TRI-STATE

July 22, 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-267 Lower Wilson Removal

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 267 (MR-267) to Permit No. C-1981-019.

MR-267 removes the Lower Wilson area from Colowyo's permit to mine. Also requested under MR-267, Colowyo requests the Division remove Stipulations 2, 3, and 4 from the permit as the applicability of the stipulations is no longer necessary with the removal of Lower Wilson area.

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.

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. 1.1.251

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

Mine Company Name: **Colowyo Coal Company** Permit Number: **C-1981-019**

Date: **July 21, 2025** Revision Description: **MR-267 Lower Wilson Removal**

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	Volume 12 Cover page (1 page)	Volume 12 Cover page (1 page)	Volume 12 Cover Page has been updated.
12	Pages South Taylor/Lower Wilson i to iv (4 pages)	Pages South Taylor Wilson i to iv (4 pages)	Table of Contents has been udpated including footer.
12	Pages List of Tables v and vi (2 pages)	Pages List of Tables v (1 page)	List of Tables has been updated.
12	Page List of Figures vii (1 page)	Page List of Figures vi (1 page)	List of Figures has been updated.
12	List of Maps Pages South Taylor/Lower Wilson viii and ix (2 pages)	List of Maps Pages South Taylor vii and viii (2 pages)	List of Maps has been updated including the footer.
12	List of Exhibits Pages South Taylor/Lower Wilson x (1 page)	List of Exhibits Pages South Taylor ix (1 page)	

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

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Date: **July 21, 2025** Revision Description: **MR-267 Lower Wilson Removal**

Volume Number	Page, Map or other Permit Entry to be REMOVED	Page, Map or other Permit Entry to be ADDED	Description of Change
12	South Taylor/Lower Wilson Introduction Page 1 (1 page)	South Taylor Introduction Page 1 (1 page)	References to Lower Wilson have been removed. Introduction page footer has been updated.
12	South Taylor/Lower Wilson Rule 2 Page 1 through 90 (90 pages)	South Taylor/Lower Wilson Rule 2 Page 1 through 72 (72 pages)	All references to Lower Wilson have been removed which caused a pagination shift through all of Rule 2. Footers have been updated.
12	South Taylor/Lower Wilson Rule 3 Page 1 (1 page)	South Taylor Rule 3 Page 1 (1 page)	Rule 3 footer has been updated.
12	South Taylor/Lower Wilson Rule 4 Pages 1 to 16 (16 pages)	South Taylor Rule 4 Pages 1 to 15 (15 pages)	
12	Table 2.04.4-1 (1 page)	Table 2.04.4-1 (1 page)	Table 2.04.4-1 title has been revised.
12	Table 2.04.9-4 (1 page)	Table 2.04.9-4 (1 page)	Table 2.04.9-4 title has been revised.
12	Table 2.04.9-9 (2 pages)		Table 2.04.9-9 has been removed from the permit.
12	Table 2.04.9-10 (1 page)		Table 2.04.9-10 has been removed from the permit.
12	Table 2.04.9-11 (4 pages)		Table 2.04.9-11 has been removed from the permit.
12	Table 2.04.9-12 (1 pages)		Table 2.04.9-12 has been removed from the permit.
12	Table 2.04.9-13 (2 pages)		Table 2.04.9-13 has been removed from the permit.
12	Table 2.04.9-14 (4 pages)		Table 2.04.9-14 has been removed from the permit.
12	Table 2.04.10-8 (1 page)		Table 2.04.10-8 has been removed from the permit.
12	Table 2.04.10-9 (2 pages)		Table 2.04.10-9 has been removed from the permit.
12	Table 2.04.10-10 (1 page)		Table 2.04.10-10 has been removed from the permit.
12	Table 2.04.10-11 (1 page)		Table 2.04.10-11 has been removed from the permit.
12	Table 2.04.10-12 (2 pages)		Table 2.04.10-12 has been removed from the permit.
12	Table 2.04.10-13 (1 page)		Table 2.04.10-13 has been removed from the permit.
12	Table 2.04.10-14 (1 page)		Table 2.04.10-14 has been removed from the permit.
12	Table 2.04.10-15 (1 page)		Table 2.04.10-15 has been removed from the permit.
12	Table 2.04.10-16 (1 page)		Table 2.04.10-16 has been removed from the permit.
12	Table 2.04.10-17 (1 page)		Table 2.04.10-17 has been removed from the permit.
12	Table 2.04.10-18 (1 page)		Table 2.04.10-18 has been removed from the permit.

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

Mine Company Name: **Colowyo Coal Company** Permit Number: **C-1981-019**

Date: **July 21, 2025** Revision Description: **MR-267 Lower Wilson Removal**

Volume Number	Page, Map or other Permit Entry to be REMOVED	Page, Map or other Permit Entry to be ADDED	Description of Change
12	Table 2.04.10-19 (1 page)		Table 2.04.10-19 has been removed from the permit.
12	Table 2.04.10-20 (1 page)		Table 2.04.10-20 has been removed from the permit.
12	Table 2.04.10-21 (1 page)		Table 2.04.10-21 has been removed from the permit.
12	Table 2.04.10-22 (1 page)		Table 2.04.10-22 has been removed from the permit.
12	Table 2.04.10-23 (1 page)		Table 2.04.10-23 has been removed from the permit.
12	Table 2.04.10-24 (1 page)		Table 2.04.10-24 has been removed from the permit.
12	Table 2.04.10-25 (1 page)		Table 2.04.10-25 has been removed from the permit.
12	Table 2.04.10-26 (1 page)		Table 2.04.10-26 has been removed from the permit.
12	Table 2.05.6-1 (1 page)	Table 2.05.6-1 (1 page)	Table 2.05.6-1 title has been updated.
12	Table 2.05.6-2 (1 page)	Table 2.05.6-2 (1 page)	Table 2.05.6-2 title has been updated.
12	Figure 2.04.6-3A (1 page)		Figure 2.04.6-3A has beeen removed from the permit.
12	Figure 2.04.10-3 (1 page)		Figure 2.04.10-3 has been removed from the permit.
12	Figure 2.04.10-4 (1 page)		Figure 2.04.10-4 has been removed from the permit.
12	Figure 2.04.10-5 (1 page)		Figure 2.04.10-5 has been removed from the permit.
12	Figure 2.04.10-6 (1 page)		Figure 2.04.10-6 has been removed from the permit.
13	Exhibit 9, Item 5 All pages (18 pages)		Exhibit 9, Item 5 has been removed from the permit.
14	Map 5C		Map 5C has been removed from the permit.
15			No Change
16			No Change
15			No Change
17			No Change
18A			No Change
18B			No Change
18C			No Change
18D			No Change

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

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19					No Change
20					No Change
20					No Change
21					No Change
22					No Change

COLOWYO COAL COMPANY

PERMIT C-1981-019

Application for Permit Revision for
Mining of the South Taylor Area

5731 State Highway 13
Meeker, Colorado 81641

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INTRODUCTION

Colowyo Coal Company L.P. (Colowyo) is proposing a surface mining areas adjacent to the existing mining operations. The land of interest includes the South Taylor area which is located south of the West Pit. The South Taylor permit revision area includes approximately 6,050 acres. The permit boundary expansion area includes Federal Coal Leases C-29225, C-29226, and C-0123476. Colowyo has acquired background environmental data covering the South Taylor permit revision area during studies conducted by Utah International (1982-1983), Consolidation Coal Company (1983-1985), and Colowyo from 1979 to the present.

The existing Colowyo Permit C-1981-019 (previously-approved permit document) contains information relevant to the South Taylor permit revision area. Additional information specific to the South Taylor Permit Area is presented herein. Sections not addressed in this document were not modified and therefore may be reviewed in the previously-approved permit document. New information specific to the South Taylor permit area is presented for the following sections:

Rule 2 Permits
Rule 3 Performance Bond Requirements
Rule 4 Performance Standards

This document has been formatted to present new information and reference information already presented in the existing permit document. As such, this revision application will become a part of Permit C-1981-019 upon approval by the Colorado Division of Reclamation Mining and Safety (Division).

RULE 2 – PERMITS

2.01 GENERAL REQUIREMENTS

The information provided in the subsections of Rule 2.01 of the original permit is specifically applicable to the South Taylor permit revision area. Information regarding the existing Colowyo Mine permit area is located in Rule 2 of Volume 1 and other referenced areas.

2.01.1 – 2.01.3 Scope and General Requirements

These sections are addressed in the existing permit, Rule 1, Volume

2.01.4 Permit Requirements for New Surface Coal Mining and Reclamation Operations

The Colowyo Mine is an existing mine operation; therefore, the requirements of this Section are not applicable.

2.01.5 Permit Term

Please see Volume 1, Section 2.01.5.

2.01.6 Permit Fees

Please see Section 2.01.6 in Volume 1.

2.02 GENERAL REQUIREMENTS FOR COAL EXPLORATION

These sections are addressed in Volume 1, Section 2.02.

2.03 LEGAL, FINANCIAL, AND COMPLIANCE INFORMATION

2.03.1 Objective

The objective of this section is to insure that the Division receives all relevant information regarding ownership and control of surface coal mining operations, the ownership and control of the property to be affected by those operations, the compliance status and history of Colowyo, and other information relevant to the South Taylor permit revision.

2.03.2 Responsibilities

Within this application, Colowyo has provided the Division with information for approval of a coal mining and reclamation permit for mining activities to be completed at the South Taylor Permit Area under the requirements of the Colorado regulations for coal mining. The information provided in this document is limited to the information required for a revision of the existing permit to include the South Taylor mining area into the existing permit area. Refer to the existing permit application (Volume 1) for general information that required no modification to include the South Taylor area. The format will parallel the Colorado coal mining regulations. This application focuses on the requirements of Rule 2, specifically Rule 2.04, Rule 2.05, and certain aspects of Rule 2.01, 2.02, 2.03, and 2.06; Rule 3 – Performance Bond Requirements; and Rule 4 – Performance Standards.

2.03.3(1-5) Format and Supplemental Information

Please see Section 2.03.3 in Volume 1.

2.03.3(6) Division Application to Conduct Coal Mining

Please see Section 2.03.3(6) in Volume 1.

2.03.3(7) Entities Consulted to Obtain Permit Information

Please see Section 2.03.3(7) in Volume 1.

2.03.3(8) Copies

Please see Section 2.03.3(8) in Volume 1.

2.03.3(9) Certification by Responsible Official

Please see Section 2.03.3(8) in Volume 1.

2.03.4 Identification of Interests

Please see section 2.03.4 in Volume 1 and Exhibit 2 in Volume 2A for current ownership and control information.

The surface and mineral ownership in the permit and adjacent areas is located in Section 2.03.4, Volume 1, and Volume 2A, Exhibit 1, Documents and Leases.

2.03.5 Compliance Information

Please see Section 2.03.5 in Volume 1.

2.03.6 Right of Entry and Operational Information

The documents contained in Exhibit 1 (Volume 2A), vests the rights shown in and to surface estate and to the coal estate within the South Taylor permit revision area. Additionally, please see Section 2.03.6 in Volume 1.

2.03.7 Relationship to Areas Designated Unsuitable For Mining

The South Taylor area is not within an area designated unsuitable for surface mining activities as defined in Rule 7 or 30 CFR 764 and 769 or under study for designation in an administrative proceeding under Rule 7 or 30 CFR 764 and 769.

2.03.8 Permit Term Information

The term of mining for the South Taylor pit is depicted on Map 23 and reclamation timing is shown on Map 29. The anticipated number of acres to be affected and reclaimed are shown in Table 2.03-1 within the Volume 1.

2.03.9 Insurance Information

Information concerning insurance held by Colowyo is included in Exhibit 3, Volume 2A.

2.03.10 Identification of Other Licenses and Permits

The list of permits and licenses covering the Colowyo surface coal mining operation can be found in Volume 1- Section 2.03.10

2.03.11 Identification of Location of Public Office for Filing of Application

Please see Section 2.03.11 in Volume 1.

2.03.12 Newspaper Advertisement and Proof of Publication

Please refer to Section 2.03.12 in Volume 1.

2.04 APPLICATION FOR PERMIT FOR SURFACE OR UNDERGROUND MINING ACTIVITIES – MINIMUM REQUIREMENTS FOR INFORMATION ON ENVIRONMENTAL RESOURCES

This section of the application provides a complete and accurate description of the environmental resources that may be affected by the surface mining activities to be conducted by Colowyo in the South Taylor permit revision area.

This application also provides a description of the environmental resources for the life-of-mine operations area.

2.04.1 – 2.04.2 Objectives and Responsibilities

The following sections provide a complete and accurate description of the environmental resources that may be impacted by surface coal mining operations at the South Taylor Pit. The applicant and federal and state agencies have provided information required by this section.

2.04.3 Land Use Information

Information regarding the existing mining areas is presented in the previously approved permit document.

The pre-mine land use of the South Taylor area and adjacent lands were mapped. Land use for the permit and adjacent areas was digitized and is provided on Map 17. Natural color aerial photographs, printed at a scale of approximately 1:24,000 from photography taken in September 1997, were used to update the Land Use information in the previously-approved permit document. Air photo interpretation resulted in a few boundary changes for the crop and pasture land use types. The "surface mine" category was expanded to include all mining associated disturbance.

Primary land use types identified in the permit area are rangeland and cropland. Present and potential production of these land uses according to the soil types which lie within them are discussed in Section 2.04.9 Soil Resource Information. Areas designated as “Existing Mine” on Map 17 include surface coal mine pits and mine facilities (e.g. maintenance shops, haulage routes, loadouts, offices, etc.) and areas that have been mined, backfilled, topsoiled, and revegetated. “Rangeland” includes sheep and cattle grazing. The croplands adjacent to the permit area have been traditionally cultivated for grass/alfalfa hay and winter wheat. According to the information provided in the previously approved permit document, winter wheat yields an average of 30 bushels/acre while irrigated hayland averages 3 tons/acre. Land conditions within areas designated as rangeland may be described as good to fair with continued improvement due to better land management techniques. Range Site Description and BLM estimates of forage production on an animal unit month basis for the vegetation communities identified in the South Taylor permit area are provided in Exhibit 9, Item 2 of Volume 2A of the existing permit document. No areas within the South Taylor permit revision area have been previously mined.

The post-mine land use for the South Taylor permit revision area will be rangeland condition capable of supporting a diversity of wildlife. Alternative post-mine land uses may be proposed for suitable areas within the permit revision area as deemed necessary.

2.04.4 Cultural and Historic Resource Information

The objectives of this section is to meet the requirements of Rule 2.04.4 et seq by furnishing Cultural and Historic Resource Information for the permit revision area in sufficient detail to determine the presence of cultural and historic resources listed or eligible for listing on the National Register of Historic Places and known significant archaeological sites.

General Description of Permit Area Resource

The permit area is near the edge of the Yampa River drainage and the White River drainage is within a few miles to the south. Jubb Creek is an ephemeral drainage, while Good Spring Creek to the east and Wilson Creek and Collum Gulch to the west are perennial streams. All of these drainages flow northeasterly to Milk Creek, a tributary of the Yampa River. Dominant bedrock includes sandstones, shales, and coal beds of the Cretaceous Williams Fork and Iles formations, and the underlying Cretaceous Mancos Shale to the north. Sediments are typically residual on the ridgetops and upper slopes, colluvial on the lower slopes, and colluvial and alluvial on the valley floors. The depositional environment is generally degrading with fairly localized pockets of alluviall or eolian aggradation. This provides few settings favorable for in-situ archaeological materials.

Vegetation in the permit area includes tall sagebrush scrub and sagebrush meadows with thickets of mountain mahogany, serviceberry, and chokecherry. Aspen groves are present on some of the higher areas and juniper are scattered through the area. Valley bottoms are generally narrow with very steep sides. Valley and gulch slopes are frequently 30 to 60 percent grade or greater, but ridgetops are wide and gently sloping.

Larger animals currently in the area include deer, elk, bear, and mountain lion, and bison were present prehistorically. Smaller animals include coyote, fox, marmots, chipmunks, snakes, and birds. The area is used for grazing, predominantly by sheep and cattle. The general area is dotted with range improvements such as stock ponds and windmills with stock tanks. Some areas in the broader valleys of perennial drainages are cultivated, but smaller valleys of ephemeral drainages are not.

General Cultural and Historic Resources Information

Existing Data and Literature Review – Cultural resources include historical or archaeological objects, sites, buildings, structures, districts, or traditional cultural properties. Significant historic properties include those sites or objects that are listed in or eligible for listing in the Register. The project area is within the prehistoric context for the Northern Colorado River Basin (Reed and Metcalf 1999) and the Colorado Plateau Country Historic Context (Husband 1984).

Prehistoric Context – Northern Colorado River Basin context encompasses the portion of western Colorado that is drained by the northern stretch of the Colorado River and includes several major tributaries of the Colorado River: the Green, Yampa, White, Gunnison, Uncompahgre, San Miguel, and Dolores rivers. Like many other regions, the vast majority of cultural resources recorded in this region are known only from surface evidence and lack temporally diagnostic artifacts or other evidence of age or cultural affiliation. Human settlement in the area is firmly documented from the earliest known inhabitants of North America, the Paleoindians, and continues through the Protohistoric period. A brief chronology summarized below (Reed and Metcalf 1999) describes the hallmarks of the major chronological divisions:

Paleoindian Stage (13,400 to 7,500 years before present (B.P.)). Characterized by kill sites and game processing sites. Tool assemblages consist of chipped stone tools, including dart points and specialized hide-processing tools, used in the hunting and processing of large animals, primarily now-extinct megafauna such as mammoth, extinct species of bison, and camels. In northwest Colorado, the Paleoindian Stage is divided into four traditions: Clovis, Goshen, Folsom, and Foothill-Mountain.

Archaic Stage (8,400 to 2,000 B.P.). Time of changing environment that necessitated modifications of the preceding lifestyle to the warmer, drier conditions. These adaptations were manifested in intensive foraging of plant resources and hunting of deer and smaller game. Technologically there was an increased use of grinding stones and a general decrease in the size of dart points. Known site types include both open sites and rockshelters. These sites often contain features such as firepits, storage cists, and architectural structures.

Formative Stage (2,400 to 700 B.P.). This stage includes the Anasazi, Fremont, Gateway, and Aspen traditions. The stage is characterized by a change in technology, subsistence, trade, and demographics. The technology is marked by the widespread use of pottery and small corner-notched and side-notched projectile points that were hafted to arrows. There is also evidence of gardening or horticulture, with corn as an important subsistence crop, combined with the use of wild plants. Site types include open sites, rock shelters, and various forms of architecture. Architecture includes masonry structures, pit structures, and kivas. In some areas there are highly patterned residential sites, water control structures, and roads.

Protohistoric Stage (700 to 120 B.P.). This stage is defined as the era at the end of the horticultural-based subsistence practices of the Formative era up through the final expulsion of the Ute to reservations (Reed and Metcalf 1999). The Ute Indians were the primary occupants of the area with Shoshone in the extreme northwest portion. The Comanche may also have occupied some areas briefly. These people were mobile hunters and gatherers. Site types include open camps, rockshelters, and wickiup sites. Artifacts include a combination of traditional hunting and gathering items, evidence of equestrian lifestyle, and European trade items.

The research areas identified settlement patterns, paleodemography, subsistence, trade and exchange, and chronology which are topics that still need further resolution for all prehistoric stages. Specific research problems are defined within these broader research areas and are discussed in greater detail in Reed and Metcalf (1999).

Historic Context – The project area is within the Colorado Plateau Country Historic Context (Husband 1984). Among the themes discussed the most relevant to the project area are fur trade and exploration, Ute-Euroamerican contact, mining, early transportation, railroads, ranching and farming, the lumber industry, recreation, and tourism.

The Spanish were the first Europeans to enter the southern portions of the area in the late 1700s but left no record of the region. Fur trappers and explorers were the first Euroamericans to have sustained contact and to leave some record of the area. John Charles Fremont made several expeditions into northwest Colorado but records show that the area was written off as worthless. It was the discovery of gold that brought a substantial number of settlers into the region. Middle Park and North Park had miners settling in the area during the 1860s gold rush. It was soon evident that gold was not panning out but settlement had begun. In 1861, William Byers bought Hot Sulphur Springs with plans on turning it into a tourist resort. However, development of the area into a bustling tourist center did not happen until a reliable access route was established. The survey by John Wesley Powell in 1869 added new and accurate information on western Colorado. Powell noted that the land was not well suited to agriculture and that to attempt it would require irrigation. The United States Geological Surveys (USGS) in the 1870s by

Hayden, Peale, Beckler, and Gannett, provided valuable information on the geology, flora, and fauna of western Colorado.

During the early mining rushes in Colorado the northwest part of the state was difficult to reach and was the undisputed territory of the Ute Indians. In the 1860s pressure from white prospectors and settlers was heaviest in the San Juan Mountains to the south. After repeated conflicts, the Evans Treaty of 1863 and the Hunt Treaty of 1868 defined Indian lands in western Colorado. Agencies were established at the White River Agency near Meeker and Los Pinos west of Saguache. Nevertheless conflicts continued, culminating in the "Meeker Massacre" and the Thornburgh battle along Milk Creek in 1881. The White River Ute bands were removed to Utah and most of the Ute lands were opened to settlement. The settlement of the area had been made easier by the completion of the Union Pacific railroad in southern Wyoming. By 1871 cattlemen were entering the area along the Little Snake, Green, Yampa and White Rivers. Open range grazing was practiced till the early 1900s. In 1890s sheep began to be grazed in the area. The warring between cattlemen and sheepherders came to a head in 1920 with the Battle of Yellowjacket Pass. The Colorado militia was called in to establish peace. Open ranching of cattle came to an end in the early 1900s due to pressure from the sheep industry to share the land, homesteaders who made claims, and large tracts established for timber reserves. The cattle industry has been and still is a mainstay of the economy of the area.

Western Colorado experienced several mining booms starting with the gold rush in the 1860s. Mining gilsonite, a rock used to produce asphalt, was an important industry for western Colorado in the early 1900s. Coal was discovered in North Park in 1890 but development had to wait until transportation was possible. Yampa valley coal fields faced the same problem. Oil fields are in the area and have been tapped since late 1890s. Today they still provide a small amount of production and economic stability.

Transportation was needed to capitalize on the coal reserves and for ranchers to reach lucrative markets. From the late 1860s through the early 1900s wagon roads and cattle trails ran north to the Union Pacific Railroad in Wyoming. In the late 1880s another railroad, the Denver, Rio Grande and Western, was completed to the south along the Colorado River. David Halliday Moffat was the first to complete a rail line into northwestern Colorado. The Denver, Northwestern and Pacific Railway, often referred to as the Moffat Road, reached Steamboat Springs in 1908. Despite severe financial difficulties and the death of Moffat in 1911, the rail line was completed to Craig in 1913 (Fraser and Strand 1997). The original line was constructed over Rollins Pass. The Rollins Pass route was clearly a difficult route and had to be eliminated. The Moffat Tunnel, which by-passed Rollins Pass, was finally approved and built in the 1920s. The railroad brought the promise of an economic boom, but was never able to successfully meet expenses. The coal, cattle, and freight had a means of transportation, but it was not enough to keep the railroad in business. Transportation was also a key factor in tourism, which has been important in the region since the entry of the railroads. Tourism became a greater element of the economy with the emergence of motor vehicles and development of state and national highway systems.

Detailed Cultural and Historic Resources Information

Files Search – A file search was conducted through the Colorado Office of Archaeology and Historic Preservation (OAHP) for the legal sections containing the South Taylor permit revision area. The files search indicated that 24 previous investigations have included parts of these legal sections and 24 cultural resource sites and 45 isolated finds have been documented in the permit revision area. Table 2.04.4-1 lists the previous cultural resource investigations within the permit area. Two of the investigations were for transmission lines, two were for well locations, two were seismic prospects, one each were fiber optic and pipeline corridors, and the remaining surveys have been for coal mining permit areas, coal exploration, or related activities. All but one are listed as intensive (Class III) investigations, but some of the earlier investigations (prior to 1980) may not have recorded all of the resources to current standards.

Investigations listed as mine exploration typically included a number of small locations for stratigraphic cores. Portions of Sections 16, 17, 20, and 28 of T4N, R93W have not yet been surveyed. The remaining portions of the permit revision area, including all of the mining affected areas, have been adequately surveyed for cultural resources. Table 2.04.4-2 briefly summarizes the cultural resource sites that are within the permit revision boundary.

Documented cultural resources within the South Taylor mining areas are shown on Map 16B. Sites located within the actual mining impact areas include a historic trash scatter, historic dugout and bridge, a prehistoric open architectural site and isolated feature, and a historic isolated collection of rock cairns. Of these, site 5MF 934 and 5MF 4005 are the only features that could be disturbed by mining activities. 5MF 934 is an unevaluated trash scatter that was considered not eligible for the Register (Pool and Spath, 1995). 5MF 4005 is an isolated collection of three rock cairns and an associated overgrown two-track; this site was considered not eligible for the Register (Pool and Spath, 1995).

Documented cultural resources in the vicinity of the new road from the Wilson Creek road to the Gossard Loadout are shown on Map 16B. They include three prehistoric camps, a historic camp, and two prehistoric isolated finds. Of these, one prehistoric camp is eligible for the Register (5MF1935), one site is unevaluated (5MF4003), and the remaining sites are recommended as not eligible for the Register. The unevaluated site, 5MF4003 is located near the crossing of Wilson Creek on the access road to the Gossard Loadout. The current road alignment might impact this site; thus the site will be evaluated prior to impact. The eligible site is on the other (west) side of the Wilson Creek Road from the crossing, and as such, is not expected to be disturbed by mine development activities. If this site cannot be avoided it will require data recovery or some other form of mitigation. The likelihood that additional eligible resources will be found in the portions of the permit area that have not yet been surveyed is considered fairly low by the archaeologists.

Documented cultural resources in the vicinity of surface disturbances at South Taylor include several isolated finds. These finds were all recommended as ineligible for the Register.

2.04.5 General Description of Hydrology and Geology

A detailed description and maps, as required, of geology, hydrology, and groundwater and surface water quality and quantity of all lands within the South Taylor permit revision area, the adjacent area, and the general area, as defined in Rule 1.04 of the Coal Regulations of the Colorado Mined Land Reclamation Board are provided below.

Since 1973, detailed data and information have been collected, compiled, and analyzed by Colowyo on the geology and hydrology of all lands within the permit revision area, the adjacent area and the general area. This information is a compilation of previously-published reports, high-density exploration drilling, field investigations, geologic mapping, aerial photography reviews, topographic mapping, data from investigations by independent consultants, and climatologic monitoring data from on-site and the Craig and Meeker climatological stations.

Colowyo has maintained close cooperation with many government agencies and has invited and allowed numerous agencies to conduct investigations and experiments within and adjacent to the mining area. These include but are not limited to the Water Resources and the Conservation Divisions of the U.S. Geological Survey, Colorado State University, Bureau of Reclamation, and the Bureau of Land Management. A list of government agencies, references, and consultants that provided information used in this application is provided in the discussion under Section 2.03.3.

The "general area" with respect to hydrology is defined by Rule 1.04, as that topographic basin that surrounds the area to be mined during the life of the operation. This area includes several watersheds and groundwater systems, which will allow assessment of the probable cumulative impacts of the quantity and quality of the surface and groundwater systems. Specifically, the "general area" includes the drainages of Good Spring Creek and Wilson Creek, perennial streams; and Taylor Creek, an intermittent stream.

Both the "permit area" and the "adjacent area", as defined by Rule 1.04, lie within the "general area" as described above.

The geological information for the "permit area" and the "general area" are discussed and described in detail in Section 2.04.6. Groundwater information for the general area, adjacent area, and permit area is set forth in Section 2.04.7.

2.04.6 Geology Description

The coal to be mined in the permit area is located in the northern extent of the Danforth Hills coalfield of the Uinta Region. The Danforth Hills coal field comprises the coal deposits on the northeast flank of the Piceance Creek basin and is bordered on the northeast by the Axial Basin Anticline.

The general stratigraphy within the permit revision area is shown on Figure 2.04.6-3B and is graphically shown on figures 2.04.6-4A through 2.04.6-4F. The locations of the geologic cross sections are shown on Map 7A.

Coal seams X and A through G_{789} will be mined in the South Taylor area. The thicknesses of these seams are shown on figures 2.04.6-3B.

The coal to be mined has a high BTU value of 10,000 to 11,000 BTU per pound, low sulfur, and low ash content. It is in generally discreet seams of mineable thickness. There exists a market for this coal, in part because of its ideal qualities. The analyses of the coal seams to be mined are considered confidential and are provided in the original permit application and will be provided to the Division under separate cover.

Stratigraphy

The permit area is underlain by as much as 13,500 feet of sedimentary rock consisting of approximately 4,500 feet of Paleozoic quartzite, limestone, shale, sandstone, and gypsum; and 9,000 feet of Mesozoic limestone, shale, mudstone, sandstone, and conglomerate (Hallgarth, 1959). The coal seams mined at the Colowyo operation are of Upper Cretaceous Age.

The generalized geological setting is shown on Map 7A. The stratigraphic positions of the coals mined by Colowyo are illustrated on Figure 2.04.6-3B.

The surficial geologic formations within the area are the Upper Cretaceous Mancos Shale, which is overlain by the upper Cretaceous Mesaverde Group. The Mesaverde Group is comprised of the Iles Formation and Williams Fork Formation. Details of each formation are described below.

Mancos Shale – This thick marine formation is the oldest exposed unit in the area and is located north of the active Colowyo mine area in the Axial Basin. The formation is approximately 5,000 feet thick, consisting predominantly of a calcareous lower phase and an upper phase that contains a few thin bedded, tan, silty fine-grained sandstone layers within massive sandy shale. The deposition of the Mancos Shale occurred in quiet offshore conditions when the western interior of the North American continent was inundated by an epeiric seaway during the late Cretaceous. The Mancos Shale is generally more than 3,000 feet below ground surface in the permit area and is about 1,700 feet below the base of projected mining.

Mesaverde Group - The Mesaverde Group generally consists of interbedded sandstones, mudstones and siltstones of varying thicknesses. These beds were deposited in predominantly a near-shore terrestrial environment, with the sedimentation influenced by sea-level changes, indicated by the presence of both marine and non-marine rocks. The group consists of the Iles and the Williams Fork Formations and overlies the Mancos Shale. Carbonaceous rocks are present in both formations; however, in the area of the Colowyo Mine, thick coal beds are found only in the Williams Fork Formation.

<u>Iles Formation</u> - The Iles Formation conformably overlies the Mancos Shale. It is exposed on the edges of the Axial Basin and south and west of the permit area and active mine in the Wilson Dome area. It has a thickness of approximately 1,500 feet. It is composed of littoral sands deposited along a regressional ocean margin.

The Iles is generally comprised of light brown- to white, fine- to medium-grained, poorly sorted calcareous sandstone interbedded with red and dark maroon sandy and silty carbonaceous shale. Thin lenticular coal beds are found in the formation. A thick sandstone at the top of the Iles Formation, the Trout Creek Sandstone Member, is a reliable marker horizon for drill holes in the Danforth Hills and surrounding areas.

The Trout Creek Sandstone is light-colored, fine-grained, well-sorted, massive sandstone that was deposited in a marginal-marine or littoral environment. The thickness of the Trout Creek Sandstone varies across the area but is generally 60 to 80 feet. The deposition of the Trout Creek Sandstone marked a major regression of the Late Cretaceous seaway in this region. The resulting clean blanket sand formed by this migrating beach and barrier island complex is an aquifer of regional extent in northwestern Colorado. The Trout Creek Sandstone Member, a common ridge-forming unit in the Danforth Hills, has been called the "White Rock" because of its characteristic white sandstone exposures.

The Trout Creek sandstone underlies the lowest surface recoverable seam to be mined at South Taylor (the G_{789} seams) by approximately 590 feet.

<u>Williams Fork Formation</u> - The Williams Fork Formation is the predominant coal-bearing unit in the area of the active mine and the permit revision area. The formation conformably overlies the Iles Formation. The Williams Fork consists of a typical lagoonal sequence of interbedded tan to light gray sandstones, light gray to gray siltstones, sandy, silty, or carbonaceous gray mudstones and coals. This sedimentary sequence is an example of cyclothems deposited along a linear clastic shoreline located at the edge of an epicontinental seaway. The formation ranges from beach sands grading into lowermost deltaic sediments deposited by sluggish brackish water at the base, to middle and upper deltaic deposits deposited in a bayou setting in the upper portions of the formation. This sequence was formed as the shore transgressed seaward, resulting in the gradation from marine sediments below the formation to terrestrial sediments above the formation.

The Williams Fork Formation is the predominant coal-bearing unit in the Mesaverde Group. The coal beds in the formation are uniformly distributed near the mine but generally vary in thickness and extent away from the current Colowyo mine area. The coals are part of the Fairfield Coal Group. The natural, pre-historic burning of underlying coal beds has baked areas of the Williams Fork Formation within the permit area and the adjacent area. These surface areas are easily distinguished by their red-brown to orange-brown color on the surface. These coal burns are known to extend into the rock for up to several hundred feet.

The stratigraphic thickness of the Williams Fork Formation in the permit area is about 1,700 feet. Although the formation contains some thick sandstone layers, the Twenty Mile Sandstone Member (within the Williams Fork Formation in the Craig, Hayden, and Steamboat Springs areas) is not present in the permit area. A facies change within the Williams Fork Formation has eliminated the Twenty Mile Sandstone in the Danforth Hills Area.

A distinctive bed in the formation is a smectite layer, with an average thickness of two to three feet. Formed from the deposition of a volcanic ash, Colowyo has identified this bed as the ‘Km’. (This bed may be equivalent to the Yampa Bed in the Williams Fork to the north). The bed has been identified as an aquiclude. This bed is approximately 165 feet above the top of the Trout Creek Sandstone. It underlies the lowest seam to be mined by at least 330 feet. Thus, there should be no impact from the mining operations to the underlying Trout Creek Sandstone.

The upper Williams Fork Formation is composed of upper and middle deltaic sediments in the vicinity of the Colowyo Mine. This is evidenced by an increase in mudstone and less continuous sandstone layers than is found at other locations in the region (Kiteley, 1983; Geocid, 1998). Coarse-grained sediments in the mining area are typified by channel and bay-fill sandstones. These are of limited extent and laterally discontinuous.

Structure

The regional geologic structure of the Danforth Hills is a complex of folds dominated by the Axial Basin Uplift to the north of the existing Colowyo mine and South Taylor mining areas and the Piceance Basin on the south. The Axial Basin Uplift, an anticline, or arch, is a southeastward extension of the larger Uinta Mountain Arch to the west, which trends west by northwest. Between the Axial Basin anticline and the basin is a series of synclines, anticlines, and monoclines. The permit area is located between the Axial Basin anticline on the north and the Danforth Hills anticline /Wilson Creek dome to the south.

The southern limb of the Axial Basin anticline is shared with the Collom Syncline. The current Colowyo operation is on the southern flank of the Collom syncline. Southwest of the permit area is the Danforth Hills Anticline/Wilson Creek Dome. Southeast and east of the permit revision area is the Elkhorn Syncline. A small unnamed anticline is located beneath the permit revision area. An unnamed syncline exists along the West Fork of Good Spring Creek. These structures are affected by the Elkhorn Syncline on the east, which results in an eastward to southeastward downward dip in the South Taylor area (Map 7A). The springs in the West Fork of Good Spring Creek are the result of converging bedrock dips caused by this unnamed syncline.

Starting on the north end of the permit area, the Axial Basin anticline is an asymmetrical fold, the axis of which trends north 60° west, with strata dipping (inclining) steeper on the south side of the axis than on the north. The rocks of the broad anticline have not been stressed sufficiently to cause them to break severely, but a few discontinuous normal faults trending primarily parallel to the anticlinal axis are found in the area. The south flank of the anticline has several secondary folds trending subparallel and at approximate right angles to the main anticlinal axis.

The axis of the Collom syncline, a downward fold approximately parallel with the Axial Basin Anticline, passes north of the existing Colowyo mine and permit revision area. Bedding orientation, as measured on surface outcrops, has a strike of around N 70° W. Dips on the shared limb with the Axial Basin anticline can exceed 45°, but are normally between 25° and 35° and dip to the south. The south flank of the syncline has dips between 5° and 20° to the north (Map 7A).

Near the county line of Moffat and Rio Blanco Counties (which traverses the southern portion of the permit revision area), a small anticline trending northeast is present. This unnamed anticline is an offshoot of the Danforth Hills anticline and Wilson Creek Dome to the south and west. Dips on the south flank of this small anticline are between 3° and 20° to the southeast. This anticline is associated with a small syncline located between it and the Danforth Hills anticline. The synclinal axis is located in the West Fork of the Good Springs Valley.

South and west of the permit revision area is the Wilson Creek Dome, part of the Danforth Hills anticline. A producing petroleum reserve, the dome is capped by the Iles Formation. This uplift has caused the South Taylor area to be uplifted and only the bottom 700 feet of the Williams Fork is present. The beds in this area have a strike to the northwest with dips to the northeast of approximately 7°.

The existing mine and permit revision area are affected on the east by an unnamed syncline that is aligned with the West Fork of Good Spring Creek. This fold has a northeast strike and the western flank of the syncline causes the beds on the east side of the South Taylor and existing mine area to dip to the southeast. These beds increase their dip as the axis of the syncline is approached in the South Taylor area.

Exploration Test Borings

Exploration test borings have been conducted within the South Taylor mining areas and have been used for the following purposes:

Identifying Location of Subsurface Water - Since most of the exploration drill holes were dry, the circulation medium for most exploration drill holes drilled within the mine areas was compressed air with water and foam to lift the cuttings to the surface. Drilling mud was used when heavy fracturing or burn areas were encountered. Several drill holes throughout the area encountered minor amounts of groundwater; however, all of the data obtained to date by Colowyo and the USGS have indicated that groundwater occurrences in the Williams Fork Formation in the area are not continuous but rather are a series of perched systems of limited lateral and vertical extent. Information on groundwater occurrence is provided in Section 2.04.7.

Characterizing Physical Properties of the Overburden - The overburden material, which is removed as a part of the mining operation, consists mainly of mudstones, siltstones, and sandstones. Generally, the mudstones will have a relatively high erodibility and compaction factor, while sandstones and siltstones will have low erodibility factors and low to moderate compaction. Because of the variable lithology and lenticular nature of the strata in the permit area and the variations in the mining techniques (dragline, truck/shovel), it is difficult to determine an actual value for the swell of the overburden; therefore, the overall swell of the overburden material was estimated to be approximately twenty (20) percent.

Evaluating Geochemical Properties of Overburden - Chemical analyses of overburden and interburden strata in the areas to be mined are provided in Exhibit 6, Item 6. The ongoing overburden sampling program at Colowyo described in Exhibit 6, Item 4 of the existing permit document has confirmed earlier estimates of the geochemical properties of the overburden identified by exploratory drilling. A summary of overburden geochemistry is presented in Table 2.04.6-3 and the relevant borehole locations are shown on Map 11B.

This section presents the results and interpretations of geochemical tests performed on overburden material samples from the South Taylor pit area. The purpose of these tests is to determine the chemical composition and assess the acid-forming, toxic-forming, or alkalinity-producing potential of overburden material within the South Taylo pit area. This section describes the methods used in collecting overburden samples for testing, the types of tests performed and the tests results. In addition test result were compared with appropriate overburden guidelines to assess the acid-forming, toxic-forming, or alkalinity-producing potential of overburden material within the South Taylor pit area.

Overburden material will be excavated and stockpiled in a permanent out-of-pit disposal facility identified on Map 23 as Out of Pit Spoil and Overburden Stockpile or used for backfilling and re-contouring the pit. In addition, overburden materials around the perimeter of the mine blocks will be exposed but not removed.

Colowyo drilled boreholes to obtain overburden and interburden samples for physicochemical analysis. The locations of the boreholes relevant to this application are shown on Map 7A. These boreholes are 83-D3-06, 83-D3-07, 83-D3-10, 83-D3-12, 83-D3-14, 97-06, 97-09, 97-15, 99-02, 99-04, 99-09, 00-03, 00-08, and ST-06-08. These drill holes are near or within the footprints of the surface mine expansions.

The Division*Guidelines for the Collection of Baseline Water Quality and Overburden Geochemistry* recommends sampling one hole per square mile, with a minimum of three. The drill holes are distributed sufficiently to meet this criterion.

Overburden and interburden samples from drill holes 97-06, 97-09, 97-15, 99-02, 99-04, 99-09, 00-03, and 00-08 were collected from cuttings obtained during the drilling of each hole. The holes were drilled with air. When a water source was encountered during drilling, water was injected to help flush the cuttings from the holes. This continued until cuttings were no longer obtainable.

Overburden samples from drill holes 83-D3-06, 83-D3-07, 83-D3-10, 83-D3-12, 83-D3-14 and ST-06-08 were obtained from core samples. Drilling depths ranged from ground surface to between approximately 110 feet and 930 feet in depth. Samples were collected from intervals based on the material properties such as color and texture or were collected at regular predefined intervals. Sample intervals ranged from 0.1 feet to 91 feet and averaged 8.5 feet. A total of 555 discrete samples were collected and analyzed to characterize approximately 4731 feet of overburden. Coal seams within the drill holes were also analyzed but are not included in this section because coal will not be used as reclamation material.

The following analyses and sample preparation were performed on overburden and coal samples:

Physicochemical Analysis and Methods

• pH, sat paste	USDA No.60 (21A)
• Conductivity @ 25 C	EPA Method M120.1-meter,w/sat paste
• Saturation	USDA No. 60 (2)
• Texture	ASTM D 422 Hydrometer
• Ca (sat paste)	EPA Method M6010 ICP
• Mg (sat paste)	EPA Method M6010 ICP
• Na (sat paste)	EPA Method M6010 ICP
• SAR	calculation
• Cation Exchange Capacity	NH_4Oac, USDA No. 60 (19)
• Exchangeable Na	NH_4Oac extractable, M6010B ICP
• Exchangeable Sodium %	Exchangeable Na/CEC
• Se (hot water)	SM3500-Se.C
• B (hot water)	EPA Method M6010 ICP
• NO3 as N (water)	EPA Method M353.2-automated
• Mo (NH_4 oxalate)	EPA Method M6010 ICP
• As, Hg, Pb, Zn, Fe, and Mn (AB-DTPA Extractable)	EPA Method M6010 ICP
• NP as CaCO3	EPA Method M600/2-78-054 3.2.3
• Sulfur Forms in %	EPA Method M600/2-78-054 3.2.4
• Acid Generation Potential (AGP), Acid Neutralization Potential (ANP) and Acid Base Potential (ABP)	EPA Method M600/2-78-054 1.3
• AGP:ANP	calculation

Sample Preparation Methods

• Air Dry @ 34° C	USDA No. 1, 1972
• NH_4 oxalate	ASA No. 9, Part 2 1965 M 74.2
• Crush and Pulverize	USDA No. 1, 1972
• AB-DTPA extraction	ASA No. 9, Part 2, 1982 M3-5.2
• Hot water extraction	ASA No. 9, Part 2 1965 M 80-3
• Saturated Paste Extraction	USDA Handbook 66, M@
• Water extraction	ASA No.9 M10-2.3.2

Exploration Test Boring Results Summary

The physicochemical data from overburden sampling by Colowyo and Consol are provided in Exhibit 6, Item 6. The analytical data from Consol includes: pH, conductivity, saturation percentage, percent sand, silt, and clay, calcium, magnesium, sodium, sodium absorption ratio, boron, molybdenum, selenium, nitrate-nitrogen, arsenic, mercury, lead, zinc, iron, and manganese (AB-DTPA Extractable), acid-generating potential, sulfur forms, and total sulfur. The acid-generating potential (AGP) for these samples was calculated based on pyritic-sulfur percent.

The analytical data from the Colowyo boreholes includes: pH, conductivity, saturation percentage, percent sand, silt, and clay, sodium absorption ratio, exchangeable sodium percentage, cation exchange capacity, boron, molybdenum, selenium, nitrate-nitrogen, calcium carbonate equivalent, sulfur forms, non-sulfate sulfur and total sulfur. The AGP and the ANP:AGP ratio for samples collected in 1997 were calculated based on pyritic-sulfur percent. The AGP and the ANP:AGP ratio for samples collected in 1999 and 2000 were calculated based on total-sulfur percent. For samples collect in 2000 if the ABP was negative based on an AGP calculated using total-sulfur then, nonsulfate-sulfur was determined and used to calculate the AGP, ABP, and ANP:AGP ratio for that sample.

The criteria shown on Page 2.05-8 of Volume 1 of the current permit will be used to measure reclaimed overburden suitability. These criteria are based on negotiations with the DRMS and in part on the Wyoming Department of Environmental Quality, Land Quality Division (WDEQ-LQD), Guideline No. 1, Topsoil and Overburden, Table I-4 (August, 1994). The WDEQ-LQD guidelines were used since Colorado has no published standards as of the date this permit was revised. The overburden suitability criteria used by WDEQ-LQD are shown in Table 2.04.6-2. A summary of borehole overburden and interburden results compared to the WDEQ criteria is provided in Table 2.04.6-3, and a summary of the percentage of each borehole that is less than "suitable" for each selected WDEQ criterion is shown on Table 2.04.6-4. These comparisons are for informational purposes only, since the criteria on Page 2.05-8 of Volume 1 will determine regraded overburden success in the South Taylor mining areas.

Selenium was found to exceed the WDEQ "suitable" criterion of 0.3 ppm in 1.74% of the borehole intervals across South Taylor (Table 2.04.6-4). The Colowyo Mine regraded overburden sampling performed since 1983 and reported by Colowyo in the 2005 Annual Reclamation Report shows mean selenium concentration of 0.03 ppm, with a maximum value of 0.47 ppm and exceedances of the WDEQ "suitable" criterion in only two of the 279 samples. Similarly, boron was found to average 0.34 ppm in 279 samples, with only one sample exceeding the WDEQ boron "suitable" criterion of 5 ppm in the regraded overburden. Only one borehole (83-D3-14) exceeded the boron criterion in one interval with only 0.47% of all borehole samples in South Taylor exceeding the WDEQ boron criterion. Lead did not exceed the existing permit "suspect level" of 20 ppm in any borehole sample, and only one regraded spoil sample out of 279 exceeded this value at 20.9 ppm. Molybdenum did not exceeded the WDEQ "suitable" criterion of 1 ppm from boreholes in South Taylor. Similarly, all seven regraded overburden samples obtained by Colowyo that were analyzed for molybdenum contained 0.4 ppm molybdenum. This information indicates that selenium, boron, lead, and molybdenum are not issues in the regraded overburden in the mined formations using current mining practices. The regraded overburden analyte monitoring shown on page 2.05-8 of the existing permit has been modified with this submittal to reflect this information.

A small percentage of the overburden samples are acidic or have a potential to generate acid. Only four samples representing 21 feet or 1.23% of the overburden sampled contained ABP less than –5 tons CaCO3 equivalent/1000 tons material. Thirty-seven samples representing 85.3 feet or 1.8% of the overburden sampled had a saturated paste pH less than 5.5. Three samples representing 10.8 feet or 0.23% of the overburden and interburden sampled had a pH greater than the WDEQ "suitable" criterion of 8.5. Of 308 regraded spoil pile samples reported in the 2005 Annual Reclamation Report, none exceeded any pH criteria, with 8.4 the maximum pH, 6.3 the minimum measured pH, and 7.5 being the mean overburden pH. This indicates that homogenization of the overburden during mining results in overburden that has an ideal paste pH.

One hundred and thirty samples representing 805.9 feet or 17.04% of the borehole overburden and interburden sampled in the South Taylorarea had a SAR greater than "suitable" criterion provided in the WDEQ guidelines. These samples are all in interburden and almost exclusively beneath the deeper coal seams (Exhibit 6, Item 6). Mining operations will naturally rebury these deeper interburden layers in the lower portions of the pit. Of 308 regraded spoil piles in Colowyo Mine operations reported in the 2005 Annual Reclamation Report, only eight exceeded the WDEQ SAR “suitable” criterion of 10, only two exceeded the permit “suspect level” of 15, and the mean value was 2.01. As such, SAR is not expected to be an issue in the regraded spoil in the South Taylor pit.

Saturation percent was outside of the WDEQ “suitable” range in 477 feet, or 10.9% of the borehole intervals. Mean saturation percent ranged from about 35 to 50%. During reclamation, overburden is homogenized and the saturation percent of the various layers is averaged. As reported in the 2005 Annual Reclamation Report, the 34 samples of regraded spoil analyzed for percent saturation ranged from 28 to 60.5% saturation, which is within the WDEQ “suitable” range. There are no WDEQ “unsuitable” criteria for percent saturation.

The anticipated root and aquifer zones within the regraded overburden of South Taylor should be of suitable quality due to the following:

- There is a limited amount of unsuitable overburden material when compared to the amount of suitable overburden material within the South Taylor pit area.
- In general, the limited amount overburden material that is unsuitable will be mixed with suitable material to create suitable root zone and aquifer restoration material during mining and the backfilling of pits and out-of-pit disposal facilities.
- Unsuitable overburden materials that represent a considerable portion of the overburden to be mined will be identified, selectively handled, and isolated from aquifer and root zone areas within the backfilled pits and out-of-pit disposal facilities using the methods specified in the mine plan.
- Historic regraded spoil data from the existing operation demonstrates that current mining practices consistently result in suitable overburden at this mining location.
- The approved overburden suitability criteria for the Colowyo Mine can be found in Volume 1, Section 2.05 of the existing permit.Hydrology Description

The objective of this section is to meet the requirements of Rule 2.04.7 et seq. by furnishing hydrological information for the permit revision area in sufficient detail to describe the following:

- Character of surface and groundwater resources;
- Baseline groundwater quantity and quality;
- Baseline surface water quantity and quality;
- Seasonal variations in surface and groundwater quantity and quality; and
- Ownership and use of surface and groundwater resources.

To meet the requirements of Rule 2.04.7 et seq. both general and detailed groundwater and surface water resource information was collected, compiled, and analyzed. Groundwater resource information will be provided first followed by surface water resource information.

2.04.7 (1) Groundwater Resource Information

Both general and detailed information regarding groundwater in the vicinity of the mining areas will be presented in the following subsections.

General Groundwater Resource Information

General Groundwater Characteristics – Colowyo Coal Company's general area of operation lies within an area known as the Danforth Hills. Regionally, the Danforth Hills are bounded on the northeast by the Axial Basin Anticline, and on the southwest by the northeastern flank of the Piceance Structural Basin. The intensely folded strata of the Mesa Verde Group characterize the Danforth Hills. The groundwater in the general area occurs principally in alluvial material associated with the major stream valleys and to a lesser extent in the permeable and semi-permeable bedrock strata (CDM, 1985a). (The term 'alluvial' used in this permit application does not necessarily mean that all the materials in the valley bottom have been water deposited. In fact, the majority of these deposits are colluvial in nature).

The principal geologic units in the area are the Williams Fork Formation, the Iles Formation, and the Mancos Shale. At the top of the Iles Formation is the Trout Creek Sandstone Member. The Williams Fork Formation consists of interbedded sandstone, siltstone, and shale with coal beds, and ranges up to 1,200 feet thick in the mine area. The Williams Fork Formation is not considered to be a major aquifer in the region (CDM, 1985a). The Twenty Mile Sandstone Member, which is considered an important aquifer within the Williams Fork Formation in northern Colorado, is not present in the Danforth Hills area (CDM, 1985a). A detailed description of the hydrogeologic units in the area is provided in Section 2.04.6.

Groundwater in the bedrock is largely controlled by the existence of fractures instead of primary permeability within the rock strata itself. The low permeability and discontinuous and lenticular nature of the strata restricts the ability of the bedrock to store and transmit water. In addition to fracturing, structural features in the area influence the limited movement and occurrence of groundwater. Groundwater tends to occur in the synclinal axis of the folds in the area as a result of the increased fracturing in these areas and the general movement of groundwater in the down-dip and down-fracture direction (CDM, 1985a).

General Groundwater Quantity – Groundwater monitoring in the general and South Taylor permit area has been conducted since 1983. Monitoring wells have been established in the alluvium, the Williams Fork Formation interburden and coal, and the Trout Creek Sandstone. A summary of the bedrock and shallow monitoring wells relevant to the permit revision is presented in tables 2.04.7-25 through 2.04.7-29 and are shown on Maps 10A and 10B. Locations of all known wells and test boreholes within the permit area and adjacent area are illustrated on Map 11B.

Previous studies by CDM (1985a) and Dennis (2001, 2006) determined the hydraulic characteristics of the bedrock aquifers in the Williams Fork Formation and the Trout Creek Sandstone. The results of these studies are presented in Table 2.04.7-26 and discussed in detail below. The Trout Creek Sandstone is a moderately permeable confined aquifer and the Williams Fork Formation is mostly dry with a few, low permeability, discontinuous, and confined aquifers of limited extent.

Alluvial aquifers have moderate to high permeability where encountered, with a wide range of hydraulic values encountered. There is little groundwater in the alluvium along Wilson Creek immediately below the South Taylor affected area. There is groundwater in the alluvium along the West Fork and main stems of Good Spring Creek below the South Taylor affected area.

General Groundwater Quality – Bedrock water quality (Williams Fork Formation and Trout Creek Sandstone) in the general area was determined by previous investigations (CDM, 1985a; Dennis, 2001; Colowyo 1992). Data from these investigations indicate that the principal water type in the Williams Fork Formation is a calcium- or sodium-bicarbonate type water, containing only minor concentrations of other major ions. The concentration of total dissolved solids (TDS) is low to moderate, ranging from 440 milligrams per liter (mg/L) to 640 mg/L (CDM, 1985a). The CDM investigation revealed that the water type of the Trout Creek Sandstone is more variable than that of the Williams Fork Formation. TDS concentrations ranged from 600 mg/L to 710 mg/L, and the water type ranged from a sodium-sulfate, sodium-bicarbonate type, to a predominantly mixed cation-bicarbonate type water with equal percentages of calcium, magnesium, and sodium (CDM, 1985a). The water quality of the bedrock during the 1985 investigation did not exhibit significant seasonal variability.

The water quality of the alluvium in the general area was also investigated by CDM in 1985. These investigations revealed two distinct trends in water quality: a temporal uniformity in water type, in the relative percentages of major cations and anions, and general variability in the water quality from well to well. The water type is predominantly a magnesium-sulfate type, with moderate to high concentrations of TDS, ranging from 645 mg/L to 3,780 mg/L (CDM, 1985a). In contrast to the water quality of the bedrock, the alluvial water quality showed significant seasonal variation in the majority of the wells sampled, with TDS concentrations increasing in the spring.

General Groundwater Use – Groundwater withdrawals in the Lower Yampa River basin totaled nearly one million gallons per day (mgd) in 1995 (USGS 1995). Groundwater consumption in the basin is predominantly associated with irrigation use. About 52 percent of the groundwater withdrawals (0.5 mgd) are used for irrigation. Livestock and mining use account for the remaining groundwater withdrawals.

A search of the Colorado Office of the State Engineer's files revealed 71 permitted wells located within the permit revision area and extending at least one mile beyond the perimeter of the expansion area. Of these, five permitted wells have reported well yields of 20 gallons per minute (gpm) or greater. The maximum reported yield of these wells is 50 gpm. The remaining wells have reported yields of less than 16 gpm; with most of the wells having reported yields of less then 5 gpm. There are 49 wells with reported flows of 0 gpm. Most of the permitted wells are used for monitoring purposes, however, a few of the permitted wells support domestic and livestock uses. The permitted wells are illustrated on Map 11B.

Detailed Groundwater Information

Groundwater Characteristics – The principle structural features in the permit revision area that influence groundwater flow are an unnamed syncline, located southeast of the South Taylor mining area, and an unnamed anticline, located beneath the southern part of the South Taylor permit revision area. The synclinal axis generally corresponds to the drainage valleys of the West Fork of Good Spring Creek. The unnamed anticline parallels the topographic divide between Wilson and Good Spring Creek. The result is a stratigraphic dip-slope towards Good Spring Creek. Both the anticline and syncline axes plunge in a northeasterly direction. These structural features result in the area at the top of the anticline being the recharge area for groundwater, and the area near Good Spring Creek being the discharge area. The area for recharge of groundwater is limited to the eastern half of the anticline and does not result in the formation of a continuous aquifer in the South Taylor permit revision area.

Groundwater in the South Taylor permit revision area occurs under perched conditions in areas that are not laterally extensive, and in the alluvial of the stream valleys. The perched areas are generally within the interbedded and lenticular sandstones and on the contacts between different lithologic units of the Williams Fork Formation. Beneath the South Taylor mining area, the top of the Trout Creek Sandstone underlies the lowest seam to be mined by approximately 590 feet. The coal seams to be mined in the South Taylor mining area is lower in the coal seam sequence than found at the adjacent West and East Pits. For South Taylor, the lowest seam currently considered to be mined is the $G_{8/9}$ seam. .

The South Taylor mining area has similar lithology to that found in the current Colowyo mine. However, the mining areas are located topographically and structurally higher than what is encountered at the Colowyo mine. Therefore, the elevations of the base of the coal seam floor to be mined in both of these areas are generally higher than the old surface elevation of the already mined East and West Pits.

The topographic high and geologic structure in the South Taylor mining area (an anticline) provides little recharge area for the underlying beds and seams. The Trout Creek sandstone, a major regional aquifer, and the overlying coal sequence, outcrop west and southwest of these areas and thus are above any sources for continuous water recharge. Thus, there is no source to contribute to artesian conditions in the coal seams to be mined. Monitoring well MWST-06-04 has water at an elevation of 7,915 feet (below the floor of the G_9 seam), and piezometer PST-06-17 did not encounter water at or above the G8/9 seam. These boreholes are shown on Map 10.

Perched bedrock groundwater will be found during mining activities. This has been confirmed by water monitoring during drilling, short-term air lift tests, and an examination of the geophysical logs. This water will contribute to a significant inflow of water during the boxcut and initial mining, but should cease rather rapidly (2 years ±). No artesian groundwater conditions exist above the Km marker bed, a proven regional aquiclude (confining layer), within the mining areas.

Groundwater Quantity – Transmissivity of the perched zones of the interburden within the Williams Fork Formation ranged from 79 square feet per day (ft^2/d) to 1,930 ft^2/d. Corresponding hydraulic conductivity ranged from 3.43 feet per day (ft/d) to 80.4 ft/d (CDM, 1985a; Table 2.04.7-26). The range in values is indicative of the variability in the degree of fracturing in the formation. Published transmissivity for the upper Williams Fork Formation is 33 to 95 ft^2/d (Robson & Stewart, 1990). The $F_{a/b}$ coal seam hydraulic transmissivity was 4.3 to 5.7 ft^2/d and the conductivity was measured to be 0.24 to 0.29 ft/d (CDM, 1985a).

The Trout Creek Sandstone just south of the South Taylor box cut was found to be dry (Well 84-B-TC). Other wells north of the South Taylor mine that intersected saturated portions of the Trout Creek closer to the axis of the Collom Syncline had transmissivity that ranged from 2.06 to 4.57 ft^2/d and had hydraulic conductivity ranging from 0.086 to 0.29 ft/d. All of these values are considered to be indicative of moderate permeability, and typical of relatively clean and/or fractured sandstone lithologic units (CDM, 1985a).

Storativity values for the Williams Fork Formation and Trout Creek Sandstone could not be estimated as part of the CDM studies, however, observations made during drilling and monitoring suggest that the water-bearing intervals are of limited saturated thickness and under confined conditions with significant artesian pressure (CDM, 1985a). Storativity values (unitless) for the $F_{a/b}$ coal seam ranged from 10^{-3} to 10^{-7}, which are indicative of confined conditions. Storativity values for the Trout Creek Sandstone was about 10^{-2}.

In addition to the bedrock wells, studies of the alluvial/colluvial aquifers in the general area have also been conducted. CDM slug-tested the wells to determine the hydraulic characteristics of the shallow aquifers (CDM 1985a). A slug test consists of the introduction or removal of a known volume of water or slug then subsequently measuring the water level through time in the well as the water level declines. For each of the wells, a slug-in and a slug-out test were performed. The results of the slug tests performed on the relevant alluvial wells are presented in Table 2.04.7-27. In 1985, monitoring well A-5 was destroyed by a mass-wasting flood event, and the water table which it intersected was substantially lowered, as evidenced by the new wells MW-05-03A and MW-05-03B that were installed to bedrock at the confluence of the unnamed drainage leading out of the box-cut area and Wilson Creek (near historic A-5).

Both wells were dry at the time of construction, and MW-05-03A was permanently closed. MW-05-03B has about ½ foot of water at the alluvial-bedrock contact.

Transmissivity of the alluvium ranged from 1,935 ft^2/day to 10,909 ft^2/day. Corresponding hydraulic conductivity ranged from 29.7 ft/day to 175 ft/day.

Groundwater Quality – Baseline monitoring was conducted in 1984-85 of alluvial aquifers and springs, in 1996-1997 of the bedrock and alluvial aquifers, in 1999 -2000 of the bedrock and alluvial aquifers, and during 2005-2006 of the alluvial aquifers and seeps and springs in the South Taylor permit revision area (Tables 2.04.7-28 through -31). The Colorado Mined Land Reclamation Division's *Guidelines for the Collection of Baseline Water Quality Data* were utilized during the baseline monitoring. Water quality sampling and laboratory analyses were conducted in accordance with Rule 2.03.3(4). The depth to water in each of 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. Well samples were filtered in the field and preserved for analysis of dissolved metal concentrations.

Figures 2.04.7-12 through 2.04.7-18 present hydrographs for representative bedrock and alluvial monitoring wells from the data collected during baseline monitoring in 1996/97. Bedrock water quality as measured by specific conductance is also illustrated to show seasonal variability with respect to water levels in the wells. The Trout Creek Sandstone wells exhibit greater variability in water levels than do the Williams Fork Formation wells. The lowest water levels in the bedrock wells typically occur in the winter, whereas the highest water levels generally occur in the fall. Because the bedrock aquifers are under confined conditions, recharge from spring runoff and snowmelt is not readily apparent in these figures.

The alluvial wells exhibit a greater response in water levels in the spring, corresponding to an increase in recharge from infiltration of runoff and snowmelt. The rise in water levels in these wells was most significant in well MW-95-02, which is drilled into the alluvium of Wilson Creek to a depth of about 38 feet.

Groundwater samples were collected in the permit area as part of baseline monitoring studies conducted by Colowyo. Groundwater data from 1984/1985, 1996/1997, 1999/2000, and 2005-2006 are presented in CDM (1985a), and in tables 2.04.7-28 and 2.04.7-29. These tables include those constituents identified in Rule 2.04.7(1)(a)(v), except for total iron and manganese, which were analyzed and reported as dissolved concentrations. Trilinear diagrams depicting the mean groundwater quality for wells monitored both for this permit revision and for general Colowyo operations are presented in figures 2.04.7-19 through 2.04.7-21.

The bedrock water quality is principally bicarbonate, with relatively equal proportions of calcium, magnesium, and sodium. Groundwater from two bedrock wells, W-95-15 and W-95-02, is principally sodium bicarbonate type water. Well W-95-02, completed in the Trout Creek Sandstone, also exhibited artesian flow and warmer temperatures. The average TDS content of the bedrock aquifer ranged from 702 mg/L in well W-95-02, to 1,064 mg/L in well UL-95-45. For comparison purposes, the USEPA secondary drinking water standard for TDS is 500 mg/L. As shown in Table 2.04.7-28, dissolved iron and manganese concentrations in the bedrock aquifers also often exceed the USEPA secondary drinking water standards of 0.3 and 0.05 mg/L, respectively. The generally poor quality of the bedrock aquifers typically limits their use for domestic water supplies.

The alluvial aquifer water quality is principally a magnesium sulfate or magnesium bicarbonate type. Water quality from the shallow Gossard well is a mixed cation-anion type water, with neither a dominant cation or anion. The average TDS content of the alluvium ranged from 788 mg/L in well A-6 to 2,310 mg/L in well MT-95-02. The alluvial groundwater also often exceeds the secondary drinking water standards for dissolved iron and manganese. Results are summarized in Table 2.04.7-29.

Groundwater Use – Groundwater use in the South Taylor 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 1970's 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 feet in the Williams Fork Formation, produced 40 gpm with a depth to water of 110 feet from the surface. Taylor Creek No. 3, completed to a depth of 2,284 feet in the Iles Formation, produced 20 gpm with a depth to water of 135 feet below ground surface. Neither well has been pumping since the early 1980's. Colowyo installed a new potable water supply well in 2004. This well was completed above the Km bed (depth 1000 feet) and is located in the NW¼, Section 3, T3N, R93W. The production rate is less than four gpm.

The information collected from Colowyo's existing operations indicates that groundwater is very limited, even to depths significantly below 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 in 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 list of wells in the permit area and adjacent area is included in Table 2.04.7-37. Most wells are used for monitoring purposes and/or are registered to Colowyo. 20 wells in the permit and adjacent area are registered to entities other than Colowyo. Of these 20, four are now owned by Colowyo.

Groundwater is not currently used for industrial or mining purposes such as watering haul roads or dust control. Water for these purposes is supplied by Wilson Reservoir located in Section 13, T4N, R93W (Map 11B).

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 general 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 (CDM, 1985b).

The upland plateau region is characterized by generally flat, low-lying mesas, divided by meandering streams with shallow gradients. The valleys of the larger streams, including Milk Creek and the Yampa River are typically broad, with aggrading of the alluvial/colluvial materials. Erosion and sloughing of stream banks is often severe due to the abundance of unconsolidated materials in the valley bottom, and typically results in increasing sediment loads to the drainages (CDM, 1985b).

The climate in the region is semi-arid, characterized by low precipitation, large daily temperature fluctuations, low humidity, and abundant sunshine. Precipitation averages about 18 inches per year, with most precipitation falling in the form of snow generally between the months of October and April.

Surface flows in the general area are dominated by runoff events resulting from either snowmelt or rainfall.

Surface water resources in the general area include the drainages of Good Spring Creek and Wilson Creek, perennial streams; Taylor Creek and Streeter Gulch, intermittent and ephemeral streams, respectively; and Jubb Creek, Collum and Morgan Gulches, minor ephemeral drainages. These drainages are illustrated on Map 10. Good Spring Creek and Wilson Creek are tributaries to Milk Creek, which has its confluence with the Yampa River about 13 miles southwest of Craig, Colorado.

Stream flows vary widely within the Lower Yampa River basin, primarily due to differing climatic, physiographic, and geomorphic conditions. Stream flow in the montane areas is generally a result of snowmelt in the spring/early summer months, and in response to summer thunderstorms. The streams are usually intermittent; since there is a lack of significant spring/seep discharge and a lack of storage in the alluvial deposits. This type of stream regime is typical of the principal drainages in the area including Good Spring, Taylor, and Wilson creeks and their tributaries (CDM, 1985b).

Surface Water Quantity – Surface water monitoring in the general area and the permit and permit revision areas has been conducted since 1975. The U.S. Geological Survey has monitored hydrologic conditions in the Lower Yampa River basin at several gaging stations since as early as 1950. The data collected at the gaging stations in the general area are summarized in Table 2.04.7-32. Flows measured in Good Spring, Taylor, Wilson, and Jubb Creeks near Axial, Colorado, for the period of record ranged from minimal/no flow, to a peak flow of 82 cubic feet per second (cfs), measured in Wilson Creek. The USGS has discontinued monitoring at most of these stations.

Engineering Science measured parameters in area streams and springs from 1978 through 1982 (ES, 1982), and the USGS measured stream parameters from 1974 until 1981 in the same streams. These data are summarized in Table 2.04.7-32. The report concluded that Taylor, Good Spring, and Wilson creeks all have low baseflows, with mean flow of 1.0 cfs or less in all three drainages. It also concluded that there were no conflicts between the ES data and USGS data.

CDM investigated streamflow conditions of the streams in the general area covering a 12-month span from August 1984 through July 1985. Surface water monitoring locations were established in Good Spring Creek, Wilson Creek, and Taylor Creek as part of these studies. A summary of the current and former surface water monitoring locations is presented in Table 2.04.7-33. Monitoring locations are shown on Map 10.

CDM measured flows at two locations in Good Spring Creek that ranged from 0.77 cfs to 75.95 cfs (CDM, 1985b). Base flows typically occurred during the winter months, and ranged from 2.5 to 3.5 cfs. Peak flows generally were measured during April and May, corresponding to snowmelt, spring runoff and precipitation events. Flow measurements at two locations on Wilson Creek ranged from 0.19 cfs to 90.7 cfs (CDM, 1985b). Base flows of 0.4 to 0.7 cfs were observed in the winter months, and peak flows also occurred in the spring. Flows measured in Taylor Creek were typical of an intermittent stream. Base flows occurring during August through September ranged from 0.01 to 0.02 cfs, whereas high flows in May measured 1.87 cfs (CDM, 1985b). The drainage was dry during November. The flow data compiled by CDM for Good Spring Creek, Wilson Creek, and Taylor Creek correlates with the data compiled by the USGS and Brant Dennis.

As part of the 1985 investigation, CDM also surveyed seeps and springs within the general area along Good Spring Creek, the West Fork of Good Spring Creek, and Wilson Creek, and areas in between (Map 10). A total of 59 seeps and springs were observed during the inventory. Seeps and springs are identified in Table 2.05.6-1 and -2. Four springs within the general area appeared perennial: one on a western tributary to Wilson Creek (WCS-1), one on the eastern tributary to Wilson Creek (WCS-3), and two on tributaries to Good Spring Creek (WFS-2, JCS-1). The seeps and springs were monitored for field parameters on a monthly basis, and a single full-suite sample was collected at each location in May 1985. The monitoring data illustrate that springs contribute up to 1.9 cfs to surface flows in the West Fork of Good Spring Creek, and about 1 cfs to surface flows in the mainstem of Good Spring Creek during peak flow periods (CDM, 1985b). Contributions to surface flows from spring discharge during baseflow periods were much less, ranging from 0.03 cfs to 0.06 cfs in the West Fork of Good Spring Creek, and 0.03 cfs in the mainstem (CDM, 1985b).

Springs were also inventoried by JBR (1997). JBR identified 29 seeps and springs within areas that could be impacted by mining. Some of these correspond with springs identified by CDM. Colowyo identified several additional springs in the mining impact areas. The spring information from all sources was consolidated and 21 spring sampling locations were identified to the Division for the South Taylor impact area. The Division approved of the selected spring locations in 1999.

Surface Water Quality – Water quality data for streams and springs that is relevant to this permit revision are summarized in tables 2.04.7-30, 2.04.7-34, and 2.04.7-35**.** Several surface water investigations have been performed in the general area. These are discussed in the following paragraphs.

Engineering Science measured parameters in area streams and springs from 1978 through 1982 (ES, 1982). The report concluded that Taylor, Good Spring, and Wilson creeks all have variable water quality that depends on season. Background levels of metals indicate acute and chronic toxicity to aquatic life in all drainages. It further concluded that levels of metals in surface water may affect agricultural uses, and that high metal and sulfates may preclude the use of surface water for potable water supplies.

CDM investigated surface water quality of the streams in the general area covering a 12-month span from August 1984 through July 1985. Surface water monitoring locations were established in Good Spring Creek, Wilson Creek, and Taylor Creek as part of these studies. Generally, the surface water in Good Spring Creek is a magnesium-sulfate type with calcium and bicarbonate also occurring in significant concentrations. The TDS ranges from 713 mg/L to 1,500 mg/L (CDM, 1985b). TDS concentrations were inversely proportional to flow; TDS was highest during low flow conditions in the stream, primarily occurring during the winter months.

Most of the springs sampled in the Good Spring Creek drainage by CDM were a magnesium-sulfate water type. TDS values ranged from less than 1,000 mg/L to nearly 5,000 mg/L (CDM, 1985b). Springs sampled in the Wilson Creek drainage were lower in TDS, and had higher proportions of calcium and bicarbonate.

Water quality in Wilson Creek is a mixed cation, mixed anion type, with sodium and chloride the dominant ions in the fall and winter months, and calcium, magnesium, and sulfates the dominant ions in the spring. TDS ranged from 554 mg/L to 2,130 mg/L (CDM, 1985b). TDS concentrations were also inversely related to stream discharge. Water quality in Taylor Creek is characterized by generally low concentration of major ions. The water is primarily a calcium-bicarbonate type, with low TDS ranging from 472 to 500 mg/L (CDM, 1985b).

TDS concentrations measured at USGS gaging stations in the in Good Spring, Taylor, Wilson, and Jubb Creeks near Axial, Colorado in 1999 and 2000 ranged from 167 mg/L in Taylor Creek to 1,660 mg/L in Jubb Creek (Table 2.04.7-32). Mean TDS concentrations range from 590 mg/L in upper Wilson Creek to 1089 mg/L in lower Good Springs Creek. The USGS has discontinued monitoring at most of these stations.

Sufficient water rights to Good Spring Creek are held by Colowyo to allow them to avoid using the volume of water that is diminished during and after mining. Colowyo is a large surface water right owner in the Upper Yampa area (Water District 44) of Colorado Water Division 6. Included in these rights are several diversions on Good Spring Creek controlled by Colowyo. The appropriation date on these diversions owned by Colowyo are in the 1890's, making them the most senior rights on Good Spring Creek. Therefore, any reduction in base flow can be met by Colowyo not exercising their water rights on Good Spring Creek in the amount of the reduction of the base flow, if it is found to be necessary. Please see table below defining current water rights owned by Colowyo on Good Springs Creek.

Water Right Name	Twshp	Range	Sect	Q160	Q40	Appropriation Date	Rate Amount (CFS)	Volume Amount (ACFT)
ARTHUR COLLOM DITCH	4N	93W	23	SE	NE	1885-05-10	0.1000	
ELK HORN DITCH	3N	93W	2	SE	NW	1883-03-20	1.2300	
GOOD SPRING DITCH NO 1	3N	93W	2	SE	SW	1885-05-20	0.5000	
GOOD SPRINGS DITCH NO 2	3N	93W	2	SE	SW	1885-05-20	1.0000	
JOSEPH COLLOM DESERT LAND DITCH	3N	93W	11	NE	NW	1883-03-20	0.5000	
SPRING CREEK DITCH 2	4N	93W	26	NE	NW	1887-06-30	0.5800	
SPRING CREEK DITCH 2	4N	93W	26	NE	NW	1887-06-30	0.2900	
TAYLOR DITCH	3N	93W	2	NE	NW	1879-05-01	1.6600	
WILSON RESERVOIR	4N	93W	13	SE	SE	1975-09-16		349.6000
COLOWYO TAYLOR PUMP NO. 1	4N	93W	27	NW	SW	1980-12-31	1.11	

Surface Water Use – Surface water is used extensively in the broader stream valleys of the area. Surface water consumption is predominantly associated with irrigation of agricultural lands. Surface water withdrawals in the Lower Yampa River basin totaled 75.2 million gallons per day (mgd) in 1995 (USGS 1995). About 99 percent of the surface water withdrawals (75.1 mgd) were used for irrigation. The irrigated acreage totaled 13,240 acres. Mining and livestock use account for the remaining surface water withdrawals.

All of the major streams are over-appropriated, and therefore, many of the surface water rights are inactive (CDM, 1985b). Large storage reservoirs are often constructed to capture spring runoff and facilitate irrigation of fields in the summer months when natural flows are diminished.

Surface water adjudication rights within the South Taylor Permit Revision Area are summarized in Table 2.04.7-36, based on a CDWR water rights database (CDWR 2005). Most of the adjudications support multiple uses. The adjudication does not necessarily reflect the amount of water available in any given year for the intended uses, only a representation of legal claims to the water in a particular stream course.

Detailed Surface Water Resource Information

Surface Water Characteristics – The South Taylor permit revision area includes the drainages of Good Spring, Wilson, and Taylor Creeks. Colowyo's existing mining operations exist primarily in the Good Spring Creek drainage. Although Taylor Creek is a tributary to Wilson Creek, the point of confluence is several miles downstream from the South Taylor permit revision area, and thus Taylor Creek is examined as a separate drainage in this presentation. The principal drainages within the permit revision area described below.

Good Spring Creek – The Good Spring Creek watershed encompasses an area of about 35 square miles. The drainage is characterized by steep sloping upland areas and narrow flat valley bottoms. Slopes approaching or exceeding 50 percent are common, primarily due to the preponderance of exposed bedrock strata (CDM, 1985b). Incision has created deep gullies in reaches locally within the permit revision area, and bank sloughing is contributing to channel widening. Other, more stable reaches are armored along the channel bottom by cobbles or exposed bedrock. Good Spring Creek has a higher baseflow than other area creeks in part due to flow contributions from perennial springs in the West Fork of Good Spring Creek.

Wilson Creek – The Wilson Creek watershed encompasses an area of about 20 square miles. Similar to Good Spring Creek, the Wilson Creek drainage is characterized by narrow upland areas, steeply sloping hillsides, and flat valley bottoms. The tributary channels are incised into bedrock. The valley bottom exhibits morphologic evidence of historic landslide debris accumulation, which serves as a transporting media for bedrock groundwater discharge and side valley runoff to recharge surface water flows (CDM, 1985b). This recharge mechanism is illustrated by seeps along the banks of the stream.

Taylor Creek – The Taylor Creek watershed encompasses an area of about 7.22 square miles. Slopes are variable, ranging from 20 to 25 percent in the broad upland area in the highest portion of the watershed, and generally steeper throughout the remainder of the basin leading to the valley bottom. Bedrock stability in the area inhibits the accumulation of mass-wasting debris (CDM, 1985b). The channel is relatively steep, typically greater than ten percent, and incision and bank sloughing are limited due to the bedrock control.

Surface Water Quantity – The South Taylor permit revision area extends from Colowyo's existing mining operations in the Good Spring Creek watershed into the Wilson Creek, and Taylor Creek watersheds. Baseline monitoring was conducted from September 1996 through September 1997 in each of these drainages. Additional baseline monitoring was conducted in March 1999 through August 2000 in Good Spring Creek. The Colorado Mined Land Reclamation Division's Guidelines for the Collection of Baseline Water Quality Data were utilized during the baseline monitoring. Water quality sampling and laboratory analyses were conducted in accordance with Rule 2.03.3(4) for analytes defined in Rule 2.04.7(2) and for analytes also listed in the Division's*Guidelines for the Collection of Baseline Water Quality and Overburden Geochemistry*. Field measurements for pH, electrical conductivity, temperature, dissolved oxygen, and flow were monitored monthly. Quarterly monitoring included a full suite of analyses at each location. Analysis for metals included only total recoverable concentrations.

Baseline surface water monitoring data are presented in Table 2.04.7-34 and Table 2.04.7-35. Streamflow hydrographs for representative surface water monitoring locations in these drainages are presented in figures 2.04.7-22 to 2.04.7-28. Surface water quality as measured by specific conductance is also illustrated to show seasonal variability with respect to stream flows.

Good Spring Creek – Flow measurements obtained from surface water monitoring locations in Good Spring Creek in 1996/97 ranged from 0.85 cfs at New Upper Good Spring Creek (NUGSC) to 17.0 cfs at Lower Good Spring Creek (LGSC). Flows increased in the late spring and early summer months, corresponding to periods of high snowmelt and surface runoff. Flows measured in 1999/2000 ranged from 0.2 to 13.0 cfs at EFGSC, 0.26 to 7.0 cfs at Lower West Fork Good Springs Creek (LWFGSC), and 0.18 to 6.5 cfs at Upper West Fork Good Springs Creek (UWFGSC), respectively. Flows also increased in the late spring and early summer months.

Taylor Creek, Wilson Creek, Jubb Creek – Flow measurements obtained from surface water monitoring locations in Taylor Creek in 1996/97 ranged from 0.01 cfs at Lower Taylor Creek (LTC) to 2.04 cfs at Upper Taylor Creek (UTC). These flows are typical of intermittent streams in the area. Surface water monitoring in Wilson Creek revealed flows that ranged from 0.2 cfs at Upper Wilson Creek (UWC) to 41.25 cfs at Lower Wilson Creek (LWC). Increases in flows were also observed to coincide with periods of snowmelt and spring runoff. Measured flows in Jubb Creek illustrated the ephemeral nature of the drainage, ranging from 0.01 cfs at West Fork Jubb Creek (WFJC) and East Fork Jubb Creek (EFJC) to 1.45 cfs at the confluence of Jubb Creek (CJC).

Seeps and Springs – CDM identified 59 seeps and springs in May 1984 within the general area. Most were found by later investigations. Of these, 15 had sufficient flow to warrant study; these are summarized in this permit revision. CDM investigated springs during an unusually wet year; their reported spring flows during April and May are substantially higher than those reported by later investigators (CDM, 1985b).

JBR Environmental Consultants, Inc. (JBR) surveyed the South Taylor permit revision area in 1997 to determine the occurrences of groundwater discharge in the form of seeps and springs. Three study areas were surveyed. Study Area A included the area of Colowyo's existing mining operations. Study Area B, south and west of Study Area A, included portions of Good Spring Creek, Wilson Creek, and Taylor Creek. Study Area C, located west of Study Area A, included two short reaches of Wilson Creek on the east, and the Upper branches of Straight Gulch on the west. The intervening area included the East and West forks of Jubb Creek. The surveys were conducted during the late summer months (August and September), when base flow conditions have typically been reached. The surveys were conducted in a year with above average precipitation, and thus, surface flows in the study areas were significantly higher than normal late-summer flows (JBR, 1998a, 1998b, 1997).

The JBR surveys identified 17 potential seeps and springs in Study Area A, 29 in Study Area B, and more than 60 in Study Area C (JBR, 1998a, 1998b, 1997). Most of the seeps and springs identified in the surveys were found in or near drainage bottoms. Development of small stock ponds had taken place below many of the springs. The surveys did not include water quality sampling.

Colowyo monitored 14 seeps and springs within the permit revision area in June-August 1999 and from two springs from March 2005 – March 2006, and will monitor all springs shown in Table 2.05.6-2 from March 2006 to March 2007. Nine of those locations corresponded to seeps and springs identified in the JBR surveys. Measurable flows during all monitoring periods ranged from 0.5 gpm at SPRLW-02 to 317 gpm at JCS-1. Flow data from all sources are summarized on Table 2.05.6-2, and the locations of all monitored springs and seeps are shown on Map 10.

Surface Water Quality – Surface water samples were collected in the South Taylor permit revision area as part of the baseline monitoring studies conducted by Colowyo in 1996/1997, 1999/2000, and 2005-2006. Water quality data obtained from surface water monitoring locations in Good Spring, Taylor, Wilson, and Jubb creeks are presented in Table 2.04.7-34 and Table 2.04.7-35. These tables include those constituents identified in Rule 2.04.7(2)(b)(ii), except for acidity and dissolved iron, which were not analyzed. Values presented for iron and manganese represent total recoverable concentrations. Trilinear diagrams depicting the mean water quality data from these surface water monitoring locations are presented in figures 2.04.7-29 through 2.04.7-32. Surface water quality in each of these drainages is discussed below.

<u>Good Spring Creek</u> – The water quality in Good Spring Creek is principally magnesium sulfate or magnesium-bicarbonate. The total dissolved solids content ranged from 480 mg/L at UWFGSC to 1,600 mg/L at LWFGSC. Average TDS values for all monitoring locations exceeded the USEPA secondary drinking water standard for TDS of 500 mg/L. In addition, although the mean total recoverable iron concentration of 0.6 to 0.8 mg/L in Good Spring Creek is below the USEPA aquatic life standard of 1.0 mg/L, the individual samples often exceeded this standard.

Taylor Creek – The water quality in Taylor Creek is principally magnesium-bicarbonate or magnesium-sulfate. The average TDS ranged from 530 mg/L at UTC to 1,210 mg/L at LTC. The mean total recoverable concentration of iron of 0.3-0.6 mg/L is below the USEPA aquatic life standard for the monitoring period, although some individual samples exceeded this standard.

Wilson Creek – Bicarbonate and sulfate appear to be the dominant anions that characterize the water quality in Wilson Creek, with calcium, magnesium, and sodium generally occurring in equal proportions. TDS concentrations in Wilson Creek are typically lower than those measured in the other drainages in the general area. TDS values ranged from 560 mg/L in UWC to 920 mg/L in LWC. Mean total recoverable iron concentrations of 0.7 to 5.6 mg/L exceeded the USEPA aquatic life standard in three of the four monitoring locations.

Jubb Creek – The water quality in Jubb Creek is also magnesium-bicarbonate or magnesium-sulfate, similar to Taylor Creek. The average TDS ranged from 950 mg/L at WFJC to 1,550 mg/L at CJC. The average total concentrations of iron in the West and East Forks of Jubb Creek exceeded the USEPA aquatic life standard for the monitoring period, however, the total recoverable iron value in the main stem of Jubb Creek was below the standard for the monitoring period.

Additional water quality data for these water monitoring locations may be found in the Annual Hydrologic Reports submitted by Colowyo to Division.

2.04.7 (3) Alternative Water Supply

Colowyo's mining operations in the South Taylor area are not expected to cause significant contamination, diminution, or interruption of surface or groundwater resources, based on information provided in Section 2.05.6. The potential diminution that may result during mining is within the water rights held by Colowyo.

2.04.8 Climatological Information

Please see Section 2.04.8 in Volume 1.

2.04.9 Soils Resource Information

The objective of this section is to meet the requirements of Rule 2.04.9 *et seq.* by furnishing soils information for the South Taylor permit revision mining areas in sufficient detail to determine the following:

- General distribution, properties and present and potential productivity of soils within the mining areas;
- Distribution, suitability, and average salvage depths of soils within the disturbed areas associated with the mining areas; and,
- Quantity of salvageable suitable soil material for use in the reclamation of the disturbed areas associated with the mining.

To meet the requirements of Rule 2.04.9 *et seq.* both general and detailed soils resource information/data where assembled, collected, and analyzed for each mining area. General soils resource information will be provided first followed by detailed soils resource information for each area. Detailed soils information presented in this document are for the South Taylor mining areas located within the permit revision area only. Soils information for all other current Colowyo areas is contained in the existing Colowyo permit documents.

Order III Soil Survey – Permit Revision Area

The general soils resource information used to describe the distribution, properties, and present and potential productivity of soils within the South Taylor permit revision area are included in the following:

- Unpublished Natural Resources Conservation Service (NRCS) Order-III soil survey maps and map unit descriptions for Moffat County, Colorado (NRCS, Craig, Colorado);
- NRCS - Soil Survey Division soil series descriptions (http://www.statlab.iastausete.edu/cgi-bin/osd/osdname.cgi). This information was used for portions of the permit revision area located in Moffat County, Colorado; and,
- Order-III soil survey maps and map unit descriptions found in the Soil Survey of the Rio Blanco County Area, Colorado (1982). This information was used for those portions of the permit revision area located in Rio Blanco County.

NRCS soils map information within the South Taylor permit revision area was reviewed and is presented on Map 5A, *Order III Soils*. NRCS soil map units were identified in the area and are provided in Exhibit 9, Item 5. The information provides antiquated series names and updated NRCS field map symbol identifications. Present and potential productivity of the soil units are provided in Table 2.04.9-4.

Generally, the map unit boundaries from the unpublished NRCS soils maps for Moffat County match with those for the Rio Blanco County soils maps. To the west of the existing permit area, the mapping unit boundaries from the two soil surveys match at the county line. However, the soil map unit names are different for each county. These differences are the result of changes in the NRCS soil classification system from 1982 (when the Rio Blanco survey was published) to 1998 when the Moffat County maps were made available to the public.

Order II Soil Survey – South Taylor Mining Area

This section presents data assembled, collected, and analyzed specifically for the South Taylor mining area.

General Soils Resource Information – The identification and proper management of soil resources in the mining area is essential for the success of reclamation of any future disturbed areas and the achievement of the post-mining land use. The objective of this section is to meet the requirements of Rule 2.04.9 *et seq.* by furnishing soils information for the mining area in sufficient detail to determine the following:

1) General distribution, properties and present and potential productivity of soils within the South Taylor/Lower Wilson affected areas;
2) Distribution, suitability, and average salvage depths of soils within the disturbed area associated with the South Taylor mining area; and,
3) Quantity of salvageable suitable soil material for use in the reclamation of the disturbed area associated with the South Taylor mining area.

Detailed Soils Resource Information – The site-specific soils resource information described below pertains to the disturbed area associated with the South Taylor mining area shown on Map 5B.

Detailed soils information was collected to determine the spatial distribution, suitability, salvage depths and volume of soils available within the disturbed area associated with the South Taylor mining area. In addition, the mass balance in salvageable soil materials were calculated to assure an adequate supply of suitable soil would be available for reclamation of the surface disturbance associated with the South Taylor mining area. An overall mass topsoil balance is presented in Volume 1, Table 2.05-1.

A previous soils inventory which encompassed the majority of the disturbed area associated with the South Taylor mining area was performed by Consolidation Coal Company (CCC, 1984). The CCC soil inventory report includes soil series and map unit descriptions, soil map unit boundary delineations, physicochemical properties, and recommended soil salvage depths within the South Taylor mining area, with the exception of the southern portions of T3N, R93W Section 16 and 17. A copy of the *Soil Inventory Danforth Hills Project Rio Blanco & Moffat Counties* is included in Volume 13, Exhibit 9, Item 7. Soils information presented in the existing permit document were used for the portions of T3N, R93W Section 16 and 17 that were not included in the CCC report.

The soils were mapped according to the standards of the National Cooperative Soil Surveys. Soil series were described and sampled in locations that were typical of the series. Soil sample collection was based on profile characteristics such as texture, horizon arrangement and depth, coarse fragment, and other diagnostic characteristics. Sample locations are shown on Map 5B.

Soil samples were analyzed for the following parameters:

- pH;
- Electrical Conductivity;
- Saturation percentage;
- Sodium Adsorption Ratio (SAR);
- Boron;
- Selenium;
- Particle size (texture);
- Coarse Fragments (in the field)
- Organic Matter; and
- Soluble Ca, Mg, and Na.

The soil laboratory and field data were compared with the topsoil and substitute topsoil suitability criteria shown on Table 2.04.9-5, Soil and Soil Substitute Suitability Criteria, to determine the suitability of each horizon and map unit. These suitability criteria were developed based on a review of Wyoming Department of Environmental Quality (1996) and Montana Department of State Lands (1983) topsoil and overburden suitability guidelines in conjunction with operational and sound reclamation practices for mined land reclamation.

The soils data representing the soil series were compared to the suitability criteria provided on Table 2.04.9-5. Based on these comparisons, soil horizons that exceeded the criteria provided on the table were identified and were considered unsuitable as a plant growth medium for reclamation. The salvage depth for each series was from the surface to the top of the first unsuitable horizon.

Fourteen map units were identified within the disturbed area associated with the South Taylor mining area. A summary of the limitations and estimated depth of suitable soil is provided in Table 2.04.9-6, Summary of Soil Limitations and Salvage Depths – South Taylor Mine Area. Soil physicochemical data from the 18 CCC soil profiles are provided in Table 2.04.9-8 for a total of 60 soil samples. Descriptions of the soil map units identified in the South Taylor mining area by Consol are presented in Exhibit 9, Item 6.

The South Taylor mining area contains deep soils in mostly gently to moderately sloping locations. These soils generally have favorable textures for reclamation. Soils on steep slopes tend to be shallow and excessively channery or cobbly.

The physicochemical soil data were compared with the topsoil and substitute topsoil suitability criteria shown on Table 2.04.9-5. A summary of the limitations of each soil profile by horizon and the estimated average salvage depth for each soil map unit is shown on Table 2.04.9-6. Topsoil salvage and handling for the South Taylor mining area are shown on Map 28.

There appears to be few chemical limitations for salvage and use of soils for reclamation with the exception of clay content. The pH for the samples collected by Consol ranged from 6.5 to 8.6 with the suitability range of 5.5 to 8.5. Only two samples exceeded this suitability criterion. The highest specific conductivity reading was 1.3 mmhos/cm which is well below the level of concern (4.00). The highest SAR (sodium adsorption ratio) measured was 2.8 (values less than 11 are generally suitable). Soluble selenium levels were all below the detection level of 0.05 ppm, well below the 0.1 ppm level of concern. All samples had boron levels of 2.51 ppm or less. Levels of 5.00 ppm or greater are considered unsuitable. The saturation percent of all soils analyzed were within the acceptable range of 25% to 85%. Only two samples had a sand content of less than 15% and only one sample had clay content greater than 40%.

The main limitation for soil suitability was the percentage of coarse fragments. The coarse fragments for each soil profile were obtained from the soil description tables in the CCC soil inventory report (CCC 1984). Soils were considered suitable to the depth where coarse fragments were no greater than 35%. Some soils were found to be suitable throughout the horizon (Silas, Lamphier, Burnette, Inchau, Rhone) and most were suitable on surface horizon. Only Waybe was found have excessive coarse fragments at the surface (60% coarse fragments from 0-3 inches).

Each soil horizon was determined to be suitable or unsuitable. The weighted average depth of suitable soil was then calculated for each map unit based on the suitable depth of each soil series multiplied by the percentage of the map unit which it comprises. The weighted average depth of salvageable soil calculations are summarized in Table 2.04.9-6A.

Following the development in any one five-year mine area the amount of soil salvage will be assessed to determine the need for assessing potential substitute soil sources.

2.04.10 Vegetation Information

The objective of this section is to meet the requirements of Rule 2.04.10 *et seq.* by describing the general vegetation community types and distribution within the permit boundary revision area and providing vegetation data in sufficient detail to facilitate development of a revegetation plan and performance standards for the disturbed area associated with the South Taylor mining areas.

General Vegetation Information – South Taylor Pit Area

General vegetation mapping information was developed based on the following information:

- Colowyo Coal Company Permit C-81-019 - Application for Permit Renewal/Permit Revision - Mining – Section 2.04.10 (Colowyo Coal Co., 1991)
- Vegetation Inventory of the Danforth Hills Project, Rio Blanco County Colorado (by Harner and Associates, Inc. for Consolidation Coal Company, January, 1985) (see Exhibit 10, Item 5);
- Production Evaluation for the Sagebrush and Mountain Shrub Reference Areas – Greystone Environmental Consultants (1999);
- Color aerial photographs (Scale: 1" = 2,000') taken in September 1997;
- Digital 1.5 meter-resolution true color remote sensing imagery exposed in the summer of 2002; and
- Digital 0.5-meter resolution color-infrared remote sensing imagery exposed in September of 2005.

The delineated vegetation community types described in this section and indicated on Map 4 of the existing permit document were used as the basis of the general vegetation inventory. The Consolidation Coal Company report (January 1985) (Exhibit 10, Item 5) and color aerial photos were used in combination as the basis for delineating the various vegetation community types within the South Taylor/Lower Wilson permit revision area. In areas not covered by the Consolidation Coal Company report (January, 1985) aerial imagery was used to delineate vegetation community type by interpreting slope, aspect, coloration, and texture variability throughout the landscape and based on the knowledge of vegetation community types typical of the region surrounding the East, West, and Section 16 mining areas. Data collected by Greystone in 1999 was used for comparison of productivity in the sagebrush and mountain shrub reference areas in Figures 2.04.10-8 and 2.04.10-10. The delineated community types were digitally transferred to a base topographic map covering the permit revision area. The location and distribution of vegetation community types in the extended Permit Area are shown on the updated Map 4.

It is important to note that on permit revision area mapping, impacts generally south of the Rio Blanco / Moffat Co. line will utilize vegetation interpretations from the 1985 Danforth Hills study. Impacts on areas north of the Rio Blanco / Moffat Co. line and west of Sections 9 and 16 will utilize vegetation studies and mapping developed by Cedar Creek Associates, Inc. for work on both the Lower Wilson and Collom projects (2005). The remaining quadrant (Sections 9, 16, and areas to the north and east) will utilize original Colowyo vegetation mapping.

South Taylor Study Area

Detailed Vegetation Information – In 1984, detailed vegetation information and data were collected by performing a baseline vegetation survey within a study area that encompassed 9,725 acres containing the South Taylor mining area. Site specific information included the following:

- Detailed spatial distribution of vegetation communities;
- Plant species composition;
- Vegetation ground cover by species;
- Vegetation above ground biomass (production);

- Woody plant density; and,
- Presence/absence of rare, threatened, or endangered plant species or other important species.

Introduction – The objective of this section is to describe general vegetation community types (floral assemblages) and their distribution within the South Taylor Study Area to facilitate extrapolation to, and an update of, the remainder of the permit revision area (6,050 acres). To support this objective, vegetation data are provided in sufficient detail to formulate a revegetation plan and facilitate development of performance standards responsive to Rule 4.15.7 for the disturbed area associated with the South Taylor Mine Area. The referenced "Study Area" is a specific delineation including the overall Permit Area that incorporates all disturbances plus a buffer to facilitate modest engineering flexibility and encompasses an area of 9,725 acres (Map 4). The total acreages and percentage of each vegetation type identified in the South Taylor Mining Area are presented in Table 2.04.10-7. The vegetation communities delineated are shown on Map 4.

The vegetation inventory was conducted to: 1) determine the percent cover of vegetation canopy, rock, litter, and bare ground in major vegetation types; 2) determine the annual production of herbaceous species in major vegetation types; 3) estimate the density of woody species in major vegetation types; 4) determine carrying capacity; 5) compile a vegetation map of the study area; 6) compile a list of species observed within the study area; and 7) assess the presence or absence of threatened and/or endangered plant species within the study area; 8) obtain qualitative information concerning minor vegetation types. This inventory was conducted by Harner & Associates, Inc. for Consolidation Coal Co. during the growing season of 1984 with a report of final results submitted in January, 1985 (see Exhibit 10, Item 5 for an original copy of this document). The following discussion is excerpted (and occasionally modified) from this document.

Methodology – The following is a description of methodology used in determining and measuring vegetation communities within the South Taylor Study Area.

Community Type Mapping - Vegetation types within the study area were delineated and mapped on 1" = 2,000' color aerial photographs and 1" = 400' blue-line photomosaic base maps provided by Consolidation Coal Company. Differences in shading and texture were used as a guide in delineating vegetation types. The vegetation map was ground-truthed in the field during the course of other segments of the study. Vegetation types greater than two acres in size were mapped separately.

Species List - A list of vascular plant species was compiled from species observed during the course of field work conducted in summer of 1984. Species observed were identified in the field with the use of floral keys by Harrington (1964), Hitchcock & Chase (1951), and Weber (1976). Notes were made as to the date of collection, location of collection, habitat, exposure, slope, elevation, soil, and collector. Dried specimens were verified by Dr. William Weber at the University of Colorado Herbarium. Specimens not readily identified in the field were collected in standard herbarium manner. Weedy species were determined using Thornton et al. (1974). The authorities for scientific names were obtained from Weber and Johnson (1979). Common names were taken from the USDA Forest Service (1976).

Species considered threatened or endangered in Colorado and potentially occurring at the study area were determined by review of the USDA-USDI (1979) publication, An Illustrated Guide to the Threatened and Endangered Plant Species in the Rocky Mountain Region; the Federal Register listing of Threatened and Endangered Species (USDI 1980) and information contained with the Colorado Natural Heritage Inventory.

Study Area Defined - The study area for the vegetation inventory was defined as those lands containing the surface disturbance areas, buffer areas, and adjacent reference areas consisting of approximately 9,725 acres. Although not required by CMLRD regulations, the entire boundary was included in the vegetation sampling rather than just areas where surface disturbance was contemplated.

Sampling Design - Study area and reference area sample sites were randomly selected prior to conducting quantitative studies in the field. The sampling sites were located by establishing a grid on the blue-line photomosaic base maps (scale: 1" = 400') along north-south and east-west grid lines with spacings of 1/4" (100' ground distance). Grid lines were numbered consecutively along two axes and pairs of random numbers were plotted utilizing a random numbers table. Sampling sites were located in the field as close to the map location as possible. All sampling sites were indicated on vegetation maps.

A portion of the study area (approximately 170 acres) could not be sampled due to weather and grazing. The winter of 83-84 was particularly harsh for northwestern Colorado. Snowfall reached record levels and by spring, snowmelt caused severe flooding and landslides in the study area. Roads were washed out or blocked by slides and access was virtually impossible. Once road access was established exclosures were installed.

Not all vegetation types in the study area were sampled with the same intensity. Major vegetation types (those whose area was greater than 5 percent of the total disturbance) were quantitatively sampled. Minor vegetation types (those whose areal extent was less than five percent of the total disturbance) were sampled qualitatively as per agreement with CMLRD.

Reference Area Selection - Reference areas were selected according to the following criteria: 1) the vegetation types were similar to those within the study area, 2) the soils, slope, topography, and elevation of a vegetation type were similar to those within the same vegetation type in the study area, 3) the dominant species of a vegetation type were similar to those within the same vegetation type in the study area, 4) the areas were potentially able to be controlled by the Consolidation Coal Company and 5) surface disturbance was not contemplated in the areas.

Ground Cover Measurement - Cover was measured by point intercept techniques at one-meter intervals along a randomly oriented 50-meter transect. At each point a metal pin was projected downward from a height of four feet perpendicular to the transect and first hits on vegetation, litter, rock, or bare ground were recorded. Additional hits on vegetation were recorded by species to provide a more complete description of the species composition within each community.

Production Measurement - Herbaceous production was obtained at each random sample site by harvesting the above ground herbaceous growth in a one x one meter square quadrat. Harvested tissue was separated by major species while minor species were combined by lifeform group. Leguminous perennial forb species were separated from other perennial forb species. Species with an estimated dry weight less than one gram were noted as a "trace" and arbitrarily assigned a value of 0.3 grams in data calculations. Harvested tissue was placed in paper bags, oven dried at 105 degrees Celsius for 24 hours and weighed to the nearest 0.1 gram.

Woody Plant Density Measurement - Shrub density was obtained along a randomly oriented 50 meter transect by counting alI individuals rooted within 0.5 meter of both sides of the transect (i.e. within a 1 x 50 meter quadrat). Shrub seedlings less than 5 inches tall were not counted; however, adult shrubs possessing diminutive morphology were counted.

Tree density was obtained along randomly oriented 50 meter transects by counting all individuals rooted within 1 meter of both sides of the transect (i.e. within a 2 x 50 meter quadrat). DBH was determined for each mature individual and average height was established with a clinometer for mature trees. Trees were grouped as mature individuals (DBH greater than 2 inches), saplings (DBH less than 2 inches) and standing dead (snags).

Sample Adequacy - Adequacy of sampling was determined periodically during field sampling utilizing the following equation from Snedecor and Cochran (1967).

$$n_{min} = t^2 s^2 / (dx)^2$$

where: n_{min} = the minimum number of observations needed

t = the distribution value at a given confidence level (CL); i.e. 1.64 (90% CL) for grassland communities and 1.282 (80% CL) for shrubland communities

s^2 = the sample variance

d^2 = 10% level of accuracy, or 0.1

x = the sample mean

An adequate sample for each parameter (cover and production) was determined in each vegetation type by exceeding the n_{min} requirement obtained from the equation with a minimum of 15 samples.

Data Analyses - Cover data were summarized by determining the mean percent cover, relative percent cover, and standard deviation for each species, lifeform group, rock, litter, and bare ground within each vegetation type sampled. Above ground standing biomass of species (production) was determined as the mean dry weight of all species in all plots within each vegetation type sampled. Production was expressed in grams per square meter and pounds per acre for each type. Shrub density was computed as the mean number of plants per 50 square meters and the mean number of plants per 0.1 acre for all species. Tree density was computed as the mean number of plants per 100 square meters and the mean number of plants per 0.1 acre for all species. Species diversity was computed as the mean number of different species encountered by vegetation hits along the 50-meter cover transect.

Statistical Equivalency of Reference Areas - The statistical equivalency of each reference area with the study area was determined for vegetation cover, production and species density in each vegetation type according to the following equation (OSM 1980):

$$(\bar{x}_1 - \bar{x}_2) < or > t\sqrt{(s^2{}_1/n_1) + (s^2{}_2/n_2)}$$

Where: x = sample mean
s^2 = sample variance
t = t table value for 90% confidence level
n = sample size

Livestock Carrying Capacity - Livestock carrying capacity of each vegetation type was determined by considering the nutritional requirements of cattle and sheep (Stoddart et al, 1975) according to the following assumptions. A cow and calf (cattle animal unit) consumes 900 pounds of air-dry forage per month and a ewe and lamb (sheep animal unit) consumes 150 pounds of air-dry forage per month. The conversion of oven dry weight to air-dry weight is 1.11. The ideal utilization factor for forage grazing is 50 percent. The livestock carrying capacity was determined by the following:

LCC = (1.11 x FA x .5) / FC

where: LCC = Livestock Carrying Capacity (AUM per acre)
FA = Forage Available (oven-dry lbs/acre)
FC = Forage Consumption Requirement (900 lbs for cattle AUM, 150 lbs for sheep AUM)

Results - The vegetation of the Danforth study area is typical of northwestern Colorado. Hillsides are covered with a mixture of mountain shrub and aspen forests at upper elevations while sagebrush dominates the lower elevations. Valley bottoms are dominated by a mixture of grassy meadows and sagebrush. The valley bottoms are used more intensively for grazing than upland areas. Hay is produced in small acreage near several of the ranch houses that occur in the valleys. The land surface of the Danforth study area has a general northeastern exposure and is deeply divided by several intermittent streams that flow from the southwest to the northeast. Exposures are variable but most are north, northeast, and northwest. Slopes vary considerably from 0 to 20 percent along ridgetops whereas sideslopes range from 30 to 50 percent. Elevations range from 8660 ft. in the extreme southwest portion of the permit area to 6620 ft. in the northeast portion.

A diversity of species occur at the Danforth study area. A total of 176 different vascular plant species were observed within the study area (Table 3.1 of Exhibit 10, Item 5). Of these, three were annual grasses, 28 were perennial grasses, five were grasslike, 21 were annual forbs, 94 were perennial forbs, one was a succulent, three were sub-shrubs, 12 were deciduous shrubs, three were broadleaf evergreen shrubs, five were deciduous trees and one was an evergreen tree. The majority of the species have their origin in western floras, however, several have origins in mid-western and northwestern floras. Some weedy species have invaded from Eurasian floras.

Weedy Species - Of the 176 species observed, 33 species are considered weedy (Thorton et al. 1974). Two noxious weed species were observed (quackgrass and Canada thistle). Of the 33 weedy species, two were annual grasses, one was a perennial grass, 10 were perennial forbs, one was a sub-shrub, one was a deciduous shrub and one was a broadleaf evergreen shrub. Many of the weedy species were found along roadsides, around stock ponds, corrals, and other disturbed locations. Both quackgrass and Canada thistle were found primarily in the meadow type.

Threatened and Endangered Species - No threatened or endangered species are known to occur within the vicinity of the Danforth study area (Colorado Natural Heritage Inventory, 1984 personal communication). None were observed during the course of this study.

Reclamation Species - Several of the native species occurring within the project area have commercially available seed for use in reclamation. Of the perennial grasses, western wheatgrass, bluebunch wheatgrass, slender wheatgrass, Indian wheatgrass and big bluegrass have several commercial varieties available. To increase diversity in areas, mountain brome and Great Basin wildrye could be considered. Among the perennial forbs with commercially available seed at a reasonable price is Lewis flax and Rocky Mountain penstemon. More higher priced and not so readily available forb seed includes western yarrow, Louisiana sagewort, asters, arrowleaf balsamroot, Indian paintbrush, northern sweetvetch, aspen peavine and scarlet globemallow. Commercially available shrub seed includes serviceberry, rubber rabbitbrush, chokecherry, current, woods rose and big sagebrush.

Description of Vegetation Types - Vegetation types within the Danforth study area are divided into two categories, native and agricultural, the most predominant type was the native type which comprised 99 percent of the entire acreage of the study area (Table 3.2 of Exhibit 10, Item 5). Agricultural types comprised 1 percent of the area. Six different native vegetation types were defined within the permit area. Their distribution is presented on the vegetation maps (Maps 4). The most abundant type was mountain shrub, comprising approximately 53 percent of the total study area. Sagebrush - grassland comprised approximately 29 percent. Aspen comprised 13.6 percent of the area. A small area of Douglas fir comprised less than 1 percent of the area. Several small areas of Juniper comprised less than 1 percent of the area. Areas of native or improved haylands comprised approximately 1 percent of the study area. Several other vegetation types occurred along the railroad corridors. A small area of riparian forest occurred along Wilson Creek. Greasewood vegetation type occurred along the lower stretches of both Wilson and Good Spring Creeks. Wheat and barley are planted in cultivated lands along the Wilson and Good Spring Creek railroad corridors.

Aspen - The aspen vegetation type occurred primarily on northwest facing slopes at elevations above 7,400 feet. Large continuous stands of aspen occurred along the upper portions of the West Fork of Good Spring Creek in sections 6, 31, and 32. In sections 19 and 20, aspen stands occurred on northwest facing slopes leading to the East Fork of Wilson Creek. A typical view of the aspen vegetation type within the study area is at Figure 3.1 of Exhibit 10, Item 5. Two distinct phases occur within the aspen vegetation type; a shrub dominated understory phase and an herbaceous understory phase. The shrub-dominated phase occurred at lower elevations and was dominated by western snowberry. The majority of the study area was comprised of this phase. The other herbaceous understory phase was dominated by perennial forbs, the most prominent being sweet anise, Porter's ligusticum and peavine. This phase occurred at higher elevations. These phases have been recognized in the nearby White River National Forest (Hoffman and Alexander, 1983). They indicate that the snowberry phase occupies the lower edge of the aspen zone and was classified as the driest of any of the phases in their study. In the drier direction of the phase it is replaced by mountain shrub or sagebrush vegetation. The herbaceous phase was described as having a continuous layer of forb species with the near absence of shrub species. Fendler meadowrue may dominate on more well-drained soils while Porter ligusticum and sweet anise dominate on less well-drained soils.

Total understory vegetation cover within the study area aspen type was 66.9 percent (Table 3.3 of Exhibit 10, Item 5). Bare ground was 6.5 percent, while litter and rock cover combined was 26.5 percent. Perennial grasses had 18.3 percent cover while perennial forbs had 34.1 percent. Dominant grasses included Kentucky bluegrass, nodding brome and blue wildrye. Dominant forbs included sweet anise, and western yarrow. Woody species had 23.1 percent cover with western snowberry as the dominant shrub.

Total understory vegetation cover within the Collom aspen reference area (72 percent), shown on Map 4 and described in Exhibit 10, Item 6, was higher than that of the study area. Bare ground exposure was 8.9 percent, while litter and rock cover combined was 19.1 percent combined. Compared with the study area, perennial forbs and shrubs were lower with 26.8 and 5.2 percent cover respectively. Perennial grasses however, were higher with 38.1 percent. Dominant forbs included creeping root violet with 5.2 percent cover and poverty weed with 4.4 percent cover. A test for equivalency of the reference area was made and it was found to be equivalent (please see Exhibit 10, Item 6).

The mean herbaceous production within the aspen vegetation type of the study area was 129.1 grams per square meter (Table 3.3 of Exhibit 10, Item 5). Perennial grasses comprised the majority of the production with 68.7 grams per square meter. Kentucky bluegrass, nodding brome and blue wildrye were the dominant grasses. Perennial forbs produced an average of 48.3 grams per square meter. Ballhead waterleaf and leguminous forbs were the highest producers.

Mean herbaceous production in the Collom aspen reference area was 124.4 grams per square meter. Perennial grasses produced more than 68 percent of the total production with 86.4 grams per square meter. Mean annual above ground herbaceous production in the reference area did not exceed that of the study area samples. A test for equivalency of the reference area was made and it was found to be equivalent.

Mean density of woody species in the aspen study area samples was 31.0 shrubs per 50 square meters and 7.5 aspen trees per 100 square meters. Dominant shrubs included western snowberry with 24 individuals per 50 square meters and 6 common chokecherry individuals per 50 square meters.

The mean number of species encountered along the point cover transect was 9.8 and 12.3 respectively for study area and the Collom aspen reference area samples.

Average herbaceous production in the aspen type was 1,152 lbs. / acre oven-dry forage. Converting oven to air dry forage by a factor of 1.11, yields 1,278 lbs. / acre available herbaceous air-dry forage. Assuming a 50 per cent utilization factor and 900 lbs. / acre cattle animal unit, the cattle carrying capacity was 0.71 AUM's per acre. For sheep the carrying capacity was 4.26 AUM's per acre.

Mountain Shrub - The mountain shrub vegetation type occurs on a moisture gradient lying between the aspen and the sagebrush-grassland vegetation types. On the mesic end of the type, Gambel oakbrush was dominant while common chokecherry was co-dominant with serviceberry. On the xeric end, serviceberry was dominant and western snowberry was co-dominant. The mountain shrub type occurred throughout the study area, but was most abundant and continuous south of West Fork. North of West Fork the type was less continuous and as elevations decrease to the north was found only in isolated areas on steep north facing slopes where moisture conditions were more favorable. The mountain shrub type was identified by the dominant presence of serviceberry or Gambel oakbrush (Figure 3.3 of Exhibit 10, Item 5). The reference area for the mountain shrub vegetation type was located in section 30 on a ridgetop with east and west facing slopes at an elevation of approximately 8,000 feet. The reference area was partially dominated by serviceberry and oakbrush (Figure 3.4 of Exhibit 10, Item 5).

Total vegetation cover within the mountain shrub study area samples averaged 79.3 percent (Table 3.5 of Exhibit 10, Item 5). Bare ground averaged 5.6 percent and litter and rock was 15.0 percent combined. Mean shrub cover was 42.9 percent, more than half the total vegetation cover. Western snowberry was the dominant species with 24.9 percent cover. Serviceberry and Gambel oakbrush had 8.8 and 5.9 percent cover, respectively. Western snowberry had a significant presence in the samples because cover samples were taken from measurements made below a height of 4 feet. As such, samples were more a measurement of the understory of the type rather than the total canopy cover. Many of the serviceberry and oakbrush shrubs had heights exceeding 4 feet. Perennial grasses had a cover of 18.3 percent. Nodding brome, slender wheatgrass, and blue wildrye were the dominant grasses. Perennial forbs had a cover of 12.4 percent with silvery lupine the dominant forb. Other co-dominant forbs included western yarrow, nettleleaf horsemint, smooth fleabane and aspen peavine. Total vegetation cover within the mountain shrub reference area was higher than that of study area samples at 88.7 percent (Table 3.5 of Exhibit 10, Item 5). Bare ground was 2.9 percent and lower than study area samples. Litter and rock was also lower than study area samples at 8.9 percent. Shrub cover within the reference area was 36.8 percent. Western snowberry was the dominant shrub with 24.8 percent mean cover. Serviceberry and Gambel oakbrush had 5.9 and 3.9 percent mean cover respectively. Perennial forbs had the second highest cover as a group; 25.3 percent exceeding that of study area samples. Dominant forbs included silvery lupine, nettle-leaf horsemint, and American vetch. Perennial grasses had a mean cover of 20.9 percent. Dominant grasses included Kentucky bluegrass, nodding brome and blue wildrye.

Mean annual herbaceous production from study area samples was 151.5 grams per square meter. Perennial grasses produced 80.1 grams per square meter with Kentucky bluegrass producing 46.3 grams and nodding brome producing 9.8 grams. Perennial forbs produced 61.9 grams with nettle-leaf horsemint, silvery lupine, one-flowered helianthella, leguminous forbs and other miscellaneous forbs comprising the majority of the forbs. Mean annual herbaceous production from reference area samples was 183.4 grams per square meter. Perennial grasses produced 81.6 grams per square meter of which Kentucky bluegrass produced 53.7 grams per square meter and nodding brome produced 17.5 grams per square meter. Perennial forbs produced 79.5 grams per square meter, one-flowered helianthella produced 19.5 grams per square meter and silvery lupine produced 16.8 grams per square meter. Other miscellaneous perennial forbs produced 32.3 grams per square meter. Annual forbs produced 21.6 grams per square meter. Total above ground herbaceous production in the reference area was significantly greater than that of herbaceous production in study area samples.

Total shrub density within the mountain shrub vegetation type was 53.9 individual shrubs per 50 square meters. Western snowberry was the most abundant shrub with 31.9 individuals per 50 square meters followed by Gambel oakbrush with 11.4 and serviceberry with 4.6 individuals per 50 square meters.

The mean number of species encountered along the 50 meter point cover transect was 9.5 and 14.9, respectively, for the study area and reference area samples (Table 3.5 of Exhibit 10, Item 5).

Average herbaceous production in the mountain shrub type was 1,351 lbs. / acre oven-dry forage. Converting oven to air-dry forage by a factor of 1.11, yields 1,500 lbs. / acre available herbaceous air-dry forage. Assuming a 50 per cent utilization factor and 900 lbs. / acre cattle animal unit, the cattle carrying capacity was 0.83 AUM's per acre. For sheep the carrying capacity was 5.00 AUM's per acre.

Sagebrush-Grassland - The sagebrush-grassland vegetation type occurred on the lower elevations of the study area on ridges and southeast and southwest facing slopes. The majority of the type occurred north of West Fork. The sagebrush-grassland type within the study area was quite variable and several phases of the type were noted. The most abundant phase was the sagebrush-snowberry phase (Figure 3.5 of Exhibit 10, Item 5). This phase occurred on the deeper soils and had an understory composed primarily of Kentucky bluegrass, subalpine needlegrass, Letterman needle-grass, nodding brome and slender wheatgrass. In section 15, the mountain shrub vegetation type has been converted to a sagebrush-snowberry phase by mechanically removing all the large shrubs. In these areas, snowberry was more common than sagebrush. The sagebrush-bluebunch wheatgrass phase occurred on shallow soils usually on steep terrain (Figure 3.6 of Exhibit 10, Item 5). This type primarily occurs near Highway 13 along Good Spring Creek. Study sites 18, 19, 21 and 25 are representative of this phase of the sagebrush grassland type. Bluebunch wheatgrass was the dominant grass species within this phase. A grassland phase of the sagebrush-grassland occurred on thin scabby sites located on ridgetops primarily in sections 30 and 29 north of West Fork (Figure 3.7 of Exhibit 10, Item 5). Here the phase occurred on southwest facing slopes. These sites have served as bedding areas for sheep and cattle and are subject to intense grazing. Sites 1, 23, 14 and 2 are representative of this phase. Grasses are the dominant group within this phase, with needle-and-thread, western wheatgrass, and prairie junegrass being common. Shrub density within the type is exceedingly low. Douglas rabbitbrush was the dominant shrub. The sagebrush-grassland (*Artemisia nova*) phase occurs on one ridge within the study area, in sections 30 and 19 (Figure 3.8). This phase has a distinct dominant shrub layer of black sagebrush. Otherwise grasses were similar to that of the grassland phase of the sagebrush grassland type. No plots were randomly located within this phase. In several areas near sections 15 and 16, range improvements have been made which have altered the vegetation. The large shrubs have been removed to allow the understory species to be more productive. The practice has removed most of the serviceberry and in the process, most of the sagebrush. Snowberry dominates these sites with numerous grasses and forbs (Figure 3.9 of Exhibit 10, Item 5). Absence of grazing for the past four years in section 11 was another factor contributing to the variability within the sagebrush-grassland type. This area is controlled by the Colowyo mine and is within their fenced perimeter boundary. Samples sites 4, 5, 12, and 16 were within this area. All samples from the various phases were pooled for the sagebrush-grassland analysis. The sagebrush-grassland reference area was located in section 30 on a south-facing slope at an elevation of 8,040 feet.

Total vegetation cover within the sagebrush-grassland type from study area samples was 59.3 percent (Table 3.7 of Exhibit 10, Item 5). Bare ground exposure was 12.5 percent while rock and litter combined had 28.2 percent cover. Shrub species comprised 21.8 percent cover and big sagebrush, the dominant shrub, had 13.2 percent cover. Western snowberry had 6.1 percent cover. Perennial grasses had 20.7 percent cover of which Kentucky bluegrass had 5.5 percent cover. Western wheatgrass had 4.2 percent cover and bluebunch wheatgrass had 4 percent cover. Perennial forbs had 12.8 percent cover of which silvery lupine, arrowleaf balsamroot, eriogonum, and thistle were the most abundant. Total vegetation cover within reference area samples was higher than that of study area samples with 74.3 percent (Table

3.7 of Exhibit 10, Item 5). Bare ground was considerably lower with 5.6 percent exposure, and litter and rock combined were 20.1 percent which was also lower than study area samples. Within the reference area, perennial forbs were the most abundant group with 25.7 percent cover. Silvery lupine, American vetch, one-flowered hellianthella and aspen peavine were the most abundant forbs. Perennial grasses had 19.1 percent cover of which Kentucky bluegrass was the dominant grass. Shrubs had 28.4 percent cover of which western snowberry and Douglas rabbitbrush had 9.5 and 9.6 percent cover, respectively, while big sagebrush had 8.3 percent cover.

The mean annual herbaceous production within the sagebrush-grassland vegetation type was 123.4 grams per square meter (Table 3.7 of Exhibit 10, Item 5). Perennial grasses contributed 82.2 grams per square meter to the total production while perennial forbs contributed 35.8 grams per square meter. Dominant grasses included Kentucky bluegrass with 21.0 grams per square meter, bluebunch wheatgrass with 18.8 grams per square meter, and western wheatgrass with 22.0 grams per square meter. The dominant forb was silvery lupine with 5.0 grams per square meter. Other miscellaneous perennial forbs contributed 24.5 grams per square meter. Mean annual production within the reference area samples was 185.4 grams per square meter (Table 3.7 of Exhibit 10, Item 5). Perennial grasses contributed the majority of the production with 120.8 grams per square meter. Kentucky bluegrass was the dominant grass with 80.2 grams per square meter, followed by nodding brome with 10.9 grams per square meter. Needlegrasses, including Letterman and subalpine, contributed 7.0 and 4.3 grams per square meter, respectively. Total perennial forbs had 60.3 grams per square meter of which silvery lupine had 22.0 grams per square meter. Leguminous forbs including American vetch and aspen peavine contributed 16.8 grams per square meter.

Mean density of woody species within the sagebrush-grassland study area samples was 54.7 individuals per 50 square meters (Table 3.7 of Exhibit 10, Item 5). Big sagebrush was the dominant shrub with 24.6 individuals per 50 square meters. Western snowberry and Douglas rabbitbrush had 12.4 and 10.2 individuals per 50 square meters, respectively. Other important shrubs included rubber rabbitbrush and fourwing saltbush in the sagebrush bluebunch wheatgrass phase, and woods rose, Gambel oakbrush and western snowberry in other phases.

The mean number of species encountered along the 50 meter point cover transect was 9.6 and 11.3, respectively, for study and reference area samples (Table 3.7 of Exhibit 10, Item 5).

Average herbaceous production in the sagebrush-grassland type was 1,100 lbs. / acre oven-dry forage. Converting oven to air-dry forage by a factor of 1.11, yields 1,222 lbs. / acre available herbaceous air-dry forage. Assuming a 50 per cent utilization factor and 900 lbs. / acre cattle animal unit, the cattle carrying capacity was 0.68 AUM's per acre. For sheep the carrying capacity was 4.07 AUM's per acre.

Meadow – [Equivalent to the Bottomland Type discussed for Lower Wilson.] The meadow vegetation type occurred along the creeks and most major drainages throughout the study area. Major areas occur along Good Spring, Wilson, West Fork of Good Spring and East Fork of Wilson Creeks. The meadow type was exceedingly variable dependent upon moisture and soils. In areas where water was at the surface sedges and rushes dominated, Nebraska sedge, common cattail, and bulrush were common (Figure 3.11 of Exhibit 10, Item 5). Willows dominated several areas although they never formed continuous thickets. Grasses, including Kentucky bluegrass, Great Basin wildrye, western wheatgrass, slender wheatgrass, dominated most areas (Figure 3.12 of Exhibit 10, Item 5). Numerous forb species also occurred within this type. The meadow type is very productive and is easily grazed because of its relatively flat terrain and easy access to water. Consequently areas have been severely overgrazed and numerous weedy species occur within the type. Canada thistle is common in all drainages and forms continuous patches in places. Quackgrass is also common. Coneflower dominates several areas in the upper portions of West Fork (Figure 3.13). The meadow vegetation type was not sampled because the amount of disturbance projected for this type was less than 5 percent of the total and, as per agreement with Division, did not require sampling.

Douglas Fir – A small area of Douglas Fir forest was located in section 29 on a steep northwest-facing slope (Figure 3.14 of Exhibit 10, Item 5). Trees within the stand were all ages as determined by observation of dbh (diameter at breast height) sizes. The canopy was continuous with dense trees. Ground cover was sparse. Percentages of litter and bare ground cover were high.

Juniper – Small acreages of juniper dominated areas occurred on steep southwest-facing hillsides in section 22 overlooking Highway 13 (Figure 3.15 of Exhibit 10, Item 5). Except for the presence of Rocky Mountain juniper, the area would have been mapped as sagebrush-grassland. Juniper trees occurred as scattered individuals on the hillside. Understory species were similar to that of the sagebrush-grassland.

Riparian Woodland – A very small acreage of boxelder maple-dominated riparian woodland occurred in section 5 (Figure 3.16 of Exhibit 10, Item 5). This area along Wilson creek exhibited 95-100 percent domination by boxelder maple trees of various diameter classes. Trees were 40 to 80 feet tall. Understory species were similar to that of the meadow vegetation type. Numerous weedy species were observed in the understory including Canada thistle, rubber rabbitbrush, Great Basin wildrye, burdock and Kentucky bluegrass.

Agricultural – Small areas of hay meadows occur within the main portion of the study area and along the railroad corridor adjacent to Good Spring Creek (Figure 3.19 of Exhibit 10, Item 5). Timothy, orchard grass and wheatgrasses comprised the majority of the grasses in the hay meadows. Cultivated areas occurred along the railroad corridors. Barley, wheat and oats are the most frequently cultivated species.

Sample Adequacy and Equivalency – In general, an adequate sample was achieved for all parameters in all native vegetation types sampled (Table 3.9 of Exhibit 10, Item 5). An adequate sample for cover was generally achieved with 15 study sites. An adequate sample for production, however, depended upon the vegetation type. The mountain shrub and aspen vegetation types had lower variability than other types and therefore fewer samples needed to be obtained. The sagebrush-grassland vegetation type, because of the many phases within the type, was quite variable and as such more samples needed to be taken to adequately sample the community.

All reference areas were considered equivalent in terms of vegetation cover, production and species diversity (Table 3.10 of Exhibit 10, Item 5). Reference areas selected generally had a higher total vegetation cover and a higher production in all reference areas (except the aspen reference area) and also had higher species diversity than the corresponding study area samples. As such, the reference areas selected were considered adequate to represent the study area samples.

Justification for Reference Area Selection

COLLOM ASPEN REFERENCE AREA

The Collom Aspen Reference Area (2005) is a suitable replacement for the 1984 Aspen Reference Area, comparability for both total cover and production, when comparing the 2005 Collom Aspen Reference Area with the Aspen Reference Area (1984) and the Danforth Baseline Study. Please see Exhibit 10, Item 6.

SAGEBRUSH REFERENCE AREA

Colowyo will use the C-SRA as the sole “targeted” reference area for ground cover and production testing for all South Taylor disturbance areas as delineated by the green tie-in boundary shown on Map 23 pursuant to Section 4.15.7(3)(b)(iii). Colowyo has determined to use this reference area in this manner instead of the "Harner established" South Taylor Sagebrush Reference Area (ST-SRA) for eight reasons as follows.

First, the C-SRA is readily accessible (located near the Administration Building) and should remain accessible during the life-of-mining.

Second, the C-SRA has been measured more frequently over the past several years and therefore, presents a more extensive historic data-base. C-SRA data indicated for the third point below come from the 2005 sampling effort from the C-SRA and new tables providing these data have been provided as Tables 2.04.10-28 through 2.04.10-32.

Third, an analysis of data indicates that the C-SRA more closely resembles the South Taylor Study Area than the ST-SRA with respect to dominant species and lifeform composition. Big sagebrush (*Artemisia tridentata*) comprises 28% and 27% of the C-SRA and South Taylor Study Area's vegetation composition, respectively, while comprising only 13% (less than half) of the ST-SRA vegetation. To the contrary, deciduous shrubs comprise twice (29%) of the ST-SRA vegetative composition but only 17% and 5% of the Study Area and C-SRA's composition. And finally, perennial grasses comprise only 24% of the ST-SRA vegetative composition while comprising 32% and 40% of the Study Area and C-SRA's composition. In this regard, the C-SRA would be considered a better ecological target for reclamation attempting to re-establish sage and grassland communities.

Fourth, (and of elevated significance) it appears the ST-SRA is located in an ecotone between the more mesic mountain shrub community type and the mesic sagebrush community type based on composition data, narrative descriptions, and photographs presented by Harner in his 1984 report. Harner describes this area as the sagebrush-snowberry phase, which exhibits deeper more productive soils than the sagebrush - wheatgrass phase more typical of most Colowyo disturbances. The ST-SRA is surrounded and being invaded by mesic mountain shrub that will most likely continue to expand into, and replace, the sagebrush community as succession progresses. This observation is also verified by review of 2005 aerial imagery of the communities within and adjacent to the ST-SRA. Over the 21 years since the original mapping, the area that could be segregated as sagebrush has substantially diminished in areal extent. To the contrary, the C-SRA is located in a large expanse of the sagebrush – wheatgrass phase with occasional patches of the mountain shrub community in draws and depressions and the more shallow-soiled juniper scrub community in rock outcrop areas. Very few compositional changes in the dominant taxa are expected in this area as succession progresses. Furthermore, this sagebrush-wheatgrass phase of the sage community is a more appropriate ecological comparator given the similarity of this area's underlying soil profile with the constructed growth media profile of Colowyo's reclaimed land.

Fifth, based on statistical testing per current Division guidelines, the ST-SRA is not comparable to the South Taylor Study Area for either cover or production (see Table 2.04.10-27) but is eligible as a reference area only because values are higher than those found in the study area. The sampling adequacy and equivalency procedures used by Harner in 1984 were more liberal for such evaluations.

Sixth, a review of data presented on Figures 2.04.10 – 7 and 8 indicated that Harner's 1984 data for the ST-SRA is substantially elevated over all other comparable sagebrush data sets from the area, but most importantly, the values are 25% and 50% higher than the surrounding South Taylor Study Area during the same year for cover and production, respectively. Some of this difference with data sets from other years can be explained by an analysis of precipitation. However, the strong differences between the ST-SRA and the study area reduce the defensibility of this reference area as an appropriate comparator.

Seventh, the sagebrush-grassland ecotype is the main ecological community that will be targeted by reclamation planning for the disturbed South Taylor project area for two principal reasons. First, efforts to establish Mountain Shrub and Aspen revegetated communities in Northwest Colorado within the timeframe of the liability period have met with repeated and well-documented failures. Second, replacement of habitats conducive to Sage Grouse is of far greater importance to the CPW than any other wildlife species group. In this regard, the C-SRA provides a far better example of the long-term desirable vegetation structure and composition that is more closely tied to the habitat requisites of Sage Grouse. Given the mobility of most wildlife taxa (including Sage Grouse), there is sufficient Mountain Shrub habitat within proximity to planned disturbances to meet a majority of perceived needs of other wildlife populations including elk herds.

Eighth, a healthy stand of perennial grasses (with or without occasional stands of sagebrush) has been shown to be the most effective erosion control on young reclaimed landscapes. With fast growing roots to absorb moisture and large above-ground biomass to intercept precipitation, grasses are more effective in stabilizing barren soil than the more slow-growing deciduous shrubs of the Mountain Shrub community. A few deep-rooted and long-lived sagebrush plants provide diversity and long-term stability to reclamation provided there is a healthy component of grasses and forbs in the understory to stabilize the soil surfaces between individual shrubs. The shrub to perennial grass ratio on the C-SRA (27% sagebrush to 50% perennial grass, forb and sub-shrub composition) is a reasonable target for long-term mature reclamation with respect to erosional stability. (An ideal target for a mature community conducive to Sage Grouse brooding habitat will have a lower component of sagebrush in the composition – more in the range of 10%.)

MOUNTAIN SHRUB REFERENCE AREA

Colowyo has determined to use this reference area instead of the “Harner established” South Taylor Mountain Shrub Reference Area (ST-MSRA) for five reasons as follows.

First, the C-MSRA is readily accessible (located above Taylor Creek immediately west of Colowyo’s West Pit operations) and should remain accessible during the life-of-mining. The ST-MSRA is located high in the rugged terrain even further south than the ST-SRA where access may be intermittently or permanently interrupted by mine-related activity.

Second, the C-MSRA has been measured more frequently over the past several years and therefore, presents a more extensive historic data-base. In addition, since the C-MSRA is currently used for bond release success comparisons at the Colowyo Mine and for use as a reference area for the Collom Project, it would simplify and streamline future bond release sampling efforts at all these projects if a single mountain shrub reference area was used.

Third, based on statistical testing per current Division guidelines, the ST-MSRA is not comparable to the South Taylor Study Area for ground cover (see Table 2.04.10-27) but is eligible as a reference area only because values are higher than those found in the study area. The sampling adequacy and equivalency procedures used by Harner in 1984 were more liberal for such evaluations.

Fourth, a review of data presented on Figures 2.04.10 – 9 and 10 indicate that Harner’s 1984 data for the ST-MSRA is substantially elevated over all other comparable mountain shrub data sets from the area, but most importantly, the values are 13% and 20% higher than the surrounding South Taylor Study Area during the same year for cover and production, respectively. Some of this difference with data sets from other years can be explained by an analysis of precipitation. However, the differences between the ST-MSRA and the study area reduce the defensibility of this reference area as an appropriate comparator for the South Taylor Project Area.

Fifth, the C-MSRA is located on a ridgeline approximately two miles from the South Taylor Study Area. This reference area encompasses both the mesic mountain shrub phase (Gambel oak dominated) and the xeric mountain shrub phase (snowberry and serviceberry dominated). In addition, islands of dense sagebrush and snowberry are can also be found in a few small clearings. This assemblage of community sub-types (phases) very adequately represents the mountain shrub mosaic that is found in the Colowyo, South Taylor, and Collom Study Areas. Perusal of Figure 2.04.10 – 9 indicates that this reference area is representative of several areas with respect to cover in 2005. Between year comparisons of the South Taylor Study Area and the C-MSRA indicate nearly identical herbaceous production values under similar precipitation.

From a review of all data, it appears that the C-MSRA is comparable to the mountain shrub community in the South Taylor Study Area as well even though collected data was from different years. It also appears that the C-MSRA is equally if not more appropriate than the ST-MSRA for comparison purposes based on total ground cover and herbaceous production. However, the C-SRA will be utilized for the South Taylor Area as a "targeted reference area" for future evaluations of reclamation.

2.04.11(1-3) Fish and Wildlife Resources Information

The previously-approved permit document presents information relative to the existing mining area and surrounding areas including the South Taylor mining area. These areas were surveyed for the presence of large mammals (including elk and deer), small mammals (including various rodents), lagomorphs (including rabbits), avifauna (including raptors, upland game birds, waterfowl, and non-game birds), reptiles and amphibians, and aquatic life. Habitat for each survey group was also evaluated. The results of the surveys are presented in the previously approved permit document.

The overall objective of this resource description is to utilize existing information pertaining to the South Taylor permit revision area and the disturbed area associated with the mining areas to:

1) Quantitatively and qualitatively describe the wildlife resources;

2) Quantitatively and qualitatively describe special-interest wildlife species; and

3) Qualitatively describe the wildlife resource in the area surrounding the South Taylor permit revision area and previously-approved permit area.

The major functions of the resource descriptions are to provide adequate information to first inform the reviewer of significant wildlife features and general wildlife resource characteristics; and, second, to establish a foundation for understanding the subsequent impacts and mitigation measures necessary for inclusion under Rule 2.05. Additional objectives include:

- Identify and delineate wildlife habitats and evaluate their relative importance to various wildlife species and groups.

- Develop a list of wildlife species known to occur (observed) or potentially occur in the area.

- Identify listed occurrences of federal and state threatened, endangered, or special-concern species and identified critical habitats in the area.

- Assess the seasonal distribution of special-interest wildlife species (i.e., big game, raptors, aquatic life, and special-concern species) in the general area, and specifically in potentially disturbed area.

- Estimate relative numbers of special-interest wildlife species in the area and estimate relative numbers of small mammals and breeding birds in the potentially disturbed areas.

These objectives comply with Rule 2.04.11 of the Division regulations, which is the basis for this section.

Information Sources

The sources of wildlife resource information are provided in Section 2.03.3(7).

There is considerable overlap in the geographic extent of resource maps provided by the Consol and Colowyo studies. The extent of Monarch & Associates (i.e. Colowyo) resource studies encompasses an area from the top of the Danforth Hills on the south into the Axial Basin to the north, with Good Springs Creek and Maudlin Gulch forming the east and west boundaries of the study area. The Consol study area is bounded by the Axial Basin and Yampa River to the north and west, the White River Plateau to the east, and White River to the south. Wildlife resource data extends further south into Rio Blanco County than data from Monarch & Associates, whereas, Monarch & Associates resource boundaries extend further to the north and to the west.

Using these data sources, wildlife habitat types and special-interest wildlife habitats within the area have been identified and mapped. Special-interest habitats include critical habitats for threatened or endangered species, unique habitats (e.g., number or density of springs, seeps, cliffs, and snags), and seasonally important habitats (e.g., raptor nest sites and big game year-round range and parturition areas). Identification of special-interest habitat types was based on observed animal distributions during given time periods, indirect evidence of relative use (e.g., browse utilization, tracks, and pellets), quantitative and qualitative surveys, and scientific literature. The distribution of all special-interest habitats identified in the area are delineated on Maps 13B and 15B. Information specific to the South Taylor permit area was obtained from previous surveys conducted by others and conversations with representatives from the Colorado Parks and Wildlife (CPW).

General Observations

The previous studies indicate that several wildlife groups of importance occur in the general project area, including big game, small mammals, raptors, upland game birds, and songbirds. These species use all or portions of eight habitat types that occur within the South Taylor permit revision area, as described below.

- Mountain shrub
- Sagebrush
- Aspen woodland
- Juniper Scrub
- Riparian woodland – Bottomland/ Erosional Feature
- Cropland
- Grassland
- Wetland

These habitats are similar to those outside of the South Taylor disturbed areas except for the reclaimed habitats of the previously-approved mining area.

Big Game

Elk - Elk within the general project area are part of the White River herd as defined by the CCPW, which was estimated to include a total herd population of 28,620 animals in 1996, and represents the largest elk herd in Colorado (CCPW 1997). Within the White River herd the CCPW estimated an average cow:calf:bull ratio of 100:47.7:13.1 during the surveys completed from 1994 to 1995, this is somewhat lower than the 100:52.3:25.8 ratio average identified during the survey completed by Monarch & Associates (Monarch and Associates, 1998).

Elk utilize all habitat types within the previously approved permit area during various times of the year, and several elk ranges have been identified as shown on Map 13B Sheet 1 and are described below.

- Winter range
- Calving and summer areas
- Late fall and early spring areas

Winter ranges are typically occupied from December through April. Within the general project area, winter aerial surveys of elk from 1994 through 1997 found that elk populations varied greatly. Populations varied from a high of 1,590 and a low of 259. This represents 5.5 and 0.9 percent of the total White River herd. This variation is based on both snow depths and temperature. In general, most observations of elk during the winter were made within the mountain shrub habitat type in the previously approved permit area.

Elk calving and summering areas are typically occupied from May through September and occur within the upper ends of drainages within the mountain shrub and aspen habitat types within both the previously approved and South Taylor permit revision areas. During the period of 1994 through 1997 the calf:cow ratio averaged 58:100 in these areas (Monarch and Associates, 1997).

Calving and summering areas are the predominant elk habitat in the vicinity of the South Taylor permit area (Monarch and Associates, 1998), which provides cover, forage, and water during the April to July period until early snows cause them to move down country to wintering ranges. As indicated by Jon Wangnild, the CPW District Wildlife Manager for the Meeker North Area, mining activities in the South Taylor permit revision area will not be a migratory limiting factor nor will it limit habitat due to the relative small area of impact and the abundance of suitable habitat in surrounding areas.

Mule Deer - Like elk, mule deer within the general project area utilize all habitat types and are part of the White River herd. The buck:doe ratio of the White River herd in 1997 was 11:100. This is somewhat higher than the 8.5:100 ratio noted in the general project area from 1994 through 1997.

Four types of mule deer range occur within the previously approved and the South Taylor permit areas, as described below. Locations of the high use wintering areas and late fall to early spring areas are shown on Map 13B Sheet 2.

- Spring/summer range

- Winter range
- High use wintering areas

Late fall and early spring areas

The mule deer spring/summer range is typically occupied from May through September. Spring aerial counts varied from a high of 711 deer in 1995 to a low of 529 animals in 1996 in this habitat type.

Mule deer winter range and mule deer high use wintering areas, which are the two areas found in the South Taylor permit revision area, are generally occupied from December through April. Aerial winter counts ranged from a low of 184 animals in 1994 to a high of 918 in 1997, with the majority of observations occurring in the sagebrush and mountain shrub habitats.

Raptors

Based on a four-year period of observation, thirteen raptor species have been observed in the previously approved and South Taylor permit areas (Monarch and Associates, 1998). In addition to these opportunistic sightings, intensive survey of raptor nesting activity was carried out over several periods between 1984 and 1997 (as reported in Monarch and Associates, Wildlife Baseline Studies 1998; and Monarch and Associates, Raptor Nesting Activity Report, 1998). Based on these studies, a total of 6 nests have been identified within the previously approved permit area. Five hawk nesting sites and three unknown nesting sites were identified in the South Taylor Permit Area (Table 2.04.11-14Ch; Map 15B Sheet 1).

Birds

A total of ninety-two species of birds occur within the general project area. However, the diversity and density of these species within the various habitat types vary by season. Appendix A of the Wildlife Baseline Studies for the Colowyo Coal Company L.P. Properties in the Danforth Hills (Monarch and Associates, 1998) provides a list of these species, habitat, and number of birds/ kilometer.

Sage Grouse – Historically, sage grouse have occurred throughout northwestern Colorado. However, in the late 1980's and early 90's sage grouse populations have declined throughout the range. But, by 1996 the numbers of sage grouse within the general project area began to increase. Although populations are not as high as in the early 80's, the populations appear to be increasing. This increase may be related to both favorable weather conditions during the brood rearing season and vegetative manipulations within the general mine area.

Sage grouse have been observed within the general project area during all seasons of the year, within the sagebrush, mountain shrub, and bottomland grassland habitat types. Studies conducted in more recent years resulted in the identification of the SG-1 and SG-2 leks located immediately adjacent to the South Taylor permit revision area (Map 15B Sheet 2), though reports from these studies have also made the case that these two proximate leks should be regarded as one (Monarch and Associates, 1998). Fieldwork conducted in subsequent years has also documented the occurrence of sage grouse hens with broods on ridges in the vicinity of SG-1 and SG-2 (Monarch and Associates, 2000). This would indicate that nesting is occurring within these areas. During the late summer broods have been observed in the mountain shrub communities northwest of the Permit Revision Area, between Morgan Gulch and the Wilson drainages. Although winter birds have been observed within the general area, it appears that better wintering areas occur north of the property in the Axial Basin.

Sharp-tailed Grouse – One sharp-tail grouse lek (ST-6) occurs within the previously approved permit area. No additional leks have been identified in the South Taylor permit revision area (Map 15B Sheet 3). However, broods have been observed in the mountain shrub communities above 7,400 feet in elevation and in the sagebrush and grassland habitats. Wintering birds have also been observed in the mountain shrub communities that occur in close proximity to aspen stands.

Fish

Fish within the revision area are limited to Wilson Creek and the West Fork of Good Spring. Good Spring Creek has been classified by the CPW as a non-fishery stream. The CPW has not rated Wilson Creek, but it is expected to contain similar species to Good Spring Creek.

Habitat Types

Although some species utilize all habitat types within the general project area, numerous other species groups are associated with specific habitat types. The following section identifies species occurrence within the various habitat types of the revision area.

The mountain shrub habitat type supports a large number of bird species including upland game birds and nontropical migrant species, and provides foraging habitat for several raptor species. Typically gamebird and nontropical species include blue grouse, sage grouse, Columbian sharp-tailed grouse, mourning dove, broad-tailed hummingbird, Say’s phoebe, dusky flycatcher, and black-capped chickadee. Raptor species include northern goshawks which are winter and spring residents, golden eagles which occur year-round, Swainson’s hawks that occur only in the spring, and American kestrels that occur in the spring and summer. Mammal species that may occur in this habitat type include coyotes, mountain lions, masked shrew, montane vole, and deer mice.

The sagebrush habitat type also supports various species. Like the mountain shrub type numerous upland gamebirds utilize the sage habitat including blue grouse, sage grouse, and Columbian sharp-tailed grouse. Raptor species such as red-tailed hawks, and great horned owls also utilize this habitat type for foraging. Songbirds within this habitat type include northern flicker, horned lark, American robin, mountain bluebird, vesper sparrow, and Brewer’s blackbird. Due the similarity of the sagebrush and mountain brush habitat types the mammal species that use these areas are nearly identical.

Aspen habitats within the revision area support species such as Columbian sharp-tailed grouse, downy woodpecker, house wren, hermit thrush, and yellow-rumped warbler. Various raptor species such as great horned owls, sharp-shinned hawk, and Cooper’s hawks may use these areas for nesting. In addition, these areas provide important thermal and security cover for both elk and deer.

The pinyon/juniper habitat occupies a portion of the revision area. Like the aspen habitat, this type also provides security habitat for elk and deer, as well as nesting habitat for numerous bird species. Common bird species include Cooper’s hawk, red-tailed hawk, common nighthawk, dusky flycatcher, blue-gray gnatcatcher, and chipping sparrows.

The riparian deciduous and riparian sagebrush habitats provide habitat for similar species including waterfowl species such as mallards, American green-winged teal, and northern shoveler. In addition, these habitat types provide habitat for a wide variety of bird species including killdeer, northern flicker, western wood peewee, American robin, mountain chickadee, bank swallow, rufous-sided towhee, song sparrow, American goldfinch, Cooper’s hawk, American kestrel, black-billed magpie, northern rough-winged swallow, bank swallow, MacGillivray’s warbler, and Brewer’s blackbird. These habitats also provide important habitat for big game species, predators, and small mammals including deer mice, voles, shrews, and squirrels.

Bottomland grass habitats provide limited habitat for wildlife. However, it does provide foraging habitat for some species, including sage grouse, turkey vulture, horned lark, American robin, song sparrow, vesper sparrow, and western meadowlark. Elk and deer also use this type for foraging through out the year.

Habitats within the general project area are same as the above except for burned and reclaimed habitats. These habitats are similar and provide habitat for similar species. Typical species include mourning dove, American kestrel, red-tailed hawk, mountain bluebird, vesper sparrow, song sparrow, Brewer's blackbird, golden eagle, western kingbird, horned lark, and house wren.

2.04.11(4) Threatened and Endangered Wildlife Species

Please see Volume 1, Section 2.04.11 for a discussion on threatened and endangered wildlife species within the permit area.

2.04.11 (5) Threatened and Endangered Plant Species

Please see Volume 1, Section 2.04.11 for a discussion on threatened and endangered plant species within the permit area.

2.04.12 Prime Farmland Investigation

The presence of potential prime or important farmlands within the disturbed areas associated with the South Taylor mine areas was determined based on a reconnaissance inspection. Results of the investigation indicate that all of the area potentially disturbed by surface operations or facilities associated with these areas can be excluded as prime or important farmland, since the land has not historically been used as cropland. Colowyo requested a prime farmland determination for the permit revision area from the U.S Department of Agriculture – Natural Resources Conservation Service (NRCS) in 2002. The NRCS responded to the request in a letter dated October 9, 2002 which indicated that no areas of prime farmland are present in the expansion area. A copy of the letter is presented in Exhibit 9, Item 4 of the existing permit document. Based also on soil survey information, no soil surveys encountered within the disturbed area associated with the areas of impact of the permit revision area have been designated as soil map units classified as prime or important farmland. Based upon the information presented in this section, Colowyo recommends a negative determination for prime farmland within the permit boundary.

2.04.13 Annual Reclamation Report

Please see Section 2.04.13 in Volume 1.

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 South Taylor pit 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 operation plan is described in detail within Volume 1, Section 2.05.3.

Topsoil removal schedules and stockpile locations are delineated on the Topsoil Handling Map, (Map 28). The amounts of topsoil to be replaced is found in Volume 1 on Table 2.05-1. Topsoil will be removed from an area primarily during the summer and fall months to allow for one year of mining advance. A buffer zone, with topsoil removed, will be left between the undisturbed area and the crest of the pit.

Once the overburden is sufficiently fragmented to allow for efficient removal and loading, overburden removal will commence. The location of the area to be mined is shown on the Mine Plan Map (Map 23).

Colowyo will utilize two distinct methods of overburden removal in the mining operation of South Taylor: (1) truck/shovel techniques and (2) dragline technique. By combining the use of both shovel and trucks, and draglines, Colowyo can both efficiently and economically handle the logistics involved in a multiseam, open pit coal mine.

The truck/shovel operation will be used to open up the initial boxcut, and then will be generally utilized in removing overburden over the upper coal seams. In some areas of the pit the truck/ shovel will be utilized by taking all seams from the "X3" to the "G8" (X3, X4, B0, B1, B2, B3, C5, D1, D2, E2, F1, F6, F7, FA, FB, G7 and G8). In the dragline portions of the pit the dragline will generally uncover the "F6" through the "G8" (F6, F7, FA, FB, G7 and G8). From time to time, based on production requirements, truck/shovel or loader/truck methods may be utilized to assist the dragline operation in the lower seams.

The overburden material is removed in a series of lifts or benches; the height of these benches will be influenced by the distance between the coal seams to be mined (see Map 24B, Mining Range Diagrams), and the equipment mining those benches.

Overburden removal by the, truck/shovel method progresses on approximately 170-240 foot wide benches and has a maximum highwall height of about 60 feet. Electric shovels or front-end loaders load this overburden into 50, 170, 190 or 240-ton trucks. The trucks then haul the overburden around the active coal pit and dump this material into the mined-out or stock pile areas. The truck/shovel operation will always precede the dragline operation in the multiple seam pits.

A dragline will be used for overburden removal over the lower coal seams and the generalized multi-seam dragline sequence at the Colowyo operation is as follows:

The dragline will begin the sequence by removing the overburden over the "F6" through the "FA" seams in a single sidecast mode, spoiling the overburden into the previously mined-out pit. The "FB" through the "G8" is removed from the spoil side of the pit. The spoil from the benching operation will be placed to allow the draglines sufficient room and adequate reach to remove overburden while operating on the spoil side. The draglines construct temporary ramps in order to walk to the spoil side.

The "F6" overburden is first drilled and blasted, removed by the draglines, "F6" coal is removed behind the advance of the draglines, then the drilling is initiated on the overburden of the "F7" seam. This sequence is typical through the "G8" seam. With the dragline only mining through the F6 and below spoil, it will ensure that any suspect level spoil, based upon the suitability criteria, will stay in the bottom of the pit and will buried by a minimum of 50 foot of suitable Truck Shovel material.

Upon complete removal of the overburden over the "G8" seam, the draglines walk around the end of the pit to the next cut to begin removal of the overburden over "F6" coal seam.

No Special Handling Procedures will be required for the overburden in the South Taylor pit. The current overburden sampling program that will be used for the East Pit, West Pit, Section 16 Pit and the South Taylor Pit is described within Volume 1, Section 2.05. It was discussed between the Division of Reclamation, Mining and Safety (DRMS) and Colowyo that suspect levels of the Sodium Adsorption Ratio (SAR), Selenium (Se), Boron (B), Saturation % (Sat), and Molybdenum (Mo) need to be addressed in more detail to determine that Special Handling Procedures, that are outside the normal pit operational procedures, will not be needed in the South Taylor pit area. For this purpose, Colowyo will only use the material that is removed and stockpiled by the Truck/Shovel operation to cap the regraded areas. It was also noted through review of Exhibit 6, Item 6, that in the region of the initial boxcut area, no unsuitable material was found in the seam sequence from the F6 coal seam to the G8 coal seam that will be removed by the Truck/Shovel operation. The entire seam sequence from the top overburden through to the bottom G8 seam, which resides in the area of the initial boxcut, will be placed in the valley fill locations; this will allow Colowyo enough spoil room to reach the desired mining depth.

In the following analysis, Colowyo has demonstrated that no Truck/Shovel spoil material will exceed the suitability range for overburden criteria as described in Volume 1, section 2.05. This demonstration will be completed by showing the total percentage of unsuitable material in comparison to the total amount of suitable material in the truck/shovel sequence as it relates to the drill hole data shown in Exhibit 6, Item 6. It was discussed with DRMS, that as long as the total percentage does not exceed 15% of the total truck shovel sequence for each drill hole, spoil suitability will not be an issue based upon the overburden seams.

Drill Hole 83-D3-06

Unsuitability range in feet of Truck Shovel Sequence:

SAR > 15 = **N/A**
Se > 0.3 = **6.7 feet**
B > 5.0 = **N/A**
Sat <25 or >80 = **28.5 feet**
Mo > 1.0 = **7.8 feet**

Total Depth from surface to Bottom of Truck Shovel Sequence (F6) = **184.7 feet**

Total Percentage of each criteria for Truck Shovel Sequence:

SAR = **N/A**
Se = **6.7 feet/184.7 feet = 3%**
B = **N/A**

Sat = **28.5 feet/184.7 feet = 15%**
Mo = **7.8 feet/184.7 feet = 4%**

Suitability analysis for Drill Hole 83-D3-06 shows all criteria within the suitable range.

Drill Hole 83-D3-07

Unsuitability range in feet of Truck Shovel Sequence:

SAR > 15 = **7.6 feet**
Se > 0.3 = **5.0 feet**
B > 5.0 = **N/A**
Sat <25 or >80 = **8.4 feet**
Mo > 1.0 = **15.8 feet**

Total Depth from surface to Bottom of Truck Shovel Sequence (F6) = **295.1 feet**

Total Percentage of each criteria for Truck Shovel Sequence:

SAR = **7.6 feet/295.1 = 3%**
Se = **5.0 feet/295.1 feet = 2%**
B = **N/A**
Sat = **8.4 feet/295.1 feet = 3%**
Mo = **15.8 feet/295.1 feet = 5%**

Suitability analysis for Drill Hole 83-D3-07 shows all criteria within the suitable range.

Drill Hole 83-D3-10

Unsuitability range in feet of Truck Shovel Sequence:

SAR > 15 = **2.7 feet**
Se > 0.3 = **N/A**
B > 5.0 = **N/A**
Sat <25 or >80 = **40.4 feet**
Mo > 1.0 = **12.9 feet**

Total Depth from surface to Bottom of Truck Shovel Sequence (F6) = **291.2 feet**

Total Percentage of each criteria for Truck Shovel Sequence:

SAR = **2.7 feet/291.2 feet = 1%**
Se = **N/A**
B = **N/A**
Sat = **40.4 feet/291.2 feet = 14%**
Mo = **12.9 feet/291.2 feet = 4%**

Suitability analysis for Drill Hole 83-D3-10 shows all criteria within the suitable range.

Drill Hole 83-D3-12

Unsuitability range in feet of Truck Shovel Sequence:

SAR > 15 = **47.9 feet**
Se > 0.3 = **0.3 feet**
B > 5.0 = **N/A**
Sat <25 or >80 = **N/A**
Mo > 1.0 = **22.7 feet**

Total Depth from surface to Bottom of Truck Shovel Sequence (F6) = **326.8 feet**

Total Percentage of each criteria for Truck Shovel Sequence:

SAR = **47.9 feet/326.8 feet = 15%**
Se = **0.3 feet/326.8 feet = 0%**
B = **N/A**
Sat = **N/A**
Mo = **22.7 feet/326.8 feet = 7%**

Suitability analysis for Drill Hole 83-D3-12 shows all criteria within the suitable range.

Drill Hole 83-D3-14

Unsuitability range in feet of Truck Shovel Sequence:
SAR > 15 = **N/A**
Se > 0.3 = **N/A**
B > 5.0 = **22.5 feet**
Sat <25 or >80 = **N/A**
Mo > 1.0 = **6.0 feet**
Total Depth from surface to Bottom of Truck Shovel Sequence (F6) = **212.0 feet**

Total Percentage of each criteria for Truck Shovel Sequence:
SAR = **N/A**
Se = **N/A**
B = **22.5 feet/212.0 feet = 11%**
Sat = **N/A**
Mo = **6.0 feet/212.0 feet = 3%**

Suitability analysis for Drill Hole 83-D3-14 shows all criteria within the suitable range.

After removal of the overburden, the coal seams are exposed. As the coal seams are exposed, they are cleaned using auxiliary equipment, then either drilled and shot with explosives or ripped to prepare the coal for loading and removal.

When explosives are needed, the drilling is performed by an auger drill. The drill hole pattern is generally spaced approximately 12 feet by 12 feet, but is dependent upon the actual coal seam thickness. Drill holes are loaded with either ANFO or a waterproof explosive, if the holes are wet.

Once the coal has been prepared for loading by blasting or ripping, a rubber-tired front-end loader loads the coal into haulage trucks. Following loading, these haulage trucks transport the coal along in pit haulage routes to the primary crusher located just outside of the mining area as shown on the Existing Structures - South Map (Map 22).

In order to visualize the overall mine plan, a range diagram was drawn. This diagram is found as Mining Range Diagram (Map 24B) and depicts operations by draglines in combination with shovels and trucks.

Coal from the mining area is transported to a coal crushing facility as shown on the Existing Structures - South Map (Map 22). Details of the coal crushing and load-out facilities are included in Volume 1, Section 2.05.3 under the heading of Mine Facilities.

After coal recovery by conventional truck/shovel and dragline methods has reached the maximum economical recovery limit, Colowyo has the potential of using a highwall miner when the conditions allow. The highwall miner can recover additional reserves left in the pit face that were deemed non-recoverable by conventional surface mining methods. This new highwall miner technology can recover coal up to 1600 feet in advance of the final pit walls with an approximate coal recovery ratio of 40% to

60%. Once the coal has been recovered and stockpiled in the pit, then the coal will be transported to the primary crusher and train loadout by coal haul trucks. Refer to Map 23 for the location of potential highwall mining areas.

As soon as possible after the coal is removed from the mining area and sufficient room is available for back-filling, reclamation begins. In general, rough backfilling is completed by the over-burden trucks and bulldozers. As stated earlier, overburden material removed ahead of the operation is transported by truck around the active coal mining areas and deposited into the mined-out and stockpile areas. A dragline may also be utilized on the backfill material to assist in final spoil placement and in achievement of the planned final topography.   Final grading for topsoil placement will be done in a manner that reduces erosion and provides a surface for topsoil that minimizes slippage. Prior to completion of topsoil replacement on 3:1 (horizontal to vertical) slopes, a dozer will construct a drainage control bench or furrow, where necessary, to slow water flow on the longer slopes and minimize erosion. The design Calculations for the benches and furrows are found in Exhibit 7, Hydrology Information. At the completion of the final grading, topsoil will be redistributed over the regraded spoil and revegetated in accordance with Volume 1, Section 2.05.4.

Other surface treatments are also described in Volume 1, section 2.05.4. A list of the equipment used by Colowyo in order to perform the day-to-day operation of coal mining is shown in Volume 1, Table 2.05-3.

**2.05.3 (2)	Operation Description**

A detailed narrative description of the land to be affected within the South Taylor area is provided above under the heading Production Methods and Equipment. The mining plan for South Taylor is graphically portrayed on the Mine Plan Map (Map 23). The various acreages to be affected by the planned mine operation are shown in Volume 1, Section 2.03 on Table 1, Affected Areas for Mining and Reclamation. The details of these operations for South Taylor are shown on the Mining Range Diagram (Map 24B).

The lines on Map 23 refer to coal seam mining, the lines on Map 28, Topsoil Handling, refer to the anticipated overall disturbance that not only includes coal mining, but also associated perimeter disturbances as well.

**2.05.3 (3)	Mine Facilities**

The existing buildings, structures, utility corridors and other facilities are shown on the Existing Structures - North Map (Map 21), Existing Structures - South Area (Map 22) and Existing Structures – South Taylor Area (Map 22A). Colowyo only anticipates the need for a minimal amount of major structures within the South Taylor area, which will include the installation of utility lines, water lines and in-pit haulage routes. No out of pit haul roads are anticipated. All other support facilities are located on maps 21 and 22, which will continue to be used for the life of mine.

Please refer to Volume 1, Section 2.05 for a complete description of Operational procedures within the permit boundary including the South Taylor area.

Power Lines

Because Colowyo utilizes many electric-powered mining machines, a network of electric power lines is located in the permit area to supply electricity to the equipment. The locations of the Colowyo power lines are shown on the Existing Structures maps (Map 22A and Map 22B).

Electrical power lines located in the permit area will be constructed in accordance with requirement of Section 4.18 to minimize potential electrical hazards to large raptors.

The major pieces of equipment that are powered by electricity and will be used in the South Taylor area are draglines, shovels and the highwall miner. Therefore, during the life of the mine it is necessary to periodically move the existing power line loop to accommodate the advancement of the pit.

Along the both end walls and both highwalls of the South Taylor pit operations, highwall mining activities will be conducted to extract coal that would otherwise be deem non-recoverable under existing operational procedures and economic conditions. See Map 23 for the location of the area to be mined.

Haul and Access Roads

All truck routes within the South Taylor area and connecting the South Taylor area to the existing operation will be constructed as in-pit truck routes, due to their location within existing pit limits. Therefore, all truck routes constructed during the permit term within the immediate mining area are exempt from any construction specifications, since roadways within the immediate mining pit area are not designed in accordance with Rule 4.03.1(1)(d)(i).

In order to access the Section 28 Sediment Pond during construction and to access this area for routine monitoring and maintenance operations, the existing two-track Sturgeon Road will be upgraded. See Section 4.03 for construction requirements and Map 25B for road design information.

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. The designs for these features are presented in Exhibit 7, Item 20. 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.

2.05.3 (5) Topsoil

Prior to any mining related disturbances, topsoil will be removed from the site to be disturbed as discussed in Volume 1, Section 2.05 and Section 4.06 and redistributed or stockpiled as necessary to satisfy the needs of the reclamation timetable.

Topsoil will be removed in the permit area by large crawler mounted bulldozers, loaders or scrapers as described in Volume 1, Section 2.05.3.

The sequence and timetable for all topsoil redistribution and revegetation activities is found on the Topsoil Handling Map (Map 28). The overall life-of-mine topsoil balance is estimated in Volume 1, Table 2.05-1.

All yardage and acreage figures have been calculated based upon the assumption that topsoil would be removed in advance of mining activities as shown on Topsoil Handling Map (Map 28).

Mine development into the South Taylor area required an initial boxcut, resulting in additional stockpiling of topsoil. The stockpiling of topsoil will continue until all pit development has progressed to its maximum extent. After mining and regrading operations have ceased, all stockpiled topsoil will be used to reclaim the pit disturbance.

Topsoil will be stored in topsoil stockpiles as shown on Map 28A. Construction specifications for these stockpiles will follow all prudent regulations within this section (2.05.3(5)) and as follows. Stockpiles will be constructed with stable slopes and will be located to avoid erosion from wind and water and additional compaction or contamination. As can be determined from the Topsoil Handling Map (Map 28), all stockpiles are located within stable areas. The piles will be protected from wind erosion by planting a perennial mixture as explained in Section 4.06.3 as soon as conditions allow. Proper seasons of planting will be early spring or late fall. In addition to the planted material, a considerable amount of volunteer growth can be expected to grow on all stockpiled topsoil.

External erosion will be controlled through proper location of the stockpiles. No topsoil stockpiles will be placed in a drainage bottom where external erosion might pose a potential threat.

Unnecessary compaction will be avoided by keeping all but essential traffic off the stockpiled areas. Topsoil signs will identify topsoil stockpiles. Contamination of the stockpiles will be eliminated by the careful selection of sites that are distant from the areas where actual mining activities are occurring. Drainage ways and areas near spoiling and blasting will be avoided where possible.

2.05.3 (6) Overburden

The complete description of the removal, handling and storage of all overburden material within the permit area is described under the Production, Methods and Equipment Section found at the beginning of Section 2.05.3. The spoil handling procedures and spoil monitoring plan parameters for the operation can be found on Section 2.05.3 of Volume 1. The mining sequence for the planned operation is shown on the Mine Plan Map (Map 23). Cross sections showing the mining operation during the "steady-state" operation are found on the Mining Range Diagram (Map 24B). For the spoil disposal locations and volumes for both the East and West Taylor valley fills and the temporary overburden stockpile, please refer to Map 45. Permanent Valley fill construction and design criteria is described in detail in Section 4.09.

A temporary overburden stockpile will be built above the East Taylor valley fill. The spoil suitability and special handling procedures are described in detail in section 2.05.3(1). The initial development of the stockpile began in 2008 and completed in 2013. The temporary overburden stockpilewas constructed in 50 foot lifts by use of trucks, dozers and loaders. The side slope of the temporary overburden stockpile are generally at a1.3H:1Vslope and will be maintained during active times of operation. Maintenance techniques consist of blading of roads and ramps, along with the use of dust control during active times of operation. Sediment control will be implemented to ensure adequate containment of potential runoff throughout the life of the operation. Following the completion of mining, this temporary overburden stockpile will be removed and placed back into the open pit.

Blasting

All blasting within the South Taylor area will be conducted in accordance with the blasting parameter described in Volume 1, Section 2.05.

Colowyo will keep a record of each individual blast by utilizing report formats shown in Volume 1, Figure 2 - Blasting Report (coal and overburden), and Volume 1, Figure 3 – Colowyo Chargeweight Sheet (overburden only).

Pre-Blasting Survey

In accordance with Rule 4.08.2, written notification was provided to all residents and/or owner of dwellings or other structures that are located within one-half mile of the permit amendment area. Copies of the letters are included Exhibit 14, Item 6. These residents/ owners include:

Colorado Department of Transportation
Highway 13
Region 3, Section 6
270 Ranney Street
Craig, Colorado 81625

Stevens Residences
6647 & 7072 MCR 51
Meeker, Colorado 81641

White River Electric Association
P.O. Box 958
Meeker, Colorado 81641

Tri-State Generation and Transmission Association, Inc.
1100 West 116th Avenue
Westminster, Colorado 80234

Wold Oil Properties, Inc.
139 West 2nd Street, Suite 200
Casper, Wyoming 82601

Qwest
12680 Weld County Road 58
Greeley, Colorado 80648

Texaco, Inc.
7265 South County Road 9
Craig, Colorado 81625

Pre-blasting surveys and assessments of surface structures have been conducted for eleven power pole foundations and the two residential structures located at 6647 and 7072 MCR 51. Copies of the summary reports are included as Exhibit 14, Items 4 & 5 and are summarized in Section 4.08.2 of this document.

Public Notice of Blasting Schedule

Colowyo will annually publish a blasting schedule similar to the one set forth in Volume 1, Section 2.05 Figure 1.

Disposal of Excess Spoil

Colowyo constructed two separate “valley fills” which are called the East Taylor Fill and the West Taylor Fill. These fills were necessary due to the early operation of the South Taylor mining area; overburden needed to be placed into the fills so that sufficient working area could be developed prior to the placement of subsequent overburden into the mined-out areas.

Detailed geotechnical investigations were completed for both the East Taylor Fill and the West Taylor Fill. A report of the investigations can be found in Exhibit 21 Item 1. Construction plans for the fills, addressing the requirements of Rule 4.09, Disposal of Excess Spoil, can also be found in Section 4.09 and Exhibit 21. Locations of the East Taylor Fill and West Taylor Fill can be found in Exhibit 21 and on Map 23.

2.05.4 (1) Reclamation Plan

The reclamation objective for the South Taylor area is to restore the mined area to a land use capability which will, be equal to or better than that which currently exists. The first objectives of all reclamation practices are to stabilize the soils, maintain hydrologic and vegetation resources, and to restore the approximate original contour of the mined area. Ultimately, the areas being mined will be returned to their approximate original use as rangeland with watersheds having their approximate pre-mining character. In general, the long term appearance and usefulness of the mine plan area will be similar to that which would have been encountered prior to any mining.

The reclamation plan for the existing mining areas provides information relevant to the reclamation of the South Taylor mining area, which can be found in Volume 1, Section 2.05.4. Specific topics requested by the regulations and not incorporated into Volume 1 are included in the following subsections.

2.05.4 (2)(a) Reclamation Timetable

The sequence for reclamation following the mining process is shown on Map 29. Final reclamation of the South Taylor pit will be delayed, due to the shape, size and depth of the pit; which will result in leaving the majority of the spoil backfilling process until final pit closure. The majority of the spoil will be stacked in the initial boxcut area and associated valley fill areas, allowing adequate space to perform mining operations in a geotechnically safe environment. Although the final reclamation of the South Taylor will be delayed due to the mining operations in the pit, Colowyo is committed to reclamation in accordance with Rule 4.13 and will perform reclamation activities as contemporaneously as practicable with the South Taylor mining operations. With the limitation of areas available for reclamation prior to final pit backfill, Colowyo will reclaim as many areas as allowed by the mine plan as shown on Map 29, prior to final pit closure. The South Taylor pit reached a steady state operation in 2013; where as all spoil material produced in the advancing cut is backfilled into the previously mined areas. In general, it is anticipated that the vast majority of reclamation activities in the South Taylor pit area will begin in the lower elevation areas and progress upslope to the highest elevation areas. This is a matter of practical necessity due to the operational constraints encountered in the area which were also reflected in the hydrological modeling found in Exhibit 7, Item 20. Major departures from this premise will result in the need to revisit the adequacy of the sediment control structures designed and submitted as part of this permit.

2.05.4 (2)(b) Reclamation Costs

The estimate of the cost of reclamation of the operations required to be covered by the performance bond is found under Rule 3.

2.05.4 (2)(c) Backfilling Plan

As the mining progresses to the west, overburden material from each successive cut will be backfilled into the previously mined out area and the additional spoil will continue to buildup in previously mined areas. This cycle will be repeated for the entire mining area. Due to shape, size and depth of the South

Taylor pit results in leaving the majority of the spoil backfilling process until final pit closure. As a result, Colowyo has been granted a variance for a delay in contemporaneous reclamation based on Rule 4.14.1(1)(d) which states that "Rough backfilling and grading shall be completed within 180 days following coal removal and shall not be more than four spoil ridges behind the pit being worked..". The mining techniques utilizing dragline and truck/shovel operation are shown in detail on Mining Range Diagram (Map 24B), and show the approximate distance between topsoil removal and replacement. Premining topography is presented on Map 18A and the postmining topography is shown on Map 19. Map 20B provides cross-sections of the premining and postmining topography. Map 28 presents the topsoil handling movements and the timing of stripping activities. Map 29 shows the spoil grading sequence timing of reclamation activities.

The backfilled mining areas will be graded to establish a stable post mine topography that blends into the undisturbed areas outside the mining limits (Map 19). Colowyo will grade all final slopes so that overall grades do not exceed 33% (Map 20B). Additional information on the backfilling and regrading plan are discussed further in Volume 1, Section 2.05.4 and Section 4.14.

2.05.4 (2)(d) Topsoil Salvage and Replacement

Prior to any mining-related disturbances, all available topsoil will be removed from the site to be disturbed as discussed in Section 2.05.3, and will be redistributed or stockpiled as necessary to satisfy the needs of the reclamation timetable.

Final grading before topsoil placement will be conducted in a manner that minimizes erosion and provides a surface for the topsoil that minimizes slippage. If spoil compaction is a problem, the spoil will be ripped with a dozer to minimize compaction, assure stability and minimize slippage after topsoil replacement.

Topsoil will normally be reapplied by hauling in trucks or scrapers, from topsoil stockpiles or from areas where topsoil has been removed for mining advance, to the regraded spoil areas and then redistributed with scrapers and/or dozers. Topsoil replacement depths for the South Taylor area are discussed in Volume 1, Section 2.05.4.

Reapplied topsoil will be left in a rough condition to control wind and water erosion prior to seeding. Seedbed preparation, other surface manipulation practices, and seeding will be completed primarily during the fall months. Contour furrows, approximately 4-12 inches deep at the deepest point and 20-36 inches wide, which have been used on slope areas very successfully during the past years, will be used on as needed to reduce erosion potential, conserve moisture, and maintain site stability until vegetation is sufficiently established. The size of the furrows may be increased if necessary to control erosion, and the distance between the furrows will vary, depending on each application. Small rock check dams may also be used where appropriate to aid in control of erosion both prior to seeding and if necessary, after an area has been seeded.

2.05.4 (2) (e) Reclamation Revegetation

Revegetation techniques described in Volume 1, Section 2.05.4 will be employed at the South Taylor mining area.

2.05.4(f-h) Disposal, Mine Openings, Water and Air Control

These topics are discussed in Volume 1, Section 2.05.6. There will be no substantive changes to the approaches already employed for these topics.

2.05.5 Post-Mining Land Uses

The reclamation plan described in Section 2.05.4 will be implemented to restore the disturbed areas associated with the South Taylor mining areas to the pre-mining use of rangeland. The land use of rangeland for these areas is identical to the pre-mining use. Specifically, Colowyo will reclaim the mined areas to a rangeland condition capable of supporting both domestic livestock and wildlife. Other information relevant to this section can be found in Volume 1, Section 2.05.5.

2.05.6 Mitigation of Impacts of Mining Operations

2.05.6 (1) Air Pollution Control Plan

Air quality will be protected in accordance with the procedures outlined in Volume 1 and Exhibit 15 in Volume 5B.

2.05.6 (2) Fish and Wildlife Plan

Procedures specified in the Volume 1, Section 2.05.6 will be followed by Colowyo to ensure minimal impacts to fish and wildlife in the South Taylor mining areas. At the conclusion of the mining activities, disturbed lands will be restored in accordance with the reclamation plan.

2.05.6 (3)(a) Protection of the Hydrologic Balance

Surface Water

Surface water will be protected in the mining areas as described in Section 2.05.3(4) . Protection includes the use of diversion ditches to route surface water around the mining impact areas and sediment ponds downstream of the mining impact areas.

Current surface water rights will not be impacted by mining operations at South Taylor. There is no expected long-term measurable impact to the quantity of surface water in Wilson, Taylor, or Good Spring creeks or any of their tributaries. Surface water amounts that will be used in mining operations will be within the water rights owned by Colowyo.

Surface water quality of the three creeks is calculated to only be marginally impacted by mining activities. This marginal impact, described in the Probable Hydrologic Consequences section (Section 2.05.6 (3)(b)(iii)), will be due to meteoric water being captured in and evaporated from the mine pit during operations, and meteoric water contacting an increased surface area of soil in the vadose zone and thereby theoretically increasing the mass of dissolved solids entering the groundwater. These dissolved solids in groundwater will eventually enter the surface water system, with a theoretical increase in dissolved solids in the surface water. This increase is calculated to be small enough to have no impact on the current or projected surface water uses in Wilson, Taylor, or Good Spring creek drainages.

Groundwater

Groundwater in the vicinity of the South Taylor mining areas is restricted to perched aquifers of limited extent within bedrock of the Williams Fork Formation, the Trout Creek aquifer (a bedrock aquifer of regional extent), and valley fill deposits as described in Section 2.04.7. The Williams Fork Formation aquifers have no beneficial use owing to their limited extent and minimal production. The Trout Creek Sandstone is a sandstone unit underlying most of the permit area and extending across much of northwestern Colorado. It contains water of useable quantity and quality as demonstrated by beneficial wells near the permit area. The Trout Creek Sandstone is beneath the mining impact areas and is separated from these impacts by clay and claystone layers within the Williams Fork Formation (see Section 2.04.5 and 2.04.6). A borehole intersecting the Trout Creek (84-B-TC - NW¼, NE¼, Sec. 19, T3N, R93W) was adjacent to the South Taylor mining area. The Trout Creek formation was dry at this location, since the sandstone in this area outcrops to the west and is above any recharge source. With the dip of the strata to the north and east, the Trout Creek Sandstone, and overlying strata, do not become saturated until (1) the strata dips below the valley floor and (2) the elevation of the appropriate strata equals the elevation of surface water in Wilson and Good Spring Creek. Based on this information, mining is anticipated to have no impact on the Trout Creek aquifer. Groundwater in the shallow valley fill of Good Spring Creek is calculated to be marginally impacted by surface mining activities at South Taylor as described in the Probable Hydrologic Consequences. There are no registered beneficial-use wells in the Colorado Division of Water Resources well database within several miles, down gradient of the mining impact areas (Map 11B).

2.05.6 (3)(b)(i & ii) Hydrologic Controls

Surface water and groundwater drainage from the mining areas will be controlled as described in Section 2.05.3(4) and Section 4.05.Surface water flow will be diverted around the mining operations and into sediment ponds. Stormwater that enters the mining operations and water that occurs on the mining operations will be allowed to evaporate or infiltrate, or will be routed into these surface structures.

2.05.6 (3)(b)(iii) Probable Hydrologic Consequences

Rule 2.05.6(3)(b)(iii) requires determination of probable hydrologic consequences for the mining operations. This rule indicates that these consequences must be defined for both the permit area and adjacent areas, for quantity and quality of surface and ground waters. Baseline conditions must be established, and possible impacts from the activities must be anticipated.

Summary of the Probable Hydrologic Consequences – South Taylor Pit

The anticipated probable hydrologic consequences of mining coal in the South Taylor area are:

Springs near the South Taylor Pit might experience increased and/or decreased flow.
The South Taylor pit will eliminate several seeps and springs.

- Dewatering of the pit is not anticipated.
- Hydraulic transmissivity within the backfilled pit will be higher than the adjacent unmined areas.
- Base flow in Good Spring Creek will be reduced by up to 7% during and for 45 years after mining.
- Total dissolved solids in the base flow of Good Spring Creek will increase by 1.6% to 13.5% for several hundred years after mining has been completed, with sulfate the dominant increasing ion.
- Base flows of Taylor Creek will not be reduced, and peak flow of Taylor Creek will be reduced 2% by the South Taylor pit.
- No other statistically significant changes to surface water quality or quantity are anticipated.

These 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. A total of 8 springs, which maintained flow for the month of July, contribute to base flows in the receiving streams adjacent to South Taylor, and were determined as a critical component of the hydrologic balance. Seeps and springs relevant to this permit revision are shown on Map 10.

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.

Springs that have a potential to be impacted by mining activities include 3-93-17-142, 3-93-17-432 (Taylor Creek), WFS-1 and -1A, WFS-2, WFS-4, WFS-5, and WFS-7 (West Fork Good Spring Creek), and GSCS-1 (Good Spring Creek). Springs that will be eliminated by the South Taylor pit include 3-93-20-212 and 3-93-17-432 (Taylor Creek), 3-93-20-213, and 3-93-20-214 (West Fork Good Spring Creek). The FW source is an artesian well completed in the Trout Creek Sandstone that flows through a cracked wellhead and not a natural water discharge point. Table 2.05.6-1 lists the springs found in the vicinity of the South Taylor mining area. The locations of the investigated springs and seeps are presented on Map 10.

The elevations of the springs were compared to the elevation of the confined groundwater of the Williams Fork Formation in well 84-0-OB. The water level in this well was 7,054 feet above mean sea level in October 1984 (CDM 1985a). Of the base flow springs, GSCS-1, WFS-2, and WFS-2A are below this elevation and may result from confined groundwater recharge from the Williams Fork Formation.

Data collected for the springs contributing to the base flow of the surface water system and that have a potential to be impacted by mining are summarized in Table 2.05.6-2. During peak flow, typically April or May, seven springs contribute a combined approximately 130 gallons per minute (gpm) [equivalent to 0.3 cubic feet per second (cfs)] into the West Fork Good Spring Creek. About 20 gpm (0.04 cfs) is contributed during base flow periods.

Potential Impacts to Bedrock Groundwater Quantity

No impacts are anticipated to the quantity of groundwater in the Williams Fork Formation or the Trout Creek Sandstone of the Iles Formation. Drilling and mining by Colowyo in the area identified very limited perched water, and no saturated conditions, in the Williams Fork Formation. In the Williams Fork Formation, the low permeability and depositional nature of the strata restrict the ability of the bedrock to store and transmit water. There are no continuous non-coal beds in the Danforth Hills. Groundwater movement is mainly controlled by fractures of varying orientation.

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 alluvial and surface waters are accessible. Where wells yield water, the water quality in the Williams Fork Formation is generally good. Very few registered wells for domestic, agricultural, or industrial purposes are completed in the Williams Fork Formation in the vicinity of the South Taylor pit. Drilling by Colowyo and other parties encountered no significant water in the South Taylor pit area in the litholgic sequence which is planned to mined. This is based on the drilling and geophysical logs.

It should be noted that the current East and West Pits at the Colowyo Mine do not intersect any significant aquifers. Perched aquifers have been encountered which drain rapidly. Once drained, they do not produce any significant water to the current pits. Since the South Taylor pit is higher in elevation than the two current pits, and also up dip of the current pits, no significant aquifers should be encountered in this pit.

The Trout Creek Sandstone aquifer is separated from the lowest coal seam (G8) to be mined by approximately 590 feet in the South Taylor 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 165 feet above the Trout Creek Sandstone, a two-foot thick smectite clay layer (known as the Km bed) exists that is found throughout the Danforth Hills area. This layer has low permeability and therefore would be an additional impediment to downward or upward groundwater flow.

To determine the potential for the operations to encounter substantial groundwater and thus to require dewatering, elevations of groundwater and the depth of the pits were compared. The elevation of the potentiometric surface in well 84-0-OB was 7,054 feet above mean sea level (AMSL) in October 1984 (CDM 1985a). This well was completed in the sandstone in the above the I_3 seam of the Williams Fork Formation (as correlated by Colowyo). The lowest projected depth of the South Taylor pit is approximately 7,320 feet AMSL. The Trout Creek Sandstone aquifer has a potentiometric elevation of between 7,050 and 7,100 feet AMSL beneath the South Taylor mining area (CDM, 1985a). This indicates that the pit bottom is above the saturated bedrock.

Since the base of the pit will be above the elevations of the potentiometric surfaces in bedrock and alluvial aquifers, no impacts to the quantity of groundwater available in the Williams Fork Formation or the Trout Creek Sandstone are anticipated.

Pit Inflow and Pit Surface Water Recharge Impacts

The minor springs located on the hill slopes adjacent to the South Taylor Pit (Map 10), which flow four months of the year or less, are the springs likely to experience diminished flow. Springs 3-93-20-212 and 3-93-17-142, -143, -144, and -432 (South Taylor) and 3-93-20-213, -214, and -215 (West Fork Good Spring Creek) are located within the pit boundary and will be eliminated by the pit. Taylor Creek would potentially lose about 20 gpm of its peak flow (0.04 cfs), which is about 2% of its 1.9 cfs peak flow. The West Fork Good Spring Creek would potentially lose about 5 gpm (0.01 cfs) of its peak flow which is 0.5% of its 2.1 cfs peak flow. Since these springs only flow seasonally, neither creek would lose any base flow by the elimination of these springs.

The South Taylor pit is likely to be within the watersheds for these springs: GSCS-1, WFS-1, WFS-2, WFS-4, WFS-5 and 5A, and WFS-7 and 7A, and 3-93-29-234. These springs collectively contribute about 20 gpm to the base flow and about 130 gpm to the peak flow of Good Spring Creek, the majority of this flow originating in the WFS-2 complex. This is equivalent to 0.04 cfs contribution to the base flow and about 0.3 cfs contributed to the peak flow. The WFS-2 spring complex is located in the bottom of the drainage and therefore is likely to obtain most of its water from areas outside of the South Taylor pit area.

If all the contributions from these springs were terminated by South Taylor mining, the West Fork Good Spring Creek would lose 0.04 cfs of its base flow, and about 0.3 cfs of its peak flow. This amounts to a calculated loss of about 5% of the base flow of 0.85 cfs and about 3% of the peak flow of 11 cfs (as measured at NUGSC). However, since much of the recharge is from undisturbed areas outside of the South Taylor pit, the probable reduction is likely to be less than half of this amount and not expected to be measurable or statistically significant. Once the mining has been completed and the pit has been saturated, the contributions to surface water from springs originating from infiltration into the South Taylor pit would return to normal.

South Taylor Pit Hydrology – The South Taylor pit will have a reclaimed surface area of approximately 1004 acres and a pit bottom that inclines predominantly towards the Good Spring Creek drainage (Figure 2.05.6-1). Assuming resaturation would raise a pit aquifer level to 7,500 feet AMSL (the elevation of the lowest point on the southeastern pit boundary) and considering the pit topography, the volume of materials that must be resaturated is calculated to be 6.92×10^8 cubic feet (ft^3). Assuming 20% effective porosity, 1.38×10^8 ft^3 of water (3,178 acre-feet) must infiltrate from the surface and from the Williams Fork Formation to fill the pit to this level.

Prior to flow from a pit, resaturation of the materials in the pit must occur. The time necessary for the resaturation of the backfilled pit can be estimated by utilizing the volume of the pit, the infiltration rate, and the porosity of the materials within the pit. Published infiltration rates for the area are 0.5 inches per year (Rice, 1979) and 3 inches per year (Williams & Clark, 1992), for an average value of 1.8 inches per year. Calculated inflows, in the above equations, indicate an inflow rate 92 gpm (approximately 150 acre-feet/year from 1.8 inches infiltration over 1,000 acres) from infiltration due to precipitation. (No other water is expected to flow into the reclaimed pit materials since the South Taylor Pit is on a topographic and structural high). The volume of water needed to fill the reclaimed pit divided by the infiltration rate equals the time to fill the pit to form an aquifer necessary for sufficient outflow. The result of this calculation is approximately 45 years for pit resaturation to the elevation of the lowest point of the pit boundary where water could be discharged. This assumes no water infiltrates into the undisturbed Williams Fork Formation on the limits of the reclaimed pit, and the entire pit fill becomes saturated. It is possible that the pit fill will be anisotropic and heterogeneous in a way that can allow a pit spring to form prior to complete saturation of the pit fill. It is also possible that most or all of the pit water will enter the Williams Fork Formation (see discussion below) thereby reducing the time to reach saturation or preventing the full thickness from becoming saturated.

Groundwater from the reclaimed South Taylor pit will eventually discharge into Good Spring Creek at the drainage that is above the Sturgeon Flume (the unnamed tributary to West Fork Good Spring Creek in Section 21). This would result in a pit spoil spring and/or discharge through colluvial and shallow bedrock groundwater infiltration. This water would likely have the same characteristics as the water in the Streeter Fill well or the Streeter pond or in similar spoil springs (Williams and Clark, 1994). Analytical data for these sampling points are summarized on Table 2.04.7-31.

If all of the water that infiltrates into the pit discharges into Good Spring Creek, then 150 acre-feet per year or 92 gallons per minute (0.21 cfs) of pit spoil water will enter the Good Spring Creek drainage. This is more flow than originates from the potentially-impacted springs, which have an average annual flow of 77 gpm.

The alluvial aquifer associated with Good Spring Creek has a high transmissivity and is unconfined. Possible impacts to this aquifer would be associated with the infiltration of water from the pit and water quality deviations caused by infiltration of runoff water.

The preferential flowpath of bedrock groundwater from the reclaimed pits would tend to be down-dip through and between the different strata of the Williams Fork Formation. The discharge would be to springs and, thus, some groundwater could eventually recharge the alluvial material of Good Spring Creek.

Transmissivity of the Williams Fork Formation is presented in Section 2.04.7. Measured and published transmissivities of the upper Williams Fork Formation average about 50 square feet per day (ft^2/d). The average hydraulic conductivity of the formation is about 1 foot per day (ft/d). The values utilized to calculate these averages are presented in Table 2.04.7-26 and are from published data (Robson and Stewart, 1990; tables 5 and 6; upper member Williams Fork Formation).

A rectangular infiltration area in the undisturbed pit highwall of 133 feet long by 133 feet high could transmit all of the estimated 92 gpm (approximately 150 acre-feet) of annual recharge from the reclaimed pit. This is calculated as follows:

Annual seepage from the pit =
(133 ft high)(133 ft long)(1 ft/d) = 17,710 ft^3/d = 150 ac-ft/yr.

With approximately 400,000 square feet of buried highwall, all of the meteoric water infiltrating into the reclaimed pit that contacts the pit wall is expected to enter the strata of the Williams Fork Formation. Most of this water is expected to eventually contribute to seeps and springs tributary to Good Spring Creek. This suggests that it is possible that a reclaimed pit aquifer (if it develops) will flow entirely into the undisturbed strata, and that there will be no or limited discharge into the surficial alluvium/colluvium from the reclaimed pit. Whether the pit aquifer discharges into the bedrock of the Williams Fork Formation or into surface colluvium, it will eventually contribute to the alluvial aquifer and springs tributary to Good Spring Creek.

To evaluate the possible effects of infiltration from the pit areas, a velocity calculation for average groundwater flow can be performed. The calculation is based upon the parameters determined for the Williams Fork Formation as discussed above.

Seepage velocity (v_s), the true velocity representing the rate the groundwater flows through the pore spaces can be calculated utilizing the following formula (Fetter 2001):

$$v_s = Kdh/n_e dl$$

where:

- K is the hydraulic conductivity,
- dh is the vertical difference in groundwater elevations between two points, and
- n_e is the effective porosity, and dl is the distance between the two points.

Although the strata between the pit and the creek are discontinuous, the elevation difference between the pit aquifer and Good Spring Creek (500 feet) and the horizontal distance between the edge of the pit and Good Spring Creek (3000 feet) will be used. The gradient would approximate the dip of the lithology in the area. Assuming an effective porosity of 0.15, with an average hydraulic conductivity of 1 ft/d for the Williams Fork Formation, then:

$$v_s = (1\ ft/d)\ (500\ ft)\ /\ (0.15)\ (3{,}000\ ft)$$

$$v_s = 1.11\ ft/d$$

The average groundwater velocity of outflow from the South Taylor pit is calculated to be 1.11 ft/d, with the flow presumed to be predominantly in a southeasterly direction following the dip of the southeast dipping leg of the small anticline (refer to Map 7A). Thus, the first pit outflow through the bedrock strata would take about 2700 days or about 7 years to flow from the pit to the creek.

Potential Surface Water Quantity Impacts

As described above, diminishment of flow into Good Spring Creek appears to be probable during and for a period after mining and reclamation of the South Taylor pit is finished. The reduction can be estimated by assuming no meteoric water infiltrating into the reclaimed pit will reach the creek from a pit aquifer for approximately 45 years after the end of operations (the time to saturate the pit - see above) or that springs located downgradient from the mine will cease flowing during and for a time after mining.

The area of the South Taylor pit is approximately 1,000 acres. Assuming that 1.8 inches of precipitation infiltrates, the pit will receive approximately 150 ac-ft per year, or 92 gpm or 0.21 cfs of recharge from infiltration as shown in the preceding paragraphs. Much of this infiltration may eventually surface at springs, likely in West Fork Good Spring Creek.

The actual resultant spring discharge will likely vary from high flow to low flow periods by an order of magnitude, as measured in the surface water features. Thus, the discharge of groundwater originating as pit infiltration used in the following calculations is assumed to range from 0.06 to 0.6 cfs, which gives a geometric mean of approximately 0.21 cfs (calculated infiltration rate from above).

Assuming that 0.06 cfs enters Good Spring Creek during low flow and 0.6 cfs enters Good Spring Creek during peak flow, the pit contribution would be approximately 7% of the base flow and 5% of the peak flow to Good Spring Creek at the NUGSC measuring point or about 3% of both base and peak flows at the LGSC measuring point. This is a maximum value, since the calculated contribution from the pit spoil aquifer is greater than the average measured flow from the potentially affected springs. Thus, the probable reduction in flow will be up to 7% of base flow for 45 years after mining ceases.

Potential Surface Water Quality Impacts

Potential impacts to the surface water quality from the South Taylor pit operations are considered here. The water quality would be impacted by meteoric water that enters the hydrologic cycle being impacted by contact with the overburden fill. To estimate the impact to surface water quality, existing geochemical and flow data for Good Spring Creek were modified by changing the flow entering from the pit (described above) to have water quality similar to that found in the Streeter Well (completed in backfill in the Streeter Fill) and Streeter Pond discharge. The Streeter Well is located in the Streeter Fill of the existing East Pit, and would appear to represent water quality in direct contact with Colowyo Mine spoils. The Streeter Pond accepts primarily groundwater from the Streeter Fill.

Assumptions used include:

1. All pit groundwater will have chemistry similar to Streeter Pond, Streeter Well, or published pit spoil geochemistry
2. All pit groundwater will eventually enter the Good Spring Creek surface water regime
3. The quantity of water entering Good Spring Creek would match assumptions in the *Potenital Surface Water Quantity Impacts* section.

The South Taylor Pit will likely have geochemical characteristics similar to the water quality in the Streeter Well, the Streeter Pond, and other spoil pit aquifers (Williams and Clark, 1994), since the lithology is relatively homogenous across the area.

The TDS in the Streeter Well is 3,750 milligrams per liter (mg/L), and TDS in pit spoil wells nearby average 3,400 mg/L (Williams and Clark, 1994). TDS concentrations in the Streeter Pond averaged 1,786 mg/L in 2005 and TDS concentrations in aquifers immediately downgradient from nearby pit spoils averaged 1,796 mg/L (Table 2.04.7-31). Wells located a half mile downgradient from pit spoil averaged 900 mg/L (Williams and Clark, 1994).

An estimate of TDS loading from backfilled spoils discharge into Good Spring Creek was developed based on a simple mass balancing based on the projected increased TDS of the water contributing to Good Spring Creek. Calculated impacts of this groundwater into the alluvial and surface water flow regime at Good Spring Creek are shown here.

A calculated spoil pit maximum discharge estimate of 0.06 cfs enters Good Spring Creek during base flow, and 0.6 cfs enters during peak flow. Therefore, a maximum of 7% of the base flow and 5% of the peak flow to Good Spring Creek at the NUGSC sampling point would be contributed from the pit outflow at steady state. (These percentages are approximately twice what the springs above NUGSC actually contribute to the creek flows.)

To project the potential impact to Good Spring Creek, a weighted TDS loading between the historic low flow at NUGSC (0.85 cfs and 1,050 mg/L TDS) (Table 2.04.7-34) and the projected spoils (0.06 cfs and 3,400 mg/L (worst case) and 1,796 mg/L (likely case) TDS; Table 2.04.7-31) was performed.

Worst case (pit spoil aquifer TDS concentrations):
((0.85 cfs x 1050 mg/L) + (0.06 cfs x 3400 mg/L))/0.92 cfs = 1192 mg/L

Reasonable case (groundwater immediately downgradient from pit spoil):
((0.85 cfs x 1050 mg/L) + (0.06 cfs x 1796 mg/L))/0.92 cfs = 1087 mg/L

Thus, the base flow of Upper Good Spring Creek is calculated to have between 37 and 142 mg/L increase in total dissolved solids, or an increase of between 3.5% and 13.5% caused by the projected contribution from the pit springs. The increase in TDS in the base flow at Lower Good Spring Creek (with the base flow of 1.8 cfs and TDS of 1187 mg/l placed into the above calculations) would be between 20 mg/L and 71 mg/L, or between 1.6% and 6% of TDS increase. Peak flow TDS increases would be less than these values.

Based upon analyses performed by Williams and Clark (1994) at the Seneca II Mine, the dominant anion would most likely be sulfate and that the oxidation of the pyrite would be the main source of TDS in the spoil pit water. Oxidation of minor pyrite in the spoil could produce soluble sulfate at the South Taylor pit, which will be the dominant ion causing the increased TDS. The duration of the elevated TDS can be predicted based upon the oxidation of pyrite in the reclaimed spoils pit aquifer.

Saturation indices (SI) were calculated for the average constituent concentrations in well 84-0-OB (Williams Fork Formation well) and the Streeter Well. The SI is used to determine if a mineral will dissolve into or precipitate from solution. A negative SI indicates that the water is undersaturated with respect to the mineral and, if present, the mineral should dissolve. If the SI is positive, the water is supersaturated with respect to the mineral, and the mineral should precipitate from solution. An SI near zero indicates a condition near equilibrium. Table 2.05.6-3 presents the SI for the wells at Colowyo Mine.

The SIs presented in this table are very similar to those determined by Williams and Clark (1994). Calcite and dolomite have positive saturations indices in the sampled wells; therefore, the water is saturated with respect to these minerals and it is not anticipated that an increase in TDS would occur. Sulfate minerals (gypsum and epsomite) have negative SIs; therefore, the water is not saturated with respect to these minerals and increases in TDS would occur if sulfate minerals were present in the spoil.

This is consistent with the increase in sulfate in the Streeter Well (1,960 mg/L) as compared to Good Spring Creek (average of 600 mg/L).

The average pyritic sulfur concentration in the spoils is 0.09 percent in borehole 97-15, the only borehole in South Taylor with every interval analyzed for pyritic sulfur. The pyritic sulfur concentrations in boreholes 83-D3-07, -10, -12, and -14 were measured at only selected intervals biased towards high pyrite; the arithmetic mean of these samples is 0.45% pyritic sulfur. Based upon the exhaustion time for 0.20 percent pyrite of 300 years (Williams and Clark 1994), the time of the elevated TDS discharge would be between 150 and 600 years. The actual duration would be reduced in direct proportion to the amount of “piping” that occurs as a result of channel formation within the spoils. This type of flow is documented at other mines, and has reduced the amount of pyrite oxidized in the spoil. Prediction of the amount of piping that will occur is not possible, but assuming that 25 percent of the spoil pile would be bypassed by piping, then the duration of elevated TDS concentrations would be reduced by 25 percent to 110 to 450 years.

Other Potential Impacts

Flooding and stream flow regime do not appear to have been affected by past mining operations or reclamation, nor are they anticipated to be affected by South Taylor mining. Groundwater availability in the area may potentially be enhanced with the storage of water in the reclaimed pit. Colowyo currently owns all water rights within Taylor Creek and owns over 20% of the appropriated amount (10.83 cfs of the total 51.6 cfs available) of water available in Good Spring Creek. Thus, any potential diminishment of flow 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 in the creek, allowing downstream users full access to their water rights.

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. Likewise the mining operations will not affect any places listed or eligible for listing in the National Register of Historic Places.

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. The Red Wing Mine, a historic underground mine, exists north of the South Taylor pit and is shown on the existing Map 31.

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 South Taylor pit.

2.06.4 Steep Slope Mining

The steep slope mining procedures specified in Rule 2.06.4(2) will not be applicable to the South Taylor Mining Area; however, Colowyo will be requesting a variance from approximate original contour for steep slope mining in accordance with Rule 2.06.5 as outlined in the following section.

2.06.5 Variance from Approximate Original Contour Restoration Requirements

The South Taylor mining area will include non-mountaintop removal steep slope surface coal mining and reclamation operations, where the operation is not to be reclaimed to achieve the approximate original contour as required in Rules 4.14.1-4.14.6 and 4.27.3. Therefore, Colowyo is requesting a variance from approximate original contour in the post-mining topography (PMT). This is due to the fact that steep slopes will not remain steep slopes in the post-mining topography. However, the PMT will reflect the pre-mining topography generally, with drainages and drainage divides remaining in their approximate current locations. Post-mining topography is shown on Map 19. The PMT was designed by Norwest Corporation based on the Divisionrules for Operations on Steep Slopes as discussed in Section 4.27 of this document.

2.06.5 (2) (a) Post-Mining Land Use

Post-mining land use (agricultural/ rangeland) will be enhanced by the PMT since the reduced slopes will allow an increase in forage, will decrease erosion, and will tend to modulate surface-water runoff. Rangeland is the current and only post-mining use of the land. The written request by Colowyo for this variance is included in the cover letter.

2.06.5 (2) (b) Consultation with Planning Agencies

The land to be mined is owned by Colowyo and the Bureau of Land Management. Therefore, consultation from land-use planning agencies is not applicable.

2.06.5 (2) (c) Alternative Postmining Land Uses

Rangeland is the current and only post-mining use of the land.

2.06.5 (2) (d) Watershed Improvements

The reduced slopes of the PMT will decrease erosion and control surface-water runoff; therefore, reducing the total suspended solids and other pollutants discharged to ground and surface waters from the permit area. The total volume of flows from the permit area will not vary in a way that adversely affects the ecology. Approval from environmental agencies is not applicable.

2.06.5 (2) (e) Owner Approval

The owners of the property within the revision area are Colowyo and the Bureau of Land Management. A letter requesting that the variance from Approximate Original Contour for Steep Slope Mining be granted from BLM is included as Figure 2.06.5-1.

2.06.5 (2) (f) Compliance with Limited Variances

The operations will be completed in compliance with the requirements of limited variances as outlined in Section 4.27.4 of this permit document.

2.06.6 Prime Farmlands

Prime farmlands do not exist within the South Taylor 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

Both a field investigation and technical evaluation of the Wilson Creek drainage was conducted in accordance with this Section and draft OSM Technical Guideline, "OSM Alluvial Valley Floor Guidelines", dated June 11, 1980. The investigation resulted in no identification of alluvial valley floors in the area to be mined; however, some of the floodplains of Good Spring Creek, West Fork Good Spring Creek, Wilson Creek, lower Taylor Creek, and lower Jubb Creek may conform to the geomorphic criteria of alluvial valley floor (AVF) surface landforms because they are underlain by unconsolidated material of Quaternary Age (Map 11B). None of these floodplains are located in the area to be mined as shown on Map 23.

The Gossard Loadout is located in an area between Wilson Creek and Taylor Creek near the junction of these two drainages; however, no major subsurface disturbance has occurred in this area that might adversely affect the possible subsurface hydrologic system with regards to potential alluvial valley floors. The actual area to be mined is located well above the flood plain of Wilson, Taylor, and Good Spring Creeks, both topographically and hydrologically. As discussed in Section 2.04.7, the existence of groundwater in the mining 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 alluvium. Very little water is found in the current active mine; and, based on existing geological and hydrological evidence, the areas to be mined provide no or only minor amounts of recharge to local surface water features. Therefore, the flood plains of Wilson Creek, Good Spring Creek, lower Taylor Creek, and their tributaries will not be directly impacted except at road crossings (discussed elsewhere in the application) and should not be adversely affected by mining operations.

Geomorphic Characteristics

The investigation was initiated by mapping unconsolidated deposits in the general area, using published and unpublished geologic maps and ground reconnaissance. These deposits, their associated stream channels and the general topography of the floodplain areas are shown on Map 10. The watersheds of Good Spring Creek, Wilson Creek, and Taylor Creek are also delineated on Map 10. From field reconnaissance, it was determined that many of the mapped floodplains in the general area are extremely narrow, have been severely down-cut (Wilson and Jubb Creeks), and/or contain too much topographic relief in the form of slopes to be considered capable of being irrigated.

Agricultural Activities

Section 2.04.3 contains a description and map of agricultural activities in the permit and adjacent area. The Land Use Map (Map 17) shows that the historic pre-mining land use of the area has been generally undeveloped rangeland. The description under Section 2.04.3 documents crops in the permit area. Historically, there has not been a developed water supply for agricultural activities to expand upon; however, some limited irrigation is conducted in the floodplains of Good Spring Creek and Wilson Creek.

Flood Irrigation – The areas that are currently or were historically flood irrigated are shown on Map 17, *Land Use*. Irrigation diversion points, irrigation canals, and topography are shown on Map 10. A small area of Wilson Creek above the mine permit boundary is irrigated, and some areas near the Gossard Loadout have historically been irrigated. No irrigation has occurred in West Fork Good Spring Creek.

Subirrigation – The channel fill of the floodplains in the canyon areas is generally comprised of unconsolidated deposits in a clay matrix. The clay soil texture will minimize the transmission of water to or from the overlying stream and root zone. Due to the narrow area in the floodplains, the overall slope of the drainage and expected clay soil, the likelihood of a developed subirrigation in the canyon areas is questionable.

The West Fork Good Spring Creek does not meet the criteria of an AVF based on field reconnaissance. It has areas with flat topography and clayey soil where surface water occasionally accumulates after precipitation. This allows the valley bottom to support lush vegetation without subirrigation. Monitoring wells A-7 and A-8 reveal a water table that is at least 10 feet below ground surface. Based on field and monitoring data, the West Fork Good Spring Creek is not an alluvial valley floor.

Wilson Creek west and north of the South Taylor Pit is an area that was formerly described as a potential AVF and was mapped as such by some (OSM, 1985). This area was subjected to a flooding and mass-wasting event that downcut the alluvium 20 to 30 feet below the former surface and left two narrow terraces 20 to 30 feet above Wilson Creek on either side of the creek. These terraces are generally no wider than 100 feet and in many places are much narrower than 100 feet. A monitoring well in this section (well MW-95-03) was installed to the base of the alluvium at the mouth of the unnamed drainage in the expansion area. This well, installed during the summer of 2005, is 57.34 feet deep and encountered angular "clinkers" and no stream-rounded alluvium. The well had 3 feet of water in August 2005, but contained only a few tenths of a foot of water in September and October 2005. This indicates that the alluvium in the terraces is dry and is not sub-irrigated.

The narrow width and fragmented nature of the minimal flat land, depth to groundwater, and impracticality of irrigating or mechanically farming this stretch of Wilson Creek indicates that it does not qualify as an alluvial valley floor. However, mining will in no way adversely affect the ability to irrigate or farm any agriculture or potential agriculture area, including this area.

Water Quality and Quantity

Since 1974, Colowyo and other private and governmental groups (VTN, BLM, and USGS) have collected samples of water flows and water quality. The results of all this work is summarized in section 2.04.7.

Aerial Photograph Analysis

Aerial photographic coverage of the permit area and adjacent area has been complied by the OSM in Denver, Colorado. The photographs are infrared and show the late summer and fall season differences in vegetative growth between upland and valley floor areas. Good Spring Creek appears in the aerial photographs to possibly be an alluvial valley floor.

Effects on Essential Hydrologic Functions

Based on information accumulated, the effects of mining on any alluvial valley floor which exist in the general area would be minimal. Because of the undefined perched existences and limited amounts of bedrock groundwater in the area to be mined, the planned mining will not directly impact any alluvial valley floor. Any water recharge of the nearby drainages and unconsolidated material from the mine would be negligible in comparison with the overall natural flows of the streams recharged in areas above the operation.

The flood plains of Good Spring Creek, portions of Wilson Creek, and lower Taylor Creek may meet the geomorphic criteria and flood irrigation requirements of an alluvial valley floor. Runoff from the mining operations drains into these floodplains. Therefore, Colowyo has taken and will take appropriate measures to protect surface water. This includes designating stream buffer zones and installing sedimentation ponds on the drainages from disturbed areas feeding into surface water features (see Hydrology maps 10A and 11A). The overall role of the floodplains in collecting, storing, regulating and yielding water for agricultural activities has been unchanged and is anticipated to be unaffected by the mining operations.

The possible alluvial valley floors near the mine impact areas will incur no adverse impact due to mining by Colowyo. Surface water pollution will be controlled by sedimentation ponds, sediment control measures, proper mining and reclamation techniques, and frequent monitoring of discharge water quantity and quality. The hydrologic consequences of mining will not result in disruption of the essential hydrologic functions due to the beneficial effects of water treatment and flood control provided by the sedimentation ponds.

Additional Information

The following excerpt taken from an October 8, 1981 letter from Colowyo to the Division expands further on the alluvium/colluvium issue in the Taylor Creek drainage.

> "In the original permit application submittal, Colowyo had described the soils in the Taylor Creek Drainage (Map 10B) as Quaternary Alluvium. The description was derived from a U. S. Department of Agriculture Service Soils Classification Survey at the series level which identified the Taylor Drainage soil as a (stratified alluvium)."
>
> "On the basis of a September 18, 1981 field reconnaissance by Colowyo personnel together with Dave Craig and Brian Munson of the CMLRD staff, it was agreed that the SCS classification of Taylor Creek as an area of stratified alluvium was and is erroneous particularly as geomorphic criteria required to describe an AVF are absent. As a consequence, the designation of the Taylor Creek Drainage as quaternary alluvium on Map 10B, Regional Hydrology has been deleted. This area should be mapped as colluvium.
>
> "Other examination of the area on September 18, 1981 further confirmed a colluvial classification, in that some unsuccessful irrigation in the area is presumed to have occurred, and such irrigation was practiced on the colluvial slopes adjacent to the bottom of the drainage. No irrigation ditches, however, are extant, and it is apparent that no subirrigation occurs in the area.
>
> "Additionally, insufficient water flows in the Taylor drainage to sustain any flood irrigation. Irrigation apparently began from a ditch known as the Mary C. ditch in 1913 on an undetermined acreage, but was certainly less than 25 acres. The state Division of Water Resources records date back to 1960, and they have no record that this ditch has been used since that time. Years ago small isolated areas such as this could be irrigated economically, and were important to 160 acre size homesteads.
>
> "However, in recent years with larger farms and ranches, larger equipment, and increased labor costs, small isolated areas such as this are seldom irrigated. This is especially the case when the water source is from an ephemeral drainage such as Taylor Creek, and

runoff is mostly a function of snow melt and large precipitation events, and varies largely from year to year.

"The revised Map 10B will be submitted when all of the map revisions have been completed. Map 10 will also be revised to show that the area of quaternary alluvium extends to the confluence of Taylor and Wilson Creeks from the north. The labeling of the gauging stations at the confluence of Taylor and Wilson Creeks will also be corrected on the revised Map 10B".

In order to verify the predicted effects of mining activities on groundwater and surface water, Stipulation #1 of the initial Permit required Colowyo to submit a comprehensive water monitoring plan. For further details regarding this plan, refer to Section 4.05.13, Surface and Groundwater Monitoring. Refer to the 1983 - 1989 Annual Reclamation Reports for further details as to the data collected.

2.06.9 Augering and Highwall Mining

In the South Taylor Pit, highwall mining has successfully occurred on the E, D2, G7/G8 seams in the northwestern area of the West Taylor Fill, the low and end walls, and the northeastern extent of the South Taylor box cut. Please see Map 23 for these locations. Currently, Colowyo is will be highwall mining the G7 seam on the end wall and highwall on the southwest and west side of the South Taylor Pit (see Map 23). Once the G7 seam is exposed to the full extent, highwall mining will occur along the length of the seam exposed in the pit. Please refer to Volume 13 Exhibit 23, Item 1 and Addendum 1, and Volume 20, Exhibit 27, Item 7 for geotechnical considerations for highwall mining in the South Taylor Pit.

Please see Volume 1, Rule 2.06-8 for previously highwall mining locations in the East and West Pits.

Please see Volume 1, Rule 2.06-8 for previously and proposed highwall mining locations in the East and West Pits.

2.06.10-2.06.11 Processing Plants, In-Situ Processing

See original permit for these three sections

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, in other sections of this application, in the cover letter or is not applicable to the South Taylor mining area. Colowyo understands the permitting process employed by the Division and will facilitate that process as requested.

RULE 3 – PERFORMANCE BOND

The performance bond calculations for the entire Colowyo mining operation can be found in Exhibit 13B in Volume 20. The cumulative bond schedule for the Collom mining area can be found Exhibit 13C in Volume 20. The Bond Calculation Maps showing the Worst Case Topography and Regraded Topography are included as Map 35A and Map 36A, respectively. Bond Calculation Cross Sections are provided on Map 39.

RULE 4 – PERFORMANCE STANDARDS

4.02 SIGNS AND MARKERS

4.02.1 Specifications

Colowyo has posted and will maintain all signs and markers required by this section. All of the signs are of uniform design and can be easily seen or read. The signs are made either of metal or wood; they are durable enough to withstand extreme climatic conditions that are inherent at the operations. The signs conform to local ordinances and codes.

Colowyo will maintain signs and markers during the conduct of all activities to which they pertain.

4.02.2 Mine and Permit Identification Signs

Please see Section 4.02.2 in Volume 1.

4.02.3 Perimeter Markers

Please see Section 4.02.3 in Volume 1.

4.02.4 Duration of Maintenance

Colowyo will maintain signs and markers throughout the life of the operation or post new signs and markers as necessary.

4.02.5 Stream Buffer Zone Markers

Please see Section 4.02.5 in Volume 1.

4.02.6 Blasting Signs

Please see Section 4.02.6 in Volume 1.

4.02.7 Topsoil Markers

Colowyo clearly marks all stockpile topsoil with signs reading "Topsoil."

4.03 ROADWAYS

The following sections deal with roads defined per Rule 1.04 (111).

4.03.1 Haul Roads

The construction, location, and maintenance of haul road "A" (4 mile roadway from pit area to Gossard Loadout) and haul road "B" (1.4 mile roadway from Highway 13 to haul road "A") is discussed in the existing permit document. These roads will continue to be used as part of the South Taylor mining area. Refer to the existing permit document for details regarding these haul roads.

Roads that will be constructed in the actual mining areas will constantly change as the operation progresses. The “in-pit” roads will be maintained by a motor grader and regularly wetted to minimize dust as required by the air quality permit. Any drainage off the "in-pit" roads will be retained in the pit or diverted to the drainage and sediment control structures located on Map 33B and in Exhibit 7, Hydrology.

Colowyo will maintain the haul roads throughout the life of the mine with repairs including blading, filling of potholes, and replacement of road surface as necessary. Likewise, watering for dust control will be implemented as necessary. Other information relevant to haul roads is provided in the existing permit.

4.03.2 Access Roads

Other than the Sturgeon Access Road, there will be no changes to existing access roads for the South Taylor pit expansion.

The existing two-track Sturgeon Road will be upgraded to allow access for construction and for routine monitoring and maintenance. Map 25B provides the road design information for Sturgeon Access Road.

The Sturgeon 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 road has been built as designed. Following all mining activities, the road will remain in place as a private ranch road and will not be reclaimed. Colowyo as the land owner has provided the Division with a letter documenting this request.

4.03.3 Light-Use Roads

This section is discussed in Volume 1. There will be no changes to this section resulting from the South Taylor pit.

4.04 SUPPORT FACILITIES

Please see Sections 2.05.3 and 4.04 in Volume 1.

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 groundwater quality. This monitoring plan is described in Volume 15, Section 4.05.13 and the monitoring locations are graphically shown on Map 10B. Excess spoil valley fill areas are located up-dip from mining and reclamation areas and periodic monitoring for seeps and springs and periodic monitoring of piezometer wells will detect the formation of spoil springs.

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 Erosion and Sediment Control Structures (Exhibit 7, Item 20) provides for temporary diversion of surface drainages within the permit area. A system of temporary ditches will be used to divert runoff from disturbed areas to sediment ponds. Temporary diversions will be constructed to pass at a minimum the runoff from the precipitation event with a two-year recurrence interval.

The temporary diversions drain watersheds less than one square mile in size and serve to reduce the contribution of suspended solids to runoff. The diversions will be constructed with a minimum gradient to pass the design flow and will be stabilized with grasses or riprap. If not removed by mining, upon completion of mining and at an appropriate point mandated in the Coal Regulations of the Colorado Mined Land Reclamation Board, the temporary diversions will be reclaimed as required in Section 4.05.17.

The only stream channels that will be impacted by the South Taylor pit are headwaters tributary to Taylor Creek and West Fork Good Spring Creek, which are intermittent and drain watersheds less than one square mile. There will be no upstream diversions of these streams since mining will extend to the top of the drainages. The headwaters systems will be restored to historic drainage patterns once temporary diversion ditches are removed; therefore, there will be no permanent diversions of these channels.

4.05.4 Stream Channel Diversions (Relocation of Streams)

No diversions of perennial streams or streams that drain watersheds that are greater than or equal to one square mile in size are planned or provided for at this time. The stream channels of Good Spring and Wilson Creeks will be maintained in their natural positions.

4.05.5 Sediment Control Measures

Sediment control measures to be implemented are shown in Erosion and Sediment Control Structures (Exhibit 7 Item 20). 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 temporary diversion ditches and check dams upslope from the mining activities, serve to divert runoff away from the disturbed areas. Because South Taylor mining activities cover the top of the drainages, no upstream facilities are necessary. Temporary diversion ditches below the disturbed area 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. This captured water and sediment will not leave the mining areas. 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 the Operations and Reclamation Plan described in 2.05.4.

Channel lining rock riprap and energy dissipaters will be used when necessary. As stated above, all temporary diversion structures will be seeded and revegetated. 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 sedimentation ponds are presented in Erosion and Sediment Control Structures (Exhibit 7, Item 20). The design plans and specifications for the sedimentation ponds are described in this section. 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 disturbance boundaries, necessitating down-valley locations. 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.

This application contains calculations used to determine runoff volumes and flow rates for the theoretical 10-year, 25-year, and 100-year, 24-hour precipitation events and 50 percent of the probable maximum precipitation (PMP), as well as subsequent sediment volumes. PMP information is required for State Engineer's Office (SEO) requirements for Class II, small to moderate hazard dams. 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 – South Taylor (Map 5C).

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, which considers the worst-case scenario wherein mine phasing has caused impacts to the entire disturbance area and reclamation has not yet been attained for any areas. Refer to Map 12 for a delineation of the areas used for these modeling purposes as well as the individual maps associated with each SEDCAD run. The dates indicated on Map 12 are for development of the worst-case scenario for hydrologic modeling and are not a definitive schedule for mining and reclamation activities.

It is Colowyo's contention that the models represent nothing more than the best hydrologic estimates for a described worst-case condition. The intent of the modeling is to aid in the design of sedimentation ponds to predict compliance with applicable effluent standards. A primary limitation of the modeling and subsequent designs is the available existing topography, which is very coarse at a 25-ft interval. Colowyo believes it would be an inappropriate use of the SEDCAD models to use them as an enforcement tool for such operations as topsoil stripping; backfilling, grading, reclamation, etc. Furthermore, more detailed topography must be obtained to verify results prior to implementation.

The scenario used for the sedimentation ponds corresponds to an active, disturbed operation. In terms of groundwater, Colowyo's pits have remained essentially dry. Pumping of pit water (precipitation induced surface runoff) into sedimentation ponds is not anticipated. 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 will be used as topsoil or subsoil if it meets the suitability criteria discussed under Section 2.04.9. 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. 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 postmining 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 postmining stock reservoir in the South Taylor 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 annually.

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 will be modified as a result of an updated Reclamation Plan submitted after PR-02 approval. Colowyo existing permit Section 4.06.3 must be modified to reference the updated seed mix in this location at that time.

**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 can be found in Volumes 2D, 2E, or in Exhibit 7, Item 15, in Volume 13

4.05.8 Acid-forming and Toxic-Forming Spoil

Acid forming materials do not exist 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 almost none of the encountered interburden has a net acid-generating potential, and the average acid-neutralizing potential to acid-generating potential ratio ranges from about 50 to about 90 in each borehole in the pit, indicating that there is 50 to 90 times more acid-neutralizing potential than there is acid-generating potential in the interburden (Exhibit 6, Item 6).

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..

4.05.13 Surface and Groundwater Monitoring

The current surface and groundwater monitoring program can be found in Section 4.05.13 in Volume 15.

4.05.14 – 4.05.18 Various Topics

These sections are addressed in the Volume 1.

4.06 TOPSOIL

The topsoil removal, storage, and redistribution plan for the disturbed area associated with the South Taylor mining areas will follow the procedures described in Section 4.06 in Volume 1and as described in Section 2.05.3 (5) and 2.05.4 (2) (d) of this Volume (Volume 12)..

4.07 SEALING OF DRILLED HOLES AND UNDERGROUND OPENINGS

Drill holes and underground openings will be sealed in accordance with the procedures outlined in the Section 4.07 in Volume 1.

4.08 USE OF EXPLOSIVES

Explosives will be used for blasting in accordance with the procedures and specifications presented in Volume 1, Section 4.08.. Map 26A presents distances to various structures of possible concern surrounding the mining area. Only Section 4.08.2 has changed from Volume 1; see Sections 4.08.1 and 4.08.3 through 4.08.6, in Volume 1.

4.08.2 Pre-Blast Survey

In accordance with Rule 4.08.2(1), pre-blast surveys have been offered to owners of all structures within one-half mile of the permit area. Pre-blast surveys were conducted on residential structures located at 6647 and 7072 Moffat County Road 51, various associated groundwater supply wells, and eleven power pole foundations located along the ridge between Wilson and Taylor Creeks. Copies of the surveys are included in Exhibit 14, Item 4.

4.09 DISPOSAL OF EXCESS SPOIL

Spoil removed from the South Taylor pit will be stockpiled as shown on Maps 45 and 20B. Colowyo expects a 20% swell of excavated materials; therefore, part of the material stockpiled in the East and West Taylor Fills will remain at the conclusion of the project as shown on Map 19. Placement will occur as described in previous sections of this volume and in Volume 1.

Design of the two (East Taylor and West Taylor) fills associated with the South Taylor Mine plan are provided in Exhibit 21. The East Taylor Fill will contain approximately 26.6 million yards of temporary out-of-pit spoil and approximately 7.5 million yards of permanent out-of-pit spoil. The West Taylor Fill will contain approximately 10.9 million yards of temporary out-of-pit spoil and approximately 22.6 million yards of permanent out-of-pit spoil. Both fills will be regraded in accordance with the approved post mine topography shown on Map 19. The final configuration of the fills is designed to minimize erosion. This takes into account a number of the components of the other fill piles at the mine, which have proven successful. The final outslope will not exceed 3h:1v.

Fill Name	Temporary Volume	Permanent Volume
East Taylor Fill	26,663,608 Cubic Yards	7,511,137 Cubic Yards
West Taylor Fill	10,993,667 Cubic Yards	22,609,016 Cubic Yards

Designed terrace ditches will be constructed at approximately 100 foot vertical increments. Terrace ditches will be backsloped to direct runoff against the face to prevent flows from overflowing the edge of the ditch. These terrace ditches will direct surface runoff perpendicular to the face into a permanent drainage channel designed to pass safely the runoff from a 100 year, 24 hour precipitation event. Terrace ditches are shown on Map 12 and design information is provided in Exhibit 7, Item 20, Parts A and B.

Reclamation, specifically topsoil replacement, seeding etc. will be implemented consistent with the Section 2.05 of the permit.

<u>CONSTRUCTION PLAN</u>

All available topsoil will be removed and either stockpiled for later use or direct haul replaced to a reclaimed area.

Due to the fact that the valley fill locations are in close proximity to the initial boxcut area means the entire footprint of these fills must be stripped of topsoil. As described in further detail in this submittal under Section 2.05.3(1); "The entire seam sequence from the top overburden through to the bottom G8 seam, which resides in the area of the initial boxcut, will be placed in the valley fill locations; this will allow Colowyo enough spoil room to reach the desired mining depth."

It is anticipated the valley fill drains and associated lateral drains will be constructed as one project during the first two years of operation in the South Taylor operation for practical purposes and as a necessary step in preparation of the area for full scale mining.

Channels constructed along the outside of the valley fills (perimeter relief drains) will be built immediately after the logical completion of each terrace ditch across the faces of the fills, which obviously cannot be completed until such a time as the fills themselves develop and are constructed to meet PMT compliance. This activity will be logically sequential in that they will be developed from the bottom up.

Colowyo will follow the Shannon & Wilson recommendation for excavation as described in Exhibit 21.

A controlled underdrain in accordance with the Shannon & Wilson recommendations will be placed in the natural drainage bottom from the head to the top of the fill, The harder, available sandstones obtained from the mining operation will be selectively handled and placed in at least a 24 foot wide by 8 foot high configuration to serve as the underdrain before covered by spoil material. The natural spoil sorting which will occur by utilizing the thicker lifts recommended by Shannon & Wilson will be sufficient to protect the drain from clogging above the geotextile fabric.

Lift thicknesses up to 100 feet thick is acceptable and will be utilized to construct the fill. This method of spoil placement also enhances the construction of a free draining layer of spoil material at the base of the fill. Experience at Colowyo provides evidence that the natural sorting process which occurs while dumping in higher lifts is sufficient to create this drain. Inspection and documentation of this natural sorting is recommended and will be conducted by Colowyo. See the Inspection Plan section for additional details.

INSPECTION PLAN

During construction of the East Taylor and West Taylor Fills, Colowyo will provide the following information in certified reports as required by Rule 4.09.1(11).

1. Inspections will be conducted at least quarterly during the construction period and during the following specific construction periods.

    a. removal of topsoil and organic material
    b. placement of underdrain system
    c, installation of surface drain system
    d. placement of fill material to insure that the largest rocks are reaching the bottom of the dump face and that the formation of voids that adversely affect mass stability are prevented and
    e. revegetation

The purpose of the inspections is two fold. First, these inspections will document and certify that the construction plan is being followed. Secondly, during the above phases of the construction, a key emphasis of all inspections will be to implement routine contingencies as situations warrant. For example, perhaps a section of underdrain should be reworked, or the spoil dump raised to provide optimum gravity spoil sorting. Inspections and implementation of contingencies during these critical phases of fill construction will be a routine but very important component of fill inspections.

2. Each certified inspection report will be provided to the Division within two weeks after each required inspection. Each report will certify that the fill has been constructed as specified in the minimum design approved by the Division. The reports will include a description of any appearances of instability, structural weakness and other hazardous conditions observed during the inspection.

3. Certified reports addressing the underdrain system will include color photographs taken during and after construction, but before the underdrain is covered with spoil.

After construction, the South Taylor fills will be monitored quarterly for the following items and reports will be submitted quarterly. Monitoring will continue until such time that Division allows relinquish of quarterly monitoring.

1. The groundwater piezometer well will be established in the West Taylor valley fill (please see Map 10B) and will be monitored quarterly for water level and the other parameters consistent with the present Colowyo groundwater monitor plan.

2. On a quarterly basis, a certified report by a registered engineer will be completed taking into consideration any changes and will note any evidence of surficial slope failure or the formation of springs or seeps on the face of the fill.

4.10 – 4.12 DISPOSAL OF EXCESS SPOIL

These sections are addressed in Volume 1.

4.13 CONTEMPORANEOUS RECLAMATION

All reclamation efforts, including backfilling, grading, topsoil replacement and revegetation, of land disturbed by the mining activities in the South Taylor pit shall occur as contemporaneously as practicable with mining operations. Colowyo has formally requested a variance for a delay in contemporaneous reclamation in the South Taylor mining area due to the unachievable requirements listed in Rule 4.14.1(1)(d), which the Division has approved.

4.14 BACKFILLING AND GRADING

4.14.1 General Requirements

The mining operations of Colowyo will not employ the use of contour mining methods.

Colowyo does not have thin or thick overburden as defined in Subsection 4.14.4 or Subsection 4.14.5.

The mining plan, as described in Section 2.05.3, maximizes coal conservation and recovery while minimizing adverse environmental impacts. Because of the multi-seam mining configuration planned by Colowyo, an exemption from the 180 day or four spoil ridge limitations has been formally requested and granted by the Division. The mining plan has been designed as a continuously-moving open pit operation with the mine advancing approximately parallel to the dip of the numerous coal seams. The mining operation is an extension of the existing Section 16 mine operation, and will progress in a southward direction with shovels/trucks/ proceeding along the entire length of the mining area (Map 23). With the numerous benches used in an open pit operation, the mine area will be opened for some time until the equipment comes back to initiate another pass on a designated bench.

As the mining operations remove coal seams, the mining area must be left open until such time as the lower-most coal seam can be recovered. With the mining configuration, the time differences between mining the upper-most seam versus the lower-most seam will be greater than 180 days. As the operation advances, backfilling will be as contemporaneous as practical but not so as to interfere with removal of the lower-most coal seam. Colowyo will rough backfill and grade as shown on the Map 29. All disturbed areas will be returned to the appropriate final contour by grading and backfilling with the use of a dragline, trucks, dozers, and scrapers. Additional detail of the backfilling and grading for the mining operation is set forth in the discussion under Sections 2.05.3 and 2.05.4.

The area to be mined will be restored to a topography approximating pre-mining grades. The slopes of backfilled areas, as necessary, will utilize terraces and/or contour furrows for erosion control and stability. These terraces and contour furrows will be constructed according to the requirements outlined in Section 2.06.2. Where applicable, Colowyo will retain all overburden and spoil on the solid portion of existing benches. The final graded slopes will not exceed the approximate original pre-mining slope grade as shown on the Map 19. Post-mining surface drainage channels will be located to minimize erosion and to minimize slippage.

4.14.2 General Grading Requirements

The final graded slopes at the mining operation will not exceed the approximate original pre-mining slope grade as shown on Map 19. Colowyo will retain all overburden and spoil material on solid portions of existing or new benches. The final highwall at the operation will be eliminated by backfilling overburden into the final pit area.

Small depressions of a holding capacity slightly greater than one cubic yard of water may be used to create a moist micro climate to aid in shrub establishment. See Section 2.05.4, Planting and Seeding Methods for further information regarding these small depressions. Also, several stock watering ponds will be constructed to compliment the post-mining land use. Providing a supply of water is an integral part of the grazing post-mining land use. Colowyo will not be mining on any slopes above 20° as shown on Map 18A.

Final grading before topsoil placement will be conducted in a manner that minimizes erosion and provides a surface for the topsoil that minimizes slippage. Final grading will be accomplished so that overall grades will not exceed lv:3h. The plan for backfilling and grading is shown graphically on the Map 29.

4.14.3 Covering Coal and Acid and Toxic Forming Materials

Colowyo will not have any exposed coal seams remaining at the end of mining and reclamation. Colowyo does not have any acid forming materials at the mine. For discussion on acid- and toxic-forming materials, refer to Section 2.04.6. For disposal of non-coal wastes or materials constituting a fire hazard, refer to Section 4.11.4.

4.14.4 Thin Overburden

Colowyo does not have a thin overburden situation as defined in Section 4.14.4 of the regulations.

4.14.5 Thick Overburden

Colowyo does not have a thick overburden situation as defined in Section 4.14.5 of the regulations.

4.14.6 Re-grading or Stabilizing Rills and Gullies

Please see Section 4.14.6 in Volume 1.

4.15 REVEGETATION REQUIREMENTS

4.15.1 – 4.15.7 Revegetation Requirements, Various

These sections are addressed in the Volume 1.

Field Trails

A full description of field trials that have occurred adjacent to the South Taylor Pit can be found in Volume 1, Section 4.15.6.

4.15.8 Revegetation Success Criteria

The vegetation monitoring methods and statistical analyses for the demonstration of revegetation success, vegetation cover, herbaceous production, and woody plant density are described in Volume 1, Sections 4.15.7 and 4.15.8. Refer to Section 2.04.10 of Volume 12 regarding vegetation reference areas applicable to the South Taylor mine area.

4.15.9 Cropland Revegetation Success

None of the reclaimed land will be used as cropland; therefore, the requirements of this subsection are not applicable.

4.15.10 Previously Mined Land Revegetation Success Criteria

Although portions of the South Taylor pit have been previously mined, the revegetation success criteria established in 4.15.8 shall be used across the entire South Taylor pit.

4.16 POSTMINING LAND USE

4.16.1 General

Implementation of the detailed reclamation plan as presented in Section 2.05.5 will result in a landscape and vegetative cover that is equal to or better than the pre-mining condition for rangeland use that currently exists in the area.

4.16.2 Determining Use of Land

The pre-mining land uses for the mine and adjacent areas are shown on Map 17. The narrative describing the land use of the South Taylor permit area is presented under Section 2.04.3. The post-mining land use will involve the restoration of the pre-mining land use of rangeland, as described in Section 2.05.5.

4.16.3 Alternative Land Uses

The land use of rangeland will be restored in a timely manner as outlined in Section 2.05.4. Implementation of the timetables contained therein will assure a successful reclamation program. No alternative land uses will be implemented in the reclamation plan set forth under Section 2.05.4.

4.17 AIR RESOURCES PROTECTION

Please see Section 2.05.6 in Volume 1.

4.18 PROTECTION OF FISH, WILDLIFE, AND RELATED VALUES

As described in Section 2.04.11, no threatened or endangered species are known to utilize the habitats present in the permit area; however, it is unlikely that any impact will occur with respect to those threatened and endangered species which are known to occur in the region. No critical habitat for any species is known to exist in the South Taylor permit revision area. Golden Eagle nesting complexes, which are located within the permit area but outside the area to be mined, are described in Section 2.04.11 of the existing permit document.

Section 4.18 in Volume 1 discusses electric power line and transmission facility construction guidelines for retrofitting of existing power poles to project raptors. Colowyo has implemented these measures to protect raptors in the mine permit area.

As described in Section 2.05.6 of Volume 1 all disturbed acreage, including roads, have been kept to a minimum by proper planning to reduce impacts to all environmental resources, including impacts on wildlife.

As part of the plan to return the post-mining land use to a rangeland condition capable of supporting the diverse wildlife populations identified in the permit area, Colowyo initiated efforts to restore wildlife habitats during pre-mine planning and early mining. This was accomplished by conducting an extensive four year study to assist in determination of the best techniques for revegetating disturbed areas with native species to enhance wildlife habitat. In addition, Colowyo implemented a habitat improvement program in 1975 to offset temporary habitat loss during mining. The reestablishment of herbaceous species, topographic relief, impoundments and limited reestablishment of a shrub component form the integral elements of the reclamation plan.

To date these efforts have proven successful. Large herds of deer and elk are regularly seen grazing on the reclaimed areas. Rodent and small game populations have reestablished on the reclaimed areas providing a readily available food source for local raptor populations and other predators.

4.19 PROTECTION OF UNDERGROUND MINING

Colowyo will conduct no coal mining closer than 500 feet to any point of either an active or abandoned underground mine. Underground coal mines have been operated in the past as discussed in Section 2.04.4, but their locations were on the-northern side of Streeter Draw well over 500 feet from present Colowyo mining.

The surface mining activities of Colowyo have been designed so as not to endanger any present or future operations of either surface or underground mining operations. As discussed in Section 2.05.3, Colowyo has engineered its mining plan to maximize recovery of coal by current economical surface mining methods.

4.20 SUBSIDENCE CONTROL

Colowyo is conducting a surface coal mining operation. Therefore, the requirements of 4.20 are not applicable to the Colowyo operation.

4.21 COAL EXPLORATION

All coal exploration activities within the South Taylor permit revision area will be completed in accordance with the requirements and procedures outlined in Volume 1.

4.22 CONCURRENT SURFACE AND UNDERGROUND MINING

Colowyo does not currently plan to have concurrent surface or underground mining activities; therefore, the requirements of this Section are not applicable to this permit application.

4.23 AUGER AND HIGHWALL MINING

4.23.1 Scope

This Section establishes environmental protection performance standards in addition to those applicable performance standards in Rule 4, to prevent any unnecessary loss of coal reserves and to prevent adverse environmental effects from auger mining incident to surface mining activities.

4.23.2 Maximize Recoverability of Mineral Reserves

Colowyo has identified areas suitable for highwall mining at South Taylor (Map 23). Highwall mining allows for the recovery of additional coal resources beyond the final pit highwalls and end-walls. These coal reserves are economically recoverable using highwall mining methods.

From a strip mining perspective, the South Taylor Pit clearly delineates the maximum recoverable coal resources attainable today with modern surface technology and coal market demand and pricing. The highwall mining of the G-seams on the west side of the pit represents recovery of reserves that would not have been recovered by any other means utilizing either surface or underground mining techniques.
Section 4.23 of Volume 1 contains additional discussion regarding the removal of coal using highwall mining methods. The document includes a summary of the geologic factors that limit removal of the coal using conventional methods, the requirements for leaving undisturbed areas of coal in un-mined sections, procedures for working around underground mines, surface and groundwater pollution prevention procedures, reduction in fire hazards, backfilling, grading, and PMT requirements for all areas previously permitted.

4.23.2(1) Undisturbed Areas of Coal Shall Be Left in Unmined Sections

As for the rules requirements [Rules 4.23.2(1)(a)-(c)] for leaving undisturbed areas of coal in unmined sections, Colowyo requests a variance from the requirements of this rule for the South Taylor Pit. Colowyo's highly successful highwall mining methods that have been used and will be in the future in the South Taylor Pit, will maximize production and ensure no subsidence occurs. Using this particular method of highwall mining by leaving pillars and barriers allows the seams to be mined below each other and still ensures geologic stability once all seams have been mined out. Please see Exhibit 27, Item 6 and Item 7 in Volume 20 for further discussion on the geotechnical design and operational considerations implemented highwall mining the South Taylor Pit.

4.23.2(2) Abandoned or Active Underground Mine Workings

No abandoned or active underground mine workings have ever existed or currently exist in any of the coal seams in the areas to be highwall mined. Highwall mining will not take place within 500 feet of any abandoned or active underground mining operation.

4.23.2(3) Surface Mining Activities and Highwall Mining

The highwall mining shall follow the surface coal mining activities in a contemporaneous manner consistent with the applicable requirements of Division Rule 4. Due to active pit progressions and sequencing of mining (in addition to meeting the Permit requirements for contemporaneous reclamation), it is required that highwall mining occurs timely if not immediately following conclusion of pit mining activities. Also, as described more fully in 2.06.9(2), the need to backfill, is mandatory for Colowyo in order to build the pit floor from which to work from to mine the successively higher (in the geologic column) coal seam. Hence successful highwall mining is in part dependent upon timely backfill of the pit.

4.23.2(4) Prevent Pollution of Surface and Groundwater and to Reduce Fire Hazards

Ground water in the pit or highwall mining holes will not be problematic since the South Taylor Pit is essentially dry (minor perched aquifers with limited seasonal flows), and is located above the 1st regional aquifer (Trout Creek) by a substantial distance. Ground water flow regimes and the negligible impact that Colowyo's surface mining activities have on ground water as a result of mining these target coal seams/rock interburdens are detailed extensively in Section 2.04.7(1). From this extensive body of data and from experiences to date with mining activities, no toxic forming or acid forming water discharge is anticipated from any of the highwall openings. Should toxic forming or acid forming water discharges be encountered, the opening exhibiting the discharge will be backfilled within 72 hours of completion.

Colowyo will backfill each highwall miner entrance hole within 30 days following coal extraction. All highwall miner entrance holes will be further buried by pit backfill during the normal backfill sequence for the pit to remain in compliance with Rules 4.05.1 and 4.05.2. Ground water hydrologic regimes will be re-established in the backfilled pits with no anticipated detrimental effects from the highwall miner holes.

4.23.2(5) Holes Need Not Be Plugged

All highwall miner entrance holes will be backfilled in accordance with the requirements set forth in 4.14.

4.23.2(6) Division Shall Prohibit Auger (Highwall Mining) Mining

There is no probable reason to prohibit the highwall mining in light of no anticipated adverse impacts to water quality, fill stability, pit backfilling, increased resource recovery, and highwall mining is designed for zero subsidence to prevent disturbance or damage to powerlines, buildings, or other surface facilities.

4.23.2(7) Backfill and Grading Requirements

Highwall mining will be conducted in accordance with the backfilling and grading requirements of 4.14.

4.24 OPERATIONS IN ALLUVIAL VALLEY FLOORS

The field investigation described in Section 2.04.7 and 2.06.8 resulted in no identification of alluvial valley floors in the general area which would be adversely affected by mining operations; therefore, no special performance standards for operations in the alluvial valley floors are applicable to the South Taylor mining area.

4.25 OPERATIONS ON PRIME FARMLANDS

Since a negative determination of prime farmland was arrived at using the eligibility requirements established for prime farmland under Section 2.04.12, these performance standards do not apply to the present permit application.

4.26 MOUNTAINTOP REMOVAL

The South Taylor Pit, although removing the entirety of the X and A seams from the top of the unnamed mountain separating the drainages of Taylor, Wilson, and Good Springs Creeks, Colowyo will be mining deeper coal seams. Based on this information, the Division has determined that the South Taylor pit does not meet the criteria for mountaintop removal.

4.27 OPERATIONS ON STEEP SLOPES

No operations at Colowyo will be conducted on steep slopes as defined in this section.

4.28 FACILITIES NOT LOCATED AT THE MINESITE

This section is not applicable to the permit revision. All facilities used by Colowyo in their current operations will continue to be used for the South Taylor mining operations.

4.29 IN SITU PROCESSING

This section is not applicable.

4.30 CESSATION OF OPERATIONS

4.30.1 Temporary

If, for any unforeseeable circumstances, temporary cessation of mining and reclamation operations at the Colowyo operation becomes necessary for a period of thirty (30) days or more, Colowyo will submit to the Division a notice of intention to temporarily cease or abandon mining and reclamation activities. This notice will include a statement of the exact number of acres which will have been affected in the permit area prior to temporary cessation, the accomplished, an identification of back filling, regarding, revegetation, environmental monitoring, and water treatment activities that will continue during temporary cessation.

4.30.2 Permanent

At the permanent conclusion of surface mining operations, Colowyo will close, backfill, or otherwise permanently reclaim all affected areas. The reclamation plans are set forth in Section 2.05.5. The projected post-mining topography is set forth on the Post-mining Topography maps (maps 19A and 19B).

Colowyo will remove any equipment, structures, or other facilities at the conclusion of mining activities and will reclaim the affected land.

Table 2.04.4-1 Previous Cultural Resource Investigations in the South Taylor Permit Expansion Area

OAHP ID	Type	Organization	Year	Total Acres
MF.LM.R287	block/linear – mine and railroad	UC, Boulder	1975	10,152
MF.PA.CR	linear – transmission line	CSU – LOPA	1977	1,600
RB.LM.TI	block/linear – well and access	Western Wyoming	1977	n/a
MF.LM.U1B	multiple blocks – mine exploration	CSU – LOPA	1980	55.6
MF.LM.U3	block – mine	BLM Craig District	1980	240
MF.OSM.C	block – mine	WCRM	1981	1,975
MC.E.CA	linear – transmission line	Gilbert/Commonwealth	1982	1,424
MF.LM.R285	block – mine	Mariah	1983	2,820
MC.LM.R103	block/linear – mine and exploration	Metcalf	1995	10,192
MF.LM.R269	blocks/linear – mine exploration	Metcalf	1995	116
MF.LM.R281	blocks – wells	Metcalf	1995	90
MC.CH.R96	linear – fiber optic	Centennial	1999	16,570
MC.LM.R45	multiple sample blocks – coal deposits	Archaeological Cons.	1983	7,760
MF.LM.MB	block – mine exploration	Archaeological Cons.	1980	1
MF.LM.NR238	linear – seismic	Grand River	1988	2.4
MF.LM.R59	block – lease and conveyor	Nickens	1988	1,805
MF.OSM.C	block – mine	WCRM	1981	1,975
RB.LM.DH	block/linear – lease	Nickens	1984	4,563
RB.LM.M1	small block – drill sites	Gordon-Kranzuch	1980	.04
RB.LM.NR17	linear – pipeline	Grand River	1984	45
RB.LM.NR204	multiple small block – drill locations	Grand River	1982	11
RB.LM.NR315	linear – seismic	Grand River	1985	60
RB.LM.NR98	small block and linear – test holes	Grand River	1983	42
RB.PA.P	small block and linear – test holes	Centuries	1979	47

Table 2.04.9-4

Present and Potential Productivity of Soils Within the South Taylor Permit Area

County	Map Unit Symbol	Soil Name	Range Production - Low Value (lbs. dry wt./acre)	Range Production - Representative Value (lbs. dry wt./acre)	Range Production - High Value (lbs. dry wt./acre)
Moffat	3	Adderton loam, 1-10% slopes	2000	2500	3000
Moffat	10	Battlement fine sandy loam, 0-3% slopes	1000	2000	3000
Moffat	25	Campspass fine sandy loam, 3-12% slopes	600	900	1200
Moffat	26	Campspass fine sandy loam, 12-25% slopes	600	900	1200
Moffat	37	Cochetopa loam, 12-25% slopes	1200	1500	1800
Moffat	38	Cochetopa loam, 25-65% slopes	1500	2000	3000
Moffat	39	Cochetopa loam, warm, 3-12% slopes	1200	1500	1800
Moffat	52	Danavore-Waybe complex, 5-30% slopes	200	400	500
Moffat	66	Evanot loam, 1-12% slopes	900	1500	1800
Moffat	70	Fluvaquents and haplaquolls soils, frequently flooded	-	-	-
Moffat	77	Forelle Loam, 3-12 % slopes	500	800	1000
Moffat	108	Jerry-Cochetopa complex, 5-35% slopes	1500	2000	3000
Moffat	112	Kemmerer-Moyerson silty clay loams, 20-40 % slopes	400	650	800
Moffat	113	Kemmerer-Yamo complex, 5-30% slopes (Kemmerer)	400	650	800
Moffat	113	Kemmerer-Yamo complex, 5-30% slopes (Yamo)	600	900	1200
Moffat	117	Lamphier-Jerry complex, 25-65% slopes	1500	2000	3000
Moffat	118	Lander Loam, 0-3% slopes	1500	1700	2000
Moffat	134	Morapos loam - 3-12% slopes	1200	1500	1800
Moffat	135	Morapos loam - 12-25% slopes	1200	1500	1800
Moffat	141	Nortez, cool-Morapos Loam, 3-12% slopes	-	-	-
Moffat	142	Nortez, cool-Morapos Loam, 12-25% slopes	1200	1500	1800
Moffat	149	Pinelli loam, 3-12% slopes	600	900	1200
Moffat	152	Pinridge loam, 1-12% slopes	1000	2000	3000
Moffat	160	Rock outcrop-torriorthents complex, 50-75% slopes	-	-	-
Moffat	162	Rock River sandy loam, 3-12% slopes	500	800	1000
Moffat	163	Rock River sandy loam, 12-25% slopes	500	800	1000
Moffat	197	Torriorthents-rock outcrop, sandstone complex, 25-75 % slopes	-	-	-
Moffat	206	Ustorthents, frigid-borolls complex, 25-75 % slopes	300	575	725
Moffat	216	Yamo loam, 3-15% slopes	600	900	1200
Moffat	217	Yamo loam, 15-30% slopes	600	900	1200
Rio Blanco	57	Owen Creek-Jerry-Burnette loams, 5-35% slopes	-	2000	-
Rio Blanco	77	Rhone-Northwater-Lamphier loams, 3-50% slopes	-	2250	-
Rio Blanco	84	Silas Variant loam, 1-3% slopes	-	2500	-
Rio Blanco	91	Torriorthents-Rock outcrop complex, 15-90% slopes	-	100	-
Rio Blanco	98	Waybe-Vandamore Variant-Rock outcrop complex, 5-30% slopes	-	350	-

\- Information not available from NRCS

TABLE 2.05.6-1
SPRINGS IN THE AREAS OF THE SOUTH TAYLOR PIT

Spring	Approximate Elevation (Feet AMSL)	Direction from Proposed Pit	Source- Formation
3-93-17-142	7484	North of ST	Not Available
3-93-17-143	7922	North of ST	Not Available
3-93-17-144	7625	North of ST	Not Available
3-93-17-432	7850	In ST Pit	Not Available
3-93-20-212	7900	In ST Pit	Not Available
3-93-21-233	7350	East of ST	Not Available
3-93-28-122	6975	East of ST	Not Available
3-93-28-131	7000	South of ST	Not Available
3-93-29-233	7150	South of ST	Not Available
3-93-29-234	7120	South of ST	Not Available
FW (3-93-28-212)	6950	South of ST	Iles
GSCS-1	6950	East of ST	Williams Fork
WFS-1	7175	East of ST	Williams Fork
WFS-2	7000	South of ST	Williams Fork
WFS-2A	7025	South of ST	Williams Fork
WFS-4	7450	South of ST	Williams Fork
WFS-5-A	7625	South of ST	Williams Fork
WFS-5	7675	South of ST	Williams Fork
WFS-7	7375	South of ST	Williams Fork
WFS-7A	7400	South of ST	Williams Fork

TABLE 2.05.6-2
SEEP AND SPRING MONTHLY FLOWS
SOUTH TAYLOR PERMIT AREA

Spring	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	July
GSCS-1	[2]	[1]	[<1]					D	D	D	[2]	
WFS-1 (3-93-21-233)	(3) [3]	[D]	[D]					3	1	D	[5]	[5]
WFS-2	[15]	[67]	[49]					[12.5] 75	89	[12.5] 75	[7]	
WFS-2a		[4.9]	[1.9]					[6] D	D	[6] D	[2]	
WFS-2b (3-93-28-131)	(10-15) [20]	[59]	[49]					[1.5] 8.25	75	75	[1.5]	
WFS-4	[D]		[0.5]							[1]	[<1]	
WFS-5 and -5a								0.75	D	D		
WFS-7								D	D	D	[2]	
(3-93-17-142)	(2-3) [6]	[D]	[D]	[D]				D	6	4.5		[6]
(3-93-17-143)	[<1]	[<1]	[<1]					D	7.2	[4-5] 0.7		
(3-93-17-144)	(1-2) [4]	[4]	[1]					1.25	1.4	2.5	[1]	[<1]
(3-93-17-432)	(3-4) [7]	[6]	[4]					1.5	23	19.2		[3]
(3-93-20-212)	[<1]	[1]	[1]								[2]	[1]
(3-93-20-213)	[D]	[D]	[D]					D	0.45	D	[3]	[D]
(3-93-20-214)	[D]	[D]	[D]					D	0.15	[3-4]	[D]	[D]
(3-93-20-215)	[D]	[D]	[D]					D	D	[D]		
(3-93-28-122)	(<1)							D	D	D	[D]	
(3-93-29-233)	(<1) [D]	[D]	[D]					D	D	D	[D]	[D]
(3-93-29-234)	(5) [1]	[1]	[<1]					D	1	1.8	[<1]	[<1]
Sturgeon Flume								D	D	D		
FW- (3-93-28-212)	(5) [12]	[12]	[12]					9	11	10.1	[5]	[6]
SPRLW-01 (3-93-18-434)	0.9 (1-2)	D	D	F	F	F	F			2	1.5	1.5
SPRLW-02*	D	D	D	F	F	F	F			1.8	0.7	0.5

Flow Rates in gallons per minute (gpm)
F- Frozen or snow-covered.
Flow rates from Walsh, 2005-2006.
Numbers in parentheses are springs identified in JBR, 1997; flow rate in ( ) from JBR, 1997. Flows rates in [ ] from Colowyo, 1999.

* - Spring identified by Walsh, 2005
D – Dry or no measurable flow