erodible Channel)

Collom Haul Road North Ditch to Culvert 36

Triangular Erodible Channel Inputs:

Material: Shales and hardpans

Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Manning's n	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
1.5:1	7.0:1	7.9	0.0250				6.0

Erodible Channel Results:

	w/o Freeboard	w/ Freeboard
Design Discharge:	0.29 cfs	
Depth:	0.15 ft	
Top Width:	1.30 ft	
Velocity:	2.96 fps	
X-Section Area:	0.10 sq ft	
Hydraulic Radius:	0.074 ft	
Froude Number:	1.89	

Structure #4 (Culvert)

Culvert 36

Culvert Inputs:

Length (ft)	Slope (%)	Manning's n	Max. Headwater (ft)	Tailwater (ft)	Entrance Loss Coef. (Ke)
238.00	20.00	0.0150	1.00	0.00	0.90

Culvert Results:

Design Discharge = 0.29 cfs

Minimum pipe diameter: 1 - 4 inch pipe(s) required

Structure #6 (Null)

Null at Culvert 36 & 36A Confluence

Structure #2 (Riprap Channel)

C-3 Channel

Trapezoidal Riprap Channel Inputs:

Material: Riprap

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)
5.00	2.0:1	2.0:1	17.0	2.92		

Riprap Channel Results:

Simons/OSM Method - Steep Slope Design

	w/o Freeboard	w/ Freeboard
Design Discharge:	3.57 cfs	
Depth:	0.08 ft	3.00 ft
Top Width:	5.31 ft	16.99 ft
Velocity*:		
X-Section Area:	0.39 sq ft	
Hydraulic Radius:	0.074 ft	
Froude Number*:		
Manning's n*:		
Dmin:	3.00 in	
D50:	9.00 in	
Dmax:	11.25 in	

Velocity and Manning's n calculations may not apply for this method.

Structure #1 (Null)

Null at Confluecne of C-3 & C-4 Channels

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#9	1	28.000	0.104	0.000	0.000	47.000	S	0.00	0.000
	2	0.300	0.001	0.000	0.000	85.000	F	0.22	0.012
	Σ	**28.300**						**0.22**	**0.012**
#5	Σ	**28.300**						**0.22**	**0.012**
#3	1	0.500	0.002	0.000	0.000	85.000	F	0.36	0.023
	2	2.300	0.007	0.000	0.000	47.000	S	0.00	0.000
	Σ	**31.100**						**0.58**	**0.034**
#8	1	4.100	0.123	0.000	0.000	85.000	F	2.99	0.222
	Σ	**4.100**						**2.99**	**0.222**
#7	Σ	**4.100**						**2.99**	**0.222**
#10	1	17.800	0.082	0.000	0.000	47.000	S	0.00	0.000
	2	0.400	0.001	0.000	0.000	85.000	F	0.29	0.017
	Σ	**18.200**						**0.29**	**0.017**
#4	Σ	**18.200**						**0.29**	**0.017**
#6	Σ	**22.300**						**3.28**	**0.240**
#2	1	0.400	0.002	0.000	0.000	85.000	F	0.29	0.017
	2	1.200	0.007	0.000	0.000	47.000	S	0.00	0.000
	Σ	**23.900**						**3.57**	**0.257**
#1	Σ	**55.000**						**4.16**	**0.292**

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#2	1	5. Nearly bare and untilled, and alluvial valley fans	49.00	24.99	51.00	7.000	0.002
#2	**1**	**Time of Concentration:**					**0.002**
#2	2	3. Short grass pasture	37.00	49.95	135.00	4.860	0.007
#2	**2**	**Time of Concentration:**					**0.007**
#3	1	5. Nearly bare and untilled, and alluvial valley fans	47.50	25.17	53.00	6.890	0.002
#3	**1**	**Time of Concentration:**					**0.002**
#3	2	3. Short grass pasture	24.60	25.09	102.00	3.960	0.007
#3	**2**	**Time of Concentration:**					**0.007**

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#8	1	5. Nearly bare and untilled, and alluvial valley fans	8.00	100.32	1,254.00	2.820	0.123
#8	**1**	**Time of Concentration:**					**0.123**
#9	1	3. Short grass pasture	17.80	225.16	1,265.00	3.370	0.104
#9	**1**	**Time of Concentration:**					**0.104**
#9	2	5. Nearly bare and untilled, and alluvial valley fans	50.00	25.00	50.00	7.070	0.001
#9	**2**	**Time of Concentration:**					**0.001**
#10	1	3. Short grass pasture	17.60	174.94	994.00	3.350	0.082
#10	**1**	**Time of Concentration:**					**0.082**
#10	2	5. Nearly bare and untilled, and alluvial valley fans	50.00	20.50	41.00	7.070	0.001
#10	**2**	**Time of Concentration:**					**0.001**

C-5 and C-6 Channel Configurations

10-Year 24-Hour Storm Event

Tony Tennyson

Tri-State Generation & Transmission Assoication, Inc.
1100 West 116th Avenue
Westminster, CO 80234

Phone: (970) 326-3560
Email: ttennyson@tristategt.org

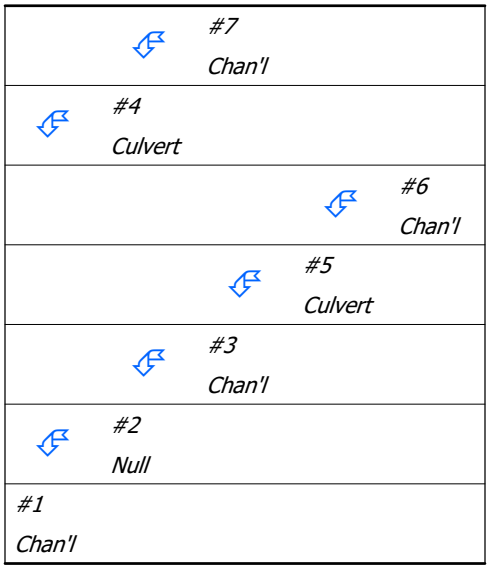
General Information

Storm Information:

Storm Type:	NRCS Type II
Design Storm:	10 yr - 24 hr
Rainfall Depth:	1.800 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Channel	#1	==>	End	0.000	0.000	C-5 Channel
Null	#2	==>	#1	0.000	0.000	Null at Confluence of C-5 and C-6 Channels
Channel	#3	==>	#2	0.000	0.000	C-6 Channel
Culvert	#4	==>	#1	0.000	0.000	Culvert 34A
Culvert	#5	==>	#3	0.000	0.000	Culvert 34
Channel	#6	==>	#5	0.000	0.000	Collom Haul Road Ditch South
Channel	#7	==>	#4	0.000	0.000	Collom Haul Road Ditch North



Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#7	4.200	4.200	2.52	0.22
#4	0.000	4.200	2.52	0.22
#6	88.100	88.100	0.73	0.05
#5	0.000	88.100	0.73	0.05
#3	0.900	89.000	1.09	0.08
#2	0.000	89.000	1.09	0.08
#1	0.900	94.100	3.91	0.33

Structure Detail:

Structure #7 (Erodible Channel)

Collom Haul Road Ditch North

Triangular Erodible Channel Inputs:

Material: Shales and hardpans

Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Manning's n	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
1.5:1	7.0:1	4.3	0.0250				6.0

Erodible Channel Results:

	w/o Freeboard	w/ Freeboard
Design Discharge:	2.52 cfs	
Depth:	0.38 ft	
Top Width:	3.26 ft	
Velocity:	4.03 fps	
X-Section Area:	0.62 sq ft	
Hydraulic Radius:	0.187 ft	
Froude Number:	1.62	

Structure #4 (Culvert)

Culvert 34A

Culvert Inputs:

Length (ft)	Slope (%)	Manning's n	Max. Headwater (ft)	Tailwater (ft)	Entrance Loss Coef. (Ke)
200.00	2.00	0.0150	1.00	0.00	0.90

Culvert Results:

Design Discharge = 2.52 cfs

Minimum pipe diameter: 1 - 15 inch pipe(s) required

Structure #6 (Erodible Channel)

Collom Haul Road Ditch South

Trapezoidal Erodible Channel Inputs:

Material: Shales and hardpans

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Manning's n	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
0.00	1.5:1	7.0:1	4.3	0.0250				6.0

Erodible Channel Results:

	w/o Freeboard	w/ Freeboard
Design Discharge:	0.73 cfs	
Depth:	0.24 ft	
Top Width:	2.04 ft	
Velocity:	2.96 fps	
X-Section Area:	0.25 sq ft	
Hydraulic Radius:	0.117 ft	
Froude Number:	1.50	

Structure #5 (Culvert)

Culvert 34

Culvert Inputs:

Length (ft)	Slope (%)	Manning's n	Max. Headwater (ft)	Tailwater (ft)	Entrance Loss Coef. (Ke)
220.00	36.00	0.0150	2.00	0.00	0.90

Culvert Results:

Design Discharge = 0.73 cfs

Minimum pipe diameter: 1 - 6 inch pipe(s) required

Structure #3 (Riprap Channel)

C-6 Channel

Trapezoidal Riprap Channel Inputs:

Material: Riprap

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)
5.00	2.0:1	2.0:1	7.6	2.91		

Riprap Channel Results:

Simons/OSM Method - Steep Slope Design

	w/o Freeboard	w/ Freeboard
Design Discharge:	1.09 cfs	
Depth:	0.09 ft	3.00 ft

	w/o Freeboard	w/ Freeboard
Top Width:	5.37 ft	17.01 ft
Velocity*:		
X-Section Area:	0.48 sq ft	
Hydraulic Radius:	0.088 ft	
Froude Number*:		
Manning's n*:		
Dmin:	1.00 in	
D50:	3.00 in	
Dmax:	3.75 in	

Velocity and Manning's n calculations may not apply for this method.

Structure #2 (Null)

Null at Confluence of C-5 and C-6 Channels

Structure #1 (Riprap Channel)

C-5 Channel

Trapezoidal Riprap Channel Inputs:

Material: Riprap

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)
5.00	2.0:1	2.0:1	10.0	2.89		

Riprap Channel Results:

Simons/OSM Method - Steep Slope Design

	w/o Freeboard	w/ Freeboard
Design Discharge:	3.91 cfs	
Depth:	0.11 ft	3.00 ft
Top Width:	5.45 ft	17.01 ft
Velocity*:		
X-Section Area:	0.58 sq ft	
Hydraulic Radius:	0.106 ft	
Froude Number*:		
Manning's n*:		
Dmin:	2.00 in	
D50:	6.00 in	
Dmax:	7.50 in	

Velocity and Manning's n calculations may not apply for this method.

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#7	1	4.200	0.155	0.000	0.000	85.000	F	2.52	0.220
	Σ	**4.200**						**2.52**	**0.220**
#4	Σ	**4.200**						**2.52**	**0.220**
#6	1	1.000	0.003	0.000	0.000	85.000	F	0.73	0.054
	2	87.100	0.198	0.000	0.000	47.000	S	0.00	0.000
	Σ	**88.100**						**0.73**	**0.054**
#5	Σ	**88.100**						**0.73**	**0.054**
#3	1	0.400	0.004	0.000	0.000	47.000	S	0.00	0.000
	2	0.500	0.001	0.000	0.000	85.000	F	0.36	0.023
	Σ	**89.000**						**1.09**	**0.077**
#2	Σ	**89.000**						**1.09**	**0.077**
#1	1	0.700	0.003	0.000	0.000	85.000	F	0.51	0.038
	2	0.200	0.011	0.000	0.000	47.000	S	0.00	0.000
	Σ	**94.100**						**3.91**	**0.334**

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	5. Nearly bare and untilled, and alluvial valley fans	52.00	49.92	96.00	7.210	0.003
#1	**1**	**Time of Concentration:**					**0.003**
#1	2	3. Short grass pasture	18.00	25.56	142.00	3.390	0.011
#1	**2**	**Time of Concentration:**					**0.011**
#3	1	3. Short grass pasture	35.00	24.85	71.00	4.730	0.004
#3	**1**	**Time of Concentration:**					**0.004**
#3	2	5. Nearly bare and untilled, and alluvial valley fans	54.00	24.84	46.00	7.340	0.001
#3	**2**	**Time of Concentration:**					**0.001**
#6	1	5. Nearly bare and untilled, and alluvial valley fans	50.00	50.00	100.00	7.070	0.003
#6	**1**	**Time of Concentration:**					**0.003**
#6	2	3. Short grass pasture	15.00	331.50	2,210.00	3.090	0.198
#6	**2**	**Time of Concentration:**					**0.198**
#7	1	5. Nearly bare and untilled, and alluvial valley fans	4.30	49.79	1,158.00	2.070	0.155
#7	**1**	**Time of Concentration:**					**0.155**

C-7 Channel Configuration

10-Year 24-Hour Storm Event

Tony Tennyson

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1100 West 116th Avenue
Westminster, CO 80234

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Email: ttennyson@tristategt.org

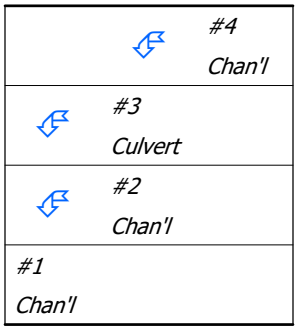
General Information

Storm Information:

Storm Type:	NRCS Type II
Design Storm:	10 yr - 24 hr
Rainfall Depth:	1.800 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Channel	#1	==>	End	0.000	0.000	C-7 Channel
Channel	#2	==>	#1	0.000	0.000	Collom Haul Road Ditch South
Culvert	#3	==>	#1	0.000	0.000	Culvert 30
Channel	#4	==>	#3	0.000	0.000	Collom Haul Road Ditch North



Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#4	35.000	35.000	0.58	0.04
#3	0.000	35.000	0.58	0.04
#2	4.900	4.900	2.93	0.26
#1	0.400	40.300	3.57	0.32

Structure Detail:

Structure #4 (Erodible Channel)

Collom Haul Road Ditch North

Triangular Erodible Channel Inputs:

Material: Shales and hardpans

Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Manning's n	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
1.5:1	7.0:1	6.2	0.0250				6.0

Erodible Channel Results:

	w/o Freeboard	w/ Freeboard
Design Discharge:	0.58 cfs	
Depth:	0.21 ft	
Top Width:	1.75 ft	
Velocity:	3.21 fps	
X-Section Area:	0.18 sq ft	
Hydraulic Radius:	0.100 ft	
Froude Number:	1.76	

Structure #3 (Culvert)

Culvert 30

Culvert Inputs:

Length (ft)	Slope (%)	Manning's n	Max. Headwater (ft)	Tailwater (ft)	Entrance Loss Coef. (Ke)
160.00	13.00	0.0150	1.00	0.00	0.90

Culvert Results:

Design Discharge = 0.58 cfs

Minimum pipe diameter: 1 - 6 inch pipe(s) required

Structure #2 (Erodible Channel)

Collom Haul Road Ditch South

Trapezoidal Erodible Channel Inputs:

Material: Shales and hardpans

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Manning's n	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
0.00	7.0:1	1.5:1	6.5	0.0250				6.0

Erodible Channel Results:

	w/o Freeboard	w/ Freeboard
Design Discharge:	2.93 cfs	
Depth:	0.38 ft	
Top Width:	3.19 ft	
Velocity:	4.89 fps	
X-Section Area:	0.60 sq ft	
Hydraulic Radius:	0.183 ft	
Froude Number:	1.99	

Structure #1 (Erodible Channel)

C-7 Channel

Trapezoidal Erodible Channel Inputs:

Material: Shales and hardpans

Bottom Width (ft)	Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Manning's n	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
2.00	2.0:1	2.0:1	2.0	0.0250	2.63			6.0

Erodible Channel Results:

	w/o Freeboard	w/ Freeboard
Design Discharge:	3.57 cfs	
Depth:	0.37 ft	3.00 ft
Top Width:	3.46 ft	13.98 ft
Velocity:	3.56 fps	
X-Section Area:	1.00 sq ft	
Hydraulic Radius:	0.275 ft	
Froude Number:	1.17	

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#4	1	0.800	0.010	0.000	0.000	85.000	F	0.58	0.043
	2	34.200	0.104	0.000	0.000	47.000	S	0.00	0.000
	Σ	**35.000**						**0.58**	**0.043**
#3	Σ	**35.000**						**0.58**	**0.043**
#2	1	4.900	0.168	0.000	0.000	85.000	F	2.93	0.256
	Σ	**4.900**						**2.93**	**0.256**
#1	1	0.400	0.001	0.000	0.000	85.000	F	0.29	0.017
	Σ	**40.300**						**3.57**	**0.317**

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	5. Nearly bare and untilled, and alluvial valley fans	58.00	29.00	50.00	7.610	0.001
#1	**1**	**Time of Concentration:**					**0.001**
#2	1	5. Nearly bare and untilled, and alluvial valley fans	6.50	100.10	1,540.00	2.540	0.168
#2	**1**	**Time of Concentration:**					**0.168**
#4	1	5. Nearly bare and untilled, and alluvial valley fans	16.00	24.64	154.00	4.000	0.010
#4	**1**	**Time of Concentration:**					**0.010**
#4	2	3. Short grass pasture	29.00	469.50	1,619.00	4.300	0.104
#4	**2**	**Time of Concentration:**					**0.104**

C-8 and C-9 Channel Configurations

10-Year 24-Hour Storm Event

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Westminster, CO 80234

Phone: (970) 326-3560
Email: ttennyson@tristategt.org

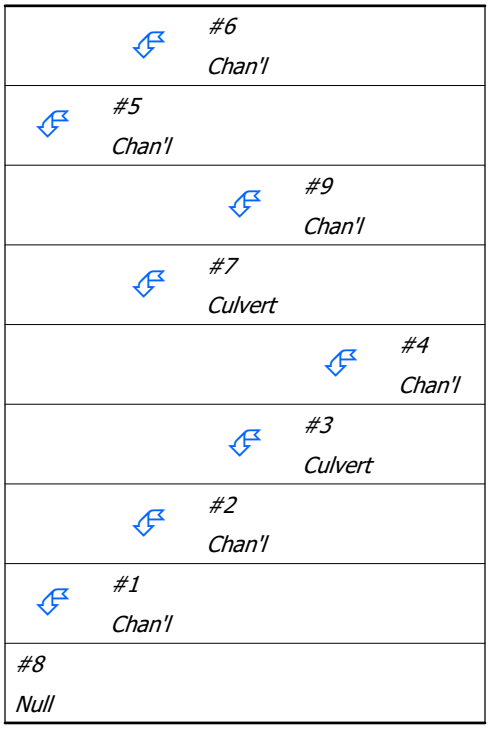
General Information

Storm Information:

Storm Type:	NRCS Type II
Design Storm:	10 yr - 24 hr
Rainfall Depth:	1.800 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Channel	#1	==>	#8	0.000	0.000	C-8 Channel
Channel	#2	==>	#1	0.000	0.000	Collom Haul Road Ditch South
Culvert	#3	==>	#2	0.000	0.000	Culvert 28
Channel	#4	==>	#3	0.000	0.000	Collom Haul Road Ditch North Upper Segement
Channel	#5	==>	#8	0.000	0.000	C-9 Channel
Channel	#6	==>	#5	0.000	0.000	Collom Haul Road Ditch South
Culvert	#7	==>	#1	0.000	0.000	Culvert 26
Null	#8	==>	End	0.000	0.000	Null at Sediment Sump
Channel	#9	==>	#7	0.000	0.000	Collom Haul Road Ditch North Lower Segement



Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#6	2.300	2.300	1.38	0.12
#5	0.500	2.800	1.63	0.14
#9	17.700	17.700	0.12	0.01
#7	0.000	17.700	0.12	0.01
#4	21.800	21.800	0.73	0.05
#3	0.000	21.800	0.73	0.05
#2	3.600	25.400	2.71	0.24
#1	0.500	43.600	3.18	0.27
#8	0.000	46.400	4.81	0.41

Structure Detail:

Structure #6 (Erodible Channel)

Collom Haul Road Ditch South

Triangular Erodible Channel Inputs:

Material: Shales and hardpans

Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Manning's n	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
7.0:1	1.5:1	3.0	0.0250				6.0

Erodible Channel Results:

	w/o Freeboard	w/ Freeboard
Design Discharge:	1.38 cfs	
Depth:	0.33 ft	
Top Width:	2.78 ft	
Velocity:	3.03 fps	
X-Section Area:	0.45 sq ft	
Hydraulic Radius:	0.159 ft	
Froude Number:	1.32	

Structure #5 (Erodible Channel)

C-9 Channel

Triangular Erodible Channel Inputs:

Material: Shales and hardpans

Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Manning's n	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
2.0:1	2.0:1	2.0	0.0250	2.49			6.0

Erodible Channel Results:

	w/o Freeboard	w/ Freeboard
Design Discharge:	1.63 cfs	
Depth:	0.51 ft	3.00 ft
Top Width:	2.04 ft	12.00 ft
Velocity:	3.14 fps	
X-Section Area:	0.52 sq ft	
Hydraulic Radius:	0.228 ft	

	w/o Freeboard	w/ Freeboard
Froude Number:	1.10	

Structure #9 (Erodible Channel)

Collom Haul Road Ditch North Lower Segement

Triangular Erodible Channel Inputs:

Material: Shales and hardpans

Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Manning's n	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
1.5:1	7.0:1	3.0	0.0250				6.0

Erodible Channel Results:

	w/o Freeboard	w/ Freeboard
Design Discharge:	0.12 cfs	
Depth:	0.13 ft	
Top Width:	1.08 ft	
Velocity:	1.61 fps	
X-Section Area:	0.07 sq ft	
Hydraulic Radius:	0.062 ft	
Froude Number:	1.13	

Structure #7 (Culvert)

Culvert 26

Culvert Inputs:

Length (ft)	Slope (%)	Manning's n	Max. Headwater (ft)	Tailwater (ft)	Entrance Loss Coef. (Ke)
156.00	2.00	0.0150	2.00	0.00	0.90

Culvert Results:

Design Discharge = 0.12 cfs

Minimum pipe diameter: 1 - 4 inch pipe(s) required

Structure #4 (Erodible Channel)

Collom Haul Road Ditch North Upper Segement

Triangular Erodible Channel Inputs:

Material: Shales and hardpans

Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Manning's n	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
1.5:1	7.0:1	2.8	0.0250				6.0

Erodible Channel Results:

	w/o Freeboard	w/ Freeboard
Design Discharge:	0.73 cfs	
Depth:	0.26 ft	
Top Width:	2.22 ft	
Velocity:	2.52 fps	
X-Section Area:	0.29 sq ft	
Hydraulic Radius:	0.127 ft	
Froude Number:	1.23	

Structure #3 (Culvert)

Culvert 28

Culvert Inputs:

Length (ft)	Slope (%)	Manning's n	Max. Headwater (ft)	Tailwater (ft)	Entrance Loss Coef. (Ke)
200.00	2.00	0.0150	2.00	0.00	0.90

Culvert Results:

Design Discharge = 0.73 cfs

Minimum pipe diameter: 1 - 6 inch pipe(s) required

Structure #2 (Erodible Channel)

Collom Haul Road Ditch South

Triangular Erodible Channel Inputs:

Material: Shales and hardpans

Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Manning's n	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
7.0:1	1.5:1	2.8	0.0250				6.0

Erodible Channel Results:

	w/o Freeboard	w/ Freeboard
Design Discharge:	2.71 cfs	
Depth:	0.43 ft	
Top Width:	3.63 ft	

	w/o Freeboard	w/ Freeboard
Velocity:	3.50 fps	
X-Section Area:	0.77 sq ft	
Hydraulic Radius:	0.208 ft	
Froude Number:	1.33	

Structure #1 (Erodible Channel)

C-8 Channel

Triangular Erodible Channel Inputs:

Material: Shales and hardpans

Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Manning's n	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
2.0:1	2.0:1	2.0	0.0250	2.35			6.0

Erodible Channel Results:

	w/o Freeboard	w/ Freeboard
Design Discharge:	3.18 cfs	
Depth:	0.65 ft	3.00 ft
Top Width:	2.62 ft	12.02 ft
Velocity:	3.72 fps	
X-Section Area:	0.86 sq ft	
Hydraulic Radius:	0.293 ft	
Froude Number:	1.14	

Structure #8 (Null)

Null at Sediment Sump

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#6	1	2.300	0.135	0.000	0.000	85.000	F	1.38	0.120
	Σ	**2.300**						**1.38**	**0.120**
#5	1	0.500	0.002	0.000	0.000	85.000	F	0.36	0.023
	Σ	**2.800**						**1.63**	**0.143**
#9	1	17.500	0.087	0.000	0.000	47.000	S	0.00	0.000
	2	0.200	0.135	0.000	0.000	85.000	F	0.12	0.007
	Σ	**17.700**						**0.12**	**0.007**
#7	Σ	**17.700**						**0.12**	**0.007**
#4	1	20.800	0.100	0.000	0.000	47.000	S	0.00	0.000
	2	1.000	0.005	0.000	0.000	85.000	0.73	0.054	
	Σ	**21.800**						**0.73**	**0.054**
#3	Σ	**21.800**						**0.73**	**0.054**
#2	1	3.600	0.147	0.000	0.000	85.000	F	2.16	0.188
	Σ	**25.400**						**2.71**	**0.242**
#1	1	0.500	0.002	0.000	0.000	85.000	F	0.36	0.023
	Σ	**43.600**						**3.18**	**0.272**
#8	Σ	**46.400**						**4.81**	**0.415**

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#1	1	5. Nearly bare and untilled, and alluvial valley fans	50.00	32.00	64.00	7.070	0.002
#1	**1**	**Time of Concentration:**					**0.002**
#2	1	5. Nearly bare and untilled, and alluvial valley fans	2.80	24.83	887.00	1.670	0.147
#2	**1**	**Time of Concentration:**					**0.147**
#4	1	3. Short grass pasture	30.00	473.10	1,577.00	4.380	0.100
#4	**1**	**Time of Concentration:**					**0.100**
#4	2	5. Nearly bare and untilled, and alluvial valley fans	53.50	74.90	140.00	7.310	0.005
#4	**2**	**Time of Concentration:**					**0.005**
#5	1	5. Nearly bare and untilled, and alluvial valley fans	50.00	37.50	75.00	7.070	0.002
#5	**1**	**Time of Concentration:**					**0.002**

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#6	1	5. Nearly bare and untilled, and alluvial valley fans	3.00	25.35	845.00	1.730	0.135
#6	**1**	**Time of Concentration:**					**0.135**
#9	1	3. Short grass pasture	33.00	476.85	1,445.00	4.590	0.087
#9	**1**	**Time of Concentration:**					**0.087**
#9	2	5. Nearly bare and untilled, and alluvial valley fans	3.00	25.35	845.00	1.730	0.135
#9	**2**	**Time of Concentration:**					**0.135**

Exhibit 7, Item 25F
Collom Haul Road Culverts

Introduction

The location of the Collom Haul Road is presented on Map 25E. Sheet 1 of that Map presents the general location of the road, and the individual culverts presented in this exhibit.

As discussed with DRMS staff during initial permitting for the Collom Mine, it was agreed and subsequently approved that an alternate flood prediction tool could be used for these two larger watersheds because of SEDCAD's inability to accurately predict peak flows from such a large drainage areas. A program known as Trihydro was chosen. This program has developed and maintained by WWC Engineering of Sheridan, Wyoming. It is based on the NRCS Triangular Unit Hydrograph method and has been in widespread use in the mining field for over 25 years.

Wilson Creek Crossings

For the Wilson Creek culvert, the upstream drainage area consists of Wilson Creek for about 10 miles south to the ridgeline known as the Danforth Hills. Map 12B shows the boundaries of this drainage basin. At the proposed crossing point, the upstream drainage area is about 9,241 acres (14.43 square miles).

Rule 4.03.1(4)(e) requires that crossings be designed for a 20 year-24 hour event if the average end area of the culvert is expected to exceed 35 square feet (an 80-inch diameter culvert). In spite of this, for a more conservative approach, the culvert at Wilson Creek has been designed for the 100 year event. Based on the drainage areas, the stream lengths, elevation changes and other parameters as shown in Figures 1, Trihydro predicts 100 year peak flows for Wilson Creek to be 404 cfs and the total runoff volume to be 242 acre-feet.

Figure 2 presents a generally accepted FHWA nomograph for flow through culverts operating under the entrance control condition. The nomograph is marked up to illustrate acceptable pipe diameters for the Wilson Creek crossing. Acceptable solutions have been limited to diameters that can deliver the design flow with a Headwater/Diameter (HW/D) ratio of 1.5 or less. Pipe ends mitered to conform to the slope have been assumed, and the pipe will have riprap placed at the sides and inlet to a height 4 feet about the top of the crown.

At Wilson Creek, it can be seen on Figure 2 that a 7-foot diameter pipe can pass the 404 cfs design flow at a HW/D of about 1.3. An alternate design of twin 66 inch diameter pipes would also be adequate. In the final road design however, it was determined that a 12 foot diameter pipe will be installed at this crossing which surpass the minimum requirements. This pipe size was selected as approximately 3 foot of fill will be placed in the pipe bottom for a natural channel surface to comply with other regulatory requirements.

Jubb Creek Crossings

For the Jubb Creek Culvert, the upstream drainage area consists of the combined streamflows from both the West Fork and East Fork of Jubb Creek. Map 12B shows the boundaries of this

drainage basin. At the proposed crossing point, the upstream drainage area is about 4,665 acres (7.29 square miles).

Rule 4.03.1(4)(e) requires that crossings be designed for a 10 year-24 hour event if the average end area of the culvert is expected to less than 35 square feet (an 80-inch diameter culvert). Nevertheless, for a more conservative approach, the culvert at Jubb Creek has been designed for the 25 year-24 hour event. Trihydro predicts the peak flow from the 25 Year storm to be 131 cfs and the total runoff volume to be 70 acre-feet (see Figure 3).

Figure 4 presents a generally accepted FHWA nomograph for flow through culverts operating under the entrance control condition. The nomograph is marked up to illustrate acceptable pipe diameters for the Jubb Creek crossing. Acceptable solutions have been limited to diameters that can deliver the design flow with a Headwater/Diameter (HW/D) ratio of 1.5 or less.

At Jubb Creek, Figure 4 indicates that a single 5-foot diameter culvert can pass the 131 cfs design flow with a HW/D ratio of 1.3. A 60 inch diameter culvert was included in the final design.

General Culvert Design

For the remaining smaller culverts under the Collom Haul Road, SEDCAD™ was used to determine the design flow and appropriate culvert size. Table 1 provides a listing of all the culverts numbers and diameters for the Collom Haul Road. Locations of the culverts can be found on Map 25E Sheet 1. .
The hydrologic methodology used for Collom Haul Road culverts is somewhat different than the methodology presented in Volume 2D, Exhibit 7. Runoff curve numbers assigned to the undisturbed portions of the Collom Haul Road watersheds are based on pre-mine vegetation communities presented on Map 4. Curve numbers (CN) utilized for the general culvert design for the undisturbed watersheds are as follows:

Bottom Land – CN 57
Grassland – CN 57
Juniper/Scrub – CN 73
Sagebrush – CN 63
Mountain Shrub – CN 57

Curve numbers for disturbance areas were selected in accordance with Exhibit 7 in Volume 2D, Table 1.

A representative SEDCAD™ analysis is attached which provides a general culvert sizing for all culverts installed on the Collom Haul road. This design is based on a 10 year, 24 hour design event. The largest contributing watershed to an individual culvert is the watershed contributing to culvert 16. Please see Figure Exh. 25F-1 for the delineation of the watershed contributing to culvert 16. The design flow and corresponding size for culvert 16 is the basis for all the culverts under the Collom Haul Road.

As shown of the attached SEDCAD™, culvert 16 is configured to require a 30 inch culvert. All culverts for the Collom Haul Road are 36 inch culverts; therefore all installed culverts with 36 inch culverts are more than adequate to handle the 10-year 24-hour storm event.

Culvert installation lengths will vary as shown on the plans but typically range from 165 feet to 327 feet. Most culverts shall have riprap erosion protection at the inlet and outlet points. Riprap is underlain by a geotextile fabric.

Topsoil Access Road Culvert

The topsoil access road will require a culvert to be installed where the access road crosses the D-2 perimeter ditch. The culverts have been designed to safely pass the 10-yr, 24-hr storm event in accordance with Rule 4.03.1(4)(e)(i). SEDCAD's culvert utility option was utilized since a known peak discharge (cfs) for the D-2 Ditch is presented in Volume 18B, Exhibit 7, Item 23, Part C. The following specifications were utilized to for this culvert:

Peak Discharge: 10.52 cfs
Pipe Slope: 3.1%
Maximum Headwater: 4 feet
Tailwater: 0.0 feet
Length: 160 feet
Manning's n: 0.024
Entrance Loss Coefficient: 0.90 Ke

Given these specifications SEDCAD indicates the minimum pipe size required for the D-2 Ditch is an 18" culvert. However, Colowyo will install one 36" culvert.

Figure 1 - Trihydro Flood Calculation for the Wilson Creek Culvert

TRIHYDRO-98

100 Year Design Storm "100 Year Wilson Creek Road Crossing"

SCS Type II, 24-Hour General Storm

100-Year Return Period

Drainage Basin Characteristics

Drainage Area (A)	14.430	square miles
Stream Length of Longest Watercourse (L)	10.400	miles
Elevation Difference Along Longest Watercourse (H)	2,100.000	feet
Runoff Curve Number (CN)	63.000	
Minimum Infiltration Loss (iph)	0.000	inches/hour

Precipitation for the Specified Storm

Adjusted Precipitation for the Selected Storm	2.700	inches

Resultant Hydrograph Values

Peak Discharge	404.08	cfs
Runoff Volume	242.04	acre-feet
Time to Peak Discharge	15.50	hours
Time of Concentration	3.43	hours

Figure 2 - Nomograph for Wilson Creek Culvert

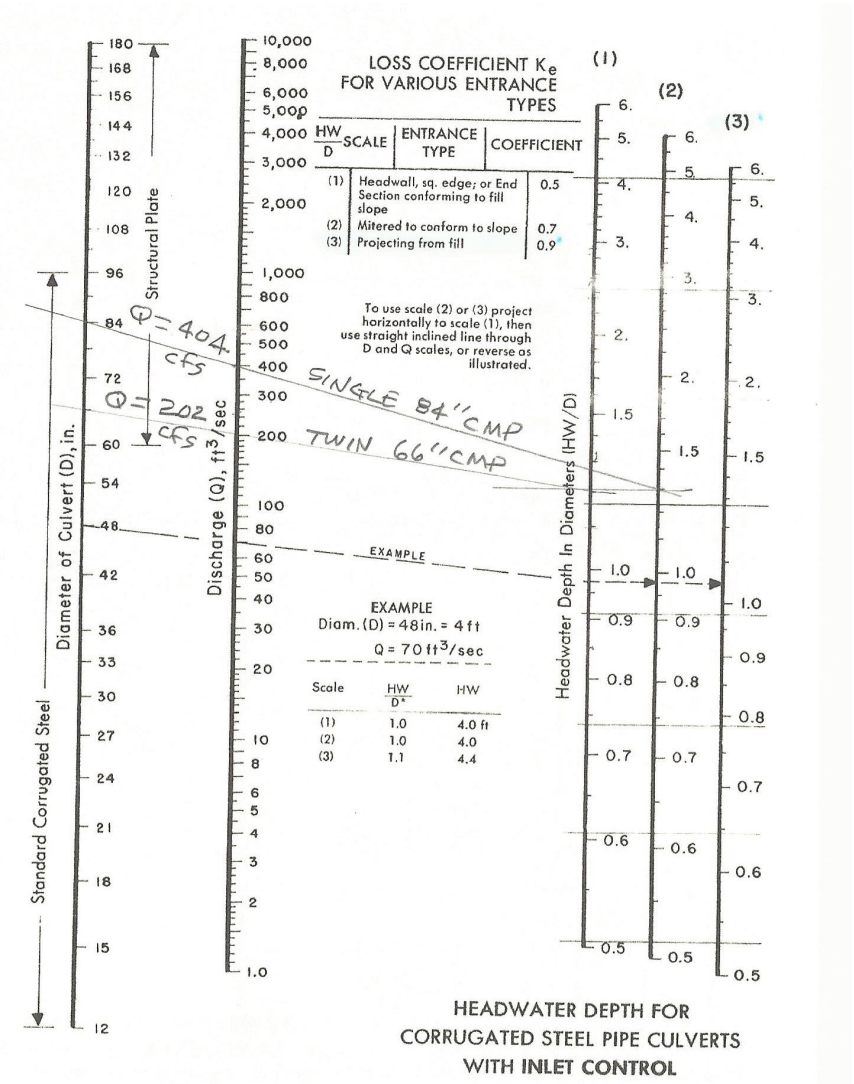


Figure 4-28 *Inlet control* nomograph for corrugated steel *pipe* culverts. The manufacturers recommended keeping *HW/D* to a maximum of 1.5 and preferably to no more than 1.0.

Figure 3 - Trihydro Flood Calculation for the Jubb Creek Culvert

TRIHYDRO-98

25 Year Design Storm, Jubb Creek Road Crossing

SCS Type II, 24-Hour General Storm

25-Year Return Period

Drainage Basin Characteristics

Drainage Area (A)	7.290	square miles
Stream Length of Longest Watercourse (L)	6.510	miles
Elevation Difference Along Longest Watercourse (H)	1,650.000	feet
Runoff Curve Number (CN)	63.000	
Minimum Infiltration Loss (iph)	0.000	inches/hour

Precipitation for the Specified Storm

Adjusted Precipitation for the Selected Storm	2.300	inches

Resultant Hydrograph Values

Peak Discharge	131.01	cfs
Runoff Volume	70.36	acre-feet
Time to Peak Discharge	14.27	hours
Time of Concentration	2.19	hours

Figure 4 - Nomograph for Jubb Creek Culvert

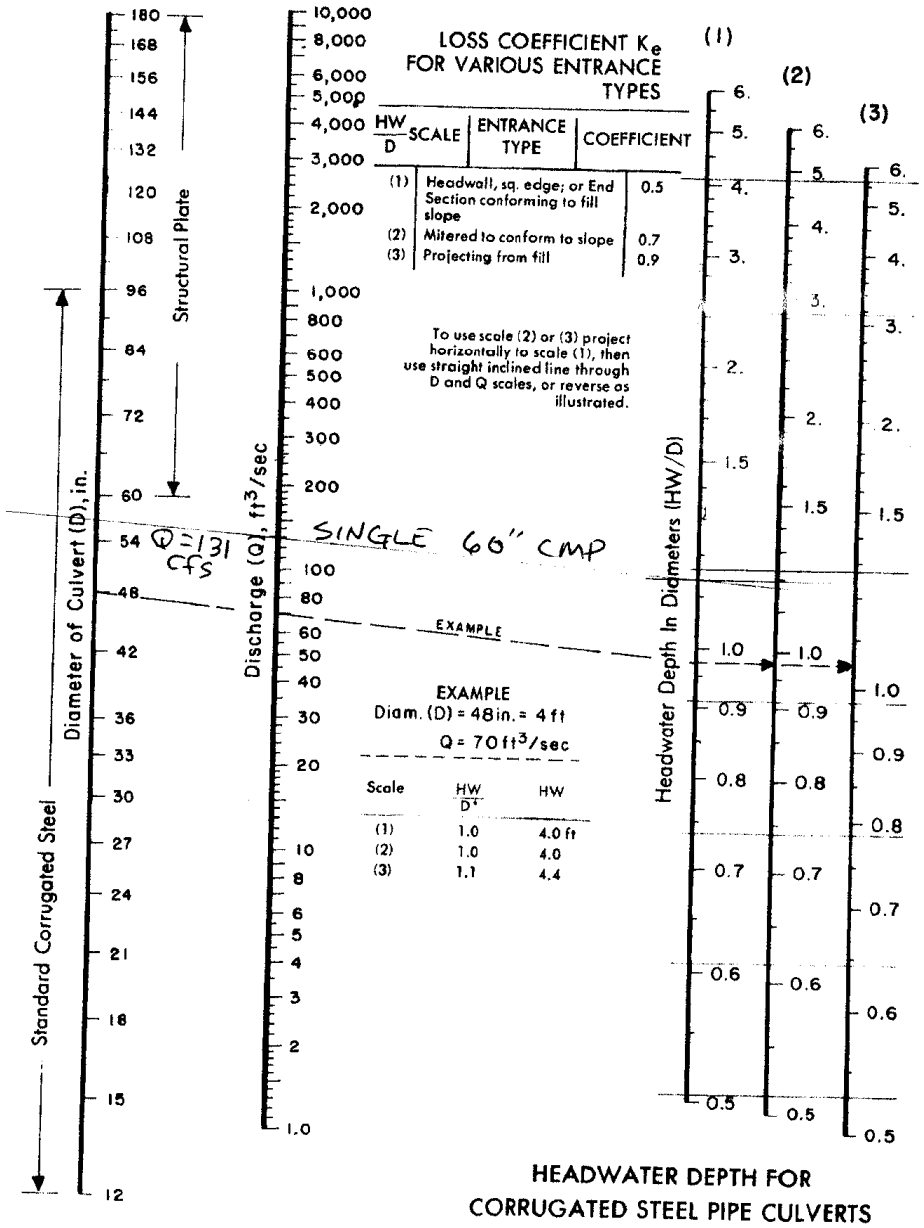
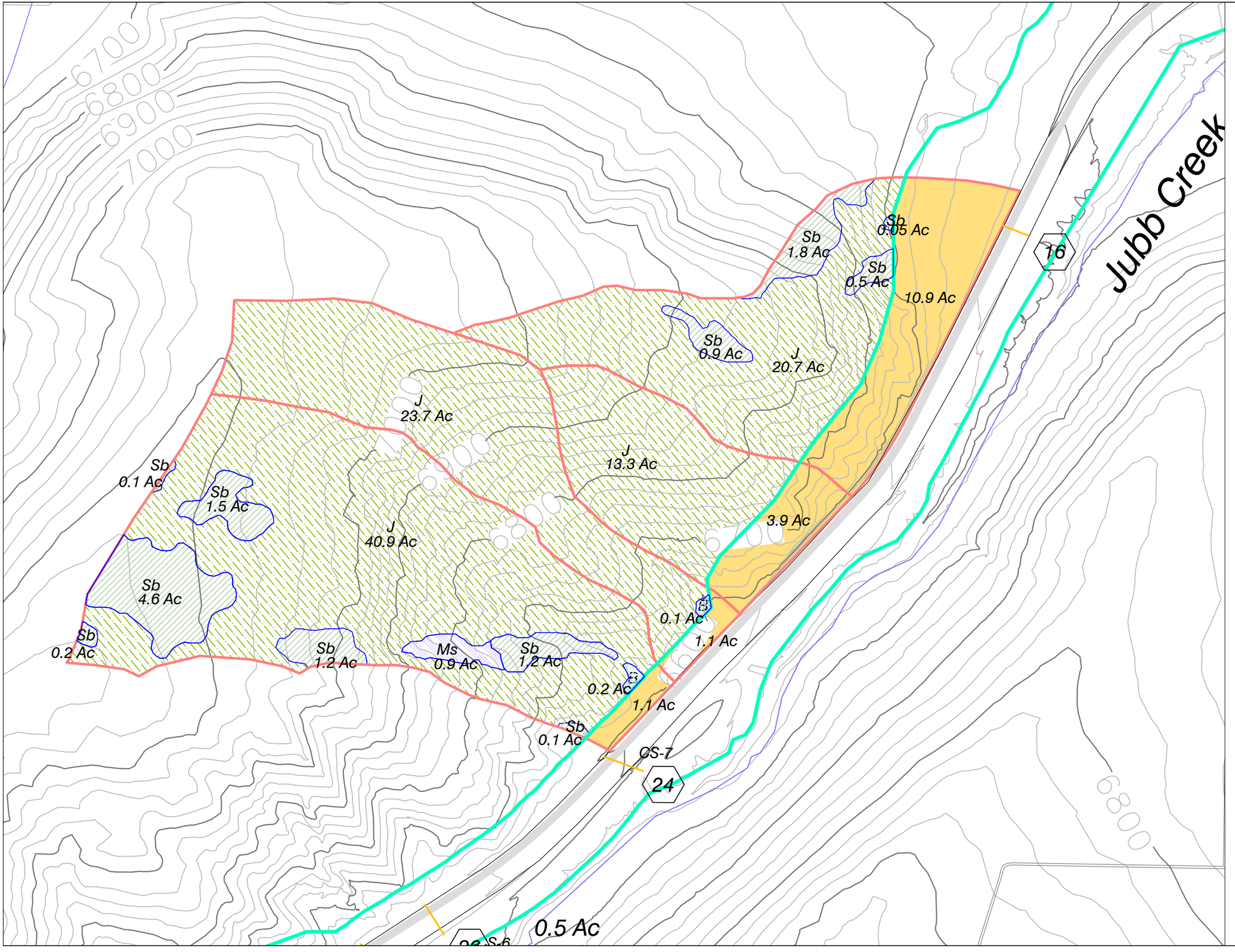


Figure 4-28 *Inlet control* nomograph for corrugated steel *pipe* culverts. The manufacturers recommended keeping *HW/D* to a maximum of 1.5 and preferably to no more than 1.0.

Table 1 Collom Haul Road Culverts

Pipe Number	*Diameter (Inches)*	*Notes*
1	36	
2	36	
5	144	See Wilson Creek Crossing narrative above.
6	36	
6A	36	Culvert was installed as deemed necessary by the field engineer during construction
7	36	
8	24	2- 24” pipes were installed as depth of cover was much shallower than design.
10	36	
11	24	2- 24” pipes were installed as depth of cover was much shallower than design.
13	60	See Jubb Creek Crossing narrative above.
16	36	
20	36	Abandoned in place
24	36	
26	36	
28	36	
30	36	
32	36	Abandoned in place
34	36	
34A	36	Culvert is a 36” half culvert on the outslope of the Collom Haul Road
35	36	
36	36	
36A	36	Culvert is a 36” half culvert on the outslope of the Collom Haul Road
38	36	
40	36	Abandoned in place
40A	36	Culvert is a 36” half culvert on the outslope of the Collom Haul Road
44A	60	The design for culvert 44A (60 inch) is separately provided as structure 6 in the East Side Model presented in Volume 18, Exhibit 7-23C in the SEDCAD output.
47	36	
51	36	
52	36	



Legend

- Streams
- Disturbance Boundary
- Culvert
- Watershed Boundary
- Collom Haul Road Paved Portion
- Disturbed

Vegetation Communities (Map 4)

- B — Bottomland
- G — Grassland
- J — Juniper Scrub
- Sb — Sagebrush
- Ms — Mountain Shrub

N
W E
S

0' 400' 800'

CONTOUR INTERVAL 25 FT.
June 2020 Topography

Collom Haul Road

Culvert 16 Watersheds

Colowyo Coal Company
SAFETY · PEOPLE · PRODUCTION · ENERGY
Colowyo Coal Company
5731 State Highway 13
Meeker, Colorado 81641

SCALE: 1" = 400'
DATE: 6/16/21
DRWG. BY: Tony
APPROVED BY: Tony

DRWG NO.
Figure Exh. 7-25F-1

No.	REVISION	DATE	BY	CHK

Collom Haul Road Culvert 16

10 Year, 24 Hour Storm Event

Tony Tennyson

Tri-State Generation & Transmission Association, Inc.
1100 W. 116th Ave.
Westminster, CO 80234

Phone: 970-326-3560
Email: ttennyson@tristategt.org

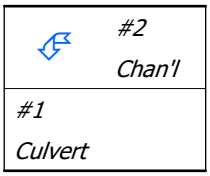
General Information

Storm Information:

Storm Type:	NRCS Type II
Design Storm:	10 yr - 24 hr
Rainfall Depth:	1.800 inches

Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Culvert	#1	==>	End	0.000	0.000	Culvert 16
Channel	#2	==>	#1	0.000	0.000	North Ditch Collom Haul Road



Structure Summary:

	Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#2	128.950	128.950	26.95	2.65
#1	0.000	128.950	26.95	2.65

Structure Detail:

Structure #2 (Erodible Channel)

North Ditch Collom Haul Road

Triangular Erodible Channel Inputs:

Material: Shales and hardpans

Left Sideslope Ratio	Right Sideslope Ratio	Slope (%)	Manning's n	Freeboard Depth (ft)	Freeboard % of Depth	Freeboard Mult. x (VxD)	Limiting Velocity (fps)
2.0:1	7.0:1	2.9	0.0250				6.0

Erodible Channel Results:

	w/o Freeboard	w/ Freeboard
Design Discharge:	26.95 cfs	
Depth:	0.98 ft	
Top Width:	8.84 ft	
Velocity:	6.21 fps	
X-Section Area:	4.34 sq ft	
Hydraulic Radius:	0.479 ft	
Froude Number:	1.56	

Structure #1 (Culvert)

Culvert 16

Culvert Inputs:

Length (ft)	Slope (%)	Manning's n	Max. Headwater (ft)	Tailwater (ft)	Entrance Loss Coef. (Ke)
125.00	2.00	0.0240	6.00	0.00	0.90

Culvert Results:

Design Discharge = 26.95 cfs

Minimum pipe diameter: 1 - 30 inch pipe(s) required

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#2	1	10.900	0.008	0.000	0.000	85.000	F	7.95	0.591
	2	0.050	0.017	0.000	0.000	63.000	M	0.00	0.000
	3	1.800	0.016	0.000	0.000	63.000	M	0.02	0.004
	4	0.500	0.007	0.000	0.000	63.000	M	0.00	0.000
	5	0.900	0.023	0.000	0.000	63.000	M	0.01	0.000
	6	20.700	0.107	0.000	0.000	73.000	M	5.52	0.407
	7	13.300	0.071	0.000	0.000	73.000	M	3.54	0.261
	8	3.900	0.011	0.000	0.000	85.000	F	2.84	0.212
	9	23.700	0.176	0.000	0.000	73.000	M	3.11	0.378
	10	0.100	0.017	0.000	0.000	57.000	M	0.00	0.000
	11	1.100	0.006	0.000	0.000	85.000	F	0.80	0.059
	12	0.100	0.017	0.000	0.000	63.000	M	0.00	0.000
	13	0.200	0.034	0.000	0.000	63.000	M	0.00	0.000
	14	4.600	0.065	0.000	0.000	63.000	M	0.06	0.023
	15	1.500	0.029	0.000	0.000	63.000	M	0.02	0.002
	16	1.200	0.023	0.000	0.000	63.000	M	0.01	0.000
	17	0.900	0.028	0.000	0.000	57.000	M	0.00	0.000
	18	40.900	0.174	0.000	0.000	73.000	M	5.38	0.653
	19	1.200	0.032	0.000	0.000	63.000	M	0.01	0.000
	20	0.100	0.006	0.000	0.000	63.000	M	0.00	0.000
	21	0.200	0.007	0.000	0.000	57.000	M	0.00	0.000
	22	1.100	0.003	0.000	0.000	85.000	F	0.80	0.059
	Σ	**128.950**						**26.95**	**2.651**
#1	Σ	**128.950**						**26.95**	**2.651**

Subwatershed Time of Concentration Details:

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#2	1	5. Nearly bare and untilled, and alluvial valley fans	55.20	124.97	226.40	7.420	0.008
#2	**1**	**Time of Concentration:**					**0.008**
#2	2	3. Short grass pasture	1.00	0.50	50.00	0.800	0.017
#2	**2**	**Time of Concentration:**					**0.017**
#2	3	3. Short grass pasture	29.40	74.94	254.90	4.330	0.016
#2	**3**	**Time of Concentration:**					**0.016**
#2	4	3. Short grass pasture	58.00	99.99	172.40	6.090	0.007

Stru #	SWS #	Land Flow Condition	Slope (%)	Vert. Dist. (ft)	Horiz. Dist. (ft)	Velocity (fps)	Time (hrs)
#2	**4**	**Time of Concentration:**					**0.007**
#2	5	3. Short grass pasture	11.00	24.97	227.00	2.650	0.023
#2	**5**	**Time of Concentration:**					**0.023**
#2	6	3. Short grass pasture	19.90	275.41	1,384.00	3.560	0.107
#2	**6**	**Time of Concentration:**					**0.107**
#2	7	3. Short grass pasture	24.60	249.93	1,016.00	3.960	0.071
#2	**7**	**Time of Concentration:**					**0.071**
#2	8	3. Short grass pasture	45.90	99.92	217.70	5.410	0.011
#2	**8**	**Time of Concentration:**					**0.011**
#2	9	3. Short grass pasture	20.60	473.90	2,300.50	3.630	0.176
#2	**9**	**Time of Concentration:**					**0.176**
#2	10	3. Short grass pasture	1.00	0.50	50.00	0.800	0.017
#2	**10**	**Time of Concentration:**					**0.017**
#2	11	5. Nearly bare and untilled, and alluvial valley fans	22.50	25.01	111.20	4.740	0.006
#2	**11**	**Time of Concentration:**					**0.006**
#2	12	3. Short grass pasture	1.00	0.50	50.00	0.800	0.017
#2	**12**	**Time of Concentration:**					**0.017**
#2	13	3. Short grass pasture	1.00	1.00	100.00	0.800	0.034
#2	**13**	**Time of Concentration:**					**0.034**
#2	14	3. Short grass pasture	5.60	25.12	448.70	1.890	0.065
#2	**14**	**Time of Concentration:**					**0.065**
#2	15	3. Short grass pasture	9.60	24.89	259.29	2.470	0.029
#2	**15**	**Time of Concentration:**					**0.029**
#2	16	3. Short grass pasture	23.20	75.11	323.79	3.850	0.023
#2	**16**	**Time of Concentration:**					**0.023**
#2	17	3. Short grass pasture	20.40	74.84	366.90	3.610	0.028
#2	**17**	**Time of Concentration:**					**0.028**
#2	18	3. Short grass pasture	22.20	524.40	2,362.20	3.760	0.174
#2	**18**	**Time of Concentration:**					**0.174**
#2	19	3. Short grass pasture	22.30	99.79	447.50	3.770	0.032
#2	**19**	**Time of Concentration:**					**0.032**
#2	20	3. Short grass pasture	20.00	16.92	84.60	3.570	0.006
#2	**20**	**Time of Concentration:**					**0.006**
#2	21	3. Short grass pasture	5.00	2.50	50.00	1.780	0.007
#2	**21**	**Time of Concentration:**					**0.007**
#2	22	5. Nearly bare and untilled, and alluvial valley fans	32.20	24.98	77.60	5.670	0.003
#2	**22**	**Time of Concentration:**					**0.003**

LIST OF EXHIBITS – VOLUME 20

Exhibit 10, Item 6	Proposed Collom Coal Mine Project Baseline Vegetation Survey, May 2006, Cedar Creek Associates, Inc.
Exhibit 10, Item 7	Wetlands and Waters of the US Delineation for Collom Project, May 2006, Cedar Creek Associates, Inc.
Exhibit 11, Item 1	Wildlife Survey Report for the Collom Permit Study Area, August 25, 2006, Cedar Creek Associates, Inc.
Exhibit 11, Item 2	2007 Wildlife Monitoring Report for the Collom Permit Study Area, December 20, 2007, Cedar Creek Associates, Inc.
Exhibit 13C	Cumulative Bond Collom Haul Road and Facilities
Exhibit 14, Item 7	Pre-Blast Survey – Structures within ½ Mile of Collom Mining Area (Pending)
Exhibit 14, Item 8	Pre-Blast Survey – Offering Letters Pre-Blast Structure Locations Drawing
Exhibit 23, Item 1	Geotechnical Report for the Temporary Spoil Pile
Exhibit 23, Item 2	Addendum to Geotechnical Analysis
Exhibit 25 Item 1	Groundwater Monitoring Well Information
Exhibit 26, Item 1	Alluvial Groundwater Monitoring Well Information
Exhibit 27, Item 1	Collom Haul Road Geotechnical Drilling
Exhibit 27, Item 2	Wilson Reservoir Geotechnical Drilling
Exhibit 27, Item 3	Collom In Pit Drilling
Exhibit 27, Item 4	Collom Topsoil Depth Testing
Exhibit 27, Item 5	Collom Facilities Geotechnical Drilling
Exhibit 27, Item 6	Collom Highwall Mining Geotechnical Design and Operational Considerations
Exhibit 27, Item 7	Addendum Collom and South Taylor Highwall Mining Geotechnical Design and Operational Considerations

Table of Contents

List of Maps

Table 13C-3 List of Culverts for the Collom Haul Road & Jubb Creek Access Road

Culvert Name	Length (ft)	Diameter (in.)
1	197	36
2	164	36
5	217	144
6	74	24
6A	97	36
7	70	36
8	154	2 at 24
10	214	36
11	162	2 at 24
12	49	24
12A	49	24
12B	60	24
12C	111	24
13	338	60
16	143	36
20 (Abandoned)	201	36
24	193	36
26	167	36
28	200	36
30	158	36
32 (Abandoned)	199	36
34	286	36
34A		36” Half Culvert
35	269	36
36	244	36
36A		36” Half Culvert
38	193	36
40 (Abandoned)	327	36
40A	281	36” Half Culvert
44A	291	60
47	95	36
51	97	36
52	164	36

Table 13C-6A Demolition of Country Road 51 Crossing

Structure Name	Dimensions
County Road 51 Haul Road Crossing (Circular Area)	48'x24'217'

Note: Regrade requirements for this structure are contained in Table 13C-4 (stations 0+00 to 208+00). Topsoil requirements for this structure are contained in Table 13C-5 (stations 0+00 to 149+00), and revegetation requirements are contain in Table 13C-6.

Table 13C-6B Collom Haul Road Lighting

Task	
Remove Power Lines	9,617 Feet

Table 13C-6C Collom Haul Road Channels

Name	Topsoil (Cubic Yards)	Riprap (Cubic Yards)	Revegetation (Acres)
C-1	1606	121	1.2
C-2	0	10	0.1
C-3	268	61	0.2
C-4	1,339	28	1.0
C-5	67	39	0.05
C-6	254	15	0.2
C-7	241	0	0.2
C-8	803	0	0.3
C-9	0	0	0.3