TRI-STATE

July 16, 2025

Ms. Hunter Ridley
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
MR-266 Collom Dewatering Plan and Trout Creek Well

Dear Ms. Ridley,

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 minor revision 266 (MR-266) to Permit No. C-1981-019.

MR-266 proposes to remove the dewatering plan for the Collom Pit and to discontinue monitoring of the Trout Creek Well. As discussed in Volume 15, Section 2.05.3(1), Colowyo will mine down to the E Seam in the Collom box cut. The original mine plan for the Collom Pit had mining occurring down to the G seam. If Colowyo was to mine below the E Seam in the Collom box cut as originally planned, it would have required Colowyo to install the dewatering well system several years ago to allow adequate time to dewater the strata prior to commencing mining below the E Seam. Since Colowyo has completed mining to the E seam in the Collom box cut and will be ceasing mining operations entirely in the Collom pit later this year, Colowyo is proposing to remove the dewatering plan and potential groundwater impacts from dewatering of the pit from the mine permit.

With the removal of the dewatering plan, and the limited mine plan down to the E seam in the Collom box cut, the Division's previous concerns of potential impacts to the Trout Creek aquifer below the Collom Pit from dewatering of the pit will not occur. Therefore, Colowyo proposes discontinuing monitoring of the Trout Creek Well as potential impacts to the Trout Creek aquifer will not occur due to the minimal Collom pit depth compared to what was originally permitted mining down to the G seam.

Finally, with the proposed removal of the dewatering plan for the Collom Pit, Colowyo requests that the Division remove Stipulations 19 and 20 from Colowyo's permit as both stipulations are no longer applicable with the removal of the dewatering plan.

Included in this minor revision is a change of index sheet to ease incorporation of this minor revision into the permit document. If you should have any additional questions or concerns, please feel free to contact Tony Tennyson at (970) 824-1232 at your convenience.

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Sincerely,

DocuSigned by:
Chris Gilbreath
D250C711D0BF450...

Chris Gilbreath
Senior Manager,
Remediation and Reclamation

CG:TT

Enclosure

cc: Tom Cummins (BLM-WRFO)
Tony Tennyson (via email)
File: C. F. 1.1.1.24

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

Mine Company Name: **Colowyo Coal Company**
Date: **July 16, 2025**

Permit Number: **C-1981-019**
Revision Description: **MR-266 Collom Pit Dewatering and Trout Creek Well**

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
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	Table of Contents Page ii (1 page)		Table of Contents Page ii (1 page)		Table of Contents has been updated.
15	List of Exhibits Page viii (1 page)		List of Exhibits Page viii (1 page)		List of Exhibits has been updated.
15	Collom Rule 2 Pages 27 and 28 (2 pages)		Collom Rule 2 Pages 27 and 28 (2 pages)		Text was inserted to note that dewatering of the Collom Pit did not occur, and text removing dewatering well water has been updated.
15	Collom Rule 2 Page 69 (1 page)		Collom Rule 2 Page 69 (1 page)		Section 2.05.3(1) was updated.
15	Collom Rule 2 Page 87 to 108 (21 pages)		Collom Rule 2 Page 87 to 106 (20 pages)		All references to the dewatering plan and potential impacts have been removed which caused a pagination shift.

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

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Revision Description: **MR-266 Collom Pit Dewatering and Trout Creek Well**

Volume Number	Page, Map or other Permit Entry to be REMOVED	Page, Map or other Permit Entry to be ADDED	Description of Change
15	Collom Rule 4 Pages 10 and 11 (2 pages)	Collom Rule 4 Pages 10 and 11 (2 pages)	Trout Creek Well has been removed from the monitoring program.
16			No Change
15			No Change
17			No Change
18A			No Change
18B	Exhibit 7 Item 22B All pages (57 pages)		Exhibit 7 Item 22B is being removed from the permit document.
18C			No Change
18D			No Change
19			No Change
20			No Change
20			No Change
21			No Change
22			No Change

TABLE OF CONTENTS

LIST OF EXHIBITS

the wells and field measurements for pH, electrical conductivity, and temperature were monitored monthly. Quarterly monitoring included a full suite of analyses on each well. Water samples from the wells were filtered in the field and preserved for analysis of dissolved metal concentrations. Groundwater samples were also collected in Collom permit expansion area wells in 1984-1985, 1996-1997, and 1999-2000 as part of earlier studies; pertinent data from those data sets are included in the discussion presented in this section. Figures 2.04.7-36 and 2.04.7-37 present trilinear diagrams illustrating water quality for representative bedrock and valley fill monitoring wells from the data collected during baseline monitoring in 2004-2006.

Groundwater samples for water quality analysis were collected from the bedrock and monitoring wells in 2004 to 2006. Water samples were also collected from well C-04-16B (this well was one of several monitoring wells around exploration hole C-04-16), constructed for use in a long-term aquifer test in the Collom Pit area, to characterize the groundwater that would be produced during Collom Pit dewatering operations. Due to a short mine life Collom Pit and a reduced mining depth, dewatering of the Collom Pit did not occur as it was not necessary. Additional data collected in 1996 and 1997 from wells UL-95-01, W-95-11 and UL-95-40 were also available. The locations of these wells are shown on Map 10B. A summary of the sampling history and results is provided in Table 2.04.7-42 for the bedrock wells. Table 2.04.7-42 also lists the Federal drinking water maximum contaminant levels (MCLs) and secondary drinking water quality criteria. Although these criteria are not specifically applicable, they provide a basis for comparison.

The inorganic chemistry of the bedrock groundwater changes as a function of depth and distance downdip along groundwater flow paths. Groundwater samples from the F sandstone are calcium/magnesium–bicarbonate waters and fall within Region 1 on Figure 2.04.7-39. Within Region 1, the downdip wells show a gradual evolution toward sodium-bicarbonate water. Samples from the F/G sequence contain higher percentages of bicarbonate and occupy Region 2. These wells also evolve towards a more sodic chemistry with distance down dip. Samples collected from well C-04-16B, which is screened over the 400-ft interval from the D coal to the H sandstone, fall into to this region and most closely resemble the groundwater from well MWC-04-13FG. Groundwaters in the H sandstone are all sodium bicarbonate types, with the sodium content a function of the distance down dip. These groundwaters generally plot in Region 3 on Figure 2.04.7-39. The inorganic chemistry of some of the samples collected from wells MWC-04-33H and MWC-04-13H plots in Region 1. Well MWC-04-033H is actually screened in the lower part of the G sequence and plots near Region 2, as would be more typical for its construction. Two samples from well MWC-04-13H plot in Region 1, close to the samples from well MWC-04-13FS, suggesting either a hydraulic connection or possibly a handling issue with those samples from well MWC-04-13H. The other samples from well MWC-04-13H plot at the extreme far end of Region 3, as expected.

Historic data from well UL-95-01, located a short distance northeast of well cluster MWC-04-33 and completed in the Fab coal seam, indicate groundwater quality that plots in Region 2 on Figure 2.04.7-39. The chemistry of this groundwater is very similar to a majority of samples from upgradient F sandstone wells. Samples from well UL-95-01 collected between September 1996 and August 1997 show relatively little variation over time. Samples from well W-95-11, located on the ridge crest between Jubb and Wilson Creeks, plot in Region 2, indicating that the well is screened in the F/G sequence. The samples show little variation between October 1996 and August 1997. Total dissolved solids (TDS) ranged between 500 and 1,000 milligrams per liter (mg/L), which exceeds the secondary drinking water MCL of 500 mg/L. The pH of the samples is slightly alkaline, ranging from 7.6 to 8.1. Concentrations of dissolved metals were generally low. Problematic metals (cadmium, lead, mercury and selenium) were not detected above the laboratory reporting limits. Concentrations of iron and manganese exceeded their respective drinking water criteria of 0.3 and 0.5 mg/L in all bedrock groundwater samples except those from wells C-04-16B, MWC-04-1FG, MWC-04-05H, and MWC-04-13FG (Table 2.04.7-41).

Water quality data are available for the valley-fill monitoring wells from 2004 through 2006. Additional data collected in 1996 and 1997 from wells MJ-95-01, MJ-95-02, and MJ-95-03 were reviewed. Results of the valley-fill well samples are summarized in Table 2.04.7-42. The complete dataset is provided in Appendix 5.K of the WMC (2005) report (Exhibit 7, Item 21), as are laboratory analysis sheets for samples collected in 1995-1996. Table 2.04.7-42 also lists the Federal MCLs and secondary drinking water quality criteria. All samples except from well MJ-95-02 exceeded the secondary drinking water MCL for TDS of 500 mg/L. Water quality in several wells also exceeded the secondary drinking water MCLs for iron (0.3 mg/L) and manganese (0.05 mg/L).

Groundwater Use – Groundwater use in the Colowyo revised permit area is limited due to the depth to water, the generally poor quality, and its limited overall availability. Colowyo installed and developed two wells in the late 1970s to supply a portion of the domestic needs. The two deep wells, Taylor Creek Nos. 1 and 3, are located in Section 33, T4N, R93W, and in Section 4, T3N, R93W, respectively (Map 11B). Taylor Creek No. 1, completed to a depth of 850 ft in the Williams Fork Formation, produced 40 gpm. Taylor Creek No. 3, completed to a depth of 2,284 ft in the Iles Formation, produced 20 gpm. Neither well has been pumping since the early 1980s. Colowyo installed a new potable water supply well in 2004. That well was completed in the Trout Creek Sandstone and is located in the NW¼ of Section 3, T3N, R93W. The production rate is less than four gpm.

The information from Colowyo's existing operations indicates that groundwater is very limited, even to depths significantly below current mining activities. This conclusion is supported by the depths of the potable wells, Taylor Creek No. 1 and Taylor Creek No. 3, and the newer water well. Further evidence of lack of significant groundwater resources within and adjacent to the mine area is that most residents in the general area haul drinking water from the towns of Craig or Meeker.

A search of the Colorado Office of the State Engineer's files revealed 116 permitted wells located inside or within one mile of the permit revision area (Table 2.04.7-44). Of the 23 wells with reported yields, only three have yields greater than 15 gpm. The maximum reported yield is 50 gpm, and the median reported yield is 8 gpm. Most (91) of the permitted wells are used for monitoring purposes; nine of the permitted wells support domestic or domestic and livestock uses, and 11 are used for livestock. The locations of the permitted wells are illustrated on Map 11B.

Groundwater is not currently used for industrial or mining purposes such as watering haul roads or dust control.Water for these purposes is currently supplied by Wilson Reservoir located in Section 13, T4N, R93W.

2.04.7 (2) Surface Water Resource Information

Both general and detailed information regarding surface water in the vicinity of the mining areas are presented in the following subsections.

General Surface Water Resource Information

Surface Water Characteristics – The Colowyo Coal Company's area of operation is located within the Lower Yampa River basin in northwestern Colorado. The physiography of the area consists of a montane region and an upland plateau. The montane region typifies the headwater reaches of most drainages, which are characterized by steep, narrow, bedrock-controlled channels. The channels are generally straight with limited sediment accumulation. Active erosion is limited to areas with erodible shale or friable sandstone (Camp Dresser & McKee (CDM), 1985b).

2.05 OPERATION AND RECLAMATION PLANS

2.05.1 Objectives

The planned operations and reclamation will be similar to those presented in Volume 1, Section 2.05. Operational changes and information specific to the Collom Pit within the Collom mining area are described in the following sections of this permit revision application.

2.05.2 Operation Plan - Estimated Area for Life of Operation

Information regarding the permit term is delineated in Section 2.01.5. Information for the operation plan is delineated in Section 2.05.3. Likewise, for purposes of this application, the permit area identifies the area for the life of the mine

Colowyo will employ detailed and current engineering designs for all surface mining activities in order to maximize coal recovery. The open pit mining technique minimizes or eliminates coal rib losses and coal fenders. The mining operations described in Section 2.05.3 are designed for maximum coal recovery.

2.05.3 (1) Operation Plan – Production Methods

Colowyo has selected its mining procedures on the basis of information from numerous exploration drill holes which penetrated the overburden, the interburden, and the coal seams. Each phase of mining has been carefully scheduled so that all equipment can be operated in situations suitable to their design capabilities. The overall operation plan is designed to flow logically from topsoil removal through reclamation. The plan is designed to maximize coal recovery and minimize environmental disturbances. Colowyo's existing operation plan is described in detail within Volume 1, Section 2.05.3.

The locations of the areas to be mined are shown on the Mine Plan Map (Map 23B). Topsoil removal schedules and stockpile locations are delineated on the Topsoil Handling Map, (Map 28C Sheet 1). Topsoil will be removed from an area primarily during the summer and fall months to allow for advancement of mining. A buffer zone, with topsoil removed, will be left between the undisturbed area and the crest of the pit. Additional information on topsoil handling is presented in Section 2.05.3 (5).

The area to be mined within the Collom Pit covers an area of two long ridge lines at about 7900 feet in elevation which is bisected by a 100 to 200 feet deep valley formed by the stream channel of Little Collom Gulch. Ultimately the Collom Pit could cover about 880 acres and could be up to 600 feet deep in places.

Seams that can be be mined in the Collom Pit include the Y, X, A, B, C, E, F, and G. The lowermost seam that could be developed is the G_{ab}. However, Colowyo will only mine down to the E Seam in the Collom box cut only. As shown on the geologic cross-sections presented in Figure 2.04.6, all the coal seams in th Collom Pit are dipping at approximately 8 percent to the northeast. Cross section locations are shown on Figures 2.04.6 Sheets 1 and 2.

Given current market forecasts for coal sales, not all coal seams located within the Collom Pit are scheduled to be mined at this time. Should coal markets change, the Collom Mine Plan will be revised to mine additional seams as needed to meet contractual obligatoins. The current operating plan is to finish dragline operations in the South Taylor Pit, and then relocate the dragline into the Collom Pit in or around 2023. Once the dragline is in the Collom Pit, it will uncover the upper-most X coal seam and spoil overburden in the last-pass cut location. The truck/shovel fleet will excavate and transport X coal, and will also continue developing the Collom boxcut through the B,C,D and E coal seams.

Summary of Probable Hydrologic Consequences

An evaluation was made of potential hydrologic impacts of the Collom mine to determine if the potential impacts are likely to occur and if they would be significant. Based on the assessment of potential impacts, the probable hydrologic consequences of the Collom Project are:

- Two springs mapped within the pit footprint and facilities area will be eliminated by mining. Springs near the Collom pit might experience decreased flows during mining. Significant impacts to other springs are not anticipated.
- The hydraulic conductivity within the backfilled pit is anticipated to be more uniform and higher than the hydraulic conductivity of the individual geologic units in the adjacent unmined areas. This will result in alternation of the groundwater flow gradient in the mine footprint area and the immediate area surrounding the footprint. In general, the higher permeability of the spoil backfill will result in a flatter groundwater gradient. Groundwater flow conditions in the areas north of the pit are expected to be similar to the pre-mining groundwater flow conditions after re-saturation of the spoil backfill.
- No other statistically significant changes to surface water and groundwater quality or quantity are anticipated.

The potential impacts that were evaluated and the resulting hydrologic consequences are discussed in the following subsections.

Potential Impacts to Springs and Seeps

Springs in the Colowyo Mine area result from three general sources: 1) typified by a relatively deep soil accumulation immediately upslope and shallow bedrock downslope of the point of discharge, 2) discharge within valley bottom deposits, and 3) from sheer bedrock faces on hillsides (CDM 1985b). The first two of these sources may mask or contribute to bedrock sources of the springs. The seeps and low volume springs flow generally in response to snowpack accumulation and subsequent melting resulting in seasonal flows.

The majority of the springs with bedrock sources appear to be contact springs. A contact spring results from the infiltration of water from the surface to a porous zone (such as sandstone) above a horizontal hydrologic barrier (such as shale) where the water preferentially flows along the contact to the exposure. This type of spring is common in areas where alternating sequences of lithologies exist that exhibit differential hydraulic conductivities, such as the Williams Fork Formation.

Table 2.05.6-4 lists the springs and seeps found in the vicinity of the mining area. The locations of the investigated springs and seeps are presented on Map 10B. Data collected for the springs and seeps were previously summarized in Table 2.04.7-49.

The potential impacts to springs and seeps listed below are evaluated for each of the three surface drainage areas that will be affected by the mine:

- Elimination of springs and seeps
- Changes in flow
- Formation of new springs and seeps

Little Collom Gulch Area

Two springs (SPRLC-01 and SPRLC-02) maintained flow during July and August 2005 in Little Collom Gulch, and produced a total of 0.30 cfs during spring runoff in June 2005, and 0.045 cfs during August 2005 base flow. (Table 2.04.7-49) Spring/seep SPRLC-03 produced a minor flow of 0.009 cfs in December 2004, and produced no measurable flow for any other sampling event. Springs/seeps V11 and V29 produced no measurable flow for any sampling event. All Little Collom Gulch spring and seep flows subsequently infiltrated into the valley fill or were captured by stock ponds. Streamflow monitoring point LLCG located near the mouth of Little Collom Gulch was dry throughout the 18 month sampling period.

Spring SPRLC-01 (V24) is located at an elevation of about 7270 ft in Little Collom Gulch within the pit footprint area and will be eliminated by the mining operations. The bedrock groundwater elevation in this area is about 7150 ft so the source of this spring is probably from perched groundwater. Spring V11 was mapped in the Little Collom Gulch drainage area at an elevation of about 7230 ft in the footprint area of the facilities but had no measurable flow during the 2005 and 2006 monitoring events. It may reflect localized discharge from snowmelt but is not a significant spring. It likely will be eliminated by the facility construction.

Spring SPRLC-02 (V30) is located at an elevation of about 6926 ft in Little Collom Gulch near the toe of the excess overburden pile and in the area of the southeast of the Section 25 Pond. Construction of the sediment pond may affect the discharge zone of this spring. Springs SPRLC-03 (V31) and V29 are located at elevations of about 6691 ft and 6845 ft, respectively, in Little Collom Gulch north of the excess overburden pile and the Section 25 Pond. Neither of these springs is a significant feature and V29 was dry during the 2005 and 2006 monitoring events, and neither spring is anticipated to be impacted.

In Little Collom Gulch, the springs potentially affected by mining operations produced a combined average flow of about 0.16 cfs with a maximum flow of about 0.30 cfs and a minimum flow of about 0.015 cfs during the baseline monitoring period.

As discussed below, there is a slight chance for a spring to develop in Little Collom Gulch during the post-mining period if the pit backfill re-saturates up to the elevation that the northern pit highwall daylights in Little Collom Gulch. This spring would discharge groundwater from the mine backfill material. Further evaluation is provided under the discussion of potential impacts to groundwater.

West Fork Jubb Creek Area

There are no mapped springs in the West Fork of Jubb Creek drainage that will be directly eliminated by the mining activities.

As indicated in Table 2.05.6-4, spring V1 is not a naturally occurring feature. It is a flowing well (Well Permit No 175218) located in the stream valley at about elevation 7170 ft and is completed at a depth of at least 600 ft below ground surface. Based on the data fromavailable drill logs in the area the well is completed in the Trout Creek Sandstone. The Trout Creek Sandstone aquifer will not be affected by mining so the flow in this well would not be impacted.

Springs V10, and V32 are located at elevations 7295 ft and 7600 ft, respectively, along the West Fork of Jubb Creek and on the west side of the stream channel. However, the spring elevations are generally above the bedrock groundwater elevations and are likely sourced locally.. Spring V2 is located at about elevation 6860 ft on the west side of the West Fork of Jubb Creek. It is north of the mine area and is likely sourced from local recharge. It is located within the Collom Haul Road corridor and will likely be impacted to some degree during the construction of the road.

Springs V3, V9a and V9b are also located well north of the mine area at elevations 6820 ft, 6895 ft and 6886 ft, respectively, along the east side of the stream channel. These springs are sourced from areas to the east of the stream and are not expected to be impacted by the mining activities. Two springs potentially affected by mining operations (V10, and V32) produced a combined average flow of about 0.013 cfs, a maximum flow of about 0.022 cfs and a minimum flow of about 0.004 cfs during the baseline monitoring period.

It is not expected that new springs will develop in the West Fork of Jubb Creek during the post-mining period.

Collom Gulch Area

There are no mapped springs in the Collom Gulch drainage that will be directly affected by the mining activities.

Springs SPRC-02 (V8), V27, V28 and SPRC-04 (V7) are located at elevations 6807 ft, 6701 ft, 6696 ft and 6601 ft, respectively, along the east side of Collom Gulch north of the mine area. These springs are more likely sourced from local groundwater that will not be affected by mining.

Springs SPRC-03 (V26), V20, V21 and V25 are located at elevations 6753 ft, 7074 ft, 7076 ft and 6785 ft, respectively, along the west side of Collom Gulch. These springs are sourced from areas to the west of Collom Gulch and are not expected to be impacted by the mining activities. Other springs listed in Table 2.05.6-4 are located up-gradient of the mine and are likely sourced from shallow groundwater and are not expected to be impacted by the mining activities.

In Collom Gulch, the springs potentially affected by mining operations (V27, V28, SPRC-02 and SPRC-04) produced a combined average flow of about 0.057 cfs, a maximum flow of about 0.13 cfs and a minimum flow of about 0.002 cfs during the baseline monitoring period.

It is not expected that new springs will develop in Collom Gulch during the post mining period.

Potential Impacts to Streams

The three streams potentially affected by mining include Little Collom Gulch, the West Fork of Jubb Creek and Collom Gulch. An evaluation of each stream was made for the following potential impacts from mining operations:

- Changes in direct surface runoff to streams from storm flow and snowmelt
- Changes in stream base flow amounts
- Changes in surface water and groundwater interactions
- Effects from discharge of water from settling ponds

Little Collom Gulch

Little Collom Gulch is an ephemeral stream throughout its entire length, has a drainage area of about 2.9 square miles (WMC, 2005) and flows south to north through the center of the mine footprint. The area of Little Collom Gulch within the pit footprint is about 0.74 square miles and the area within the spoil pile footprint is about 0.59 square miles for a total area of about 1.33 square miles. Thus, the disturbance is about 46% of the total watershed area. Several clean water diversion structures are planned in Little Collom Gulch upstream of the pit to intercept and safely reroute storm flows around the mine area. The water collected in these structures will come from undisturbed areas.

As described in Section 2.04.7 (2) no flow was observed in Little Collom Gulch during any of the sampling events.

The direct surface runoff from 25% of the drainage area of Little Collom Gulch will be intercepted by the pit and will be either lost to evaporation or be utilized for dust control within the pit. The surface runoff from 20% of the drainage area of Little Collom Gulch will be incident upon the out of pit spoil pile. This runoff will be captured by one of the five sediment ponds (See Map 41B) and will either be lost to surficial evaporation or be discharged according to CPDES requirements to Little Collom Gulch or Collom Gulch. Another 8% (0.24 square miles) of the watershed will be disturbed by the facilities area and report ultimately to the Section 25 Pond and will be lost either to evaporation or discharged to Little Collom Gulch. The runoff intercepted by the Little Collom Gulch clean water diversion structures upstream of the mine pit (0.78 square miles of drainage) will be redirected to either Collom Gulch or the West Fork of Jubb Creek and not be impacted by mining activities. Surface water flows in Little Collom Gulch have not been observed so impacts to direct runoff in Little Collom Gulch are expected to be minimal. Since Little Collom Gulch does not normally contribute to the direct surface water runoff in Collom Gulch, the overall effects on the streamflow in Collom Gulch are expected to be insignificant. During the post-mining period, the Little Collom Gulch surface drainage pattern will be re-established to pre-mine density.

There is currently a small amount of recharge to the shallow valley fill groundwater that occurs from precipitation and surface runoff in Little Collom Gulch. This source of recharge will be eliminated during mining by the pit and the spoil pile. There may also be some discharge of perched groundwater from the upper bedrock units to the Little Collom Gulch valley fill that could be affected (e.g., springs SPRLC-01, SPRLC-02). The potential impacts on spring flow are discussed above and impacts to groundwater are discussed in a following section.

There may be periodic releases of water from the Section 25 sediment pond located in Little Collom Gulch near the toe of the spoil pile. This water will be released to Little Collom Gulch and will either infiltrate into the valley fill or contribute to surface flows in Little Collom Gulch. It is possible that some surface flow may make it to Collom Gulch during the higher flow periods.

<u>West Fork Jubb Creek</u>

The West Fork of Jubb Creek is an intermittent stream. It joins the East Fork of Jubb Creek to the northeast of the mine area to form Jubb Creek. The total drainage area of Jubb Creek above the USGS gaging station is about 7.53 square miles, including both the East and West Forks (WMC, 2005). The area of the West Fork of Jubb Creek within the pit footprint is about 0.21 square miles and no areas are within the spoil pile footprint. Thus, the mine disturbance affects is less than 3% of the total watershed area of Jubb Creek.

As described in Section 2.04.7 (2), the West Fork of Jubb Creek produced flow from May through August with a peak flow of about 0.30 cfs in June. It remained dry during late summer, fall and winter. As described above, there is flowing well in the West Fork of Jubb Creek at the location mapped as spring V1. This well contributes water to a small stock pond. Water from the pond infiltrates into the stream valley fill deposits and contributes to shallow ground water flow.

The lower portion of Jubb Creek below the confluence of the East and West Forks typically produces flow for much of the year except during the winter months. Based on USGS stream gaging data from 1976 to 1981 on the lower reach of Jubb Creek (WMC, 2005), the annual flow volume is highly variable, ranging from less than 2 to over 300 acre-ft per year with an average of 81 acre-ft per year.

The direct surface runoff from about 3% of the drainage area of the Jubb Creek watershed will be intercepted by the excavation of the Collom Pit. This minor amount of disturbance is not expected to have a significant impact on the amount of direct surface runoff in Jubb Creek.

Collom Gulch

Collom Gulch is an intermittent stream in its upper reaches but generally has perennial flow in its lower reach. It has a drainage area of about 5.05 square miles above its confluence with Little Collom Gulch. The watershed area of Collom Gulch within the pit footprint is about 0.41 square miles and the area within the spoil pile footprint is about 0.39 square miles for a total area of about 0.80 square miles. Thus, the mine disturbance is about 16% of the total watershed area above the Little Collom Gulch confluence.

As described in Section 2.04.7 (2), the lower Collom Gulch monitoring location had a maximum flow of about 3.5 cfs during the spring runoff period with a base flow of between 0.03 and 0.04 cfs during the summer and winter periods, respectively. Based on WMC (2005) the upper portion of Collom Gulch flows during the spring runoff period and this streamflow contributes groundwater recharge to the valley fill along the stream channel. During the summer and winter base flow periods, the upper portion of the stream typically does not flow so stream base flow in the lower reach of Collom Gulch is maintained by discharge of groundwater from the valley fill to the stream.

The direct surface runoff from 8% of the drainage area of Collom Creek above the confluence with Little Collom Gulch will be intercepted by the pit. The direct surface runoff from 8% of the drainage area which is associated with the excess overburden pile will be routed to the Sidehill Pond and West Pond sediment ponds. It will either be stored for on-site use or discharged using CDPHE criteria to Collom Gulch downstream of the Collom Pit. Therefore, the reduction of the amount of direct surface runoff in Collom Gulch caused by the mine is probably less than 16% and more likely in the range of 8 to 16%.

As described in Section 2.04.7 (2) the upper reach of Collom Gulch is generally intermittent with measured base flow in the range of 0.004 cfs and periods when the stream goes dry. The lower reach of Collom Gulch generally has perennial flow that is maintained during the summer and fall by discharge of groundwater from the valley fill. Most of the groundwater recharge to the valley fill comes from the flow in the upstream reach of Collom Gulch during the spring runoff season, which will not be affected by the mine. Therefore, the impacts of the mine on stream base flow are expected to be insignificant.

Flow in springs SPRC-02, V27, V28 and SPRC-04 should not be impacted by mining operations. These springs make up less than 5 % of the measured surface flows in Collom Gulch so the potential impact of reduced flows on Collom Gulch is not considered significant if it were to occur.

There may be periodic releases of water from the Section 26 Pond located in the Collom Gulch watershed at the toe of the spoil pile. This water will be released to Collom Gulch via a surface channel and will either infiltrate into the valley fill or contribute to surface flows in Collom Gulch, depending on the time of year.

Potential Impacts to Groundwater

Drilling of exploration and monitoring wells by Colowyo and other parties in the Collom pit area as discussed in Section 2.04.7 identified very limited perched water in the shallow coal beds and interburden and saturated conditions in the lower third of the sequence to be mined. There are no continuous non-coal aquifers in the saturated section of the pit to be mined.

This subsection provides a discussion of the following potential impacts to groundwater:

- Changes in groundwater levels during mining
- Potential interactions with springs and seeps
- Potential interactions with valley fill aquifers and streams
- Effect on existing groundwater users in the area
- Effect on the Trout Creek Sandstone aquifer
- Effect of mining on the groundwater flow system
- Re-saturation of the pit backfill during the post-mining period

Changes in groundwater levels during mining

The Collom Pit will be excavated to a depth above the regional groundwater table; therefore, no changes in the groundwater level during mining should occur. a

Potential interactions with springs and seeps

Impacts to springs and seeps is not expected to occur due to limited mining activities above the groundwater table which is the recharge source for seeps and springs adajacent to the Collom Pit.

Potential interactions with valley fill and streams

There is some groundwater flow in the valley fill deposits associated with Little Collom Gulch that eventually enters Collom Gulch at the confluence between Little Collom Gulch and Collom Gulch. Recharge to shallow groundwater in the Little Collom Gulch valley fill will be reduced because the recharge area for valley fill groundwater south of the pit highwall will be eliminated during mining. This may result in an approximate 50% reduction in shallow groundwater flow in the Little Collom Gulch during mining.

The amount of groundwater flow in the Little Collom Gulch valley fill is estimated to be about 2,060 ft^3/d (17 ac-ft/yr). This estimate is based on a hydraulic conductivity of the valley fill that averages 33 ft/d (WMC, 2005), a gradient of 0.025 ft/ft, a saturated thickness of valley fill of 25 ft (based on the measurements in valley fill monitoring well MLC-04-1 located near the mouth of Little Collom Gulch), and an estimated lateral extent of the saturated valley fill of 100 ft.

WMC (2006) estimates that the total valley fill groundwater flow is about 18,850 ft^3/d to the north in Collom Gulch below the confluence with Little Collom Gulch. Of this amount, about 12,000 ft^3/d is flowing in valley fill aquifer and an additional 6,900 ft^3/d is groundwater flow that discharges to the stream as base flow. Thus, if the valley fill groundwater inflow from Little Collom Gulch is reduced by 50% from 2,060 to 1,030 ft^3/d, this would only reduce the total groundwater flow out of Collom Gulch by about 5%.

The valley fill groundwater system in the West Fork of Jubb Creek is not anticipated to be affected by mining. The Jubb Creek area disturbed by mining is small, less than 3% of the total watershed area, and most of the recharge to the valley fill groundwater system will come from spring runoff from the higher elevation portions of the watershed. No measureable impacts to stream base flow are anticipated.

Potential effect on existing groundwater users in the area

The Collom mine area and the surrounding land is predominantly owned and/or controlled by Colowyo Coal Company and/or its subsidiaries. There are numerous monitoring wells on these lands which are registered by Colowyo as wells under Colorado State Engineer's rules and regulations. Thus, any well within the limits of the Collom permit expansion is owned and controlled by Colowyo and the only impact from mining will be on Colowyo itself. However, since mining activities are occurring above groundwater no impacts to any groundwater wells is expected to occur. Table 2.04.7-44 and Map 11B reflect the location, ownership and control status of these wells.

The closest known and registered/permitted non-Colowyo owned domestic or commercial wells are located approximately two miles southeast of the initial Collom boxcut area. These wells are located in the SW1/4, Section 7, T.3N., R.93W and are completed below the base of the Williams Fork formation, in the Iles Formation, or in valley fill material along Wilson Creek. This can be verified by comparing the Geology map (Map 7A) with the well location map (Map 11B). Thus, no impacts to these wells from mining activities in the Collom pit is anticipated.

There are no beneficial use wells (other than those owned and/or controlled by Colowyo) within a two mile radius of the northern pit limit of Collom. Therefore, there will be no impact on any non-Colowyo well caused by the miningoperations,

There is a lack of groundwater communication in the vicinity of the Collom pit with any beneficial use well located in Wilson Creek. The KM layer (an aquiclude) precludes any impact from mining activities above the groundwater level on the upgradient wells in Wilson Creek. In addition, the dip of the KM bed and the Trout Creek sandstone top is to the north and any groundwater flow would be down dip away from Wilson Creek. An examination of the cross section illustrated in Exhibit 7 Item 23B,

Potential effect on the Trout Creek Sandstone aquifer

No impacts are anticipated to the quantity of groundwater in the Williams Fork Formation or the Trout Creek Sandstone of the Iles Formation. The Williams Fork Formation is not a significant water supply source in the Danforth Hills. It is not used as a source of water where the valley-fill aquifers and surface waters are accessible.

The Trout Creek Sandstone aquifer is separated from the lowest coal seam to be mined by approximately 400 feet in the Collom pit area. Between this coal seam and the Trout Creek Sandstone is a mudstone/shale, sandstone, siltstone, and coal sequence of the Williams Fork Formation. About 200 feet above the Trout Creek Sandstone, a laterally continuous, smectite clay layer known as the KM bed exists. This layer has very low permeability and, therefore, is an effective barrier to vertical groundwater flow.

No impacts from mining are anticipated to the quantity of groundwater in the Williams Fork Formation or the Trout Creek Sandstone of the Iles Formation.

Potential effect of mining on the groundwater flow system

The bedrock groundwater system intersected by the Collom Pit will be affected by mining and backfilling activities. The existing bedrock groundwater system is highly anisotropic because of the alternating layers in the bedrock that have permeabilities varying over many orders of magnitude. The coal seams generally comprise the higher permeability layers, the sandstones have a lower permeability and the siltstone and mudstone units have a very low permeability. The hydraulic conductivity values of the bedrock units are reported to average about 0.14 ft/d for the coal seams and about 0.006 ft/d for the sandstone units. The hydraulic conductivity value for the mudstone and siltstone units is expected to be less than 0.0001 ft/d (WMC, 2005). Mining will displace these layers within the mine footprint and replace them with a more uniform and isotropic backfill material.

The permeability of the backfill will be higher than the bedrock units and will be more similar the permeability of an valley fill material. The hydraulic conductivity of the backfill is expected to be in the range of 1 to 200 ft/d. The geometric mean value of hydraulic conductivity for valley fill is about 33 ft/d (WMC, 2005) so this value is considered a reasonable estimate of the hydraulic conductivity of the backfill.

The capacity of the backfill to transmit groundwater will be much greater than the capacity of the un-mined bedrock as a result of the higher hydraulic conductivity. This means that the saturated thickness of the spoil backfill necessary to provide the same quantity of groundwater flow under a similar hydraulic gradient will be much less than the saturated thickness of the un-mined bedrock. Thus, it is likely that the groundwater level in most parts of the backfilled pit area will be lower than the current groundwater level in the bedrock. Conceptually, this means that the groundwater levels in bedrock around the backfilled areas up-dip of the highwall will re-adjust to lower groundwater levels in the backfill itself. The exception will be near the north highwall of the pit where the quantity of groundwater flow to the north from the backfill will be limited by the permeability of the bedrock units to the north. In this area, groundwater levels are expected to re-establish to the pre-mining elevation of about 7150 ft or higher.

Re-saturation of the pit backfill during the post-mining period

During mining the Collom pit will be progressively backfilled with spoil material once the initial boxcut is established. The mine advances from north to the south, which is the up-dip direction for the bedrock layers, so as the deeper portions of the pit are backfilled with spoil, water accumulating in the pit can flow down-dip along the pit bottom into the backfill. The mining activity will not cause any decrease in the hydraulic conductivity or transmissivity of the un-mined bedrock units located down-dip (north) of the pit, and the capacity of the bedrock units to transmit groundwater will not diminish. Consequently, the recharge and upgradient inflow entering the pit area will re-enter the bedrock units on the down dip side of the pit.

Some of the seepage from the pit into the backfill may accumulate against the highwall of the pit since the permeability of the unmined bedrock units is expected to be lower than that of the backfilled spoil material. The amount of water that accumulates will depend on the quantity of water available in the pit and the rate that the groundwater system recovers.

Once mining is completed the Collom pit will have a reclaimed surface area of approximately 825 acres and a pit bottom that dips predominantly toward the north. The low point in the reclaimed pit surface topography will be at its intersection with Little Collom Gulch at an elevation of approximately 7,300 feet amsl. During the post-mining period, re-saturation of the reclaimed pit backfill will occur from bedrock groundwater inflow from the pit walls, infiltration of direct precipitation on the backfill area, seepage of surface water flowing over the backfill area, and groundwater inflow from the bedrock units underlying the backfilled pit. The groundwater level will recover in the backfill until pre-mine water levels of 7100 to 7150 ft amsl are reached. These elevations would be below the Little Collom Gulch channel elevation of 7,300 ft amsl. Outflow will occur as bedrock groundwater flow in a down-dip direction to the north. Post mining backfill static water levels may be elevated at times above pre-mine levels due to the higher transmissivity of the backfill and infiltration of surface water runoff. It is highly unlikely that backfill water levels would rise sufficiently to reach a level where a spring would emanate into Little Collom Gulch.

The pre-mining bedrock groundwater elevation in the northern portion of the pit is in the range of 7100 to 7150 ft based on WMC (2005). This is likely the minimum groundwater level that will be re-established in the backfill in the northernmost part of the pit. As described above, some re-saturation of the backfill may occur during mining.

The pre-mining rate of groundwater flow from south to north through the bedrock units in the northern part of the pit can be estimated based on the measured transmissivity in the bedrock, the hydraulic gradient and the width of the flow zone, taken to be the east-west distance between the West Fork of Jubb Creek and Collom Gulch. The long-term pumping test reported in WMC (2005) measured a transmissivity in this area of about 15 ft^2/d, with about 10 ft^2/d attributed to the F/G sequence and 5 ft^2/d to the bedrock units above the F_{ab} coal. This transmissivity value represents a saturated thickness of bedrock in the range of 200 ft (from elevation 6950 to 7150 ft). The hydraulic gradient in this area is measured from wells and piezometers to be about 0.04 ft/ft. The width of the zone is about 10,000 ft. This results in a pre-mining groundwater flow rate from south to north at the northern pit highwall of about 50 acre-ft per year.

The hydraulic head in the backfill at the northern wall of the pit should re-establish itself to at least elevation 7150 ft once equilibrium conditions are reached. At this hydraulic head, the post mining rate of groundwater flow from south to north out of the backfill will be about equal to the pre-mining flow rate and the post-mining groundwater flow system down-gradient of the mine will be essentially the same as the pre-mining system.

The time for the pit backfill to re-saturate to the 7150 ft elevation at the north highwall is estimated based on the volume of backfill in the pit up to the 7150 elevation and the estimated recharge rate to the backfill. The bottom of the pit dips upward to the south at about 250 ft vertical distance per 2,000 ft horizontal distance or at slope of about 0.125 ft/ft. The width of the pit is about 4,500 ft. This results in a backfill volume of about 1.44 billion cubic feet. At a 20% porosity in the backfill, the volume of water needed to saturate the backfill up to an elevation of 7150 ft is about 288 million cubic feet or about 6,610 acre ft. At the estimated pre-mining groundwater flow rate through the pit area of 50 ac-ft/yr, this would require about 130 years to re-saturate assuming no flow to the north out of the pit backfill.

The infiltration rate into the mine backfill may be higher than under pre-mining conditions because of the substitution of the highly stratified pre-mine bedrock aquifers with the homogenous backfill aquifer. The pre-mining groundwater recharge rate from infiltration in the Collom area is estimated to range from about 0.11 in/yr in the southern portion of the area to about 1.1 in/yr in the northern areas where bedrock units outcrop (WMC, 2006). The backfill area is expected to cover about 825 acres. If infiltration into the backfill increases to 3 in/yr (about 20% of precipitation) then an additional amount of groundwater recharge will be available to saturate the pit backfill. Under this condition, it is estimated that the total amount of recharge to groundwater would be about 230 ac-ft per year and the time to re-saturate the backfill would decrease to about 30 years, again assuming no outflow of groundwater to the north.

Groundwater will flow down-dip in the bedrock units to the north from the pit backfill as the backfill re-saturates. If it is assumed that the flow rate out of the backfill at the north pit wall is equal to the pre-mining flow rate at this location, then there will be an annual average groundwater flow of about 50 ac-ft per year. At the higher groundwater recharge rate into the backfill of about 230 ac-ft/yr as described above, this would result in a time to re-saturate of about 40 yrs. Lower infiltration rates into the backfill would increase the time to re-saturate the backfill. The estimated range of times to re-saturate the backfill up to the 7150 ft elevation varies from about 30 to 130 years.

Potential for development of springs from pit backfill

If the saturated thickness of the backfilled area of the pit increases as described above, then the groundwater flow rate to the north potentially will be higher than the natural groundwater flow rate because of the higher hydraulic head. This may result in a groundwater elevation in the highwall area of the pit backfill that is higher than the pre-mining groundwater level elevation of about 7150 ft.

Little Collom Gulch intersects the north wall of the pit at about elevation 7300ft. If the water level in the backfill increases to the 7300 ft elevation, then a spring could develop in Little Collom Gulch where it intersects the pit highwall. An evaluation of the time that would be needed to re-saturate the backfill to the elevation and the potential spring flow quantity is made based on the information in WMC (2005, 2006) and the information presented above.

The time re-saturate the backfill up to the 7300 ft elevation will largely depend on the infiltration rate into the backfill. It is expected to be about 40 years for the maximum infiltration rate of 3 in/yr into the backfill considered above.

The likelihood of a spoil spring developing is considered to be low. Based on the estimates described above, an infiltration rate of less than about 2.5 in/yr into the backfill would not result in a saturation level in the backfill high enough to form a spring. It is unlikely that the effective infiltration rate will be greater than 2.5 in/yr. It is more likely to be in the range of 1 to 1.5 in/yr, which is similar to the value of 1.1 in/yr estimated for the upper portion of the watershed in the regional groundwater model (WMC, 2006).

If a spring develops at this location, the flow will likely re-infiltrate into the valley fill in Little Collom Gulch and not flow down the stream channel as a surface flow. There is a significant thickness of unsaturated valley fill in lower portion of Little Collom Gulch. The water level in well MLC-04-01 near the mouth of Little Collom Gulch is at 46 ft below ground surface. Therefore, it is unlikely that a spoil spring would result in surface water flow down Little Collom Gulch.

Potential Impacts to Water Quality

The quality of surface water, springs and seeps and groundwater is described in Sections 2.04.7 (1) and 2.04.7 (2). This section evaluates potential impacts of mining to water quality including:

- Potential effect on stream water quality
- Potential effect on spring and seep water quality
- Potential effect on groundwater quality

Potential effect on stream water quality

As described above, Little Collom Gulch is ephemeral, and showed no evidence of surface flow during 18 months of baseline monitoring. As a result, no water quality samples are available.

There may be periodic releases of water to Little Collom Gulch from the Section 25 pond. Most of the water released from the pond will probably infiltrate into the valley fill in the Gulch and will result in little if any direct surface flow down to the mouth of Little Collom Gulch. Adequate settling time will be provided in the pond to meet Colorado Point Discharge Elimination System (CPDES) permitted discharge criteria. The water quality from any pond discharge is anticipated to be of higher quality than the surface water quality seen in the lower reaches of the streams in the Collom area. No surface water quality impacts to Little Collom Gulch or to Collom Gulch as a result of surface water flow from Little Collom Gulch are anticipated.

Periodic releases of water to Collom Gulch from the Section 26 sediment pond may occur. This section of Collom Gulch is intermittent so some of this discharge may continue down the stream as surface water flow. Adequate settling time will be provided in the pond to meet CPDES permitted discharge criteria. The quality is anticipated to be of higher quality than the surface water quality seen in the lower portions of the streams in the Collom area. Periodic discharge of water may occur from the Little Collom Gulch diversion structures to Collom Gulch and the West Fork of Jubb Creek. This water will be surface runoff from undisturbed areas and will have a good water quality. No surface water quality impacts to Collom Gulch or to the West Fork of Jubb Creek from these potential releases are anticipated.

In C-04-16B, the pH is approximately 7.2, while the pH is greater than 7.5 in JC and CG. The total dissolved solids (TDS) are 710 ppm in 16B, while in the CG, the mean was 838 and in JC the mean was 1663. All water samples were high in bicarbonate, while the groundwater from 16B had higher sodium than calcium, while the surface water had higher calcium than sodium. No heavy metals were detected in the 16B water sample while the surface water samples from both streams had low levels of selenium and manganese (approximately 0.10 ppm for both metals). Thus, except for adding excess sodium tho the surface water, all other qualities are better.

Thus, the water quality will be improved for a short distance until it intermixes with any surface water.

<u>Potential effect on spring and seep water quality</u>

Based on data presented in WMC (2005) springs and seeps have variable water quality with TDS concentrations ranging from 390 to 1,780 mg/l. This variable water quality reflects the source waters for the springs. Springs sourced from local infiltration and shallow groundwater will generally have lower TDS concentrations and springs sourced from the deeper bedrock groundwater will have higher TDS concentrations.

No significant impacts to spring and seep water quality are anticipated. Springs lying outside of the mine footprint that are sourced from local infiltration and shallow groundwater will not be affected by mining and no changes in the water quality are expected.

Spring SPRLC-01 lies within the pit footprint and will be eliminated by mining. However, it has a relatively high TDS concentration of 1,720 mg/l which is likely representative of the deeper bedrock groundwater quality. In the unlikely event that a spoil seep develops after the mine backfill re-saturates, the water quality of the spoil groundwater is expected to be similar to that of the deeper bedrock so TDS concentrations will be similar. Springs SPRLC-02 and SPRLC-03 are located north of the pit and spoil pile and their TDS values are in the range of 390 to 770 mg/l, probably reflecting a relatively shallow water source. During mining, potential seepage through the spoil pile up-gradient of the source areas of these springs may result in somewhat higher TDS values. Once mining is completed, the spoil pile will be removed from the Little Collom Gulch drainage as part of the mine reclamation and the Section 25 Pond will be removed following bond release. The source areas for these two springs should be re-established and no long-term changes to water quality at these two springs are expected.

<u>Potential effect on groundwater quality</u>

The main impact to pre-mining groundwater quality would be caused by flow out of the re-saturated pit backfill. The water quality of the groundwater at the Collom site is summarized in WMC (2005). The bedrock groundwater generally has TDS concentrations of 500 to 1,000 mg/l, a pH between 7.6 to 8.3 and low concentrations of dissolved metals. The valley fill groundwater has TDS concentrations of 400 to 1,500 mg/l, a pH between 7.6 to 8.1 and low dissolved metals concentrations. The springs and seeps, which reflect discharge from groundwater, have TDS concentrations of 390 to 1,780 mg/l, a pH between 7.8 and 8.3 and low dissolved metals concentrations.

With respect to spoil water quality, current water, rock, and soil quality analyses at the Colowyo Mine predominantly show a basic environment with a pH above 7.0. This chemical environment has been present in this area since quality testing was initiated. Some adverse chemical conditions have been identified in the soils and overburden analyses; however, these have been discussed in the application and have been adequately handled by Colowyo in the past.

The mine backfill will be comprised of spoil material that is not geologically or chemically different from the surrounding bedrock units that currently comprise the bedrock groundwater system. The water quality of the groundwater that will be contained in the mine backfill after it re-saturates is expected to be similar to the measured quality of groundwater in the bedrock and valley fill and the water quality of the spring discharges. Since there will be a mixing of various geologic units in the mine backfill, the average groundwater quality in the backfill may reflect the higher end of the measured groundwater quality, in the range of 1,500 mg/l TDS. No significant changes in bedrock or valley fill groundwater quality are anticipated as a result of mining.

For valley fill ground water, comparing 16B water quality with the downsteam water quality on JC and CG, all values except for metals are comparable. However, while the valley fill wells did contain low levels of iron, manganese and selenium, these metals were not detected in the sample from 16B.

Other Potential Impacts

Flooding and stream flow regimes in the Colowyo Mine area do not appear to have been affected by past mining operations or reclamation, nor are they anticipated to be affected by the Collom mining. Groundwater availability in the area may potentially be enhanced with the storage of water in the reclaimed pits. Colowyo owns significant water rights within the affected drainages. Any potential diminishment of flow that impacts other adjudicated water rights will be compensated for by reduced use by Colowyo. There is sufficient capacity for Colowyo to reduce their use of adjudicated water to compensate for potential diminishment of flow, allowing downstream users full access to their water rights.

With respect to alluvial valley floors (AVFs), lower portions of Collom Gulch have been studied prior to and after the release of the 1985 OSM Alluvial Valley Floor (AVF) Reconnaissance map. The reconnaissance by OSM was compiled on 1:100,000-scale maps and was meant to represent a reconnaissance level effort to identify areas which are likely to meet the AVF definition (from Introduction to OSM report accompanying this study). Thus, any areas identified on the OSM maps are potential AVFs. It was recognized in this study that future studies may more conclusively prove or disprove the AVF findings in the report.

Colowyo and other companies in this area performed AVF studies to more conclusively prove or disprove the existence of AVFs in this potential coal mining area of the Danforth Hills. For the Collom area, there have been significant studies to date examining the Collom Gulch area and the potential for an AVF possibly affected by mining activities in the Collom area.

Alluvial sediments are present in the valley bottoms of the Collom Gulch drainages but are intermixed with significant fractions of colluvium and sheetwash from adjacent slopes. This can be seen in the geologic description of the monitoring well (MC-04-02) in the lower portion of Collom Gulch in Section 24, T. 3 N., R. 93 W. The cuttings obtained from the drill hole are predominantly silty clays, with minor amounts of sand and gravel (<25%). Based on depth to groundwater in this drill hole (10 feet below ground surface), it is doubtful that sub irrigation of any plant crop is possible. Further to the north, near the confluence of Collom Gulch and Little Collom Gulch, monitoring well MLC-04-01, has a groundwater level of between 40 and 50 feet below ground surface.

In addition, active erosion in the Collom Gulch channel is causing further incision, which is lowering the unconfined groundwater table found in the valley. The incision in Collom Gulch is at least two feet and in excess of 20 feet in sections before that flow of Collom Gulch exits through the ‘hogback’ and flows onto the Mancos Shale located in the Axial Basin to the north. The incision is also widening due to the down cutting and erosion of the supporting banks during periods of higher flow (normally occurring during the spring). With the low surface water flow rates and the reduced flood frequency, this has reduced the ability of the valley bottoms to support any agricultural use other than rangeland.

Local and regional agricultural economics are prohibitive to developing irrigation projects within these valley bottoms, and such practices are in decline locally, especially on such a small scale as would be required by the narrow and fragmented nature of irrigable bottomlands within the subject drainages.

The narrow width and fragmented nature of the minimal flat land, depth to groundwater, and impracticality of economically irrigating or mechanically farming the valley bottoms within Collom Gulch indicate that those drainages do not qualify as alluvial valley floors.

In conclusion, no adverse impact to the water environment downstream of the reclaimed Collom Pit is projected.

2.05.6 (4) Protection of Public Parks and Historic Places

No public parks are located within the permit or adjacent areas; therefore, no public parks will be affected by the mining operations. The mining operations are anticipated to affect specific sites and areas listed or eligible for listing in the National Register of Historic Places. These sites are discussed in further detail in Sec 2.04.4. A treatment plan has been prepared for some of the sites expected to experience impacts from the development of this mine. This treatment plan will identify specific mitigation processes needed to develop in and around these sensitive locations.

2.05.6 (5-6) Surface Mining near Underground Mining; Subsidence Control

No surface mining activities will be conducted within 500 feet of an underground mine. Therefore, there is no subsidence control plan for operations.

2.06 PERMIT REQUIREMENTS - SPECIAL MINING CATEGORIES

2.06.1-3 Scope, Experimental Mining, and Mountain Top Removal

There will be no experimental mining practices at the Collom Pit.

2.06.4 Steep Slope Mining

Colowyo may request a variance for mining and reclamation for steep slope mining as specified in Rules 2.06.4(2) and 4.27.

2.06.5 Variance from Approximate Original Contour Restoration Requirements

The Collom mining area will include non-mountaintop removal steep slope surface coal mining and reclamation operations. Colowyo is not currently requesting a variance from approximate original contour in the post-mining topography (PMT), but maintains the option to pursue this in the future as an amendment to the permit. The PMT as presented reflects the pre-mining topography generally, with drainages and drainage divides remaining in their approximate current locations. Some minor moderation in topography is expected due to limitations associated with reclamation equipment. Post-mining topography is shown on Map 19C. The PMT is designed based on the Division's rules for Operations on Steep Slopes as discussed in Section 4.27 of this document.

2.06.6 Prime Farmlands

Prime farmlands do not exist within the Collom permit revision boundary (see Section 2.04.12).

2.06.7 Reclamation Variance

There will be no delay in contemporaneous reclamation due to underground mining activities; therefore, this section is not applicable.

2.06.8 Alluvial Valley Floor (AVF)

General

The geologic and hydrologic conditions of the Collom Mine Expansion area have been studied since at least 1980 by Colowyo and other potential interests. These studies have included the examination of the valley bottoms for the possible presence of alluvial valley floors. These studies include the 1985 Office of Surface Mining Reclamation and Enforcement (OSMRE) Alluvial Valley Floor (AVF) Reconnaissance report and map of northwest Colorado. The reconnaissance by OSMRE was compiled on 1:100,000-scale maps and was meant to represent a reconnaissance level effort to identify areas which are likely to meet the AVF definition (from Introduction to OSMRE report). Thus, any area identified on the OSMRE maps is only potential AVFs. It was recognized in the OSMRE study that future studies may more conclusively prove or disprove the AVF findings in the report.

In examining the land of the Collom Mine Expansion area and the surrounding area, the landforms are controlled by two distinct geologic features. One is the Collom syncline/Danforth Hills and the other is the Axial Basin (these have been described previously in section 2.04.6 - Geology Description). The area of the Collom Syncline has sloping topography to the north until the Collom Syncline axis is reached and then a hogback formed by the uplift of the Iles formation is present. Proceeding north, the open area of the Axial Basin is then encountered.

All drainages in the Collom Mine Expansion area form on the southern portion of the Collom syncline/Danforth Hills. These drainages all flow northward toward and cross the Iles formation and then flow into the Axial Basin. The drainages tend to be narrow, confined drainages until the drainages exit to the Axial Basin.

AVF Specific Study-Collom Mine Area

In 2005, Tetra Tech, doing business as Maxim Technologies, conducted a preliminary field investigation and technical evaluation of the Collom permit expansion area located in the Collom syncline area to determine the presence of alluvial valley floors. The drainages examined include Collom Gulch, Little Collom Gulch, and Jubb Creek (including the West Fork of Jubb Creek). The investigation was conducted in accordance with Section 2.06.8 of the Regulations of the Colorado Mined Land Reclamation Board for Coal Mining and OSMRE Technical Guideline. The results of the investigation concluded that no alluvial valley floors exist in the areas to be mined. The findings were submitted to CDRMS on September 23, 2005 in a letter, a copy of which is included in Volume 18A, Exhibit 7, Item 22. These findings are also discussed further in appropriate sections below.

The mined area is located within Little Collom Gulch, and the Collom Pit and excess overburden pil will occupy much of the Little Collom Gulch valley bottom during the mining operation. Portions of the Collom Pit will lie within the adjacent watersheds of Collom Gulch and the West Fork of Jubb Creek, but will not encroach on the valley bottoms (Map 23B). Groundwater in the general area occurs in valley fill material associated with the stream valleys and in the permeable and semi-permeable bedrock strata (CDM, 1985a). As discussed in Section 2.04.7, the existence of groundwater in the permit expansion area is limited to perched systems that primarily discharge small amounts of water in the canyon walls near the mine on a seasonal basis, and in some of the unconsolidated valley fill. Little Collom Gulch is ephemeral, and did not produce any measurable flow during the baseline hydrologic monitoring efforts described in Section 2.04.7. Very little groundwater is found in the current active mine; and, based on existing geological and hydrological evidence, the area to be mined provides no or only minor amounts of recharge to local surface water features.

Geomorphic Characteristics

Tetra Tech's 2005 investigation included mapping unconsolidated valley deposits in the Collom permit expansion area, using published and unpublished geologic maps and ground reconnaissance. The results are shown in Figure 1 of Exhibit 7, Item 24. Much of the mapped valley deposits contained substantial proportions of colluvium and/or sheetwash materials. The source material for the valley fills was primarily erosion and deposition of loess, leading to a loamy soil texture which supports more lush vegetation than adjacent uplands, even absent sub-irrigation.

In addition, valley bottoms within the permit expansion area were very narrow and historically uncultivated. Most floodplains in the area are generally extremely narrow (less than 20 feet), have been severely down-cut, and/or contain too much topographic relief in the form of slopes to be considered capable of being irrigated. Due to downcutting, flooding does not extend beyond the limits of the incised channel.

Flood Irrigation and Agricultural Activities

Section 2.04.3 contains a description and map of agricultural activities in the permit and adjacent area. The Premining and Postmining Land Use Map (Map 17) shows that the historic pre-mining land use of the area has been generally undeveloped rangeland. Exceptions to undeveloped range land in the permit area include the presence of equipment staging areas, small structures, reservoirs, roads, and stream crossings. However, documentation exists indicating several small parcels along the West Fork of Jubb Creek, totaling approximately 24 acres, were historically used for hay production. No evidence of any irrigation for these parcels was found.

Historically, there has not been a developed water supply for agricultural activities in the potentially-affected drainages. In addition, based on field investigations, there is no evidence of historical flood irrigation in the Collom permit expansion area.

Subirrigation

Depths to groundwater in the valley fill materials in the Collom Mine Expansion area have been recorded as between 9 feet below ground surface (bgs) along West Fork Jubb Creek (near a small pond), to greater than 47 feet bgs within Little Collom Gulch. Further information on groundwater occurrence is provided in Section 2.04.7.

The effects of the mass-wasting event of 1983-1984 downcut the valley fill throughout this area as much as 20 to 30 feet below the former surface in some locations. The resulting lowering of the valley fill groundwater table was noted by Tetra Tech as having caused drying of former wetlands and colonization of the land by upland plant species. Remaining wetlands in the valley bottoms are generally associated with springs and seeps issuing from perched water in bedrock along the valley wall. Examination of non-wetland soil profiles next to drainages revealed very few soils with mottles, shallow rooting depth, or other characteristics indicative of subirrigation.

Suitability for Flood Irrigation

Since 1974, Colowyo and other private and governmental groups have collected samples of water flows and water quality in the area. Water of sufficient quality and quantity for seasonal flood irrigation does exist in some areas (WMC 2005). However, the cost to develop such an irrigation system would be prohibitive given the remote location and limited area available for irrigation (Dames and Moore 1980, Walsh 1984). New irrigation projects are very rare in local agricultural practice, and would incorporate sprinkler irrigation rather than inefficient flood irrigation.

Conclusion

Tetra Tech's 2005 report presented the following findings regarding the presence of alluvial valley floors in the Collom permit expansion area:

- Alluvial materials are present in the valley bottoms of the Collom Gulch, Little Collom Gulch, and Jubb Creek drainages, but the materials are intermixed with significant fractions of colluvium and sheetwash from adjacent slopes.
- Based on depth to groundwater, subirrigation within these valley bottoms is very limited.
- Active erosion in the stream channels is causing further incision, lowering of the groundwater table, and reduced flood frequency, reducing the ability of the valley bottoms to support any agricultural use other than rangeland.
- Local and regional agricultural economics are prohibitive to developing irrigation projects within these valley bottoms, and such practices are in decline locally, especially on such a small scale as would be required by the narrow and fragmented nature of irrigable bottomlands within the subject drainages.

The narrow width and fragmented nature of the minimal flat land, depth to ground water, and impracticality of economically irrigating or mechanically farming the valley bottoms within Collom Gulch, Little Collom Gulch, and West Fork of Jubb Creek of the Collom Mine Expansion area indicate that those drainages do not qualify as alluvial valley floors.

Specific discussion of the Collom Gulch Valley

As noted in the previous text, alluvial materials are present in the valley bottoms of the Collom Gulch drainages but the materials are intermixed with significant fractions of colluvium and sheetwash from adjacent slopes. This can be seen in the geologic description of the monitoring well (MC-04-02) in the lower portion of Collom Gulch in Section 24, T. 3 N., R. 93 W. The cuttings obtained from the drill hole are predominantly silty clays, with minor amounts of sand and gravel (<25%).

Based on depth to groundwater in this drill hole (10 feet below ground surface), it is doubtful that subirrigation of any plant crop is possible. Further to the north, near the confluence of Collom Gulch and Little Collom Gulch, monitoring well MLC-04-01 has a ground water level of between 40 and 50 feet below ground water surface.

In addition, active erosion in the Collom Gulch channel is causing further incision, which is lowering the unconfined groundwater table found in the valley. The incision in Collom Gulch is at least two feet and in excess of 20 feet in sections before that flow of Collom Gulch exits through the 'Iles formation hogback' and flows onto the Mancos Shale located in the Axial Basin to the north. The incision is also widening due to the downcutting and erosion of the supporting banks during periods of higher flow (normally occurring during the spring). With the low surface water flow rates and the reduced flood frequency, this has reduced the ability of the valley bottoms to support any agricultural use other than rangeland.

Local and regional agricultural economics are prohibitive to developing irrigation projects within these valley bottoms, and such practices are in decline locally, especially on such a small scale as would be required by the narrow and fragmented nature of irrigable bottomlands within the subject drainages.

The narrow width and fragmented nature of the minimal flat land, depth to ground water, and impracticality of economically irrigating or mechanically farming the valley bottoms within Collom Gulch indicate that these drainages do not qualify as alluvial valley floors.

AVF Studies- Gossard Loadout and surrounding areas

All the streams/creeks that exit the Collom syncline/Iles formation hogback still exhibit the deep downcutting that originates in the Collom Syncline lands. This downcutting is easily visible in all streams/creeks exiting the hogback and continues for several miles downstream. This downcutting was due to the 1983/1984 mass-wasting event discussed above. The two streams that will be affected by the Collom Mine Expansion are Jubb Creek and Wilson Creek, near the Gossard Loadout.

The possibility of any AVF in Jubb Creek was discussed above. As noted, there is no AVF in the Jubb Creek valley north of the hogback. With respect to Wilson Creek, after the creek exits the hogback, a broad valley filled with valley fill materials is encountered. In the area where the Collom haul road crosses from the Collom Pit to the Gossard loadout, Wilson Creek is at least 20 feet deep. The banks show some undercutting and blocks of valley fill material coming off the sides. The vegetation on the land on both sides of the creek in this area is predominantly upland vegetation. The vegetation is old growth due to the size of the brush in this area. The deep valley of the creek and vegetation continues along the length of Wilson Creek to the north of the loadout and for several miles north of the loadout.

Groundwater is this area is at least 20 feet below ground surface (bgs) in the shallow monitoring wells, Gossard Well and MW-95-02. The Gossard Well is located northeast of the Gossard Loadout in the field and MW-95-02 is located on the east bank of Wilson Creek, southwest of the loadout. The historical average depth to water at the Gossard Well is approximately 21 feet (2009 Annual Reclamation Report). Tetra Tech (2005) concluded that such depths to groundwater are too great to allow for agriculturally significant subirrigation. MW-95-02 had a water level of 25.1 feet bgs in November 2016. (Further information on groundwater occurrence is provided in Section 2.04.7).

In September of 2015, four geotechnical holes were drilled on both sides of Wilson Creek where the crossing for the haul road leading from the Collom pit to the loadout is to be located. Groundwater was detected in these geotechnical test hole at approximately 25 feet bgs. There are no visible seeps on the sidewalls of the valley in the crossing area and both upstream and downstream of the crossing area. This new data provides additional information to the conclusion that groundwater in the area is too deep for any subirrigation.

The near surface valley fill materials in the area of the Collom haul road crossing over Wilson Creek were found to be predominantly clay, based on the four geotechnical test holes. The clays do contain minor amounts of gravel, sand and silt and were gray to dark brown in color. The thickness of the clays are at least 10 feet thick and are stiff to hard. The materials present do not appear to meet the definition of alluvial material for alluvial valley floors.

No evidence of flood irrigation was found for the fields surrounding the Gossard loadout. However, some limited flood irrigation was conducted in the floodplain of Wilson Creek, north of and outside the permit boundary (north of County Road 17). The ditch constructed for this irrigation is now heavily overgrown with upland vegetation. The gate for this water diversion sets several feet above the Wilson Creek channel and cannot be reached by current water flow from Wilson Creek. The area of concern surrounding the Gossard Loadout facility was bypassed for flood irrigation historically in order to apply irrigation water downstream to lands outside the current permit boundary.

Irrigation diversion points, irrigation ditches, and topography are shown on Map 10B. These areas are well outside the subject drainages of Collom Gulch, Little Collom Gulch, and Jubb Creek.

Thus, the same conclusions as those previously presented for the creeks in the Collom syncline area may be reached for the area of disturbance for construction of the Collom Haul Road in the vicinity of the Gossard Loadout facility (Map 25E Sheet 1 of 4):

- Alluvial materials are present in the valley bottom of the Gossard Loadout complex, and the lower reaches of the Lower Wilson Creek drainage, but the materials are intermixed with significant fractions of colluvium and sheetwash from adjacent slopes and the mass wasting event experienced in 1983-1984.
- Based on an average depth to groundwater of at least 20 feet , coupled with data from monitoring wells and geotechnical test holes in the Wilson Creek area drilled in 2015,subirrigation within this valley bottom is very limited in extent (outside and north of the permit area) or non-existent. Active erosion in the stream channels is causing further incision and reduced flood frequency, reducing the ability of this valley bottom to support any agricultural use other than rangeland or dryland agriculture. There is no evidence of “modern terracing” in the area that will be disturbed near the Gossard Loadout facilities.
- Local and regional agricultural economics are prohibitive to developing irrigation projects within this valley bottoms, and such practices are in decline locally.
- Historical irrigation activities associated with the “diversion structure and ditch” located on Wilson Creek; divert water around the existing grain fields, under County Road 17, outside the current permit boundary to the fields northeast of County Road 17. This activity is still performed when water is available to the diversion structure as the mass wasting events (1983-1984) limited the function of this system.

Colowyo contends that based on the descriptions and defining characteristics needed to classify an area as a functioning alluvial valley floor, the area to be disturbed that is associated with the Collom Haul Road within the Lower Wilson Drainage does not qualify as an alluvial valley floor. Thus, no material damage assessment, water monitoring program, etc., is required due to the fact the area is not a functional alluvial valley floor. Colowyo does plan to return the area of disturbance to pre-disturbance condition at the cessation of mining activities.

2.06.9 – 2.06.11 Augering, Processing Plants, In-Situ Processing

In the Collom Pit, specifically the endwall and low walls of the box cut, highwall mining will target the X3/X4, B2/B3, C3/C5, D1/D2, E2, F5/F6, F_A/F_B, G8/G9 and G_B seams. Please see Map 23B for the overall extent of the highwall mining plan for the Collom Pit. All seams will be developed in a top-down sequence following the Collom box cut down as it is driven. The planned highwall mining sequencing will begin with the X3/X4 seam, and once mining is completed the highwall mining will continue down to the next available seam in the sequence following right behind pre-strip surface mining operations. For additional detail on the highwall mining technique that will be utilized please see Volume 1, Section 2.06.9.

Please see Volume 1 for Sections 2.06.10 and 2.06.11.

2.06.12.1 Coal Refuse Piles

Coal refuse piles do not exist on the Colowyo property. Thus, this section is not applicable.

2.07 – 2.10 VARIOUS

Information required by these sections is included in Volume 1.

TR = Total Recoverable

Prior to mining at Lower Wilson, the following three surface water monitoring sites will be added to the sampling schedule:

1. Upper Wilson Creek (UWC) represents water quality upstream of all mining impacts.
2. Upper Middle Wilson Creek (UMWC) represents water quality downstream of the proposed Lower Wilson mining area.
3. Lower Wilson Creek (LWC) represents water quality immediately upstream of the confluence with Taylor Creek.

Groundwater – Eleven valley fill groundwater sites and one deep groundwater well will be monitored as a result of mining activity at Colowyo. Please refer to Exhibit 26, Item 1 for additional details regarding the wells in the Collom Area. Field parameters and laboratory anaylsis are gathered each quarter.

Monitoring Type	Monitoring Location	Monitoring Frequency	Quarterly Field Parameters	Quarterly Parameters
Valley Fill Groundwater	MC-04-01[1]	Quarterly	Water level, Temperature, pH, Conductivity	See Below
Valley Fill Groundwater	MC-04-02[2]	Quarterly	Water level, Temperature, pH, Conductivity	See Below
Valley Fill Groundwater	MLC-04-01[3]	Quarterly	Water level, Temperature, pH, Conductivity	See Below
Valley Fill Groundwater	MJ-95-01[4]	Quarterly	Water level, Temperature, pH, Conductivity	See Below
Valley Fill Groundwater	MJ-95-03[5]	Quarterly	Water level, Temperature, pH, Conductivity	See Below
Valley Fill Groundwater	Gossard Well[6]	Quarterly	Water level, Temperature, pH, Conductivity	See Below
Valley Fill Groundwater	A-6 Well[7]	Quarterly	Water level, Temperature, pH, Conductivity	See Below
Valley Fill Groundwater	North Good Spring Well[8]	Quarterly	Water level, Temperature, pH, Conductivity	See Below
Valley Fill Groundwater	MT-95-02[9]	Quarterly	Water level, Temperature, pH, Conductivity	See Below
Valley Fill Groundwater	A-7[10]	Quarterly	Water level, Temperature, pH, Conductivity	See Below
Valley Fill Groundwater	A-8[11]	Quarterly	Water level, Temperature, pH, Conductivity	See Below
Alluvial Well	LGSW-1	Quarterly	Water level, Temperature, pH, Conductivity	Please see Volume 2C Exhibit 7, Item 19, Table 16
Alluvial Well	LWCW-1	Quarterly	Water level, Temperature, pH, Conductivity	Please see Volume 2C Exhibit 7, Item 19, Table 16

1. MC-04-01 – Located in the Collom Gulch valley fill, this site represents the condition of the Collom Gulch valley-fill aquifer adjacent to the Collom Pit.
2. MC-04-02 – Located in the Collom Gulch valley fill, this site represents the condition of the Collom Gulch valley-fill aquifer downgradient of the Collom Pit. This location is additionally designated as a "Point of Compliance" well for valley fill groundwater monitoring purposes.
3. MLC-04-01 – Located in the Lower Collom Gulch valley fill, this site will be located north of the temporay spoils pile in Lower Collom Gulch. This location is additionally designated as a "Point of Compliance" well for valley fill groundwater monitoring purposes.
4. MJ-95-01 – Located in the West Fork Jubb Creek valley fill, this site represents the condition of the West Fork Jubb Creek valley fill aquifer adjacent to the northeast (downgradient) side of the Collom Pit. This

location is additionally designated as a "Point of Compliance" well for valley fill groundwater monitoring purposes.

5. MJ-95-03 - Located in the Jubb Creek valley fill just downstream of the confluence of the West and East Forks of Jubb Creek, this site represents the condition of the valley-fill aquifer downgradient of the Collom Pit.
6. Gossard Well – Located within valley fill beneath the rail loop, this site represents the condition of the valley fill aquifer in the vicinity of the Gossard Coal Loadout Facility.
7. A-6 Well – Located in the Good Spring Creek valley fill, this site represents the condition up-gradient of and current mining activities.
8. North Good Spring Well – Located in the Good Spring Creek valley fill, this site represents the down-dip condition below existing and mining activities.
9. MT-95-02 – Located in the Taylor Creek valley fill, this site represents the down-dip condition below current and mining activities.
10. A-7 – Located in the West Fork of Good Spring Creek valley fill, this site represents a potential down-dip condition below South Taylor mining activities.
11. A-8 - Located in the West Fork of Good Spring Creek valley fill, this site represents the condition up-gradient of South Taylor mining activities.
12. LGSW-1 – Located along Good Spring Creek, this site represents the down gradient condition below mining activities, and is designated as a "Point of Compliance" well for the alluvial aquifer on Good Spring Creek. The applicable standards are the Department of Public Health and Evnironment Water Quality Control Comission Regulation 41 - The Basic Standards for Ground Water, Interim Narrative Standard. How the Interim Narrative Standard will be implemented is described in Volume 2C, Exhibit 7, Item 19, Section 4 and the applicable standards are found in Volume 2C, Exhibit 7, Item 19, Table 16.
13. LWCW-1 – Located below the confluence of Wilson and Taylor Creeks, this site respresents the down gradient condition below mining activities and is designated as a "Point of Compliance" well for the alluvial aquifer on Wilson and Taylor Creeks. The applicable standards are the Department of Public Health and Evnironment Water Quality Control Comission Regulation 41 - The Basic Standards for Ground Water Interim Narrative Standard. How the Interim Narrative Standars will be implemented is described in Volume 2C, Exhibit 7, Item 19, Section 4 and the applicable standards are found in Volume 2C, Exhibit 7, Item 19, Table 16.

Groundwater Laboratory Parameters

pH	Conductivity at 25°C	Total Dissolved Solids	Bicarbonate (HCO_3^-)^D	Calcium (Ca^{+2})^D
Magnesium (Mg^{+2})^D	Ammonia (NH_3)^D	Nitrate^D	Phosphate (PO_4^{-3} as P)^D	Sodium (Na^+)^D
Sulfate (SO_4^{-2})^D	Arsenic (As)^D	Iron (Fe)^D	Lead (Pb)^D	Manganese (Mn)^D
Mercury (Hg)^D	Selenium (Se)^D	Zinc (Zn)^D		
D = Dissolved				

Prior to mining at Lower Wilson, the following three valley fill groundwater monitoring sites will be added:

1. MW-95-01 – Located in the Wilson Creek valley fill, this site represents the upstream, undisturbed background conditions of the valley fill aquifer.
2. MW-05-03 – Located in the Wilson Creek and unnamed drainage valley fill, this site represents valley fill groundwater quality immediately downgradient from Lower Wilson.
3. MW-95-02 – Located in the Wilson Creek valley fill, this site represents the downgradient conditions below Lower Wilson and the haul road.