BLM


**United States Department of the Interior**
**Bureau of Land Management**


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# Environmental Assessment

**for the**

**Peabody Twentymile Coal, LLC**

**COC54608 Lease Modification**

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Little Snake Field Office
455 Emerson Street
Craig, Colorado 81625



DOI-BLM-CO-N010-2014-0044-EA

DECEMBER 2015

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# CHAPTER 1 – INTRODUCTION

## 1.1 Identifying information

CASEFILE/PROJECT NUMBER: COC54608

APPLICANT: Twentymile Coal, LLC

PROJECT NAME: Twentymile Coal, LLC COC54608 Lease Modification

## 1.2 Project Location and Legal Description

LEGAL DESCRIPTION: Sixth PM, T5N, R86W;
SEC. 21: N½NW¼, N½S½NW¼, N½S½SW¼NW¼, N½SW¼NE¼, N½NE¼;
SEC. 22: N½NW¼.

Proposed Project location contains approximately 310 acres in Routt County, Colorado.

## 1.3 Background/Introduction:

This environmental assessment (EA) has been prepared by the BLM to analyze the environmental effects of a coal lease modification application. Peabody Energy's Twentymile Coal, LLC (TC) has submitted a lease modification to the Bureau of Land Management (BLM) seeking to modify an existing coal lease, COC54608. TC currently operates the Foidel Creek mine which is an underground longwall coal mine located about 20 miles southwest of Steamboat Springs in Routt County, Colorado (see Map 1). TC has been mining at the Foidel Creek Mine by underground methods since 1983. The Foidel Creek Mine is made up of 6 federal coal leases, private coal leases and state coal leases and produces approximately 4 million tons of coal per year.

The modification to lease COC54608 proposes to add 310 acres of un-leased federal coal under privately owned surface at the TC Foidel Creek Mine. Lease COC54608 was originally issued in February 1996 for 2,600 acres. Recovery of the Wadge coal seam within this 2,600 acre lease boundary occurred from June 1996 to September 2001. In August 2002, mining of the Wadge seam coal in COC54608 was completed; therefore TC relinquished 2,280 acres of lease COC54608. TC retained 320 acres of lease COC54608 for access to their continued mining operations. TC continues to mine the Wadge seam on other authorized federal, State and private leases within the permit boundary.

The lease modification application is for the Wolf Creek seam, a coal seam below the Wadge seam. It is estimated that the federal coal reserves included in this lease modification would total approximately

340,000 recoverable tons of high volatile, group B, bituminous coal. There would be no new or additional surface disturbance; unsuitability criteria apply only to surface coal mining, and therefore are not applicable for this proposed lease modification.

Coal is a federal asset, and the BLM is required by law to consider leasing federally-owned minerals for economic recovery. The Minerals Leasing Act (MLA) of 1920, as amended by the Federal Coal Leasing Amendments Act (FCLAA) of 1976; and the Code of Federal Regulations Title 43 Part 3400, et seq. provide the legal foundation for the leasing and development of federal coal resources. BLM is the federal agency delegated the authority to offer federal coal resources for leasing and to issue leases. The Mining and Minerals Policy Act of 1920 (MMPA) declares that it is the continuing policy of the federal government to foster and encourage the orderly and economic development of domestic mineral resources. BLM complies with the Federal Land Policy and Management Act of 1976 (FLPMA) to plan for multiple uses of public lands and determine those lands suitable and available for coal leasing and development.

If the BLM decides to lease the federal coal described in the lease modification submitted by TC, the fair market value (FMV) of the coal would be determined and TC would submit payment for the 340,000 tons of coal. If the coal is mined, TC would pay 8% royalties on sales of the coal.

A decision to lease these lands is a necessary prerequisite for mining, but it does not authorize mining. Leasing conveys rights to the mineral resource; however, leasing does not authorize coal mining. Subsequent permitting actions would be required to allow mining. The Surface Mining Control and Reclamation Act of 1977 (SMCRA) provides the legal framework for the federal government to regulate coal mining by balancing the need for continued domestic coal production with protection of the environment and ensuring the mined land is returned to beneficial use when mining is finished. The Office of Surface Mining Reclamation and Enforcement (OSMRE) was created in 1977 under SMCRA to carry out and oversee those federal responsibilities. OSMRE implements its MLA and SMCRA responsibilities under regulations at Code of Federal Regulations Title 30 - Mineral Resources, Chapter VII - Office of Surface Mining Reclamation and Enforcement, Department of the Interior, Subchapters A-T, Parts 700-955.

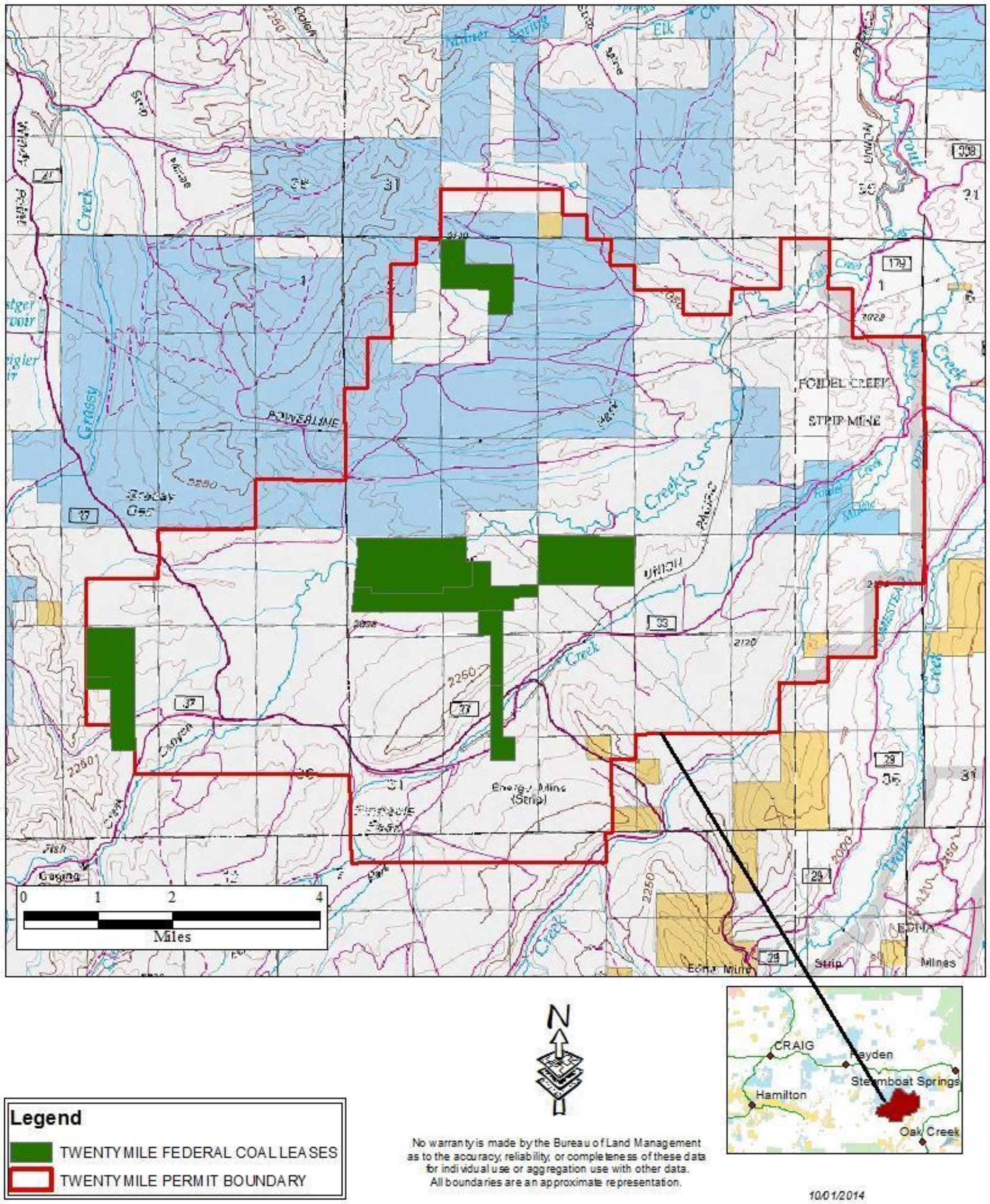
As provided for under SMCRA, OSMRE has worked with Colorado to develop its own regulatory program to permit coal mining with OSMRE in an oversight role. The Colorado Division of Reclamation, Mining, and Safety (DRMS) manages its own coal regulatory program under SMCRA and the Colorado Surface Coal Mining Control Act of 1976. Federal coal lease holders in Colorado must submit a permit revision application to DRMS for proposed expansions of existing mines that covers mining and reclamation on federal lands. DRMS reviews the permit revision package to ensure that permit application complies with the permitting requirements and that the coal mining operation would meet Colorado's performance standards. OSMRE, BLM and other federal agencies also review the application to assure it complies with the coal lease, the MLA, the NEPA and other applicable federal laws and regulations. DRMS has the authority and responsibility to make decisions to approve SMCRA mine permits and regulate coal mining under Regulations of the Colorado Mined Land Reclamation Board for Coal Mining (revised 09/14/2005). The OSMRE has agreed to be a cooperating agency in preparing this EA. When needed, OSMRE recommends approval, approval with conditions, or disapproval of the mining plan to the Assistant Secretary of the Interior, Land and Mineral Management.

TC holds a coal mining permit for the Foidel Creek Mine with DRMS. This permit was issued in 1982 (DRMS Permit C-1982-056) and encompasses 19,940 acres. The proposed 310 acre lease modification is within the TC Foidel Creek Mine boundary and is located between existing leases (federal, state and private). TC would need to modify their permit with DRMS to authorize mining of the proposed 310 acre lease modification; however the current permit boundary would not be changed.

The entirety of the lease modification tract is split estate. The lease modification involves leasing 310 acres of underground federal coal reserves beneath private lands. TC owns 290 acres of the surface while Ashley Investments owns the eastern 20 surface acres of the lease modification area. TC holds the adjacent leases and no other lease holders exist in the surrounding area. The only adjacent coal mine is the Sage Creek Mine which is also permitted by Peabody. The Sage Creek Mine is currently inactive.

The surface facilities for the Foidel Creek Mine are located on private land approximately 2 miles from the proposed lease modification. The coal which would be mined from the 310 acres covered by this lease modification would be processed at the existing Twentymile Coal Company Foidel Creek Mine surface facilities; there would be no new surface facilities.

## TWENTYMILE FEDERAL COAL LEASES




**MAP 1**

Modifying the lease by 310 acres would enable TC to lengthen one longwall panel in the Wolf Creek seam which would allow the coal to be mined. If the leases are not modified and the longwall panels not lengthened, bypass of the federal coal would occur. It would become economically unviable and technically infeasible to mine the federal coal in the 310 acre lease modification. TC would be able to maximize recovery of federal coal as an extension of their Wolf Creek seam operation. The potential economic recovery could also be lost. Mining in the lease modification would occur over a 7 year period approximately. Mining of the 310 acre lease modification would allow TC to continue to employ the existing skilled workforce for the additional time required to extract the coal.

As a result of coal leasing and probable subsequent mining and sale of federal coal resources, the public receives lease bonus payments, lease royalty payments, and a reliable supply of low sulfur coal for industrial use (e.g. fertilizer production) and power generation. Approximately 87% of the coal shipped from Foidel Creek is sold for electrical generation and approximately 13% is sold for industrial purposes. Electricity cannot be stored as electricity[1]. Electricity must be supplied as soon as the demand is created. A supply of low sulfur coal for constant generation of electricity can reliable meet the varied peak and low electricity demands.

Pursuant to the 43 CFR 3432.2, the authorized officer may modify a lease to include all or part of the lands applied for if the said officer determines that:

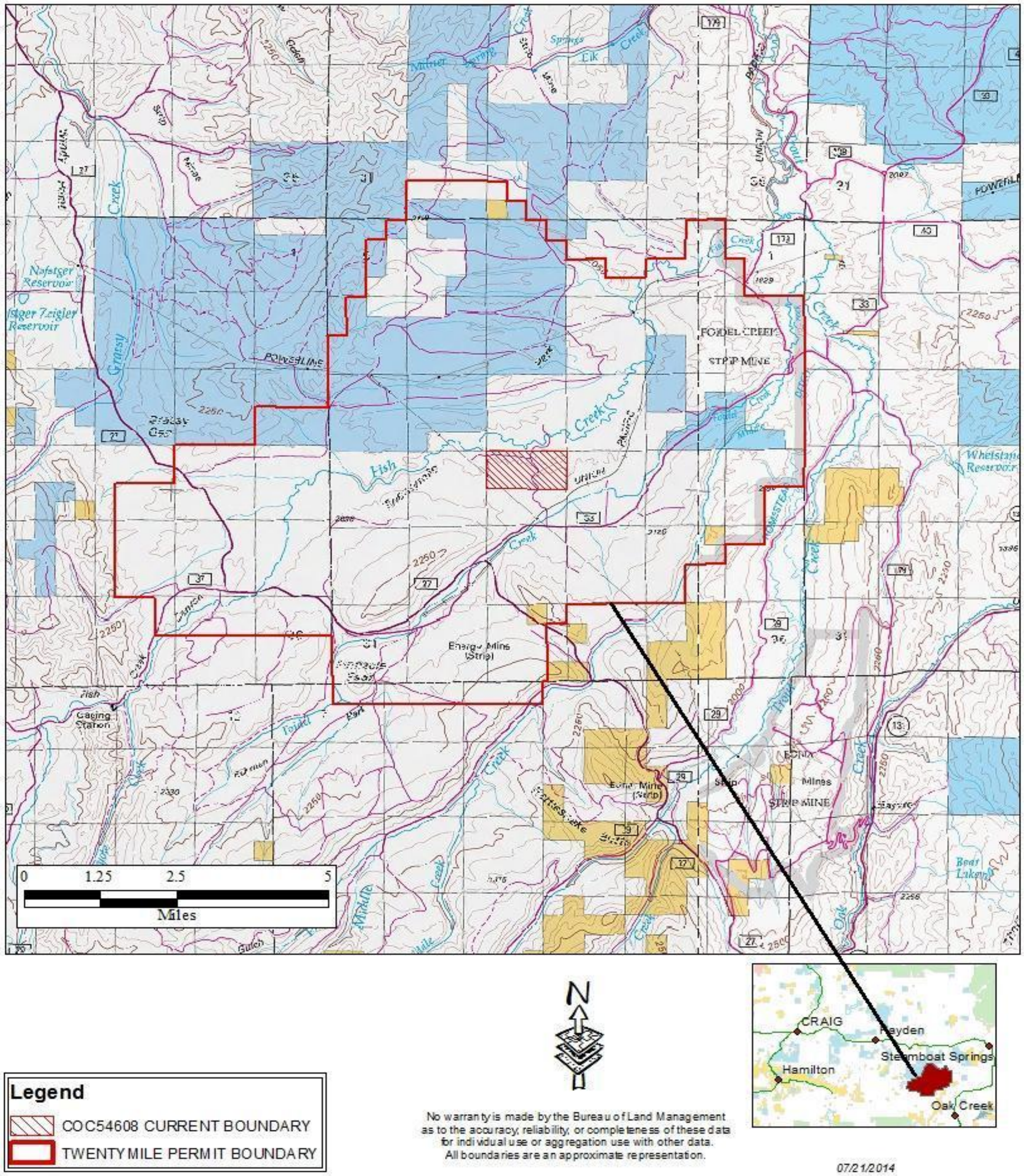
(1) the modification serves the interests of the United States;
(2) there is no competitive interest in the lands or deposits; and
(3) the additional lands or deposits cannot be developed as part of another potential or existing independent operation.

The application clearly meets the criteria for consideration as a federal coal lease modification, in that:

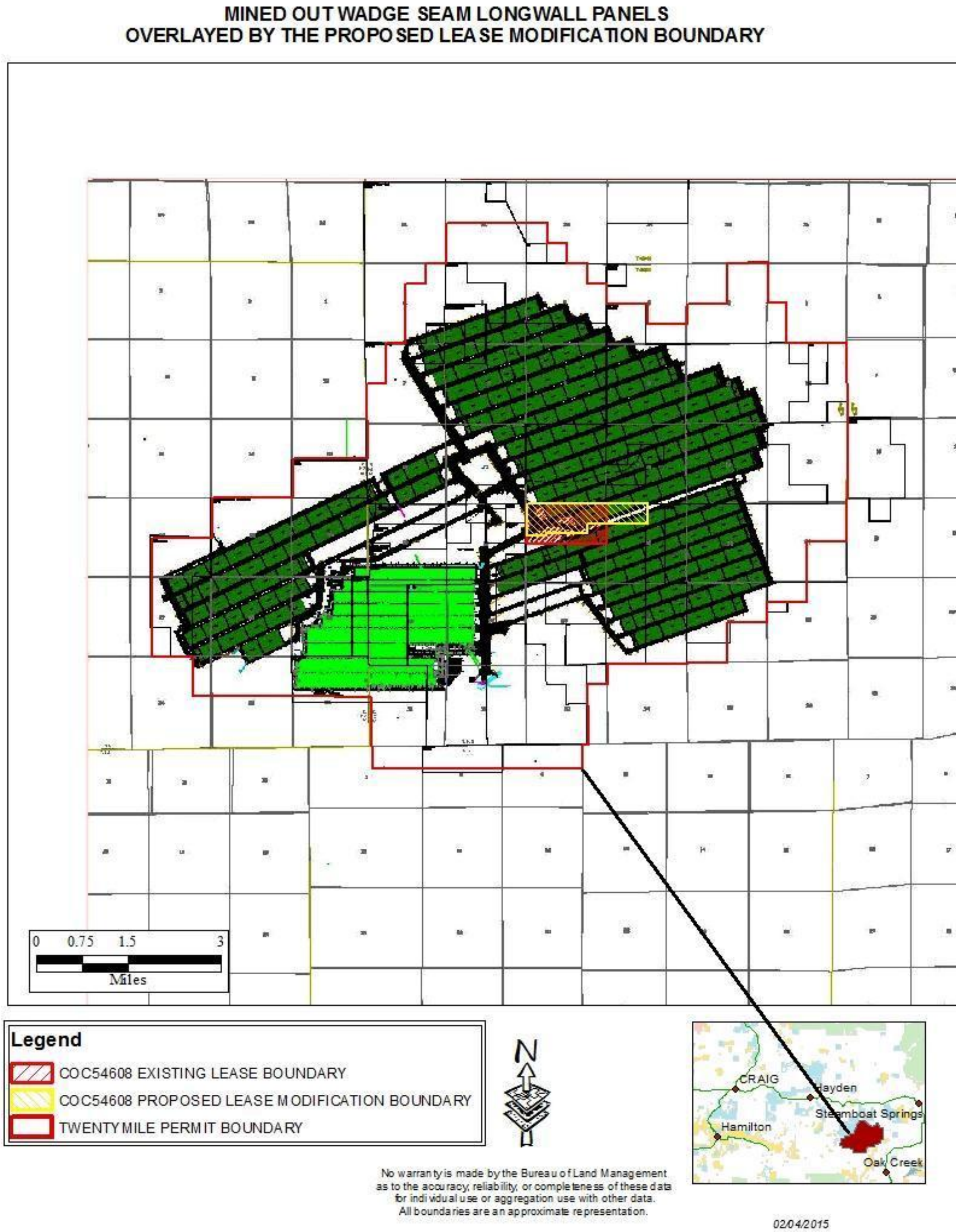
(1) Achieving MER of federal coal resources is in the interest of the United States.
(2) The applicant is the only active operation in the immediate area and no other operation would be able to economically recover these coal resources. Therefore, there is no competitive interest in the proposed lands.
(3) The limited quantity of recoverable coal in the proposed tract, along with the physical boundaries to the tract, would preclude this tract from being developed as a part of any new or existing coal mining operation.
(4) The 310 acres of the lease modification tract does not exceed the modified acreage limitation of 960 acres specified in the Energy Policy Act of 2005.

[1] http://homeenergy.hubpages.com/hub/Electricity-Storage

# EXISTING COC54608 LEASE BOUNDARY




**MAP 2**


MINED OUT WADGE SEAM LONGWALL PANELS
OVERLAYED BY THE PROPOSED LEASE MODIFICATION BOUNDARY
0 0.75 1.5 3
Miles
Legend
COC54608 EXISTING LEASE BOUNDARY
COC54608 PROPOSED LEASE MODIFICATION BOUNDARY
TWENTYMILE PERMIT BOUNDARY
N
CRAIG
Hayden
Steamboat Springs
Hamilton
Oak Creek
No warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual use or aggregation use with other data. All boundaries are an approximate representation.
02/04/2015

**MAP 3**

## 1.4 Purpose and Need

Twentymile Coal, LLC (TC) submitted an application seeking to modify existing federal coal lease COC54608 on May 15, 2014. A revised application was received January, 2015.

The purpose of the Proposed Action is to modify coal lease COC54608 to add a contiguous tract of unleased federal coal covering approximately 310 acres and containing an estimated 340,000 tons of recoverable coal, thus preventing a potential bypass of the coal reserves.

This action, if approved, would allow the applicant access to federal coal from within the modified lease boundary. The applicant would not need to modify their mining permit boundary to remove the economic coal present within the lease modification area.

This action would allow for a logical progression of sequenced mining, ensure that these resources are not bypassed, and achieve maximum economic recovery of the federal coal resource.

This action is needed to fulfill the requirement, under the Mineral Leasing Act of 1920, as amended by the Federal Coal Leasing Amendments Act of 1976 (FCLAA) and the Federal Land Policy and Management Act (FLMPA) to respond to a request to modify federal coal lease COC54608. Part of the outlined responsibility of the BLM includes encouraging development of domestic coal reserves to meet future energy needs, reduced dependence on foreign sources of energy and provides for dependable and affordable domestic energy while giving due consideration to the protection of other resource values. For the applicant's proposal, a lease modification would ensure federal coal resources that cannot be mined by any other operation are not bypassed and that maximum economic recovery is achieved.

**Decision to be Made:**
The BLM will decide whether or not to modify the existing federal coal lease COC54608 to include the tract identified in the proposed action for the purpose of extracting the coal resources, and if so, under what terms and conditions.

## 1.5 Plan Conformance Review

The Proposed Action is subject to and has been reviewed for conformance with the following plan (43 CFR 1610.5, BLM 1617.3):

Name of Plan: Little Snake Record of Decision and Resource Management Plan (RMP) as amended by the Northwest Colorado Greater Sage-Grouse Approved Resource Management Plan Amendment.

Date Approved: October 2011 and September 2015

Results: The Proposed Action is in conformance with the LUP because it is specifically provided for in the following LUP goals, objectives, and management decisions as follows:

Allow for the availability of the federal coal and oil shale estate for exploration and development.

Objectives for achieving these goals include:

- Identify and make available the federal coal and oil shale estate for exploration and development, consistent with appropriate suitability studies, to increase energy supplies.
- Facilitate reasonable, economical, and environmentally sound exploration and development of the federal coal and oil shale estate.
- Promote the use of BMP's, including implementation of sound reclamation standards.

Section/Page: RMP-36

**Other Related NEPA Documents:**

This EA tiers to the 1980 Green River – Hams Fork EIS which analyzed the leasing of coal tracts in Northwest Colorado and South Central Wyoming. In 1995, EA CO-016-95-020 analyzed the impacts that would result from the leasing and development of the original 2,600 acre COC54608 lease. The 1995 EA assessed the impacts that would result from the leasing and subsequent development of the underground minable coal.

### 1.6 Scoping, Public Involvement and Issues

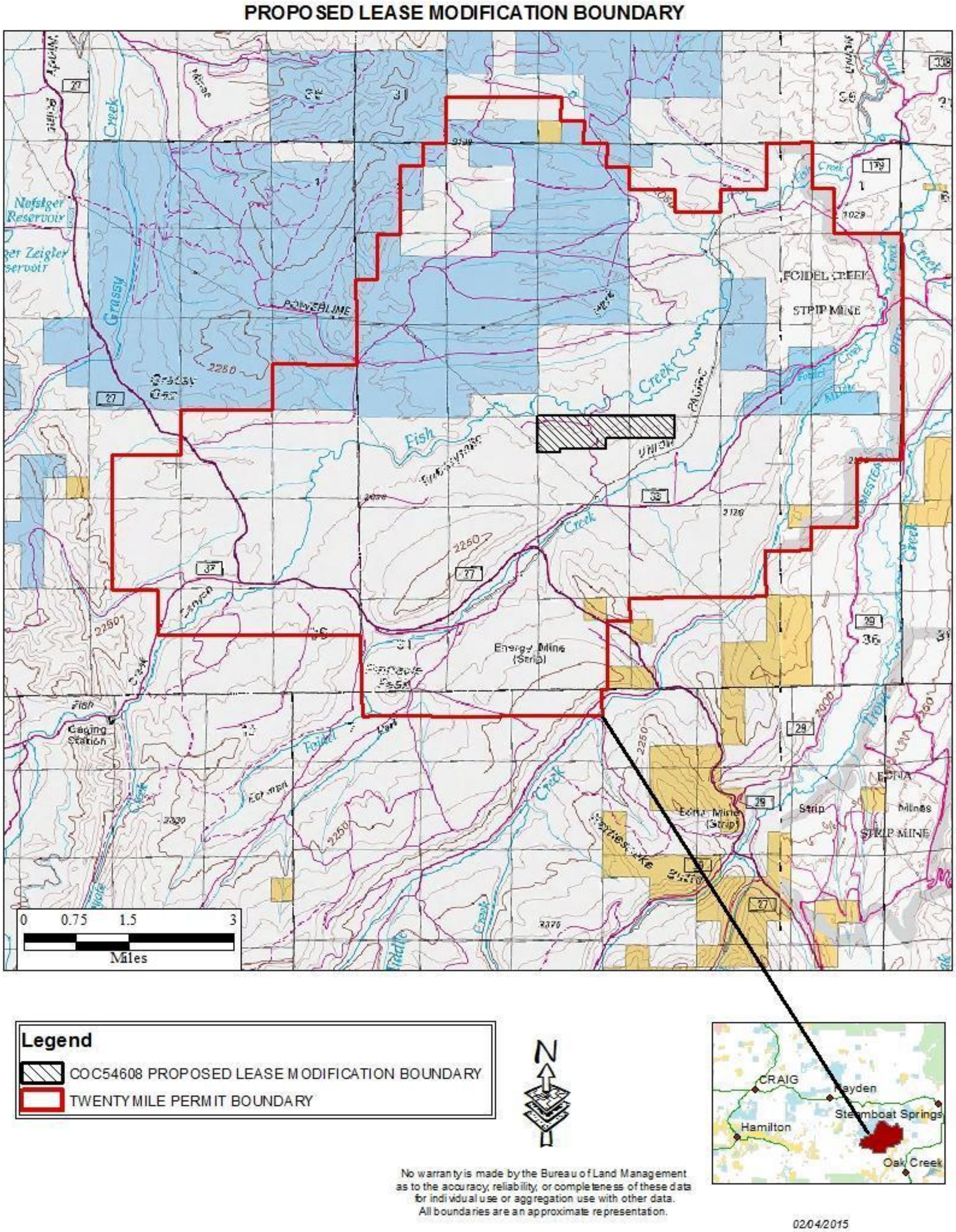
Scoping: Scoping was the primary mechanism used by the BLM to initially identify issues. Internal scoping was initiated when the project was presented to the Little Snake Field Office (LSFO) interdisciplinary team on June 30, 2014. No issues were identified during internal scoping. External scoping was conducted by posting this project on the LSFO's on-line National Environmental Policy Act (NEPA) register beginning on June 30, 2014. A 30 day comment period on the preliminary EA was announced by press release. The press release was posted in the Craig Daily Press and the Steamboat Pilot and Today newspapers and was also posted on the LSFO website, https://www.blm.gov/epl-front-office/eplanning/nepa/nepa_register.do. The preliminary EA underwent a 30 day public comment period from March 2 – April 2, 2015. Three emails and one letter were received with comments on the preliminary EA. The comments and comment responses are in Appendix D.

## CHAPTER 2 – PROPOSED ACTION AND ALTERNATIVES

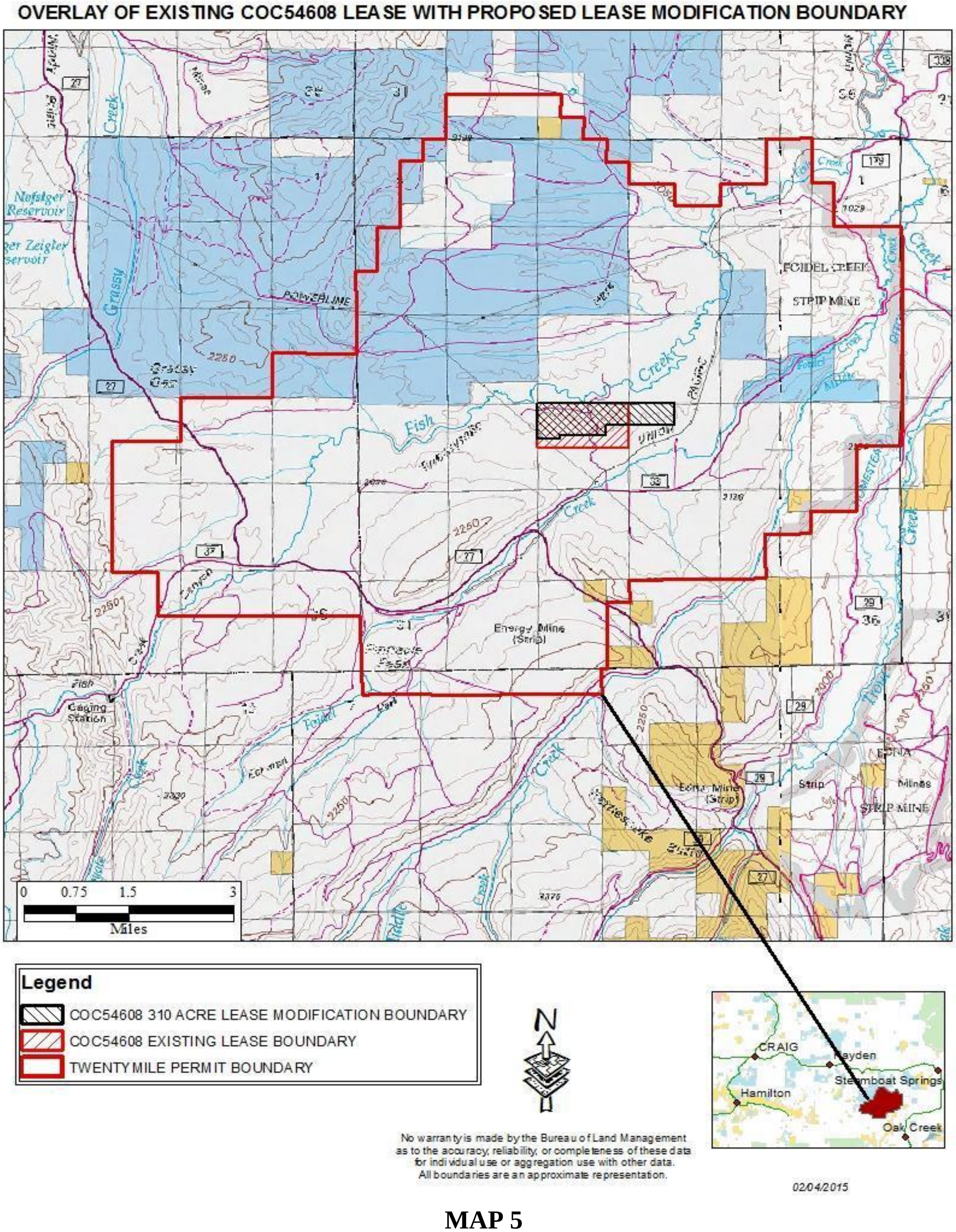
### 2.1 Alternatives Analyzed in detail

### 2.1.1 Proposed Action

The Proposed Action is to issue a federal coal lease modification to existing federal lease COC54608. Lease COC54608 was issued in February 1996 for 2,600 acres. Mining in this lease boundary occurred from June 1996 to September 2001. In August 2002, TC relinquished 2,280 acres of lease COC54680. The current COC54608 lease contains 320 acres of the Wadge seam federal coal, which has been recovered. The proposed lease modification would add approximately 310 acres of the Wolf Creek seam to existing coal lease COC54608 for underground development and production of federal coal reserves, in accordance with applicable laws and regulations, including terms and conditions for protecting non-mineral resources. The lease modification would add 230 acres of unleased coal below the existing 320 acre boundary of COC54608, and 80 acres of unleased federal coal contiguous to lease COC54608 (see Maps 2, 3, 4, and 5) for a total of 310 acres of the Wolf Creek seam. Under the proposed action, the life of the current mine would be extended by approximately 1 year.


PROPOSED LEASE MODIFICATION BOUNDARY
Legend
COC54608 PROPOSED LEASE MODIFICATION BOUNDARY
TWENTYMILE PERMIT BOUNDARY
Miles
0 0.75 1.5 3
No warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual use or aggregation use with other data. All boundaries are an approximate representation.
02/04/2015
CRAIG
Hayden
Steamboat Springs
Hamilton
Oak Creek
Fish Creek
Energy Mine (Strip)
FOIDEL CREEK STRIP MINE
POWERLINE
Grassy Gap

**MAP 4**



OVERLAY OF EXISTING COC54608 LEASE WITH PROPOSED LEASE MODIFICATION BOUNDARY
Legend
COC54608 310 ACRE LEASE MODIFICATION BOUNDARY
COC54608 EXISTING LEASE BOUNDARY
TWENTYMILE PERMIT BOUNDARY
0 0.75 1.5 3
Miles
N
CRAIG
Hayden
Steamboat Springs
Hamilton
Oak Creek
FOIDEL CREEK
STRIP MINE
Energy Mine (Strip)
POWERLINE
Nofsiger Reservoir
No warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual use or aggregation use with other data. All boundaries are an approximate representation.
02/04/2015


**MAP 5**

**Reasonably Foreseeable Mine Operations Plan**

If the lease modification is approved, development of the coal resources of the Wolf Creek seam would occur in a similar manner as the current operations, using the existing surface facilities upon approval of a Permit Application Package by DRMS. The Wolf Creek seam would be mined using a longwall. Mains and longwall panel gateroads would be developed using continuous miner units. A continuous miner unit would consist of a continuous miner, shuttle cars, roof bolter, belt feeder and conveyor belts. A longwall system would be used to mine the coal in the longwall panels (see Figure 1). A longwall system includes a shearer, face conveyor and shields. As the coal is sheared from the face, the face conveyor transports the coal to a crusher which dumps the crushed coal on to a conveyor belt. Additional conveyor belts transport the coal to the surface. Adding the lease modification would allow TC to maximize coal recovery by extending the length of the planned longwall panels.

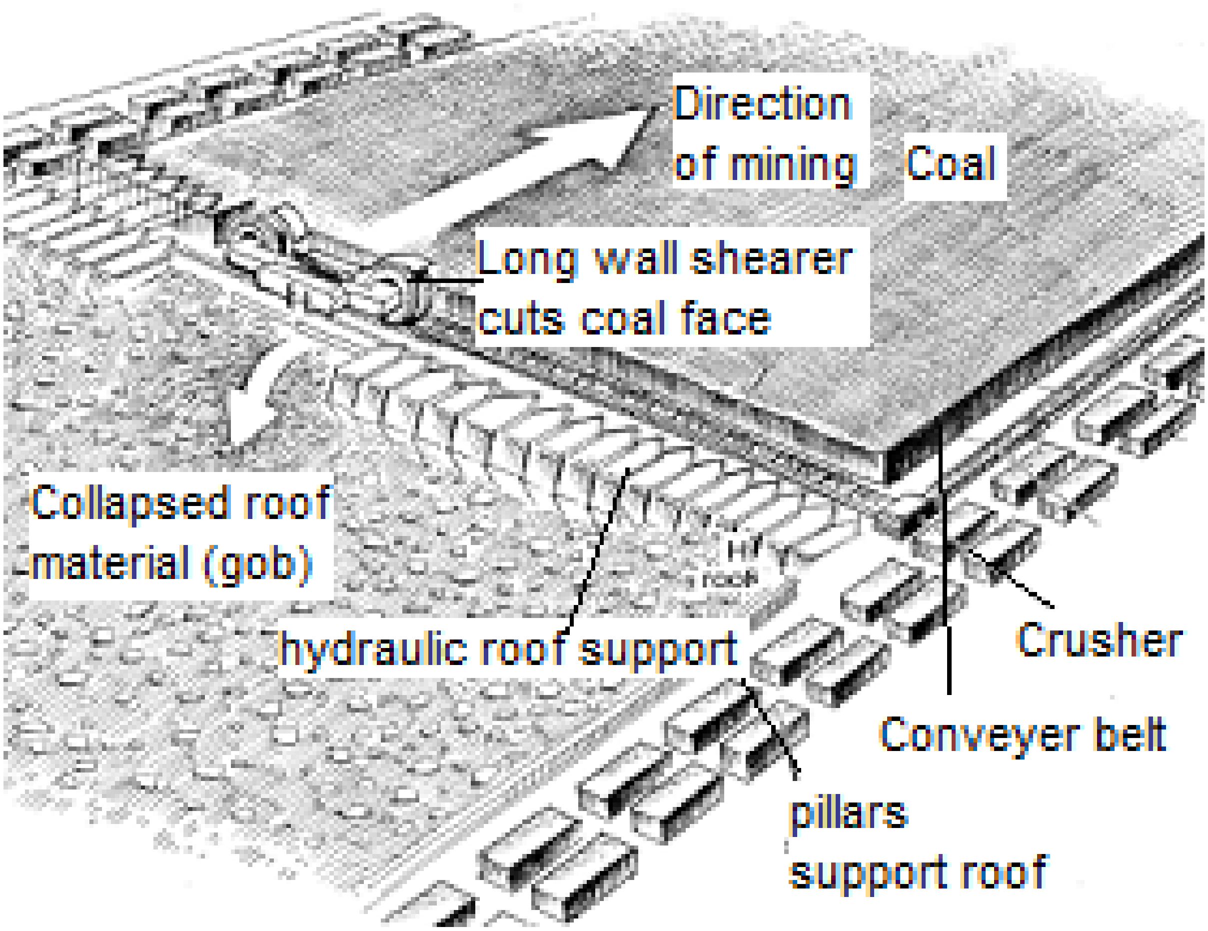



**Figure 1**
**Schematic of Longwall Mining**

There would be no new or additional surface facilities needed for the mining of the lease modification. There would be no surface mining associated with the lease modification; unsuitability criteria apply only to surface coal mining, not to underground mining.[2] All ventilation of the mine workings would be provided by existing fans. The existing belt conveyor would transport the coal to the existing Foidel Creek surface facilities. The lease modification would allow TC to continue operations by providing a logical extension to the mine's current Wadge and Wolf Creek seam operation. TC is using a 985 ft. long longwall to mine the Wadge seam. The same or a similar longwall system would be used to mine the Wolf Creek coal seam included in the lease modification. The longwall panels in the Wolf Creek seam would be mined in the same orientation as the Wadge seam (NE-SW). Portions of bleeder[3] entries and one panel would be in the proposed lease modification. Pillars would be left in place in the bleeders and full extraction of the coal would occur in the longwall block. Annual production from the mine (federal, private and state leases) would be approximately 4 million tons.

Controlled subsidence (i.e. the land surface lowered as a result of mining) would occur over the longwall panels. TC's maximum predicted subsidence above the longwall panels in the lease modification area would be 64 inches for overburden thickness of 1,000 feet. Subsidence monitoring above a previously mined longwall panel in the Wadge seam showed subsidence to be less than predicted. Mining of longwall panels has already occurred beneath Routt County Road 27, Union Pacific Railroad's Energy Spur, and the Archer-Hayden and Craig-Hayden-Steamboat Power Line. Subsidence from longwall mining has not interfered with the use of these structures.

### 2.1.2 No Action Alternative

The existing lease would not be modified. Approximately 340,000 tons of federal coal would be bypassed. The life of the mine would not be extended by 1year; production would end with depletion of the existing recoverable reserves. The mine workforce would be significantly reduced and the mine would be closed and reclaimed.

## 2.2 Alternatives Considered But Not Analyzed in Detail

If an alternative is considered during the environmental analysis process, but the agency decides not to analyze the alternative in detail, the agency must identify those alternatives and briefly explain why they were eliminated from detailed analysis (40 CFR 1502.14). An alternative may be eliminated from detailed analysis if:

- It is ineffective (does not respond to the Purpose and Need for the Proposed Action);
- It is technically or economically infeasible (considering whether implementation of the alternative I likely, given past and current practice and technology);
- It is inconsistent with the basic policy objectives for the management of the area(such as, not in conformance with the Resource Management Plan [RMP]);

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[2] CODE OF FEDERAL REGULATIONS 43 CFR § 3461.1

[3] Bleeders are entries surrounding an area being mined or which has been mined out. Bleeders are an MSHA requirement for ventilation in underground coal mines.

- Its implementation is remote or speculative;
- It would cause unreasonable environmental harm;
- It is substantially similar in design to an alternative that is analyzed; and/or
- It would result in substantially similar impacts to an alternative that is analyzed.

Alternatives specific to this EA that were considered, but that will not be analyzed in detail, are discussed below.

### 2.2.1 Alternatives Considered But Eliminated from Detailed Analysis

**Methane Capture**

Methane is released as a direct result of the physical process of coal extraction. Methane concentrations between 5-15% are explosive. Methane concentrations must be less than 1% to protect underground workers (30 CFR § 75.323). Underground coal mining techniques release methane previously trapped within the coal seam into the air supply of the mine as layers of the coal face are removed, thus creating a potential safety hazard. Methane emissions arise from the collapse of the surrounding rock strata after a section of the coal seam has been mined and the artificial roof and wall supports are removed as mining progresses to another section. The debris resulting from the collapse is known as gob and also releases methane or 'gob gas' into the mine.[3]

Coalbed methane or coal-mine methane (CMM) is a form of natural gas that can be extracted from coal beds. In recent decades it has become an important source of energy in many countries. An alternative that was considered but eliminated from detailed analysis is capturing the CMM from the mining of the additional 310 acres of the coal. This alternative was eliminated from analysis because it is technically infeasible and its implementation is remote or speculative. The obstacles include technical challenges, unresolved legal issues concerning ownership of the coalbed methane resource, power prices, and pipeline capacity, quantity of gas, and quality constraints.

Methane released from the worked coal face can be diluted and removed by large ventilation systems designed to move vast quantities of air through the mine. These systems dilute methane within the mine to concentrations below the explosive range of 5-15%, with a target for methane concentrations under 1%. The ventilation systems move the diluted methane out of the working areas of the mine into shafts leading to the surface. The methane removed from working mines via this technique is known as Ventilation Air Methane (VAM).[4] The VAM is released through the ventilation shafts and released directly into the atmosphere. VAM has the lowest concentration levels of all forms of methane from coal seams because of its high exposure to air; often displaying levels of 0.05-0.8%.

To pre-empt the release of gob gas from post mining collapse, it is possible for vertical gob wells to be drilled directly into the coal seam's surrounding strata before mining activities pass through that section. These pre-drilled wells can then remove the gob gas once the collapse takes place, thus avoiding the release of methane directly into the mine.

[4] http://www.worldcoal.org/coal/coal-seam-methane/coal-mine-methane/

All of the methane from the 310 acre lease modification and from the mine can be vented through the mine ventilation system efficiently. TC does not use gob wells (gob vent boreholes) because the methane concentrations of the mine are low and can be vented through the existing mine ventilation system to keep concentrations within Mine Safety and Health Administration (MSHA) regulations. Additionally, a gob well would require surface disturbance, which would cause environmental impacts.

There is no surface disturbance associated with the proposed action. Currently, there are more than 1,000 underground coal mines in the U.S. There are presently only 15 coal mine methane recovery and utilization projects at active underground coal mines (Environmental Protection Agency (EPA) Coalbed Methane Outreach Program (CMOP), 2011). Twentymile Coal is not a gassy mine and was not identified as a candidate for methane recovery in the CMOP report. A 2012 study by Vessels Coal Gas Inc., in the Paonia to Somerset corridor evaluated the need for volumes on the order of 10,000,000 cubic feet per day of methane to justify the costs for gas treating and pipeline facilities that would be required to access commercial natural gas markets (DOI-BLM-CO-S050-2013-0010EA). The volume of methane from TC's main fan averaged 80,600 cubic feet of methane per 24 hour period for the first 8 months of 2014. TC's secondary fan averaged 3,500 cubic feet of methane per 24 hour period for the first 8 months of 2014.[5]

Practical constraints on commercial development of methane or natural gas in this area include the depth of the resource, the occurrence of the resource, resource quality and quantity, and limitations relative to effective resource development and production and the mine life. EPA's Identifying Opportunities for Methane Recovery at U.S. Coal Mines, Revised 2009 states:

"Life expectancy refers to the number of years left in the mine's plan for mining coal; it can be an important factor in determining whether a mine is a good candidate for a methane recovery and use project." Prediction of mine life is difficult and speculative. Currently, Twentymile expects to mine the Wadge until June of 2016. Mining of the Wolf Creek seam in State and fee coal could extend the mine life an additional 10 years or more, but mine life is dependent on numerous factors, and can easily change. Mining of the 310 acre lease modification is estimated to occur over 7 years. With respect to resource quality and quantity, methane liberation and resulting concentrations from the Wolf Creek coal seam are low, and any methane released is further diluted by mine ventilation air, with the result that the concentration of any methane discharge from mining operations (as a component of ventilation exhaust air) is so low that it renders practical collection and concentration of the resource for sale and use infeasible. Even if collection and concentration were feasible, a network of collection pipelines, compressors and storage tanks would be necessary to collect, store, and transport the methane.

Since there is no gas transmission pipeline in the immediate area, the gas would have to be trucked from a central temporary storage point to either a pipeline transfer point or gas processing plant. A market for the gas would also have to exist. Only high quality gas (>95% methane) can be used for pipeline injection, if a pipeline existed. The economic viability of capturing the gas is limited due to the quantity

[5] Email from TC to BLM, 9/1/2014.

and quality of the gas and the infrastructure required for distribution. Technologies for Ventilation Air Methane (VAM) Capture are still in the developmental stage and cost information is still limited (EPA CMOP, 2011).

Therefore, the implementation of methane capture is unlikely, given past and current practice and technology.

**Methane Flaring**

The alternative to flare the methane created by mining an additional 310 acres of the Wolf Creek coal seam was also considered and eliminated from detailed analysis. BLM determined it to be technically or economically infeasible and its implementation is remote and speculative.

The Environmental Protection Agency is currently sponsoring research and outreach efforts to coal mine operators to encourage coalbed and coal mine methane capture or flaring (refer to www.epa.gov/coalbed). The methodology for flaring methane emissions from underground coal mines is emerging, but remains technologically speculative at this time. In 2014, 20 methane flaring projects were operating in 7 countries.[6] The only methane flaring project in the U.S. is at a trona (soda ash) mine in Green River, Wyoming. The hazard that flaring could create relative to the potential for an underground ignition has not been clearly dismissed by current technology. MSHA does not have regulations that would govern this activity, but has expressed concerns relative to safety with respect to the potential for propagation of fire through methane drainage boreholes into underground mines. MSHA would not approve flaring without significant preliminary testing to assure the safety of the miners. There would also be an associated potential fire hazard where flammable brush, trees, or other vegetation exists in close proximity to the wellhead. The BLM does not have a policy governing flaring of gas from coal mining operations, so the issue of whether or not a gas lease would be required is unclear. These outstanding questions would have to be resolved if flaring is considered as an alternative to discharging methane into the atmosphere.

In addition, all of the methane from the 310 acre lease modification and from the mine can be vented through the mine ventilation system safely and efficiently. Twentymile does not use methane drainage wells because the methane concentrations are low and can be vented through the existing mine ventilation system to keep concentrations within Mine Safety and Health Administration (MSHA) regulations. Additionally, methane drainage wells would require surface disturbance, which would cause environmental impacts.

Flaring of methane would result in the release of other air pollutants, including nitrogen oxides, carbon dioxide, and carbon monoxide; these pollutants are regulated by the EPA for national ambient air quality standards. Methane is not a regulated gas. Therefore, the implementation of methane flaring is unlikely, given past and current practice and technology.

[6] http://www.epa.gov/cmop/docs/CMM-Flaring-Flyer-Sept-2014.pdf

## CHAPTER 3 – AFFECTED ENVIRONMENT AND EFFECTS

### 3.1 Affected Resources

The CEQ Regulations state that NEPA documents "must concentrate on the issues that are truly significant to the action in question, rather than amassing needless detail" (40 CFR 1500.1(b)). While many issues may arise during scoping, not all of the issues raised warrant analysis in an environmental assessment (EA). Issues will be analyzed if: 1) an analysis of the issue is necessary to make a reasoned choice between alternatives, or 2) if the issue is associated with a significant direct, indirect, or cumulative impact, or where analysis is necessary to determine the significance of the impacts. Table 1 lists the resources considered and the determination as to whether they require additional analysis.

**Table 1.** Resources and Determination of Need for Further Analysis

| Determination [1] | Resource | Rationale for Determination |
|---|---|---|
| **Physical Resources** | | |
| PI | Air Quality | See Chapter 3 |
| NI | Floodplains | The proposed action does not alter the surface hydrology such that flood hazards are increased. If the stream channel grades are increased, the functionality of the floodplains could be altered. |
| PI | Hydrology, Ground | See Chapter 3 |
| PI | Hydrology, Surface | See Chapter 3 |
| NP | Minerals, Fluid | There are no fluid mineral authorizations within the proposed action. |
| PI | Minerals, Solid | See Chapter 3 |
| NI | Soils | The proposed action would not affect soil resources. |
| PI | Water Quality, Ground | See Hydrology, Ground |
| PI | Water Quality, Surface | See Hydrology, Surface |
| **Biological Resources** | | |
| NI | Invasive, Non-native Species | All activity as part of the lease modification occurs underground - no activity that disturbs or modifies invasive, non-native species is proposed. Surface ownership above the coal lease is private. |
| PI | Migratory Birds | Underground coal mining would not impact use of the surface by migratory birds. Any subsidence that occurs would not be enough modify habitat. . Please see Sections 3.1.1 and 3.1.3 for a discussion on indirect impacts due to coal combustion. |
| PI | Special Status Animal Species | See Section 3.1.3. |
| NP | Special Status Plant Species | There are no federally listed threatened, endangered, or BLM sensitive plant species populations identified within the vicinity of the proposed project area. |

| | | |
|---|---|---|
| NI | Upland Vegetation | No impacts are anticipated; there would be no new surface disturbance associated with the Proposed Action. |
| NI | Wetlands and Riparian Zones | There would be no mining and no subsidence below Foidel Creek or Fish Creek. |
| PI | Wildlife, Aquatic | Underground coal mining would not impact use of the surface by wildlife. Any subsidence that occurs would not be enough to modify habitat. Please see Sections 3.1.1 and 3.1.3 for a discussion on indirect impacts due to coal combustion. |
| PI | Wildlife, Terrestrial | Underground coal mining would not impact use of the surface by wildlife. Any subsidence that occurs would not be enough modify habitat. Some disturbance may occur during the mining phase of the project, however, since this mine has been operating for many years wildlife have either habituated to this disturbance or have likely left the area. . Please see Sections 3.1.1 and 3.1.3 for a discussion on indirect impacts due to coal combustion. |
| NI | Wild Horses | The Sand Wash Herd Management Area is not near the project area. |
| **Heritage Resources and the Human Environment** | | |
| PI | Cultural Resources | See Chapter 3 |
| NI | Environmental Justice | According to Census 2013, the only minority population of note in the impact area is the Hispanic community of Routt County. Hispanic or Latino represented 7% of the population, considerably less the Colorado state figure for the same group, 21.0%. Blacks, American Indians, Asians and Pacific Islanders accounted for around 2% of the population, below the comparable state figure in all cases. The census counted 7.5% of the Routt County population as living in families with incomes below the poverty line, compared to 12.9% for the entire state. Both minority and low income populations are dispersed throughout the county therefore no minority or low income populations would suffer disproportionately high and adverse effects as a result of any of the alternatives. |
| PI | Hazardous or Solid Wastes | See Chapter 3 |
| NP | Lands with Wilderness Characteristics | Subject to WO-IM 2011-154 and in accordance with BLM policy, the proposed project area does not have any parcels that meet the minimum size requirements for inventory finding of the presence of lands with wilderness characteristics. Size requirements are based on whether parcels are within roadless areas greater than 5,000 acres or are directly adjacent to designated wilderness or WSAs. |
| NI | Native American Concerns | Based on available information, the proposed lease modification is not expected to affect areas or sites of concern to the Native American people who inhabited northwest Colorado in historic times (the Utes and the Shoshone). The lease modification is not within an area known to be of concern to the tribes, nor are sites known to be of concern to the tribes located on ground within the lease modification boundary. As discussed in the previous section on cultural resources, a prehistoric campsite was recorded within the bounds of the lease modification as 5RT177. No artifacts diagnostic of a particular prehistoric time period or cultural group were collected from the site. Based on the artifacts recovered, therefore, |

| | | |
|---|---|---|
| | | the site cannot be specifically and definitively attributed to the Utes or the Shoshone. |
| PI | Paleontological Resources | See Chapter 3 |
| PI | Social and Economic Conditions | See Chapter 3 |
| NI | Visual Resources | The surface area is managed as Class III, where the level of change to the characteristic landscape should be moderate and where management activities may attract attention but should not dominate the view of the casual observer. Since the project is underground, the coal lease modification would not impact the visual resources on the surface. If any surface activity does occur in conjunction with the lease modification, it would have minimal impact since the proposed modification occurs under private surface in areas that have already been modified by roads, oil and gas, and agricultural development. |
| **Resource Uses** | | |
| NP | Access and Transportation | The proposed project would occur on private lands where there is no public access. |
| NP | Fire Management | No BLM surface is involved; therefore BLM fire management would not be impacted. |
| NP | Forest Management | This resource is not present in the project boundary. |
| NI | Livestock Operations | There would be no impact to surface livestock activities based on the nature of the Proposed Action and the limited amount of public lands being grazed within the lease area. |
| NP | Prime and Unique Farmlands | There are no Prime and Unique Farmlands in the project boundary. |
| NP | Realty Authorizations, Land Tenure | There are no ROW's in the proposed project area. There are no land tenure adjustments currently proposed in the area. |
| NP | Recreation | The proposed project area is located on private lands where there is no public access for recreational activities. |
| **Special Designations** | | |
| NP | Areas of Critical Environmental Concern | The Irish Canyon ACEC is not in the vicinity of the proposed project area and, therefore, would not be affected by the proposed action(s). |
| NP | Wilderness Study Areas | There are no WSAs in the vicinity of the proposed project area and, therefore, would not be affected by the proposed action(s). |
| NP | Wild and Scenic Rivers | There are no eligible rivers in the vicinity of the proposed project area and, therefore, would not be affected by the proposed action(s). |

[1] NP = Not present in the area impacted by the Proposed Action or Alternatives. NI = Present, but not affected to a degree that detailed analysis is required. PI = Present with potential for impact analyzed in detail in the EA.

### 3.1.1 Air Quality

*Affected Environment:* The Foidel Creek Mine is located in the central portion of Routt County, Colorado (Township 5 North, Range 86 West, and Township 5 North, Range 87 West), approximately 21 miles Southeast of Hayden, Colorado (population approx. 1,600), and south of State Highway 40 between the towns of Steamboat Springs to the east and Craig to the west. Topography in the project area and adjacent lands ranges in elevation from approximately 6,600 feet to 7,800 feet. The average elevation of the project area is approximately 7,040 feet. Terrain varies from rolling hills with agricultural fields and rangeland in the northwestern, central, and extreme southern extents of the project area to high ridges and steep slopes within the eastern and southwestern portions of the project area. The normal temperatures (min and max) for the area range from 4.8 to 29.1 ˚F in January to 46.9 to 83.7 ˚F in July. The regional average annual precipitation amounts to approximately 19.01 inches, which according to historical records shows the lower elevations receiving relatively higher precipitation amounts in summer, while the higher elevations receive relatively higher amounts of precipitation in winter. Average annual wind resultants are generally from the east south east at speeds of approximately 3.6 to 8.8 mph for a majority of the time.

The U.S. Environmental Protection Agency (EPA), as directed by the Clean Air Act (CAA), has established national ambient air quality standards (NAAQS) for criteria pollutants. Criteria pollutants are air contaminants that are commonly emitted from the majority of emissions sources and include carbon monoxide (CO), lead (Pb), sulfur dioxide ($SO_2$), particulate matter smaller than 10 and 2.5 microns ($PM_{10}$ and $PM_{2.5}$, respectively), ozone ($O_3$), and nitrogen dioxide ($NO_2$). Please note that ozone is generally not directly emitted from sources, but is chemically formed in the atmosphere via interactions of oxides of nitrogen ($NO_X$) and volatile organic compounds (VOCs - carbon containing compounds that readily evaporate into air) in the presence of sunlight and under certain meteorological conditions ($NO_X$ and VOCs are ozone precursors). Exposure to air pollutant concentrations greater than the NAAQS has been shown to have a detrimental impact on human health and the environment. The EPA regularly reviews the NAAQS (every five years) to ensure that the latest science on health effects, risk assessment, and observable data such as hospital admissions are evaluated, and can revise any NAAQS if the data supports a revision. The current NAAQS levels are shown in Table 3.1 below. Ambient air quality standards must not be exceeded in areas where the general public has access.

The CAA established two types of NAAQS:

> **Primary standards:** Primary standards set limits in order to protect public health, including the health of "sensitive" populations (such as asthmatics, children, and the elderly).
> **Secondary standards:** Secondary standards set limits in order to protect public welfare, including protection against decreased visibility, and damage to animals, crops, vegetation, and buildings.

The EPA has delegated regulation of air quality to the State of Colorado (for approved State Implementation Plan (SIP) elements). The Colorado Department of Public Health and Environment (CDPHE), Air Pollution Control Division (APCD) administers Colorado's air quality control programs, and is responsible for enforcing the state's air pollution laws.

The CAA and the Federal Land Policy and Management Act of 1976 (FLPMA) require the BLM to ensure actions taken by the agency comply or provide for compliance with federal, state, tribal, and local air quality standards and regulations. FLPMA further directs the Secretary of the Interior to take any action necessary to prevent unnecessary or undue degradation of the lands [Section 302 (b)], and to manage the public lands "in a manner that will protect the quality of scientific, scenic, historical, ecological, environmental, air and atmospheric, water resource, and archeological values" [Section 102 (a)(8)].

**Table 2 Ambient Air Quality Standards**

| Pollutant [final rule citation] | | Standard Type | Averaging Period | Level | Form |
|---|---|---|---|---|---|
| Carbon Monoxide [76 FR 54294, Aug 31, 2011] | | Primary | 8-hour | 9 ppm | Not to be exceeded more than once per year |
| | | | 1-hour | 35 ppm | |
| Lead [73 FR 66964, Nov 12, 2008] | | Primary and secondary | Rolling 3-month average | 0.15 µg/m3 | Not to be exceeded |
| Nitrogen Dioxide [75 FR 6474, Feb 9, 2010] | | Primary | 1-hour | 100 ppb | 98th percentile, averaged over 3 years |
| [61 FR 52852, Oct 8, 1996] | | Primary and secondary | Annual | 53 ppb | Annual mean |
| Ozone [73 FR 16436, Mar 27, 2008] | | Primary and secondary | 8-hour | 0.075 ppm | Annual fourth-highest daily maximum 8-hr concentration, averaged over 3 years |
| Particulate Matter [73 FR 3086, Jan 15, 2013] | PM2.5 | Primary | Annual | 12 µg/m3 | Annual mean, averaged over 3 years |
| | | Secondary | Annual | 15 µg/m3 | Annual mean, averaged over 3 years |
| | | Primary and secondary | 24-hour | 35 µg/m3 | 98th percentile, averaged over 3 years |
| | PM10 | Primary and secondary | 24-hour | 150 µg/m3 | Not to be exceeded more than once per year on average over 3 years |
| Sulfur Dioxide [75 FR 35520, Jun 22, 2010] | | Primary | 1-hour | 75 ppb | 99th percentile of 1-hour daily maximum concentrations, averaged over 3 years |
| Colorado (State Only) | | Primary and Secondary | 3-hour | 267 ppb | Not to be exceeded in any 12 month period |
| [38 FR 25678, Sept 14, 1973] | | Secondary | 3-hour | 0.5 ppm | Not to be exceeded more than once per year |

Source: National – 40 CFR 50, Colorado – 5 CCR 1001-14.

µg/m3 = micrograms per cubic meter, ppb = parts per billion, ppm = parts per million.

## Existing Regional Air Quality

Air quality for any area is generally influenced by the amount of pollutants that are released within the vicinity and up wind of that area, and can be highly dependent upon the contaminants' chemical and physical properties. Additionally, an area's topography or terrain (such as mountains and valleys) and weather (such as wind, temperature, air turbulence, air pressure, rainfall, and cloud cover) will have a direct bearing on how pollutants accumulate or disperse. Ambient air quality in the affected environment (i.e. compliance with the NAAQS) is demonstrated by monitoring for ground level atmospheric air pollutant concentrations. The APCD monitors ambient air quality at a number of locations throughout the state. The data is summarized by monitoring regions and CDPHE prepares an annual report (Annual Air Quality Reports) to inform the public about air quality trends within these regions. Similarly, several Federal Land Managers (FLMs) like the BLM, FS, and NPS, also monitor air quality for NAAQS and Air Quality Related Values (AQRVs) to meet or measure for mandated requirements. Table 3 below presents three years of monitoring data for criteria pollutants (with the exception of lead) for Routt (project location), Moffat, Rio Blanco, and Jackson Counties. The maximum monitoring value is presented where multiple monitors exist that monitor for the same pollutant within any single county. Concentrations are in units of the standard's form (see the "Level" column in Table 2 above), with the exception of the ozone data, which is shown as the 4th highest 8-hour average. To compute the ozone design value (3 year average of the 4th highest 8-hour max), sum all three years of data (if available) and divide by three.

**Table 3 Ambient Air Quality Monitoring Data**

| County | Pollutant | Standard | Monitored Values | | |
|---|---|---|---|---|---|
| | | | 2011 | 2012 | 2013 |
| Jackson | CO | 1-hour | | 0.2 | 0.2 |
| Jackson | CO | 8-hour | | 0.3 | 0.3 |
| Jackson | NO2 | 1-hour | 2 | 5 | 6 |
| Jackson | O3 | 8-hour | | 0.059 | 0.064 |
| Moffat | O3 | 8-hour | 0.06 | 0.066 | 0.065 |
| Rio Blanco | NO2 | 1-hour | 23 | 19 | 24 |
| Rio Blanco | O3 | 8-hour | 0.073 | 0.069 | 0.091 |
| Rio Blanco | PM2.5 | 24-hour | 21.5 | 33.4 | 26.7 |
| Rio Blanco | PM2.5 | Annual | 9.9 | 9.9 | 9.1 |
| Routt | PM10 | 24-hour | 79 | 93 | 77 |

**Emissions Source Classifications & Regulatory Authority**

Emissions sources are generally regulated according to their type and classification. Essentially all emissions sources fall into two broad categories, stationary and mobile. Stationary sources are generally non-moving, fixed-site producers of pollution such as power plants, chemical plants, oil refineries, manufacturing facilities, and other industrial facilities.

This source class can also cover certain types of portable sources (based on regulatory technicalities). Stationary facilities emit air pollutants via process vents or stacks (point sources) or by fugitive releases (emissions that do not pass through a process vent or stack). Stationary sources are also classified as major and minor. A major source is one that emits, or has the potential to emit, a regulated air pollutant in quantities above defined CAA thresholds.

Stationary sources that are not major are considered minor or area sources. Sources that take federally enforceable limits on production, consumption rates, or emissions to avoid major source status are called synthetic minors. The APCD has authority under their approved SIP to issue Air Permits for stationary sources of pollution in Colorado.

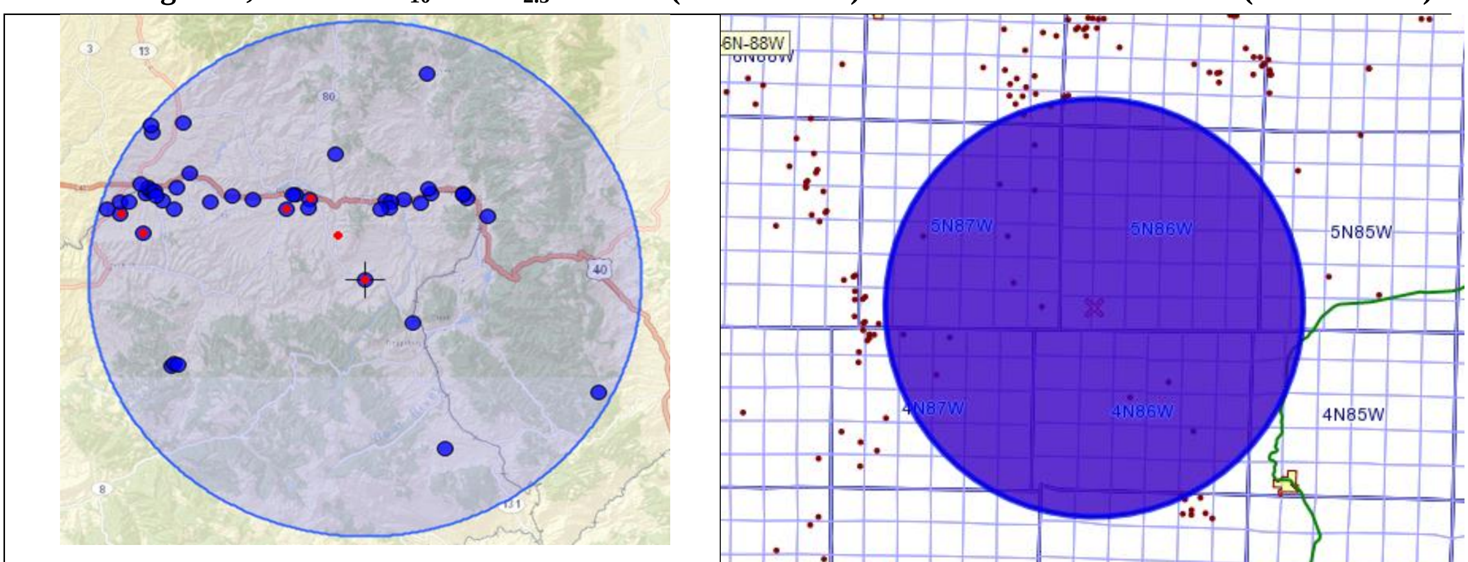
Mobile sources include any air pollution that is emitted by motor vehicles, engines, and equipment that can be moved from one location to another (typically under their own power). Due to the large number of sources, which includes cars, trucks, buses, locomotives, construction equipment, lawn and garden equipment, aircraft, watercraft, motorcycles, etc…, and their ability to move from one location to another, mobile sources are regulated differently than stationary sources. In general EPA and other federal entities retain authority to set emissions standards for these sources depending on their type (on-road or off-road) and class (light duty, heavy duty, horse power rating, weight, fuel types, etc…). Mobile sources are not regulated by the state (an exception being California) unless they are covered under an applicable SIP specific to a non-attainment or maintenance area requirement.

Table 4 below provides the most recent National Emissions Inventory (NEI) data for Routt County. As previously stated, air quality is generally a function of emissions loading within any particular region. With respect to the Foidel Creek Mine the following emissions inventories are provided to describe the affected environment in terms of current cumulative emissions intensities in Routt County.

**Table 4, Routt County NEI Data (2011)**

| Routt | PM10 | PM2.5 | VOC | CO | NOX | SO2 | CO2 | CH4 | N2O | NH3 | HAPs |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Agriculture | 244.73 | 48.94 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 393.53 | 0 |
| Biogenics | 0 | 0 | 26,888.2 | 2,440.82 | 143.76 | 0 | 0 | 0 | 0 | 0 | 1,547.4 |
| Commercial Cooking | 21.74 | 20.16 | 2.8 | 8.09 | 0 | 0 | 0 | 0 | 0 | 0 | 1.09 |
| Dust | 5,766.67 | 817.51 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Fires | 1,061.99 | 899.32 | 2,500.61 | 10,657.19 | 118.3 | 71.6 | 110,221.91 | 514.06 | 0 | 173.81 | 218.89 |
| Fuel Comb | 131.63 | 127.89 | 119.54 | 1,095.08 | 6,453.77 | 2,163.19 | 0 | 0 | 0 | 31.28 | 22.94 |
| Gas Stations | 0 | 0 | 53.93 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1.11 |
| Industrial Processes | 534.12 | 143.39 | 223.81 | 31.59 | 18.03 | 0.07 | 0 | 0 | 0 | 0 | 4.24 |
| Miscellaneous | 0 | 0 | 15.92 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1.17 |
| Mobile | 70.93 | 61.82 | 604.48 | 5,046.19 | 1,030.94 | 7.89 | 185,391.59 | 16.1 | 6.32 | 10.27 | 153.83 |
| Solvent | 0 | 0 | 150.76 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 88.73 |
| Waste Disposal | 17.28 | 9.94 | 2.3 | 0.17 | 0.21 | 0.13 | 0 | 0 | 0 | 0.09 | 0.21 |
| **Sum Totals:** | **7,849.09** | **2,128.97** | **30,562.35** | **19,279.14** | **7,765.01** | **2,242.87** | **295,613.49** | **530.17** | **6.32** | **608.98** | **2,039.6** |

**Figure 1, APCD $PM_{10}$ & $PM_{2.5}$ Sources (50km buffer)[1] & COGCC Well locations (10km buffer)[2]**




[1] 50km Buffer Map of $PM_{10}$ sources generated from the following APCD website: http://www.colorado.gov/airquality/ss_map_wm.aspx, Foidel Creek Mine located at crosshair in the center of the buffer area. **Note:** Blue dots indicate all permitted or APEN sources in APCD Database, red highlights are for sources emitting PM10 > 85 percentile emissions for all APCD PM10 (1,060 tpy) & PM2.5 (600 tpy) sources.

2 10km Buffer Map of Well Locations generated from the following COGCC website: http://dnrwebcomapg.state.co.us/mg2010app/, Foidel Creek Mine located at blue "X" in the center of the buffer area. NOTE: A well location does not necessarily mean an active well. Current O&G intensity within Routt Co. (2013) Oil = 61,510 bbl, Gas = 123,449 Mcf, Produced Water = 11,957 bbl

## Criteria Pollutants

All the criteria pollutants shown in the NAAQS table above can be directly emitted by various stationary and mobile sources, with the exception of ground level ozone and secondary $PM_{2.5}$ (also known as condensable particulate matter).

In general, ozone concentrations in the lower atmosphere are highest during warmer months; however in some parts of the western U.S. high winter-time ozone concentrations have been monitored. These events have generally been linked to areas subject to temperature inversions and consistent snow cover. It is hypothesized that adequate snow cover (depth) effectively reflects UV radiation striking the ground, essentially 'doubling' the effective path length and potential reaction rates of any ozone forming region in the atmosphere relative to the total available UV reaching the surface. Ozone formation and prediction is complex, non-linear, and generally results from a combination of significant quantities of VOCs and $NO_X$ emissions from various sources within a region. Once formed, ozone has the potential to be transported across long ranges. It is typically not appropriate to assess the potential ozone impacts that a single project (where increases in precursor emissions will occur) can have on regional ozone formation and transport.

According to the EPA fine particulate matter ($PM_{2.5}$) is chiefly comprised of five mass components: organic carbon, elemental carbon (also known as soot or black carbon), ammonium sulfates, ammonium nitrates, and crustal materials (i.e., soil). Primary fine particulate emissions result from combustion processes (including fossil fuel combustion and biomass combustion that occurs in wild fires) and include organic and black carbon. A minority component of primary $PM_{2.5}$ is made up of crustal elements (i.e. fugitive dust, generally 5-15%). Condensable particulate matter, or secondary $PM_{2.5}$ particles, are primarily ammonium sulfate and ammonium nitrate formed in the atmosphere from gaseous emissions of sulfur dioxide ($SO_2$) and oxides of nitrogen ($NO_X$), reacting with ammonia ($NH_3$). The largest constituents of fine particulate are usually organic mass, ammonium nitrates, and ammonium sulfates. Secondary particulates do not result from emissions of fugitive dust (which is the largest emissions category from the Foidel Creek Mine), and thus will not be discussed further in this document.

## Hazardous Air Pollutants

Toxic air pollutants, also known as hazardous air pollutants (HAPs), are those pollutants that are known or suspected to cause cancer or other serious health effects, such as reproductive effects or birth defects, or adverse environmental effects. The majority of HAPs originate from stationary sources (factories, refineries, power plants) and mobile sources (e.g., cars, trucks, buses), as well as indoor sources (building materials and cleaning solvents). No ambient air quality standards exist for HAPs, instead emissions of these pollutants are regulated by a variety of laws that target the specific source category and industrial sectors for stationary, mobile, and product use/formulations. The majority of HAPs emitted from the Foidel Creek mine's operations are the result of the on-road and non-road vehicle use. The largest component of the HAPs emissions from these sources are typically various benzene compounds, and the majority of them are emitted from spark ignition (gasoline fueled) combustion sources. This is simply due to the fact that benzene is present in larger per cent volumes in the fuel (typically 1.0% vs. 0.05% for diesel fuel). The majority of the vehicle emissions (all the trucks for underground transportation, scoops, graders, etc.) and all the surface equipment (dozers, loader, graders) are from diesel powered engines, and thus HAP emissions from these sources are de minimis or insignificant.

**Green House Gases**

There is broad scientific consensus that humans are changing the chemical composition of Earth's atmosphere. Activities such as fossil fuel combustion, deforestation, and other changes in land use are resulting in the accumulation of trace greenhouse gases (GHGs) such as carbon dioxide ($CO_2$), methane ($CH_4$), nitrous oxide (N2O), and several industrial gases in the Earth's atmosphere. An increase in GHG emissions is said to result in an increase in the earth's average surface temperature, primarily by trapping and thus decreasing the amount of heat energy radiated by the Earth back into space. The phenomenon is commonly referred to as global warming. Global warming is expected in turn, to affect weather patterns, average sea level, ocean acidification, chemical reaction rates, and precipitation rates, which is collectively referred to as climate change. The Intergovernmental Panel on Climate Change (IPCC) has predicted that the average global temperature rise between 1990 and 2100 could be as great as 5.8°C (10.4°F), which could have massive deleterious impacts on the natural and human environments. However, according to the Intergovernmental Panel on Climate Change, the world's surface temperatures have risen at a slower rate over the past 15 years than at any time since 1951.[7]

Although GHG levels have varied for millennia (along with corresponding variations in climatic conditions), industrialization and the burning of fossil carbon fuel sources have caused GHG concentrations to increase measurably, from approximately 280 ppm in 1750 to 400 ppm in 2014 (as of April). The rate of change has also been increasing as more industrialization and population growth is occurring around the globe. This fact is demonstrated by data from the Mauna Loa $CO_2$ monitor in Hawaii that documents atmospheric concentrations of $CO_2$ going back to 1960, at which point the average annual $CO_2$ concentration was recorded at approximately 317 ppm. The record shows that approximately 70% of the increases in atmospheric $CO_2$ concentration since pre-industrial times occurred within the last 54 years.

Carbon dioxide is emitted from the combustion of fossil fuels (oil, natural gas, and coal), solid waste, trees and wood products, and also as a result of other chemical reactions (e.g., manufacture of cement). Methane is emitted during the production and transport of coal, natural gas, and oil. Methane also results from livestock and other agricultural practices and by the decay of organics in both the natural environment and from wastes in municipal landfills.

Nitrous oxide is emitted during agricultural and industrial activities, as well as during combustion of fossil fuels and solid waste. Fluorinated gases are powerful greenhouse gases that are emitted from a

[7] ClimateWire, October 7, 2014, *Research: Conflicting ocean studies renew a scientific argument over a warming 'pause'*

variety of industrial processes and are often used as substitutes for ozone-depleting substances (i.e., CFCs, HCFCs, and halons).

These gases all have various capacities to trap heat in the atmosphere, which are known as global warming potentials (GWPs). Carbon dioxide has a GWP of 1, and so for the purposes of analysis a GHG's GWP is generally standardized to a carbon dioxide equivalent ($CO_2e$), or the equivalent amount of $CO_2$ mass the GHG would represent.
As with the HAPs, ambient air quality standards do not exist for GHGs. In its Endangerment and Cause or Contribute Findings for Greenhouse Gases under Section 202(a) of the Clean Air Act, the EPA determined that GHGs are air pollutants subject to regulation under the CAA. Under EPA's Mandatory Reporting Rule (74 FR 56260), Underground Coal Mines subject to the rule (i.e. emissions are above the reporting threshold) are required to report GHG emissions in accordance with the requirements of Subpart FF.

**Air Quality and Prevention of Significant Deterioration (PSD)**
Air quality for any given area (any geographical area that defines the class boundary) is designated as either attainment, or nonattainment. Attainment areas are those areas where criteria pollutant concentrations in ambient air do not exceed the NAAQS (or more stringent state standards) levels as outlined above. Areas or regions where criteria pollutant concentrations in ambient air exceed the NAAQS standards are designated as nonattainment. Additionally, two subset categories for attainment exist; for those areas where formal designations have not been made, i.e. Attainment/Unclassifiable (generally rural, or natural areas that lack sufficient air quality data), and for areas where previous violations of the NAAQS have been documented, but pollution concentrations no longer exceed NAAQS concentrations, i.e. Attainment/Maintenance areas. Routt County is designated as an attainment area for all NAAQS pollutants.

Air sheds are also assigned a priority Class (I, II, or III) which describes how much degradation to the existing air quality is allowed to occur within the area under the Prevention of Significant Deterioration (PSD) regulations. Class I areas are areas of special national or regional natural, scenic, recreational, or historic value, and essentially allow very little degradation in air quality (i.e. National Parks, Wilderness Areas), while Class II areas allow for reasonable economic growth. There are currently no Class III areas defined in Colorado. The closest PSD Class I areas (which require the most stringent protection for air quality) are the Mount Zirkel and Flat Tops Wilderness Areas, located approximately 30 miles to the Northeast and 18 miles South of the proposed lease modification area, respectively.

AQRVs are metrics for atmospheric phenomenon like visibility and deposition impacts that may adversely affect specific scenic, cultural, biological, physical, ecological, or recreational resources. Visibility changes can occur when excessive pollutant contaminants (mostly fine particles) scatter light such that the background scenery becomes hazy. Deposition can cause excess nutrient loading in native soils and acidification of the landscape, which can lead to declining buffering capacity changes in sensitive stream and lake water chemistries (commonly referred to as acid neutralization change (ANC)). Air pollutants are deposited by wet deposition (precipitation) and dry deposition (gravitational settling). The chemical components of wet deposition include sulfate ($SO_4$), nitrate ($NO_3$), and ammonium ($NH_4$); the chemical components of dry deposition include sulfate, sulfur dioxide ($SO_2$), nitrogen oxides ($NO_X$), nitrate, ammonium, and nitric acid ($HNO_3$). The NPS Technical Guidance on Assessing Impacts on Air Quality in NEPA and Planning Documents suggests that cumulative critical load values above 3 kg/ha-yr. (and lower in some sensitive areas) may result in moderate impacts to the landscape. AQRVs are important to FLMs because they have a mandate to ensure their Class I and sensitive Class II areas meet scientific (landscape nutrient loading) and congressionally mandated goals (i.e. regional haze). PSD sources (i.e. major sources under the CAA PSD definition) are required to provide an analysis to ensure their net emissions will not cause or contribute to a violation of any applicable NAAQS or PSD increment. In addition, the analysis required for permitting must include impacts to AQRVs. According to the most recent valid permit issued by CDPHE, the Foidel Creek Mine is not a major PSD source for any criteria pollutant.

*Environmental Consequences of the Proposed Action*

*Direct and Indirect Effects of the Proposed Action*
Implementation of the Proposed Action Alternative would result in emissions of criteria pollutants, hazardous air pollutants (HAPs), and greenhouse gases (GHGs). Fugitive particulate matter would be emitted when haul trucks and other vehicles associated with the mining activities travel on existing dirt roads or overland access routes to load-out locations. Emissions of particulate matter would be generated from processing equipment, material handling transfer points (including rail load-out locations), storage piles, and mine ventilation shafts. Air quality would also be impacted by fuel combustion sources, such as the engine exhaust emissions from locomotives, mobile material handling equipment, personnel transport equipment, and any stationary fuel combustion sources. Neither the proposed action nor the no action alternative would authorize emissions rates above those currently analyzed and authorized by CDPHE.

**Direct Emissions**
With the exception of particulate matter all of the directly emitted criteria pollutants originating from the mine's operations are from fuel combustion sources, such as mobile mining equipment, haul trucks, and stationary sources (emergency generators, light poles, heaters, etc…). HAPs and GHGs are also emitted from fuel combustion sources, albeit in de minimis amounts. Coal Mine Methane (CMM) would also be emitted by the ventilation air handling system required by MSHA to reduce the combustion / explosion potential of the mines underground atmosphere (also known as Ventilation Air Methane or VAM). Twentymile Coal, LLC does not drill gob vent boreholes (GVB) for its long wall operations at the Foidel Creek Mine to vent methane due to the area's naturally low occurring presence of the gas in the coal formation, overburden, and surrounding strata. Furthermore, the mine does not possess or plan on obtaining MSHA permits to authorize GVB drilling at this time. VAM will be the only source of CMM emissions at the Foidel Creek Mine.

Stationary sources (including any area and fugitive emissions) at the Foidel Creek Mine are regulated by CDPHE where applicable and are authorized by APCD permit number 93RO1204. The permit provides limitations and requirements to limit potential emissions from the site to below major source thresholds for certain criteria pollutants. The Foidel Creek Mine is currently classified as a synthetic minor source for all criteria pollutants and would therefore not be subject to the PSD rule requirements for permitting at this time. When pollutants are not explicitly addressed in an APCD permit it is due to the fact that those emissions are below CDPHE's permitting thresholds, or in the case of GHG's, are not part of the minor source permitting program. The Foidel Creek Mine last had its air permit revised and issued by APCD on Jan. 12, 2012. As previously stated Twentymile Coal, LLC does not anticipate modifying their permit to accommodate any additional production rate increases that could be realized from the availability of additional coal reserves within the proposed lease modification area. According to the mine's most recent three years' worth of production data, they are operating well below their permitted production limits at approximately 60% of approved capacity (which means their actual emissions are also well below the permit levels). Stationary sources of direct emissions at the Foidel Creek Mine include the following:

- Material Handling Conveyors
- Mine Ventilation Shafts
- Internal Combustion Engines
- Fuel Storage Tanks
- Material Processing Screens (93RO1204)
- Material Processing Crushers (93RO1204)
- Surface Operations (fugitive PM)
- Misc. Facility Heating Equipment

Although methane is not a regulated VOC, recent analyses of CMM gas from other mines in Colorado, including the West Elk and Elk Creek mines in the North Fork Valley (Delta and Gunnison Counties), indicate that regulated VOCs make up a minor component of the CMM constituents, and these gases would be released as result of CMM venting. CDPHE, as the regulatory authority for such emissions, sent a letter to coal mines throughout the state requesting that mines provide data that would allow them to determine the status of each mine with respect to the state's VOC permitting thresholds. The status of the request and responses, and what data CDPHE might have, is unknown to BLM at this time.

HAP emissions from stationary sources are considered de minimis. For the purposes of disclosing impacts from the alternatives proposed, insufficient data and analysis exists (as stated above) to determine if any component of the ventilation air emissions would be considered a hazardous air pollutant. Any HAP emissions from VAM would most likely be a tiny fraction of the VOC component, and would not be significant enough to analyze. Of the sources identified above, only the fuel tanks, internal combustion engine, and miscellaneous heating equipment would generate HAP emissions. Because of the limited use or the exempt status (CDPHE APEN and permitting) of the identified units, expected cumulative HAP emissions from these sources would be on the order of a few pounds per year, and therefore will not be analyzed any further in this document.

Mobile sources at the facility include underground mining equipment, listed under source classification code (SCC) 2270009010, aboveground construction equipment identified under SCC 2270002000, as well as light duty gasoline trucks and light and heavy duty diesel trucks. The underground mining mobile sources are specialized, industry specific equipment designed to function in the unique environment of an underground mine, while the aboveground sources would be typical heavy construction equipment used for material handling and stockpile management.

To provide quantifiable emissions estimates from the facility's mobile sources, BLM staff utilized EPA's Non-road model (2008a) to generate SCC specific emissions factors (grams per horsepower-hour) for Routt County based equipment inventories for the year 2005. The year 2005 inventory was chosen to match the inventory that was provided to CDPHE from the Sage Creek Mine's modeling report, which also included the Foidel Creek Mine equipment emissions. To estimate emissions from the sources, BLM staff had to determine a reasonable thermal efficiency (TE) for the diesel equipment in order to determine the total horsepower-hours the mine's annual fuel use would provide to the equipment. This was necessary because the annual fuel use was the only fleet specific variable the BLM had to estimate emissions. Appendix A contains a more thorough description of the basis for the calculations, example TE calculations, total horsepower-hours calculations, emissions factor selection, emissions calculations, and any applicable references used to support the mobile source emissions data in Table 3.4 below.
Foidel Creek Mine also uses light duty gasoline and diesel trucks (LDGT & LDDT) to ferry personnel, equipment, and supplies around the mine to conduct daily business. Peabody provided the annual fuel use (diesel and gasoline) for these sources, however BLM staff could not delineate the minor amount of diesel that would be consumed by the LDDT from the Heavy equipment use since no information was available to describe the LDDT fleet characteristics or annual vehicle miles travelled, and therefore no emissions estimates from these sources are provided. The analysis simply assumes that all of the diesel fuel is consumed in the heavy equipment, which would produce conservative emissions estimates based on their higher emissions rates.

**Table 5, Direct Criteria and GHG Emissions from Stationary and Mobile Sources (tons)**

| Sources Types | $PM_{10}$ | $PM_{2.5}$ | VOC | CO | $NO_X$ | $SO_2$ | $CO_2$ | $CH_4$ | $N_2O$ |
|---|---|---|---|---|---|---|---|---|---|
| Aggregates / Mine Vents (93RO1204) | 55.07 | 17.88 | NA | NA | NA | NA | NA | NA | NA |
| Fugitives (93RO1204) | 105.27 | 14.95 | NA | NA | NA | NA | NA | NA | NA |
| Fuel Storage Tanks (XA) | NA | NA | 3.99[a] | NA | NA | NA | NA | NA | NA |
| Emergency Generator | 0.01 | 0.01 | 0.01 | 0.14 | 0.13 | 0.00 | 19.43 | 0.00 | ND |
| Methane Sources (VAM) | NA | NA | ND | NA | NA | NA | 19,666 | 936.46[b] | NA |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Mics. Heating Equipment | 0.08 | 0.20 | 0.32 | 2.97 | 5.15 | 0.20 | 4,952.48 | 0.08 | 0.04 |
| Underground & Surface Mining Equipment | 8.08 | 7.83 | 13.17 | 53.57 | 59.64 | 0.04 | 4,481.08 | 0.20 | 0.11 |
| Pick-ups (LDGT) | 0.05 | 0.05 | 0.08 | 1.13 | 0.12 | 0.04 | 166.56 | ND | ND |
| **Total Direct Emissions** | **168.56** | **40.92** | **17.57** | **57.81** | **65.04** | **0.28** | **29,285.55** | **936.74** | **0.15** |

[a] Emissions based on APEN exemption (XA) threshold in attainment area (< 2.0 tpy) x 2 tanks.

[b] The $CO_2e$ of the methane gas is approximately 19,666 tons and is shown in the row for informational purposes only. No $CO_2$ is emitted in the VAM itself.

**Indirect Emissions**

Electrical energy consumed at the site can reasonably be expected to produce emissions from the supplying source, unless that source is some form of renewable energy. It is possible to provide rough estimates of emissions resulting from mine electricity consumption if the annual energy consumption data is known. Reasonable emissions estimates can be made for some pollutants ($NO_X$, $SO_2$, $CO_2$, $N_2O$, $CH_4$, & Hg) by making use of EPA's Emissions & Generation Resource Integrated Database (eGRID). The eGRID tool is a comprehensive inventory of environmental attributes of electric power systems and is based on available plant-specific data for all U.S. electricity generating plants that provide power to the electric grid and report data to the U.S. government, including the following agencies: EPA, the Energy Information Administration (EIA), and the Federal Energy Regulatory Commission (FERC). Emissions data collected by EPA is integrated with generation data from EIA to produce useful values like pounds of emissions per megawatt-hour (lb/MWh), which allows direct comparison of the environmental attributes of electricity generation by state, U.S. total, company, and by three different sets of electric grid boundaries. Table 3.5 provides an estimate of indirect emissions for the mine's electrical consumption data for 2013. The most recent data available online (2010) suggests Colorado imports only 1-3% of its total electricity demand on an annual basis. For the practical purposes of this EA the BLM considers Colorado to be neither a net energy exporter, or importer, and therefore all indirect emissions estimates from mine electricity consumption are based on Colorado source data.

Locomotive emissions from hauling the mined and processed coal are currently occurring in the proposed action area and would continue under the Proposed Action Alternative. It is estimated that 70% of all railroad traffic in the U.S. is dedicated to the transport of coal. Although this statistic may be appropriately applied to certain metropolitan statistical areas, it may not reflect actual rail traffic composition for Routt County. BLM could not locate any data to suggest otherwise, but to be conservative in our analysis an assumption was made that all rail emissions in Routt County are from coal hauling, and further, that all rail emissions are attributed to the Foidel Creek Mine's operations (although the Colowyo Mine in Craig, Colorado, is also likely responsible for some of the coal hauling rail traffic). It is highly likely that emissions from this source class have been decreasing, and will continue to do so in the future, due to the implementation of new emissions standards for new and reconstructed locomotives (2000 and 2008). EPA estimates that the average useful life for these engines is 750k miles or 10 years, whichever occurs first, meaning that on average an engine is replaced or reconstructed every ten years and will have to comply with the most stringent emissions requirement applicable to the engine at that time.

Combustion of the mined and processed coal would produce all of the pollutants discussed above. According to U.S. EPA figures contained in the Draft US GHG Inventory Report (2012), nearly 95% percent of all coal consumed in the U.S. during 2010 was used in the generation of electric power. Because of this, it can reasonably be assumed that the coal from the Foidel Creek Mine would be shipped to a coal-fired power plant. It would be possible to provide an estimate of Criteria, HAP, and GHG emissions associated with the burning of the mined coal at a specific facility; however, the types and location of the facilities the coal might be processed and consumed in is speculative and not foreseeable. The contractual agreements between the coal fired power plant and the coal supply company are outside the scope of this analysis, and the BLM does not determine at which facilities the future mined coal would be consumed.

The number and location of coal customers of the Foidel Creek Mine vary annually.
Even though the BLM cannot reasonably say where all of the coal produced within the lease modification would be consumed, it is still possible to do disclose the criteria (CAP) and mercury (Hg) emissions from combustion based on the EPA NEI data for the "fuel combustion - electric generation - coal" emissions inventory sector. GHG coal combustion emissions are from the 2010 eGrid data (9th edition). The BLM used the data to calculate the worst case combustion emissions (plant specific, CO and National) based on the fraction of heat input the modification coal, i.e. 340,000 tons, would provide to plant or either fleet. We assumed the Foidel mine coal had a heat content of 12,680 btu per pound. The Colorado and national coal fired power plant fleets had an annual heat input of 391,337,417 MMbtu and 19,694,876B btu, respectively for the 2010 eGrid data year. The modification coal represents 2.2% of the Colorado fleet input requirements, and just 0.04% of the national fleet requirements on an annual basis. Based on the eGrid data, the lease modification coal would provide enough fuel to operate the Hayden power plant (a frequent buyer of Foidel Mile coal) for approximately 78 days.

**Table 6 Indirect Criteria and GHG Emissions (tons, except $CO_2$ million tons)**

| Source[1] | $PM_{10}$ | $PM_{2.5}$ | VOC | CO | $NO_X$ | $SO_2$ | $CO_2$ | $CH_4$ | $N_2O$ | Hg |
|---|---|---|---|---|---|---|---|---|---|---|
| Electricity Consumption | ND | ND | ND | ND | 160 | 131 | 0.124 | 1.52 | 1.86 | 0.001 |
| Rail Hauling[2] | 7.98 | 7.35 | 11.87 | 34.22 | 231.30 | 2.42 | ND | ND | ND | ND |
| Coal Combustion (Hayden)[3] | 17 | 10 | 10 | 85 | 1364 | 501 | 0.838 | 9 | 14 | 0.001 |
| Coal Combustion (State - CO) | 994 | 680 | 476 | 14,746 | 49,478 | 44,646 | 40.61 | 456 | 681 | 0.327 |
| Coal Combustion (National) | 241,690 | 170,364 | 24,600 | 615,604 | 1,791,446 | 4,521,128 | 2,035.61 | 23,272 | 33,932 | 27.97 |
| **Total Indirect Emissions (tons)[4]** | **104.7** | **75.5** | **22.3** | **358.6** | **1,479.8** | **1,939.9** | **1.02** | **11.6** | **15.5** | **0.012** |

**1** ND = No Data
**2** Emissions from 2011 EPA NEI Mobile – Locomotives Data for Routt County, CO. Assumes all emissions from Foidel Creek coal hauling.
3 Data provided by Xcel Energy, Hayden Station operator.
4 The combustion emissions portion of the total indirect emissions are based on the worst case emissions rate for the plant specific emissions or either the Colorado or national coal fired power plant fleet (eGrid 9th edition).

## Air Quality Impacts

The Foidel Creek Mine is primarily a source of $PM_{10}$ emissions. $PM_{10}$ tends to be a localized pollutant where concentrations can vary considerably. A detailed air quality assessment, including modeling, of the mine was recently conducted to support APCD permitting of the Foidel Creek Mine at currently authorized production rates. The current APCD permit issued by the State authorizes up to 13.3 million tons of Run of the Mine (ROM) coal to be produced and processed annually. ROM coal includes any produced waste aggregates separated from the coal product that is sold from the mine.

A near field dispersion model (AERMOD), and a subsequent analysis conducted by CDPHE, was accomplished for the Foidel Creek Mine in May, 2010 and August, 2010, respectively. The modeling protocol was approved by CDPHE prior to running the model and simulated multiple operating scenarios and included a cumulative impact assessment by aggregating (ran as discrete sources within the domain) nearby facilities including: the Sage Creek Coal Mine[8], Hayden Power Plant, Connell Pit, Routt County Landfill, Milner Landfill, and Mesa Gravel Pit. The modeled pollutants included stationary and fugitive sources of $PM_{10}$ and $PM_{2.5}$, as these are the primary pollutants of concern emitted from aggregate handling and mining operations, as well as CO and $SO_2$. The model did not predict any

[8] The Sage Creek Coal Mine has been idle since 2012.

significant impact level exceedances to ambient air quality resulting from the Foidel Creek Mine's operations, and subsequently APCD issued the initial approval permit for the mine.

The BLM will not be providing any additional analysis for any potential Class I area direct impacts (AQRVs) for the proposed action for the following reasons: 1.) the BLM is not the regulatory authority authorizing the mine's emissions and enforcing applicable permit conditions, 2.) the proposed action does not authorize or anticipate an increase in emissions from the Foidel Creek Mine, and 3.) the mine does not meet the criteria for analysis under the PSD rules,. Impacts to Class I areas are very unlikely because of their distances from the mine, and fugitive dust (the majority of the $PM_{10}$ emissions) settles out quickly from entrained air.

With respect to potential ozone formation, the Foidel Creek Mine sources (including all of the diesel fired mobile sources) and associated processing equipment are not significant sources of VOC emissions (see earlier discussion on CMM VOC data limitations), the photochemical reactivity potential of methane in the troposphere is considered negligible (40 CFR § 51.100 (s)), and therefore the mines operations are not expected to contribute significantly to any regional ozone formation from its VOC emissions. The mine does emit a nontrivial amount of $NO_X$ (the majority from mobile sources) on an annual basis, however the amount is not regionally significant compared to county emissions (< 1%). Given that the area is currently attaining the ozone standard, and the mine is not anticipating changes in operations that would affect its current emissions volumes, impacts to regional air quality are not expected to produce changes from the current levels.

Ultimately, any near or far field impacts from criteria or mercury emissions associated with coal combustion sources will have already received analysis as part of the permitting process or rule implementation (BART, MATS, etc…) from their respective regulatory agencies (state or EPA). To be clear, all coal fired power plants are required to have an operating permit (Title V) for any criteria pollutant for which the facility has a potential to emit greater than 100 tpy. Based on this criteria not one plant in Colorado would be exempt from this requirement. The CDPHE as the regulatory authority for such matters would provide the analysis showing compliance with the NAAQS and provide for appropriate permit monitoring and emissions controls as necessary. This process has ample opportunity for public involvement, and the public may also petition EPA for review and remand of the permit after the state has issued it. No action taken under the CAA shall be deemed a major Federal action significantly affecting the quality of the human environment within the meaning of the NEPA of 1969.[9] Given that courts have consistently recognized that CAA act actions, which themselves are exempt from NEPA requirements[10], are in fact the functional equivalent of NEPA, it is appropriate for the BLM to rely on those permitting procedures enacted by the state and overseen by EPA as a basis for asserting that the indirect combustion impacts of the coal lease modification action have already been adequately disclosed and analyzed. Further, since that process provided for meaning public involvement it need not be re-addressed here. Given the rigorous review the combustion facilities receive to emit regulated pollutants it is exceedingly improbable that combusting the lease modification coal would cause or

[9] 15 U.S.C. § 793(c)(1)

[10] Section 7(c) of the Energy Supply and Environmental Coordination Act of 1974 (15 U.S.C. 793(c)(1)) exempts actions under the Clean Air Act from the requirements of NEPA

contribute to the likeliness, frequency, or increasing severity of any detrimental impacts to air quality in areas around or downwind of any potential combustion facility.

As related to railway emissions, in March 2008, EPA finalized a three part program that will dramatically reduce emissions from diesel locomotives of all types -- line-haul, switch, and passenger rail. The rule will cut PM emissions from these engines by as much as 90 percent and $NO_X$ emissions by as much as 80 percent when fully implemented. The rule sets new emission standards for existing locomotives when they are remanufactured--to take effect as soon as certified systems are available (as early as 2008). The rule also sets Tier 3 emission standards for newly-built locomotives, provisions for clean switch locomotives, and idle reduction requirements for new and remanufactured locomotives. Finally, the rule establishes long-term, Tier 4, standards for newly-built engines based on the application of high-efficiency catalytic after treatment technology, beginning in 2015. Therefore it is reasonable to conclude that rail emission in Routt County going forward should continue to substantially decrease in the near future, and ultimately provide a benefit to the surrounding communities and environment.

Emissions from all the mobile sources at the site are not expected to impact regional air quality due to the fact that they are not significant in the context of the regional county emissions inventory and the fleet should have decreasing emissions as a whole in the future as changes are made to upgrade to newer equipment.

Methane emissions associated with the Foidel Creek Mine are anticipated to be very low when compared to other Colorado underground coal mines. The geology of the surrounding strata and composition of the coal itself produce very little emissions during longwall panel mining. As previously stated, no GVB would be drilled in advance of the mining to adequately provide for the health and safety of the miners, since emissions of any methane liberated are being adequately managed via the main vent fans at the facility. Methane emissions estimates are provided in the direct emissions table above (Table 3.5). The data represents what the mine reported to EPA (2013 emissions) under the Greenhouse Gas Reporting Rule.

According to the U.S. Global Change Research Program (2009), global warming is unequivocal, and the global warming that has occurred over the past 50 years is primarily human-caused. Standardized protocols designed to measure factors that may contribute to climate change, and to quantify climatic impacts, are presently unavailable. As a consequence, impact assessment of specific impacts related to anthropogenic activities on global climate change cannot be accurately estimated. Moreover, specific levels of significance have not yet been established by regulatory agencies. Therefore, climate change analysis for the purpose of this environmental assessment within this air quality section is limited to accounting for GHG emissions changes that would contribute incrementally to climate change and disclosing the generally accepted changes that have been predicted regionally from global climate change modeling scenarios. Approximately 12.75 percent of U.S. emissions of methane come from coal mining activities (EPA 2012). Based upon the Inventory of U.S. Greenhouse Gas Emissions and Sinks 1990-2012, and the Final Colorado Greenhouse Gas Inventory 2013 (Draft), the total coal mining related methane emissions (CMM) in 2012 and 2010 were 81.10 Tg (teragrams=one million metric tons), and 6.63Tg on a $CO_2$e basis for the US and Colorado, respectively. Estimated total CMM emissions from the Proposed Action are approximately 19,666 short tons of $CO_2$ equivalent (at current or 2013 production rates) or 0.022% and 0.27% of the total calculated $CO_2$ equivalent emissions of CMM from the U.S. and Colorado totals. Based on BLM's analysis, all of the GHG emissions from the Proposed Action (direct and indirect – which assumes all the mined coal from the lease modification is combusted) are equivalent to approximately 19.2 Tg on a $CO_2$e basis. This represents approximately 0.29% and 15.17% of all the gross GHG emissions (does not consider GHG sinks, i.e. "net emissions") from the U.S. (2012 – 6,525.6Tg) and Colorado (2010 – 126.57Tg), respectively on an annualized basis. If the calculated GHG emissions were compared with the global figures (estimated 2010 $CO_2$ equivalent emissions of 46,000Tg (EPA 2013)[11]), the relative significance of the impact to the global scale of GHG emissions would be even further negligible.

Regardless of the accuracy of emission estimates, predicting the degree of impact any single emitter of GHGs may have on global climate change, or on the changes to biotic and abiotic systems that accompany climate change, is not possible at this time. As such, the controversy is to what extent GHG emissions resulting from continued mining may contribute to global climate change, as well as the accompanying changes to natural systems cannot be adequately quantified. The degree to which any observable changes can, or would be attributable to the Proposed Action cannot be reasonably predicted at this time.

To provide some additional context, the EPA has recently modeled global climate change impacts from a model source emitting 20% more GHGs than a 1500MW coal-fired steam electric generating plant (approx. 14,132,586 metric tons per year of CO2, 273.6 metric tons per year of nitrous oxide, and 136.8 metric tons per year of methane). It estimated a hypothetical maximum mean global temperature value increase resulting from such a project. The results ranged from 0.00022 and 0.00035 degrees Celsius occurring approximately 50 years after the facility begins operation. The modeled changes are extremely small, and any downsizing of these results from the global scale would produce greater uncertainty in the predictions. The EPA concluded that even assuming such an increase in temperature could be downscaled to a particular location, it "would be too small to physically measure or detect", see Letter from Robert J. Meyers, Principal Deputy Assistant Administrator, Office of Air and Radiation re: "Endangered Species Act and GHG Emitting Activities (Oct. 3, 2008). The project emissions are a fraction of the EPA's modeled source and are shorter in duration, and therefore it is reasonable to conclude that the project would have no measurable impact on the climate. Additionally, according to the Intergovernmental Panel on Climate Change, the world's surface temperatures have risen at a slower rate over the past 15 years than at any time since 1951.

With respect to GHG emissions, the following climate change predictions were identified by the EPA[12] for Colorado:

- The region will experience warmer temperatures with less snowfall.
- Temperatures are expected to increase more in winter than in summer, more at night than in the day, and more in the mountains than at lower elevations.

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[11] http://www.epa.gov/climatechange/science/indicators/ghg/global-ghg-emissions.html

[12] http://www.epa.gov/climatechange/impacts-adaptation/southwest.html

- Earlier snowmelt means that peak stream flow will be earlier, weeks before the peak needs of ranchers, farmers, recreationalist, and others. In late summer, rivers, lakes, and reservoirs will be drier.
- More frequent, more severe, and possibly longer-lasting droughts will occur.
- Crop and livestock production patters could shift northward; less soil moisture due to increased evaporation may increase irrigation needs.
- Drier conditions will reduce the range and health of ponderosa and lodge pole pine forests, and increase the susceptibility to fire.
- Grasslands and rangelands could expand into previously forested areas.
- Ecosystems will be stressed and wildlife such as the mountain lion, black bear, long-nose sucker, marten, and bald eagle could be further stressed.

*Environmental Consequences of the Proposed Action:*

Cumulative Effects

The following actions within the region are known or are reasonably foreseeable.

- Potential Oil and Gas Lease Sales and Development
- Future Modifications of Sage Creek Mine (Exploration and LBAs)
- Future Modifications of Sage Creek Mine (Longwall)
- Oil Shale Development

The lease modification decision for the Foidel Creek Mine would not authorize mining operations. The EA evaluates the potential impacts of mining the lease modification area, because mining is a logical consequence of issuing a lease for continued operation of the mine. The EA assesses the cumulative impact on the environment which results from the operation of the proposed lease modification when added to other past, present, and reasonably foreseeable future actions that would add to the anticipated impacts of the proposed action.

The site-specific impacts analyzed in this EA are based on the assumption that if the lease modification is issued, mining would proceed at the currently authorized production rate of 13.3 million tons per year.[13] We further assume that if the lease modification is issued, the extraction of the coal resource would proceed in accordance with all current permit conditions. In addition, it is also assumed the mined coal would be sold to coal users in response to forecasts of demand for this coal. Historically these users have been electric utilities in the United States, although there is potential for sales outside the U.S. This coal market is open and competitive, and users can buy from the most cost effective suppliers that meet their needs.

**Area Emissions**

The cumulative impacts to air quality in the Foidel Creek Mine area would result primarily from emissions of PM, $NO_X$, and CO from the current and future mining of coal within the region. As previously stated, the long term plan for the Foidel Creek Mine is to gradually replace declines in

[13] Actual production averages 4 million tons per year.

production with those from the Sage Creek Mine such that mining intensity for the region should not increase above currently authorized and evaluated levels.

In consideration of disclosing cumulative impacts, the BLM has initiated the Colorado Air Resources Management Modeling Study (CARMMS). The study includes assessing statewide impacts of projected oil and gas development and mining (both federal and fee (i.e. private)) out to year 2021 for three development scenarios (oil and gas only - low, medium, and high). Projections for development are based on either the most recent FO Reasonably Foreseeable Development (RFD) document (high), or by projecting the current 5 year average development paces forward to 2021 (low). The medium scenario included the same well count projections as the high, but assumed restricted emissions, where the high and low assumed current development practices and on the books emissions controls and regulations (2012). The study is now complete, and available for public review on the BLM Colorado website at: http://www.blm.gov/co/st/en/BLM_Information/nepa/air_quality.html. The model itself (CAMx), is a one atmosphere photo-chemical grid model and represents state of the science methodologies for modeling atmospheric chemistry and physics. Each FO or study area was modeled with the source apportionment option, meaning that incremental impacts to regional ozone and AQRVs from development in these areas are essentially tracked to better understand the significance of such development on impacted resources and populations. Mining emissions were modeled as their own source apportionment group, and thus those impacts are representative of all Colorado mines. The model accounts for every emissions source in the domain, including all of the coal fired power plants. Although these sources were not tracked using source apportionment technology, their impacts are included in the results, and in general the CARMMS data shows that air quality improves in the future. The CARMMS project leverages the work completed by the West Jump Air Quality Modeling Study (WestJumpAQMS)[14], and the base model platform (and associated model performance metrics) and meteorology are based on those products (2008). There is far too much information about the CARMMS model and emissions inventory development to list or describe here, but readers are encouraged to read the full report at the website listed above.

[14] http://www.wrapair2.org/WestJumpAQMS.aspx

**Figure 2, CARMMS Modeling Domain**

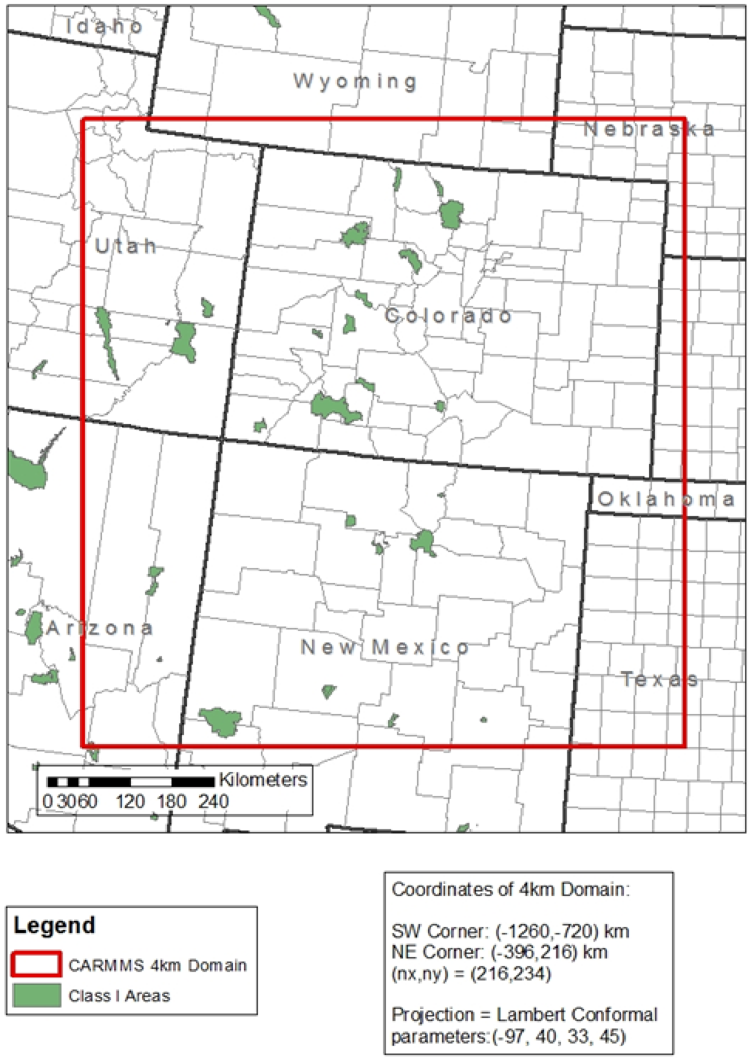



**Table 7, Modeled Emissions (Selected Source Categories - High Development Scenario) Tons per Day and as a Percent of the Total Modeled Emissions (anthropogenic only)**

| Source Group | NOx | VOC | $SO_2$ | $PM_{2.5}$ | NOx | VOC | $SO_2$ | $PM_{2.5}$ |
|---|---|---|---|---|---|---|---|---|
| Mining | 2.53 | 0.16 | 0.03 | 19.12 | 0.13% | 0.01% | 0.01% | 2.56% |
| LSFO O&G (fed) | 5.54 | 12.70 | 0.04 | 0.20 | 0.29% | 0.41% | 0.02% | 0.03% |
| Biogenics | 324.00 | 6781.80 | 0.99 | 131.03 | NA | NA | NA | NA |
| New Non-Fed O&G all BLM PAs | 178.70 | 624.00 | 0.81 | 12.42 | 9.41% | 20.12% | 0.32% | 1.66% |
| Existing O&G all BLM PAs | 220.90 | 624.50 | 0.69 | 4.24 | 11.63% | 20.14% | 0.27% | 0.57% |
| Remaining Anthropogenic | 1244.70 | 825.40 | 239.50 | 698.42 | 65.54% | 26.62% | 93.51% | 93.62% |
| Total Anthropogenic | 1899.19 | 3100.67 | 256.12 | 745.99 | 100% | 100% | 100% | 100% |
| Total Anthropogenic & Biogenic | 2223.19 | 9882.47 | 257.11 | 877.02 | NA | NA | NA | NA |

**Table 8, Visibility Impacts to Class 1 Areas & Special Class II Areas**

| Group Name | Class I Area Impacts | | | | Class II Area Impacts | | | |
|---|---|---|---|---|---|---|---|---|
| | dv >0.5 | | dv >1.0 | | dv >0.5 | | dv >1.0 | |
| | Max # of Days | Area Max Occurs | Max # of Days | Area Max Occurs | Max # of Days | Area Max Occurs | Max # of Days | Area Max Occurs |
| Mining | 23 | Flat Tops | 3 | Flat Tops | 58 | Dinosaur NM | 26 | Dinosaur NM |
| LSFO O&G (fed) | 0 | NA | 0 | NA | 0 | NA | 0 | NA |
| Natural Emissions | 192 | Bosque Little | 142 | Bosque Little | 59 | Greenhorn | 29 | West Elk |
| New Fed & Non-Fed O&G and Mining - all BLM PAs | 344 | Mesa Verde | 254 | Mesa Verde | 347 | Raggeds | 145 | Raggeds |

Deciview (dv) thresholds of 0.5 & 1.0 from FLAG 2010 guidance (http://www.nature.nps.gov/air/pubs/pdf/flag/FLAG_2010.pdf)
**NOTE:** The dv thresholds above are for "Project" level analysis, and do not represent cumulative thresholds.

The mining impacts to visibility are cumulative (from all the mines), with the majority of impacts originating from the surface mines in Colorado.

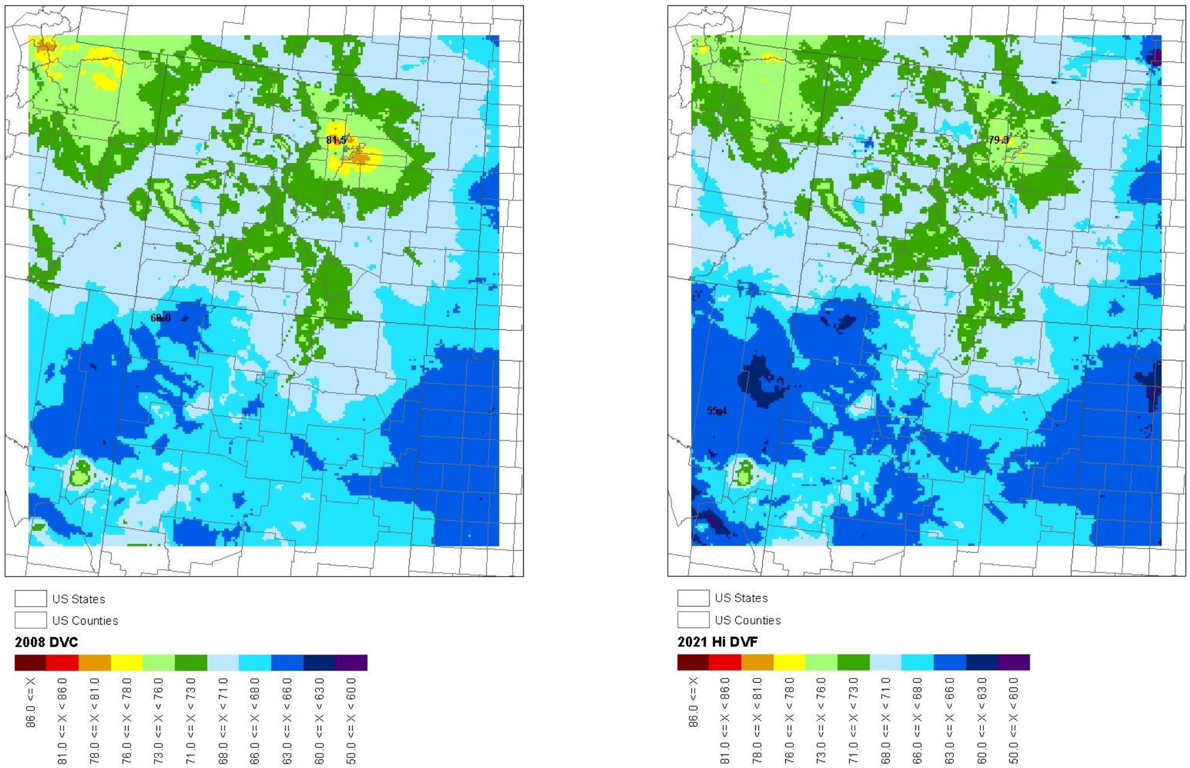
**Table 9, Deposition Impacts to Class 1 Areas & Special Class II Areas**

| Group Name | Max @ any Class I area | Class I Area where Max occurred | Max @ any Class II area | Class II Area where Max occurred |
|---|---|---|---|---|
| **Nitrogen Deposition (average from all intersecting model grid cells)** | | | | |
| Mining | 0.0054 | Mount Zirkel | 0.0054 | Mount Zirkel |
| LSFO O&G (fed) | 0.0131 | Mount Zirkel | 0.0132 | Mount Zirkel |
| New Fed & Non-Fed O&G and Mining - all BLM PAs | 0.2564 | Flat Tops | 0.2424 | White River |
| Natural Emissions | 0.6178 | Bandelier | 0.1233 | Spanish Peaks |
| All Modeled Sources | 3.3371 | Mount Zirkel | 3.1981 | Mount Zirkel |
| **Sulfur Deposition (average from all intersecting model grid cells)** | | | | |
| Mining | 0.0122 | Mount Zirkel | 0.0122 | Mount Zirkel |
| LSFO O&G (fed) | 0.0002 | Mount Zirkel | 0.0002 | Mount Zirkel |
| New Fed & Non-Fed O&G and Mining - all BLM PAs | 0.0213 | Mount Zirkel | 0.0209 | Mount Zirkel |
| Natural Emissions | 0.0183 | Bandelier | 0.0014 | Spanish Peaks |
| All Modeled Sources | 1.2246 | Wheeler Peak | 0.9729 | Mount Zirkel |

Project level Data Analysis Thresholds (DATs) are generally set at 0.005 kg/ha-yr, cumulative thresholds or critical loads vary from 1.5 – 3.0 kg/ha-yr, depending on the sensitivity of the resource.

Given that cumulative deposition is just above the DAT, it is unlikely that any single mine would significantly impact any Class I or sensitive Class II area by itself.

**Figure 3, Cumulative Predicted Ozone Concentrations (ppb) (Base – 2008 & High – 2021)**




As can be clearly seen in the plots above, the cumulative domain ozone decreases in the future, such that air quality improves. The plots look even better when contrasted against the low development scenario, which is where the BLM is currently tracking.

**Table 10, Maximum contribution to the 4th high DMAX8 ozone (ppb) for the Selected Source Groups**

| Source Group | Ozone |
|---|---|
| Little Snake FO | 1.0 |
| Federal Mining in Colorado | 0.9 |
| New Federal O&G and Mining In Colorado | 7.9 |
| New Federal/Non-Federal O&G/Mining in CO/NM | 8.4 |
| Existing and New Fed/Non-Fed O&G in 4 km Domain | 9.4 |
| Natural Emissions | 5.6 |

The data above represents the maximum contributions to ozone formation from the source apportionment area or group. This does not represent the maximum contribution to a value above the NAAQS. The mining source apportionment group contributed 0.14% to a model ozone exceedance.

**Figure 4, Cumulative Predicted $PM_{2.5}$ Concentrations ($\mu g/m^3$) All CO Mines**

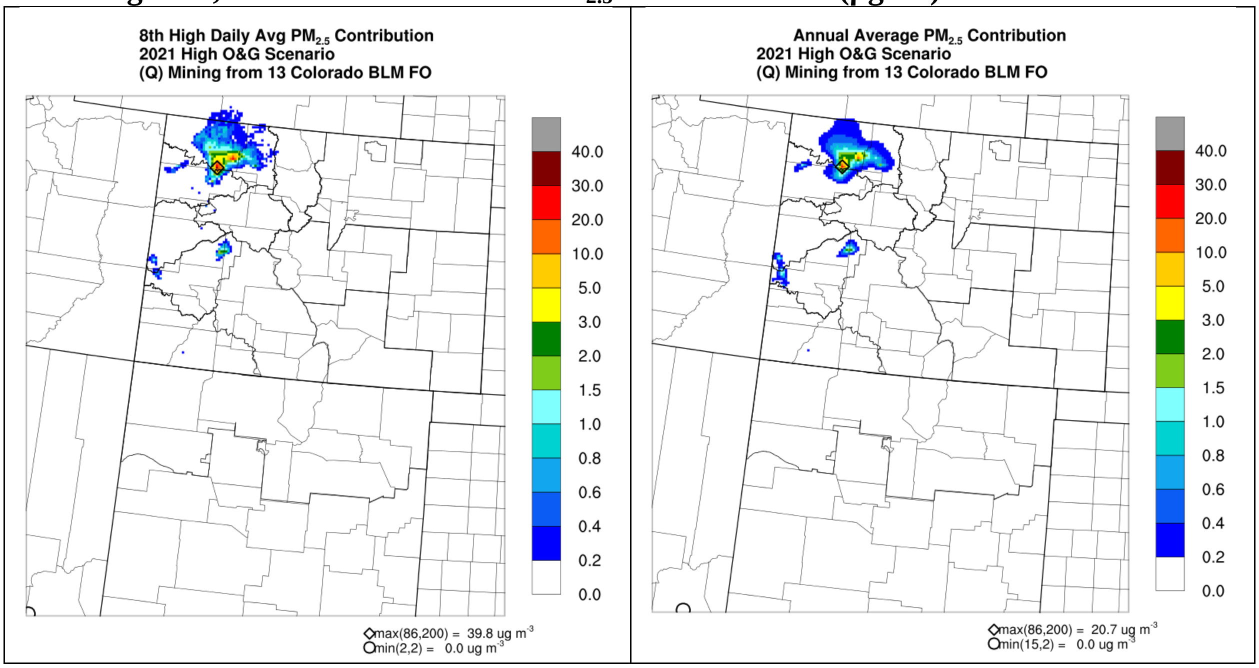
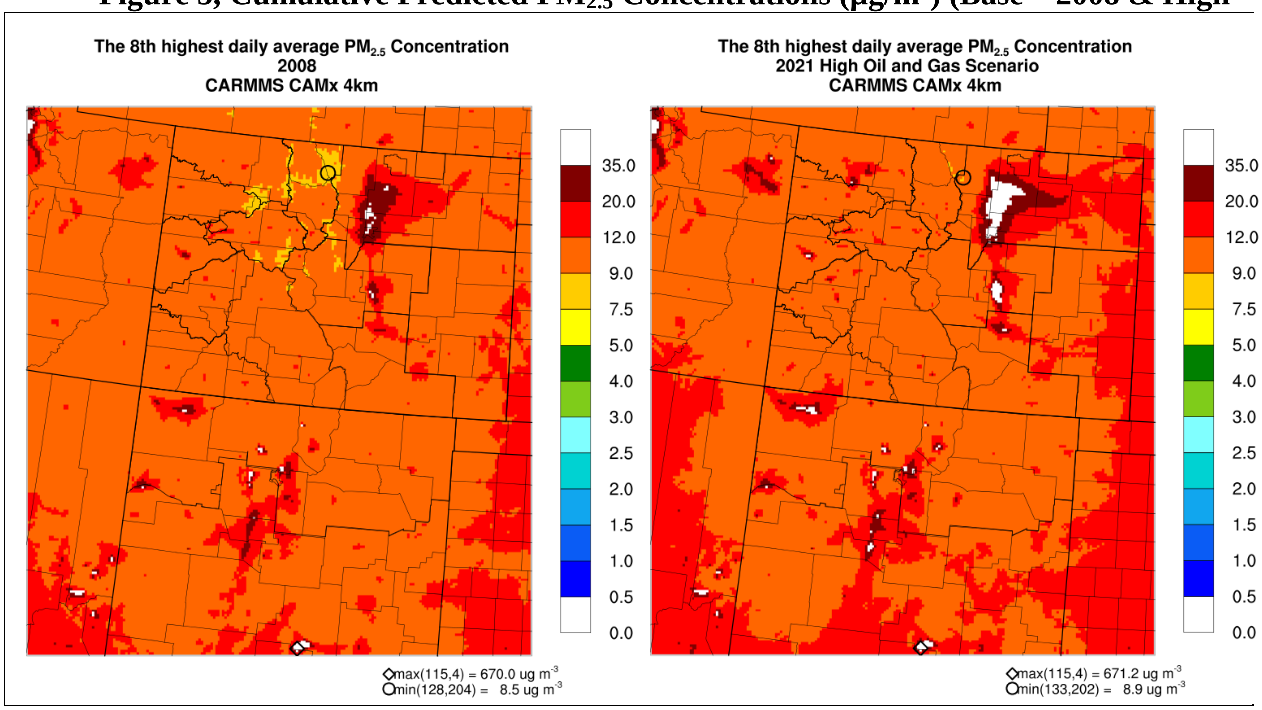



**Figure 5, Cumulative Predicted $PM_{2.5}$ Concentrations ($\mu g/m^3$) (Base – 2008 & High – 2021)**




In general the predicted future $PM_{2.5}$ emissions concentrations appear to increase in the future, especially in urban areas. It is unclear if the mines are well represented in the base case, since emissions were essentially held static across all the scenarios and each of the mines would have existed in 2008.

With respect to actual oil and gas development, the BLM will address potential impacts from oil and gas development activities through the NEPA process when subsequent APD's are filed and operators will provide pertinent details of their proposals and operations such that BLM staff can evaluate the design features and assess any potential mitigation alternatives based on the project and cumulative impact projections. At the pre-lease or lease stage any assumptions on development would be highly speculative and would need to account on economic factors such as supply, demand, and the current and projected price of natural gas, among various other considerations. However, when APDs are received BLM would accomplish the analysis and include any applicable cumulative impacts from mine lease authorizations located within the region of influence of any well. A review of the COGCC database revealed a total of 30 producing, 10 located (not yet drilled), and 9 shut in wells for all of Routt County.

With respect to oil shale development, the technologies to extract this potential energy source are not yet proven, and therefore any future impacts (cumulatively or otherwise) associated with its development are too speculative to consider in this EA. However, the BLM recently prepared a Programmatic EIS[15] to address potential issues associated with oil shale development that may be beneficial to the reader. Project specific impacts from oil shale development would be evaluated when the economic viability of the resource is proven and reasonable alternatives for NEPA analysis can be developed.

**Climate Change**

Climate change by nature is a cumulative process; the discussion of direct and indirect emissions relative to the current global GHG emissions rates and the projected impacts provided above is for all practical purposes is the same one that would be provided here, and therefore does not bear repeating. However, it is worth noting that sea level rise and ocean acidification (while not a regional concern) are a major cumulative concern that the proposed action would contribute toward, albeit insignificantly.

*Environmental Consequences of the No Action Alternative:*
Direct and Indirect Effects:
Under the No Action Alternative, the lease modification area would not be approved for leasing. Criteria, HAP, and GHG emission associated with the eventual mining of the proposed lease modification area at Foidel Creek Mine would not occur.

Cumulative Effects of the No Action Alternative
Under the No Action Alternative, mining of the lease modification area would not be permitted. No emissions (criteria, HAP, and GHG) from resource extraction would occur. Mining would continue until the remaining reserves are depleted, as would emissions at or below currently authorized rates. In all likelihood the impacts associated with climate change from the global accumulation of GHG in Earth's atmosphere would still occur.

*Mitigation:* No additional mitigation is required. It is assumed the facility would continue to comply with their APCD issued air emissions permit provisions, and any other regulatory requirements the

[15] http://ostseis.anl.gov/documents/index.cfm

facility is subject to, now or in the near future (GHG emissions reductions, methane capture, New Source Performance Standards, etc…).

With regard to production activities at the mine, methane liberation from the mine may be reduced through mine planning, sealing previously mined areas, and degasification efforts. Although no dedicated methane drainage system (i.e. GVB drainage wells) would be employed at the mine due to the inherently low levels of methane originating from the overburden and mine itself, VAM controls could still be considered by the mine in light of the future expansion of operations currently being considered by the mine owner for the adjacent Sage Creek Mine, which would utilize the Foidel Creek Mine's surface facilities and main vents for its operations.

### 3.1.2 Minerals, Solid

*Affected Environment*: The proposed action area lies within the Twentymile Park on the southeast tip of the Yampa Coal Field of the Green River Region. Twentymile Park is a structural and topographic basin. The Wolf Creek Seam is in the 75 million year old Upper Cretaceous Mesaverde Group. This sedimentary sequence was deposited in offshore, shallow, and near-marine environments at the western edge of an epeiric seaway. Coal lease COC54608 is the only solid mineral authorization within the area of the proposed action. The lease modification would add 310 acres of the Wolf Creek coal seam to existing lease COC54608. The Wolf Creek seam is below the Wadge seam, which has been mined by TC. The interburden between the two seams is 100-170 feet. The overburden ranges from 1,250- 1,500 feet. The Wolf Creek coal seam thickness ranges from 7.5 – 10 ft. thick.

## GENERALIZED LITHOLOGIC CROSS SECTION

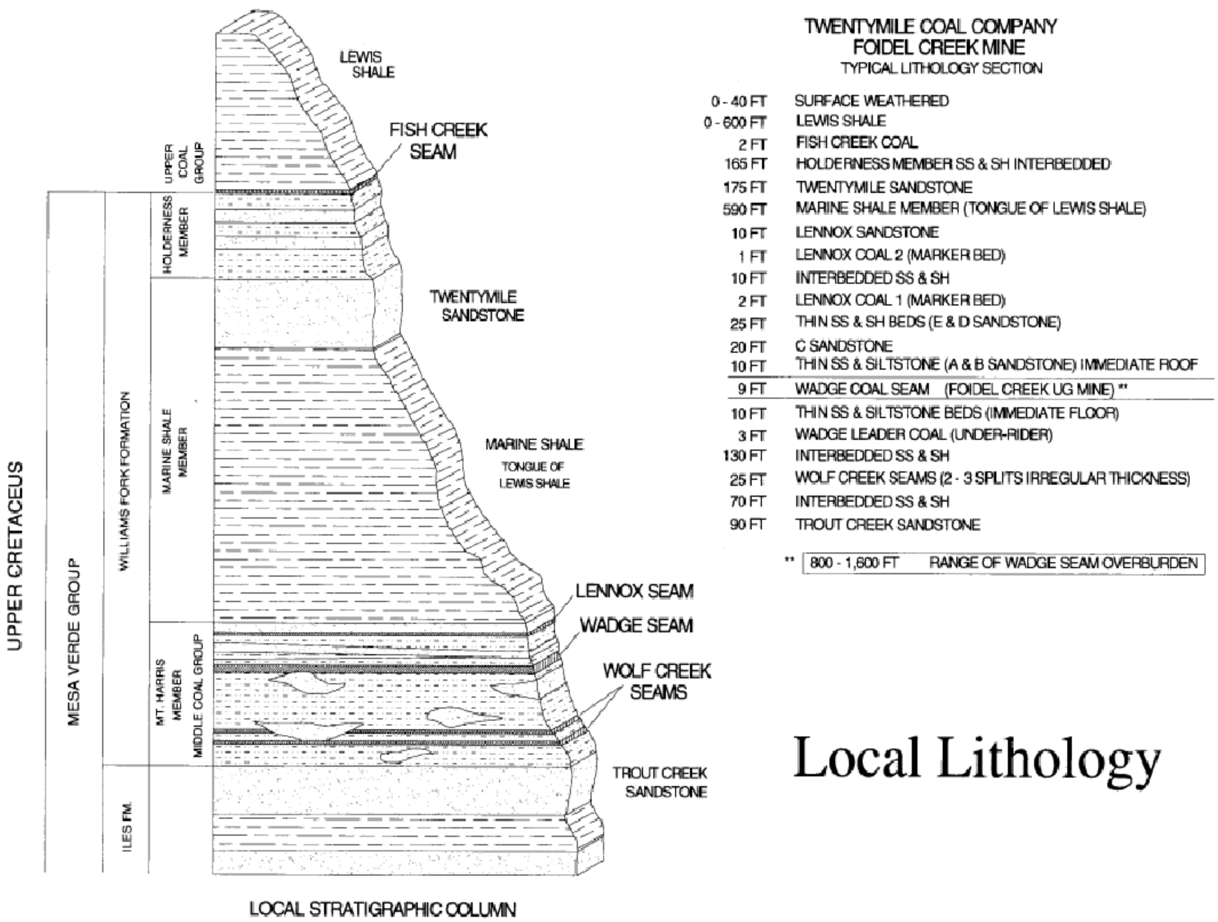



Figure 6

*Environmental Consequences of the Proposed Action:*
<u>Direct and Indirect Effects:</u> The proposed action would result in removal of the recoverable portions of the Wolf Creek coal seam within the lease modification boundary by underground longwall techniques. TC anticipates mining the 340,000 tons in the lease modification over a 7 year period.

Indirect effects to solid mineral resources would include controlled subsidence over the mined longwall areas. Subsidence would be uniform over broad areas. Strata would subside as a block and retain their internal structure. Subsidence under power lines, County Road 27, Foidel and Fish Creek, and the Union Pacific railroad has occurred with no effect to the systems. The TC Foidel Creek mine plan predicts maximum subsidence ranging from 3-6 feet in the longwall panels. Previously predicted subsidence has been greater than recorded subsidence.[16] Ninety-five to 98 percent of subsidence from longwall mining occurs during active mining. Long-term subsidence effects are not expected with longwall mining since such effects occur in a fairly short time. Except for the removal of the coal bed, the overall nature of the solid mineral resources of the area would not change. The proposed action constitutes 0.11% of the 623,860 acres of the Little Snake coal planning area.

Cumulative Effects: The BLM does not authorize mining by issuing a lease modification for federal coal, but the impacts of mining the coal are considered in the cumulative impacts summary because it is a logical consequence of issuing a lease modification.

Past coal mining in the area includes the surface Energy Strip #1, the surface Yoast Mine, the surface Seneca I, Seneca II, and Seneca IIW Mines, the surface Johnson, the surface Commander Strip #1 and #3, the surface Fish, the surface Linholm, the underground Mt. Harris Mine and the surface Edna Mine. Reclamation of the Seneca II, Seneca IIW, and Yoast Mines will continue.
TC has mined coal using underground methods at the Foidel Creek Mine since 1983. Approximately 100 million tons of coal has been mined at the Foidel Creek Mine. Currently, Foidel Creek is the only active coal mine in Routt County. There are approximately 6 months more year of Wadge seam mining and approximately 10 years of Wolf Creek seam left at Foidel Creek Mine. The 2006 Colorado Geological Survey estimated the remaining coal reserves in the Green River Coal Region to be 23,263 million tons. Mining the 340,000 tons would reduce the Green River Coal Region reserve by 0.0009%. Peabody Sage Creek Mining's permit borders TC Foidel Creek Mine permit to the northwest. The Sage Creek Mine is currently idled.

There are two permitted private sand and gravel operations in T6N, R85W and two permitted private sand and gravel operations in T6N, R86W. These sand and gravel operation permits total 300 acres.

Reasonably foreseeable future actions include: The continued mining at Twentymile Coal Foidel Creek Mine for approximately 10 more years. Sage Creek Mining was issued a DRMS permit in 2010 and was issued a 400 acre lease effective October 1, 2012. Mining began at Sage Creek in May of 2012 and was idled in September 2012 until market conditions improve. Reclamation of past surface mining would continue. Mining of sand and gravel would continue.

*Environmental Consequences of the No Action Alternative:*
Direct and Indirect Effects: The 340,000 tons of recoverable coal would not be recovered. Denying the lease modification would reduce recovery of coal resources on adjoining leases due the configuration of the longwall panels and not being able to extend the panels as far if the lease modification were approved. It is unlikely these coal reserves would be recovered at a future time since there is no logical competitive interest based upon the patchwork of coal ownership. The lease modification would allow a continuum of an existing mining block and would not represent an economic venture based on a stand-alone development of the property. The only logical access is from the applicants existing operation and adjacent leases.

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[16] CDRMS Permit C-1982-056, Exhibit 7

Cumulative Effects: None.

*Mitigation*: None.

### 3.1.3 Special Status Animal Species

*Affected Environment:* The area of the lease modification does not provide habitat for any federally listed species. Several BLM sensitive species, greater sage-grouse, Columbian sharp-tailed grouse, golden eagle and bald eagle may use habitat in the vicinity of the Foidel Mine.

In addition to underground mining, combustion of federal coal is a reasonably foreseeable action. However, the BLM has no discretion or decisions regarding this action. This is an independent, but reasonably foreseeable future activity. The indirect impacts of coal combustion may impact federally listed species. Federally listed species occurring in Routt County and species that could be indirectly affected downstream are listed in the following table:

**List of Threatened and Endangered Species (Routt County Colorado)**

| **Common Name** | **Scientific Name** | **Federal Status** |
|---|---|---|
| Bony-tailed chub | *Gila elegans* | Endangered |
| Colorado pikeminnow | *Ptychocheilus lucius* | Endangered |
| Humpback chub | *Gila cypha* | Endangered |
| Razorback sucker | *Xyrauchen texanus* | Endangered |
| Black-footed ferret | *Mustela nigripes* | Endangered |
| Canada lynx | *Lynx candensis* | Threatened |
| Yellow-billed cuckoo | *Coccyzus americanus* | Threatened |
| Greenback cutthroat trout | *Oncorhynchus clarki stomias* | Threatened |

For a detailed description of habitat for T&E species in Routt County, please see the Biological Assessment.

*Environmental Consequences of the Proposed Action:*

Direct and Indirect Effects: There would be no direct impacts to any federally listed or BLM sensitive species from the coal lease modification. Indirect impacts to sensitive species may include disruption from noise, traffic and human presence. However, since the mine has been in operation for a number of years, it is likely that individuals have either acclimated to these disruptions or have moved to adjacent habitat. No indirect impacts are expected to occur for black-footed ferrets or Canada lynx.

Formal Section 7 consultation is being completed with the U.S. Fish and Wildlife Service (FWS) for the Proposed Action. Due to the below described impacts, the BLM determined that the Proposed Action "may affect, but is not likely to adversely affect" the yellow-billed cuckoo and the lineage greenback cutthroat trout. In addition, the Proposed Action is not likely to destroy or adversely modify proposed critical habitat for the yellow billed cuckoo. In the draft Biological Opinion (BO), the FWS concurred with these determinations.

A "may affect, likely to adversely affect" determination was found for the four Colorado River Fish. However, in the FWS's draft BO, it is the Service's biological opinion that the Proposed Action is not likely to jeopardize the continued existence of the four endangered fish. In addition, the Proposed Action is not likely to destroy or adversely modify any of the critical habitats designated for the four endangered fish.

**Listed Fish Species**

***Mercury***

Mercury is a naturally occurring element. It can be found in soils and the atmosphere, as well as water bodies. Atmospheric transport and deposition is an important mechanism for the global deposition of mercury (EPRI 2014), as it can be transported over large distances from its source regions and across continents. It is considered a global pollutant. Atmospheric mercury is primarily inorganic and is not biologically available. However, once mercury is deposited to the earth, it can be converted into a biologically available form, methylmercury (MeHg), through a process known as methylation. MeHg bioaccumulates in food chains, and particularly in aquatic food chains, meaning that organisms exposed to MeHg in their food can build up concentrations that are many times higher than the ambient concentrations in the environment.

Mercury is emitted by both natural and anthropogenic sources. Natural sources include volcanoes, geothermal sources, and exposed naturally mercury-enriched geological formations. These sources may also include re-emission of historically deposited mercury as a result of evasion from the surface back into the atmosphere, fires, meteorological conditions, as well as changes in land use and biomass burning. Anthropogenic sources of mercury include burning of fossil fuels, incinerators, mining activities, metal refining, and chemical production facilities. Anthropogenic sources currently account for 30% of the mercury being emitted into the environment. The global emissions inventory for 2010 estimated that 1960 metric tons 4,319,840 lbs) of mercury was emitted into the atmosphere as a direct result of human activity (UNEP 2013), with approximately 61 metric tons supplied by North America. East and Southeast Asia were by far the highest contributors, with 777 metric tons of mercury released (UNEP 2013).

Aquatic systems receive mercury by direct deposition from the atmosphere and from overland transport from within the watershed (EPA 1997). Once mercury is converted to methyl mercury, it can bioaccumulate in endangered fish and is a potent neurotoxin that affects their fitness and reproductive health (Crump and Trudeau 2009). Once Hg enters the body, it poses the highest threats of toxicity because it can be absorbed into living tissues and blood. Once in the blood it crosses into the brain and accumulates, there is no known way to be expelled from the brain (Gonzalez et al. 2005).

The accumulation of Hg from water occurs via the gill membranes as well as through ingestion (Beckvar 1996; USEPA 1997). MeHg is eventually transferred from the gills to muscle and other tissues where it is retained for long periods of time (Julshamn et al. 1982; Riisgård and Hansen 1990). Probably less than 10 percent of the Hg in fish tissue residues is obtained by direct (gill) uptake from water (Francesconi and Lenanton 1992; Spry and Wiener 1991). Hg taken up with food initially accumulates in the tissues of the posterior intestine of fish (Boudou et al. 1991). Hg ingested in food is transferred from the intestine to other organs including muscle tissues (Boudou et al. 1991). MeHg has been reported to constitute from 70 to 95 percent of the total mercury in skeletal muscle in fish (Huckabee et al. 1979; EPA 1985; Riisgård and Famme 1988; Greib et al. 1990; Spry and Wiener 1991). MeHg accounted for almost all of the Hg in muscle tissue in a wide variety of both freshwater and saltwater fish (Bloom 1992).

The effects of mercury on fish are numerous. Lusk (2010) describes the potential affects as:

1. Potent neurotoxin:
   a. Affects the central nervous systems (reacts with brain enzymes, then lesions)
   b. Affects the hypothalamus and pituitary, affects gonadotropin-secreting cells
   c. Altered behaviors: Reduced predator avoidance, reproduction timing failure
   d. Reduced ability to feed (emaciation and growth effects)
2. Endocrine disruptor
   a. Suppressed reproduction hormones in male and female fish
   b. Reduce gonad size and function, reduced gamete production
   c. Altered ovarian morphology, delayed oocyte development
   d. Reduced reproductive success
   e. Transfer of dietary Hg of the maternal adult during oogenesis and into the developing embryo
3. Inability to grow new brain cells or significantly reduce brain mercury.

To protect human health, the EPA developed a methyl mercury water quality criteria of 3.0 micrograms per gram (µg/g) wet weight (WW) in edible fish and shellfish. Beckvar et al. (2005) suggested a threshold-effect level of 0.2 µg/g WW mercury in whole body fish as being generally protective of juvenile and adult fish. However, Yeardley et al. (1998) suggested that mercury concentrations greater than 0.1 µg/g WW may be harmful to predators eating contaminated fish.

Since Colorado pikeminnow are a long lived, top predator species, mercury would be most likely to impact this species. Osmundson and Lusk (2012) reported on the collection, locations, methods, chemical analyses, laboratory quality assurance and quality control, and interpretation of Hg in Colorado pikeminnow from Upper Colorado River Basins, including from the Yampa and White Rivers during 2008-2009. The Hg in Colorado pikeminnow muscle tissues collected from the San Juan, Green, Upper Colorado, White, and Yampa Rivers are summarized in the table below.

**Average and range of mercury (Hg mg/kg WW) in Colorado pikeminnow muscle tissues from Upper Colorado River Basins 2008-2009 (Osmundson and Lusk 2012).**

| River Basin | Average Hg in Muscle Tissue (min - max) |
|---|---|
| San Juan River ( > 400 mm TL) | 0.37 (0.31 - 0.43) |
| Green River | 0.77 (0.68 - 0.87) |
| Upper Colorado River | 0.60 (0.31 – 1.04) |
| White River | 0.95 (0.43 – 1.83) |

| | |
|---|---|
| Yampa River | 0.49 (0.44 – 0.53) |

There are currently two fish consumption advisories within the LSFO for mercury. One of the advisories applies to Elkhead Reservoir, northeast of Craig, CO and one applies to Catamount Reservoir, east of Steamboat Springs, CO. There is currently not a fish consumption advisory for either the Yampa or White Rivers.

Data from the Colorado Department of Public Health and Environment, Water Quality Control Division maintains a list of all waters in Colorado that exceed the total maximum daily loads for a variety of contaminants. The Water Quality Control Division does not list the Yampa or White Rivers as impaired for mercury levels. It should be noted, however, that impairment under this program relates to human effects and not necessarily to impacts to aquatic species.

It is expected that about one-third (112,000 tons) of the coal from this lease modification would be combusted at the Hayden Generating Station. The combustion location for the additional two-thirds of coal is speculative at this time. Coal from the Foidel Creek Mine is shipped to several power plants across the nation, with several contracts only lasting a year and destination plants often changing from year to year. Ultimately, any near or far field impacts from criteria or mercury emissions associated with coal combustion sources will have already received analysis as part of the permitting process or rule implementation from their respective regulatory agencies (state or EPA).

The Hayden Generating station has two combustion units, one which went online in 1965 and the second in 1976. Both units have several components designed to decrease air emissions, including: low NOx burners, fabric filter dust collectors (baghouses) and lime spray dryers (scrubbers). In addition, selective catalytic reduction units (SRCs) for the control of NOx emissions will be installed on both units. Although not specifically designed to reduce mercury emissions, the SRC units will oxidize elemental mercury and allow better collection of mercury in the scrubbers and baghouses. Therefore, once the SCRs go into service (November 2015 and November 2016), mercury emissions from the Hayden Station will decrease, however, to what degree is unknown. The units qualify as low emitting electric generating units (LEE) for mercury under the new EPA Mercury and Air Toxic Standards (MATS).

The 112,000 tons of federal coal from this lease modification would supply the Hayden Station from approximately 26 days. The Hayden Station emitted 9.1 lbs of mercury in 2014. If mercury emissions remain constant, the 112,200 tons of coal expected to be burned at the Hayden Station would emit ~0.65 lbs (or 0.000295 metric tons) of mercury. If 2010 numbers were used for total global emissions of mercury, this would represent an insignificant amount of mercury when compared to the global pool (1960 metric tons).

A mercury deposition network (MDN) monitoring site (Buffalo Pass – Summit Lake) is located east of Steamboat Springs, CO in the Routt National Forest. Based on mapped mercury deposition products from the MDN, the region within the regional air quality study area has seen little change in total annual average mercury wet deposition during the period from 2007 through 2013. An interesting occurrence, however, shows that deposition monitoring values for total wet deposition at the Routt Monitoring Station increased approximately 2 micrograms per square meter (µg/m2) from 7.8 µg/m2 in 2008 to 9.8 µg/m2 in 2013 even in the face of declining regional mercury emissions. One explanation for this could possibly be the increasing amount of mercury emitted from other global or regional sources.

No current data or modeling is available to indicate how much of the mercury emitted by the Hayden Station is deposited annually within local airshed. However, in the 1997 Mercury Study Report to Congress, the EPA undertook a modeling exercise to estimate the local deposition of mercury and subsequent impacts. Deposition is dependent upon a variety of factors, including the chemical species of mercury (elemental, oxidized or particulate-bound), atmospheric conditions, climate, air quality and stack height. Elemental mercury can be transported over very long distances and the global pool of mercury is primarily composed of elemental mercury. Oxidized mercury and particulate-bound mercury are deposited by wet or dry deposition up to 500 miles from sources. According to the EPA's modeling, the Hayden Station would fall in between a small and medium coal-fired utility boiler based on stack height (Unit 1 – 250 ft and Unit 2 – 395 ft). Dry deposition for this type of facility would range from 2.8% to 7.5% of emissions within 31 miles (50 km) of the facility. Wet deposition would be predicted to range from 0.9% to 1.0% of emissions within 31 miles of the facility. This would result in an expected 0.291 to 0.78 ounces of dry deposition within 31 miles of the Hayden Station from the 112,200 tons of federal coal and 0.094 to 0.104 ounces of wet deposition. The remaining mercury would be deposited over 31 miles from the Hayden Generating Station, or would be vertically diffused to the free atmosphere to become part of the global cycle. Prevailing winds in the Hayden area are predominantly from the west, therefore, the majority of deposition would be expected to occur east of the station, towards the mountains east of Steamboat Springs, CO. Wet deposition maps from the Mercury Deposition Network illustrate the majority of deposition in the local airshed does occur in mountainous areas.

Of the amount of mercury emitted from the federal coal, it is reasonable to assume that some portion would deposit directly or indirectly into the Yampa River or its tributaries. Some of this mercury would be converted into methyl mercury and thereby has the potential to affect the Colorado River fish.

In addition to impacts to individual Colorado River fish, impacts would also potentially occur to those species designated critical habitats in the region. As with any other listed species with designated critical habitat, the critical habitat for the four fish species all contain the primary constituent elements (PCEs) that are required to be present and are determined to be necessary for the survival and recovery of the species. All four species' critical habitat contains the following PCEs (50 CFR 13378):

1. Water: This includes a quantity of water of sufficient quality (i.e. temperature, dissolved oxygen, lack of contaminants, nutrients, turbidity, etc.) that is delivered to a specific location in accordance with a hydrologic regime that is required for the particular life stage for each species;
2. Physical Habitat: This includes areas of the Colorado River system that are inhabited or potentially habitable by fish for use in spawning, nursery, feeding, and rearing, or corridors between these areas. In addition to river channels, these areas also include bottom lands, side channel, secondary channels, oxbows, backwaters, and other areas in the 100-year floodplain,

which when inundated provide spawning, nursery, feeding and rearing habitats, or access to these habitats;

3. Biological Environment. Food supply, predation, and competition are important elements of the biological environment and are considered components of this constituent element. Food supply is a function of nutrient supply, productivity, and availability to each life stage of the species. Predation and competition, although considered normal components of this environment, are out of balance due to introduced nonnative fish species in many areas.

Mercury from the combustion of federal coal at the Hayden Generating Station that is deposited either directly or indirectly into the designated critical habitat for these species would have the potential to impact the critical habitat. This would occur primarily by increasing the amount of contaminates present in those areas (PCE #1). It is difficult to quantify the level of this impact from the proposed action to critical habitats given the lack of information on how much mercury would make its way to critical habitat and how much would be converted to methyl mercury. However, if it predicted that only 0.884 ounces of mercury would be deposited in the local airshed, the amount of this mercury that eventually finds its way into critical habitat and is converted to methyl mercury may be negligible.

***Selenium***

In addition to mercury, impacts to listed fish species from increases in selenium from the combustion of coal could occur. Selenium, a trace element, is a natural component of coal and soils in the area and can be released to the environment by the irrigation of selenium-rich soils and the burning of coal in power plants with subsequent emissions to air and deposition to land and surface water. Contributions from anthropogenic sources have increased with the increases of world population, energy demand, and expansion of irrigated agriculture. Selenium, abundant in western soils, enters surface waters through erosion, leaching, and runoff.

Selenium is a micro-nutrient, necessary for proper cellular function of structural proteins and cellular defenses against oxidative damage. While small amounts of selenium are essential for proper cellular functioning, excess amounts can be toxic. Excess dietary selenium causes elevated selenium concentrations to be deposited into developing eggs, particularly the yolk (Buhl and Hamilton 2000). If concentrations in the egg are sufficiently high, developing proteins and enzymes become dysfunctional or result in oxidative stress, conditions that may lead to embryo mortality, deformed embryos, or embryos that may be at higher risk for mortality.

Reporting limits for selenium in water is generally one microgram per liter (µg/L) while the EPA has set the maximum contaminant level goal of 0.05 mg/L (50 µg/L) for human consumption. During sampling of the Yampa River between 1997 and 1998, levels between less than one and 4.8 µg/L were found near Craig, between less than one and 4.9 µg/L near Maybell, and less than one and 3.6 µg/L near Deerlodge Park (USGS 2001). The peak reported levels for these sites all occurred in March, possibly during the beginning of the snow runoff. Concentrations were less than 1 µg/L during May through October. However, it should be noted that selenium in water may be less important than dietary exposure when determining the potential for chronic effects to a species (USFWS 2014).

While the reportable limit of selenium in water is 1 µg/L, the safe level of selenium for protection of fish and wildlife in water is considered to be below 2 µg/L and chronically toxic levels are considered to be greater than 2.7 µg/L (USFWS 2014). Excess selenium in fish have been shown to have a wide range of adverse effects including mortality, reproductive impairment, effects on growth, and developmental and teratogenic effects including edema and finfold, craniofacial, and skeletal deformities.

Of the four Colorado River fish species, selenium would disproportionately affect the razorback sucker more than the other three species. As with all sucker species, the razorback sucker is a bottom feeder and more likely to ingest selenium that has precipitated to the river bottoms.

If combustion of coal from the lease modification occurs at the Hayden Station, selenium could be emitted and subsequently deposited. However, as it is not monitored as it is emitted, unlike mercury, there is no information as to how much is released. When selenium is present in flue gas, it tends to behave much like sulfur and is removed to some extent via the SO2 air scrubbers in place (EPRI 2008). Since the amount of selenium in emissions from the Hayden Station is not measured, impacts cannot be measured or detected in a manner that permits meaningful evaluation. However, the coal lease adjustment is extremely small when compared to the amount of coal that is combusted within the Colorado River Basin and since the Hayden Station is over 60 miles away from razorback critical habitat, the likelihood of selenium from this coal reaching DCH may be minimal.

**Yellow-billed cuckoo**

***Mercury***

Mercury is an environmental contaminant that can also have adverse effects on riparian wildlife (Scheuhammer et al. 2012; Wentz et al. 2014). For riparian birds such as cuckoos, Hg is accumulated via ingestion of aerial insects emerging from benthic life stages in aquatic environments containing Hg or from associated predatory spiders (Cristol et al. 2008; Edmonds et al. 2012; Evers et al. 2012; Buckland-Nicks et al. 2014; Gann et al. 2014). Dietary total Hg concentrations associated with adverse effects to birds are generally greater than 0.1 mg/kg WW (DOI 1998). Once ingested, MeHg rapidly moves into the bird's central nervous system, resulting in behavioral and neuromotor disorders (Tan et al. 2009; Scheuhammer et al. 2012). The developing central nervous system in avian embryos is especially sensitive to this effect, and permanent brain lesions and spinal cord degeneration are common (DOI 1998, Bryan et al. 2003, Scheuhammer et al. 2007). Therefore, adverse effects are described for the eggs, embryos, nestlings and/or fledglings associated with elevated Hg burdens in the female parent and due to foraging.

Uptake of mercury by birds has been shown to generally impact fish eating birds more severely than insectivorous birds (Zolfaghari et al. 2009, Boening 2000). Additionally, Howie (2010) found that the lateral extent of elevated mercury levels in birds and invertebrate prey species varied from approximately 250 to 650 meters from an affected water body. After this distance, mercury levels in the blood and feathers could not be distinguished from background levels, indicating that only those individuals that forage adjacent to affected water bodies show signs of bioaccumulation of mercury.

No information is available on the levels of mercury in the Yampa River invertebrates within the analysis area. Any yellow-billed cuckoos present in the analysis area would be at risk for mercury contamination. The risk would be low considering that the primary food sources for the cuckoo are generally not aquatic. If it predicted that only 0.884 ounces of mercury would be deposited in the local airshed, the amount of this mercury that eventually finds its way into critical habitat or into cuckoo prey would likely be negligible.

Cumulative Effects: Declines in the abundance or range of many special status species have been attributed to various human activities on federal, state, and private lands, such as human population expansion and associated infrastructure development; construction and operation of dams along major waterways; water retention, diversion, or dewatering of springs, wetlands, or streams; recreation, including off-road vehicle activity; expansion of agricultural or grazing activities, including alteration or clearing of native habitats for domestic animals or crops; and introductions of non-native plant, wildlife, or fish or other aquatic species, which can alter native habitats or out-compete or prey upon native species. Many of these activities are expected to continue on state and private lands within the range of the various federally protected wildlife, fish, and plant species, and could contribute to cumulative effects to the species within the action area of the Proposed Actions. Species with small population sizes, endemic locations, or slow reproductive rates, or species that primarily occur on non-federal lands where landholders may not participate in recovery efforts, would be generally be highly susceptible to cumulative effects.

Reasonably foreseeable future activities that may affect river-related resources within the Yampa and White River watersheds include coal mining and combustion, oil and gas exploration and development, irrigation, urban development, recreational activities, livestock grazing and activities associated with the Upper Colorado River Endangered Fish Recovery Program. Implementation of these projects affects the environment including but not limited to, water quality, water rights, socioeconomic and wildlife resources.

*Environmental Consequences of the No Action Alternative:*
Direct and Indirect Effects: Since the Foidel Mine would continue to operate with or without the federal coal in this lease modification, impacts from the No Action Alternative would be similar to the Proposed Action. In addition, the same amount of coal would be combusted at the Hayden Generating Station with or without this coal lease modification. Therefore, indirect impacts would be the same for both alternatives.

Cumulative Effects: Cumulative effects would be the same as cumulative impacts for the Proposed Action.

### 3.1.4 Cultural Resources

*Affected Environment*:
A number of laws mandate that federal agencies consider the effect of proposed land use activities on cultural resources (i.e. historic and archaeological sites). The National Environmental Policy Act states that it is the responsibility of the federal government to preserve important historic and cultural aspects of the national heritage. The National Historic Preservation Act (NHPA) requires federal agencies to

take into account the effect of federal undertakings (such as coal leasing) on cultural resources that are eligible for inclusion in the National Register of Historic Places (National Register). In Colorado, the requirements of the NHPA are implemented under the terms of the Protocol Agreement between the Bureau of Land Management and the State Historic Preservation Officer.

Historic and archaeological sites present in the lease modification area have been recorded during a number of cultural resource inventories that together have provided a fairly thorough, although not 100 percent, coverage of the lease modification area. A majority of the ground surface in the proposed lease modification area has been inventoried for cultural resources. A cultural resource inventory of a large tract of land for a previous coal lease covered the eastern half of the lease modification area (Zier 1979). Many small-scale inventories have taken place in the western half of the lease modification and are fairly evenly distributed across the area. Three sites are recorded within or adjacent to the lease modification boundary.

5RT3259 A segment of a railroad spur within the lease modification was recorded as 5RT3259 and was determined to be not eligible to the National Register. In 1962, the so-called Energy Spur was built from the main east-west railroad along the Yampa River near Milner, Colorado to the Twentymile coal mine loadout facility in order to transport coal from northwest Colorado. The main rail line along the Yampa follows the route of the so-called Moffat Road, which was founded in 1902 and, in 1913, connected Craig, Colorado with the then existing railroad. In 1947, the rail line became the Denver and Rio Grande Western Railroad. The 103-mile section between Craig and Bond, Colorado on the Colorado River connected the Yampa Valley with a main east-west railway across Colorado and was essential to the coal and livestock industries in the northwestern portion of the state. The Denver and Rio Grande Western Railroad is recorded as 5RT1396 and has been determined to be eligible to the National Register. The Energy Spur, however, has been determined to not contribute to the eligibility of the main lines of the Denver and Rio Grande Western.

5RT921 This site is a section of an irrigation ditch that is not eligible to the National Register. The ditch is situated south of Fish Creek, which flows generally to the east. The beginning and end of the ditch are outside of the area inventoried for historic sites. The site recorders suspect that the ditch transported water from a headgate on Fish Creek (apparently located to the west of the recorded segment of the ditch) eastward to a reservoir built on a tributary of Fish Creek. The reservoir is east of the recorded segment of the ditch and appears on the Milner, Colorado 7.5' USGS quadrangle. Likely the water would have been used for agricultural purposes, such as watering hay fields.

5RT177 An archaeological site recorded as 5RT177 is a campsite that has been determined by SHPO to be in need of more information in order to determine its eligibility to the National Register. The site is represented by a sparse scatter of surface artifacts occurring along a tributary of Foidel Creek. Artifacts observed on the surface include a number of waste flakes, a retouched flake, a point tip that is not diagnostic of a particular time period, two manos, and one grinding slab.

*Environmental Consequences of the Proposed Action:*
Direct and Indirect Effects: The proposed action is not expected to pose direct effects to cultural resources. Subsidence that could be caused by underground mining of the Wolf Creek Seam is not anticipated to affect cultural resources. Outcrops of the cliff-forming Twentymile Sandstone occur southwest of the lease modification area. Coal mine subsidence is known to cause formation of joints and to produce rockfalls along cliffs formed by the Twentymile Sandstone. This can in turn adversely affect rock art and rockshelters. Because no cliffs of Twentymile Sandstone are present within the lease modification area, subsidence would not affect any unrecorded rock art or rockshelter sites. The subsidence that could occur if the proposed action is approved is the potential lowering in elevation of the ground surface after the coal seam is mined. The seam measures at most 11 feet in thickness in the area beneath the lease modification, therefore, the elevation of the terrain above the lease modification area may decrease by this amount. However, the existing topography is expected to remain intact. Formation of cracks in areas covered by Quaternary and Recent sediment is not expected to occur as the ground subsides. Thus, subsidence is not expected to affect the irrigation ditch, railroad, and prehistoric campsite present within the boundary of the lease modification area.

Approval of the lease modification is also not expected to cause indirect effects to cultural resources. Indirect effects include such things as increased vandalism to historic sites and surface collecting of archaeological sites that can occur when a permitted undertaking improves public access into an area via construction of roads, for example. The cultural resources described above are located on land that is privately owned with no public access.

Cumulative Effects: Permitting of the lease modification is not expected to have significant cumulative effects on cultural resources. Past underground and surface mining of coal in northwest Colorado has primarily affected archaeological sites. Excavations or some other activity intended to mitigate damage or destruction of archaeological sites can retrieve the information about prehistory that makes the site important. Activities related to coal mining in the past have impacted archaeological sites in northwest Colorado, but the cumulative effect of past leasing has not resulted in the destruction of so many sites that the ability of archaeologists to improve understanding of prehistory has been curtailed. Mitigation of the adverse effects of coal mining on archaeological sites through large-scale excavation of the sites has actually contributed much to what is currently known about northwest Colorado prehistory.

*Environmental Consequences of the No Action Alternative:*
Direct and Indirect Effects: The No Action Alternative would not have direct or indirect effects on cultural resources.

Cumulative Effects: The no action alternative would not cause negative cumulative effects on cultural resources (destruction of a non-renewable resource), nor would the no action alternative result in the positive cumulative effects of an improved knowledge of prehistory that excavation of sites prior to destruction would provide.

*Mitigation*: None.

### 3.1.5 Paleontological Resources

*Affected Environment*: The affected environment is the 310 lease modification area.
The BLM has implemented a Potential Fossil Yield Classification (PFYC) system for classifying paleontological resources on public lands. Under the PFYC system, geologic units are classified from Class 1 to Class 5 based on the relative abundance of vertebrate fossils or uncommon invertebrate or plant fossils and their sensitivity to adverse impacts. A higher classification number indicates a higher fossil yield potential and greater sensitivity to adverse impacts. The project area contains portions of geological formations known to produce a range of fossils, from PFYC 3 (moderate potential) to PFYC 5 (high potential). Bedrock outcrops would be the most sensitive to adverse impacts. There is no bedrock on the surface of the proposed lease modification. Within the lease modification area, the surface is the Cretaceous Iles Formation (PFYC 3) formation.

*Environmental Consequences of the Proposed Action:*
<u>Direct and Indirect Effects</u>: Mining of the coal could create the potential for scientifically significant fossils to be found within the roof, floor, or coal of the Wolf Creek seam. If such fossils are found, the information gained would be a beneficial impact to the science of paleontology. Scientifically significant fossils that may be inadvertently destroyed or not reported and curated would be an adverse impact due to the loss of paleontological information.

<u>Cumulative Effects:</u> The cumulative effects analysis area includes the existing TC Foidel Creek Mine leases and permit area. The proposed lease modification in addition to other uses in the area could incrementally add to the general erosion of the area. Erosion could cause exposure of fossil resources. Continued human activity in the area could uncover scientifically significant fossils and add to existing information of the area. Scientifically significant fossils could be destroyed either inadvertently or if unauthorized collection occurs.

*Environmental Consequences of the No Action Alternative:*
<u>Direct and Indirect Effects:</u> Fossils would not be destroyed as a result of mining. Potentially scientifically significant fossils would not be discovered.

<u>Cumulative Effects:</u> None

*Mitigation:* None

### 3.1.6 Hazardous or Solid Wastes

*Affected Environment:* There are no known hazardous waste sites within the proposed lease modification area. If production occurs in the lease modification area, petroleum products and solvents would be used as part of the general mining operations. Use of these products would comply with all applicable state and federal regulations, as described in this section.
Mining operations at TC must comply with regulations promulgated under the Resource Conservation and Recovery Act, Federal Water Pollution Control Act (Clean Water Act), Safe Drinking Water Act, Toxic Substances Control Act, Mine Safety and Health Act, Department of Transportation, and the federal CAA. Mining operations must also comply with all state rules and regulations relating to hazardous material reporting, transportation, management, and disposal. Disposal requirements for

waste rock/ore derived from coal mining operations are based on whether the waste material is determined to be acid-forming and/or toxic-forming. If the material is determined to be non-acid-forming or non-toxic-forming, there are generally no restrictions on disposal. The material may be stockpiled within the permit area or disposed of per the Disposal of Excess Spoil, Coal Mine Waste Bank, or Coal Mine Waste Regulations (2 CCR 407-2.2.04.09 – 407-2.2.04.11). Acid forming and toxic-forming waste material must be disposed of in accordance with 2 CCR 407-2.4.05.8 (Acid-forming and Toxic-forming Spoil), 2 CCR 407-2.4.10.1 (Coal Mine Waste Banks General Requirements), and 2 CCR 407-2.4.14.3. Potential sources of hazardous or solid waste materials in the project area would include spilling, leaking, or dumping of hazardous substances, petroleum products, and/or solid waste associated with coal development or agricultural or livestock activities. If the lease modification area goes into production, petroleum products and solvents would be used underground as part of general operations. Use of these products would comply with all applicable state and federal regulations.

*Environmental Consequences of the Proposed Action:*
Direct and Indirect Effects: The 310 acre lease modification area would be limited to underground mining. Impacts to the environment resulting from the release of hazardous or solid waste are not expected. The potential for impacts resulting from substance release would depend upon the responsible use of chemicals, and the immediate containment and adequate clean-up in the event of unintentional releases. The potential for exposure to hazardous or solid wastes would be low. Limited volumes of underground development waste would be generated from roof falls. To the extent practical, this material would be disposed of underground in mined-out areas. Coal refuse material (non-specification coal) and incombustible waste rock generated at Twentymile Coal is transported to the surface by conveyor, segregated and transported to Foidel Creek Mine's approved refuse disposal area for permanent placement. Based on sampling and analysis of the geologic materials associated with Wadge and Wolf Creek seams in the Twentymile Coal permit area of the Foidel Creek Mine, the associated strata above and below the coal seams have little or no potential to generate acid- or toxic-forming refuse materials.

Cumulative Effects: In the past, the area has been mined by surface and underground methods. Present mining activities include TC Foidel Creek Mine and reclamation of the Seneca surface mines. Operations at the Sage Creek Mine, an underground coal mine have been idled since September of 2012. The 310 acre lease modification would be mined using the same equipment that is currently operating at the TC Foidel Creek Mine. The amount of petroleum products and solvents related to mining would remain at the current levels. These materials would continue to be managed and controlled under current regulations and best management practices. Cumulative impacts would be kept within state and federal guidelines and would be minor.

*Environmental Consequences of the No Action Alternative:*
Direct, Indirect, and Cumulative Effects: Under the No Action Alternative, there would be no impacts associated with hazardous or solid wastes.

*Mitigation:* None.

### 3.1.7 Social and Economic Conditions

*Affected Environment:* The social and economic study area for the proposed lease action and associated mining includes Routt and Moffat counties and the communities of Steamboat Springs, Oak Creek, Hayden and Craig. These communities currently provide the workforce for the Foidel Creek Mine, as well as providing mining services, retail, business and consumer services in the area. Steamboat Springs is the county seat of Routt County; Craig is the county seat of Moffat County.

The proposed lease modification and mine are in Routt County. Currently, TC has 325 employees. Approximately two thirds are Moffat County residents and one third are Routt County Residents. Using the U.S. Bureau of Economic Analysis industry multiplier of 4.4, employment associated with the coal mining industry increases to 1,430 in Moffat County and Routt County. The industry multiplier accounts for other industry jobs that are created by labor, services and goods needed to operate a coal mine. In 2013, TC was the largest employer of Moffat County residents and the eighth largest employer in Routt County. Weekly coal mining wages in Routt County are the third highest wages in the State; Moffat coal mining wages are the sixth highest wages in the State.[17] The 2009 TC payroll was $28.3 million.

**Table 11, Mining Wages**

| LOCATION | HOURLY | WEEKLY | ANNUAL |
|---|---|---|---|
| ROUTT | $52.15 | $2,086 | $108,472 |
| MOFFAT | $39.83 | $1,593 | $82,836 |
| COLORADO | $44.88 | $1,795 | $93,340 |

TC accounts for more than 6% of property tax revenue in Routt County and is the top taxpayer in Routt County. TC paid $3,209,691 in property taxes in 2013.[18] Peabody contributes to local charities such as United Way, supports 4H, and also helps to sponsor local community events.

***Population***

Table 5 presents basic population and demographic information for Moffat and Routt County and the state of Colorado. Approximately sixty percent of the workforce resides in Moffat County; forty percent reside in Routt County.

**Table 12, Population by Category, 2010 and 2013, Moffat County and the State of Colorado**

| Population | Moffat County | Routt County | Colorado |
|---|---|---|---|
| 2013 | 13,103 | 23,5013 | 5,268,367 |
| 2010 | | | |
| 2013 | | | |
| % Change | -5% | 0% | +4.8% |

[17] Yampa Valley Data Partners, Colorado Dept. of Labor

[18] Routt County Assessor's Office

| | | | |
|---|---|---|---|
| Male (2013) | 51.8% | 52.7% | 50.2% |
| Female (2013) | 48.2% | 47.3% | 49.8% |
| Under 5 years | 6.8% | 4.8% | 6.4% |
| Under 18 years | 25.8% | 19.6% | 23.5% |
| 65 years and over | 12.4% | 11.3% | 12.3% |
| % Non-White (2013) | 6.1% | 3.5% | 12.9% |
| % Below poverty (2008-20132 | 12.0% | 7.5% | 12.9% |

Source: US Census Bureau, http://quickfacts.census.gov/qfd/states/08/08081.html

The town of Craig is the largest town in Moffat County with a 2013 estimated population of 8,981, a decrease of 5.1% since 2010. Other communities in the county include Maybell (2010 population of 72), and Dinosaur (2010 population of 339).[14] The US Census reports that from 2008-2012, there were 6,179 housing units in Moffat County that housed 5,243 households, indicating a vacancy rate of approximately 15.1 %. Approximately 9.8% of rental units were classified as vacant. There was an average of 2.53 persons per household. The median value of an owner occupied housing unit was $184,800, well below the state average of $236,800.[19]

The town of Steamboat is the largest town in Routt County with a 2013 estimated population of 12,100, a 0.1% increase from 2010. Other communities in the county include Oak Creek (2010 population of 884) and Hayden (2010 population of 1,810)[20]. The US Census reports that from 2008-2012, there were 16,131 housing units in Routt County that housed 9,833 households. The homeowner vacancy rate was 2.8 %; the rental vacancy rate was 15.9%. There was an average of 2.27 persons per household. The median value of an owner occupied housing unit was $407,700 well above the state average of $236,800.[14]

***Identification of Minority and Low Income Populations***

For purposes of this section, minority and low income populations are defined as follows:

> *Minority populations* are persons of Hispanic or Latino origin of any race, Blacks or African Americans, American Indians or Alaska Natives, Asians, and Native Hawaiian and other Pacific Islanders.
>
> *Low-income populations* are persons living below the poverty level. In 2000, the poverty weighted average threshold for a family of four was $17,603 and $8,794 for an unrelated individual. Estimates of these two populations were then developed to determine if environmental justice populations exist in Moffat County (see Table 6).

In 2009, Moffat County had a population of 31,322 persons, of which approximately 5,137 (16.4%) were minorities and approximately 3,790 (12.1%) were living below the poverty level. Minority populations were lower in Moffat County than in the state of Colorado; the low-income population in

[19] US Census Bureau 2008-2012

[20] US Census Bureau, 2010

Moffat County was higher than for the state of Colorado. The Council on Environmental Quality (CEQ) identifies minority and low income groups as Environmental Justice populations when either (1) the population of the affected area exceeds 50 % or (2) the population percentage in the affected area is meaningfully greater (generally taken as being at least 10% more) than the population percentage in the general population of the region or state. Neither the minority population percentage nor the low-income population percentage meets the CEQ guidelines. As a result, it is assumed that no environmental justice populations exist within the area of influence, and no impact analysis is required.

***Protection of Children***

Executive Order 13045, *Protection of Children from Environmental Health Risks and Safety Risks* (April 21, 1997), recognizes a growing body of scientific knowledge which demonstrates children may suffer disproportionately from environmental health risks and safety risks. These risks arise because (1) children's bodily systems are not fully developed, (2) children eat, drink, and breathe more in proportion to their body weight, (3) their size and weight may diminish protection from standard safety features, and (4) their behavior patterns may make them more susceptible to accidents. Based on these factors, the President directed each Federal agency to make it a high priority to identify and assess environmental health risks and safety risks that may disproportionately affect children. The President also directed each Federal agency to ensure that its policies, programs, activities, and standards address disproportionate risks to children that result from environmental health risks or safety risks.

Children are very seldom present at the coal mining facilities. On such occasions, the coal mining companies have taken and would continue to take precautions for the safety of children by using a number of means, including fencing, limitations on access to certain areas, and provision of adult supervision. No additional impact analysis is required.

*Environmental Consequences of the Proposed Action:*

Direct and Indirect Effects:

If the coal lease modification is approved, the existing TC Foidel Creek Mine's operations and facilities would be used; there would be no new or added employment at the Foidel Creek Mine. No additional demand for housing or municipal services would be anticipated. Mining operations would be extended throughout the period required to mine recoverable coal reserves. This extension of mining operations would also extend the annual payroll, local expenditures, and taxes and royalty payments for approximately a year or more.

If the lease modification is approved, TC would have to pay the Fair Market Value (FMV) price per ton on the recoverable coal. Additionally, royalties would be paid on the federal coal mined by underground methods at 8 percent of the gross sales price. The BLM receives annual payments from coal lease holders based on rents at not less than $3.00 per acre. The rental of the lease area would be $930 per year for this 310 acre lease. The revenues from the FMV of the coal, rental, and royalties of a lease go to US Treasury General Fund and to the State of Colorado. Royalties from the Federal coal are distributed in the following way: 50% returns to the Federal treasury in the general fund. The other 50% is returned to the State where the coal was mined, with a portion of that percentage being returned to the county where the coal was mined. In Colorado, those funds are managed by the State Department of

Local Affairs in the Energy Impact Fund. These monies are distributed on a grant-like basis to counties affected by energy resource development for community benefit projects.

Cumulative Effects:
The cumulative socioeconomic effects of continued mining would include a constant level of employment and tax revenues during the operation of the Foidel Creek mine. That source of income would stop when the mine closes. Residential and other development activities could increase the local population of Routt and Moffat Counties. The cumulative social and economic effects of past, present, and reasonably foreseeable actions in Moffat and Routt Counties relative to coal mining operations would be to extend the mining employment sector, mining services sector, and property tax payments.

Mining of the coal also has future foreseeable effects on socio-economics. The population centers nearest to TC are the city of Steamboat Springs in Routt County, the communities of Oak Creek and Hayden in Routt County, and Craig in Moffat County. In the past and presently, Peabody has been responsible for paying sales taxes, property taxes, royalties, and other payments. According to The Socioeconomic Impact of Sage Creek Mine on Routt County, Colorado, and Surrounding Areas (Tetra Tech 2010) Peabody Energy has paid the following:

- $4.2 million in property taxes.
- $1.3 million in sales and use taxes.
- $13.0 million in royalties.
- $1.0 million to the Abandoned Mine Fund.
- $7.9 million to the Black Lung Fund.
- In addition to taxes and other payments, Peabody made charitable donations of nearly $69,000 to area organizations.
- TC's sales 2008 were approximately: $255.1 million, generating additional sales by other businesses in Routt County of $107.4 million (Peabody 2009).
- TC employed 584 people in its Foidel Creek Mine operations in 2013, generating 2,570 additional jobs in the local economy (U.S. Bureau of Economic Analysis industry multiplier of 4.4).

The cumulative effects on the estimated earnings on the wages and benefits to the local economy include wages and benefits to employees, income to local businesses, and taxes currently paid by TC due to the operation of the Foidel Creek Mine would continue with the lease modification.

The cumulative socioeconomic effects of continued mining would include a constant level of employment, personal income, and federal, state and local revenues during the operation of the mine and the removal of that source of income when the mine is closed. Residential and other development activities are expected to increase the local population and infrastructure in the area.

*Environmental Consequences of the No Action Alternative:*

Direct, Indirect, and Cumulative Effects: Under the No Action Alternative, the impact would be that the estimated 340,000 tons of recoverable federal coal would not be recovered. Mining of the reserves at the Foidel Creek Mine would continue at existing rates until the coal reserves are depleted. Reductions in jobs and associated salaries, local expenditures, royalty and tax payments would be realized after the reserves are depleted. The cumulative social and economic effects of the no action alternative in the Moffat County and Routt County area relative to coal mining operations would not extend the mining employment sector proportionately to the length of the remaining reserves, so that jobs would be lost. The Federal government (US Treasury) and the State of Colorado would not receive the rents and royalties associated with mining the coal in the lease modification. Royalties from underground coal are 8% of the sales price. Using EIA 2012 average price of $37.54 per ton, the lost revenues from the sale of 340,000 tons of recoverable coal at 8% would be $1,021,088.00

On a cumulative basis, if the lease modification were not approved, and not offered for sale, coal mining in the Twentymile Park Area is expected to continue at existing mines until existing reserves are depleted. At that point, the coal mining employment sector would be terminated. Mining the coal reserves in the LBA would increase the life of the mine.

*Mitigation:* None

### 3.1.8 Hydrology, Ground

*Affected Environment:* All of the impacts presented in this analysis are expected to occur as a result of the approved current mining operations, regardless of the decision to modify lease COC54608. The lease modification is on the southwest flank of the structural Twentymile Park Basin. The Twentymile Park Basin is an enclosed ground water basin. The Basin is a synclinal structure with rock outcrops on the margins of the Twentymile Park Basin. Groundwater flow is controlled by lithology and geologic structure and overall movement is generally toward the north. Within the proposed lease modification area, groundwater is known to be present in the Wadge Seam, Wadge overburden, surficial alluvium along the major creek drainages, Twentymile Sandstone, Fish Creek Sandstone, and the Trout Creek Sandstone. The Trout Creek and the Twentymile Sandstones are regional aquifers separated from the Wolf Creek Seam by low-permeability shale and interbedded shale/siltstone units. The Twentymile Sandstone is approximately 800 ft. above the Wolf Creek Seam and the Trout Creek Sandstone is approximately 250 ft. below the Wolf Creek Seam.

The ground water in the Twentymile Park Basin exists primarily under confined conditions within the bedrock units and under unconfined conditions within the alluvial deposits below the major surface drainages of the area and under previously disturbed areas of adjacent former surface mines. Below the surficial alluvial deposits and above the major aquifers is 700 ft. of the low permeability Lewis Shale. Recharge to the major aquifer units takes place at the outcrops of the bedrock aquifers, mostly in the southern and western edges of the Twentymile Park Basin by infiltration of precipitation and runoff.

Ground water occurrence, storage, and movement are associated with and controlled by the porosity and continuity of water bearing units, as well as structural gradients and faults. Ground water in the bedrock aquifers is not suitable for domestic use (DRMS Cumulative Hydrologic Impact Assessment, Yampa River Basin, May 4, 2010). The one well within the lease modification area is owned by Twentymile Coal, Permit number 66799-F. It is permitted for industrial use and provides for pumped transfer of water from an underground sump in an area of sealed Wadge seam mine workings to the surface. These uses include, but are not limited to, water for the coal wash-plant, dust control for coal handling facilities and coal transfer conveyors. The water may also be treated at the surface and returned back underground for use in underground dust control and in underground mining equipment applications.

Drilling operations show 150 ft. of shale, claystone, siltstone and lenticular sandstone known as the interburden between the Wadge and Wolf Creek seams. These drilling operations into the Wolf Creek reserve showed little to no groundwater in the interburden or in the Wolf Creek Seam. No drilling fluid losses or artesian flow were encountered during drilling. No significant ground water flows have been encountered while mining in the Wolf Creek coal seam or in the interburden between the Wadge seam and the Wolf Creek seam. The interburden between the Wadge Seam and Wolf Creek Seam is of very low permeability. Consequently, mine water inflows into the Wolf Creek seam are expected to be minimal. The Wadge Seam above the Wolf Creek Reserve is mined out and filled with gob. Over time, slow water infiltration and recharge will result in some water in the Wadge seam gob, but vertical movement would be limited by the low permeability of the overlying and underlying units. There is currently an accumulation of water in the overlying sealed Wadge seam workings; this water will be transferred to sealed Wadge seam mine workings in the Western Mining District. The Western Mining District is to the west of the proposed lease modification.

*Environmental Consequences of the Proposed Action:*
Direct and Indirect Effects: No significant increased degradation of groundwater quality is anticipated as a result of the proposed leasing activity. No water quality effects in the Twentymile Sandstone or the Trout Creek Sandstone would be anticipated during mining operations. The Twentymile Sandstone and Trout Creek Sandstone would not be affected because the thick, low permeability shales limit vertical water transmission between bedrock units. Following completion of mining in an area, the mined-out area would be sealed and allowed to flood. Oxidation effects associated with contact between the ground water and exposed coal and overburden may result in changes in ground water quality and chemistry including increases in TDS and metals. These effects would be buffered by dilution by continued inflows and contact mixing with undisturbed ground water sources. These increased TDS concentrations would be limited to the overburden unit. Any localized reduction in piezometric surfaces and/or changes in water quality and chemistry should not adversely affect water users since there are no wells that intercept the Wolf Creek reserve. Piezometric surface is defined as “The level at which the hydrostatic water pressure in an aquifer will stand if it is free to seek equilibrium with the atmosphere.”

Cumulative Effects: The Twentymile Coal Foidel Creek Mine has been in operation since 1983. Since that time groundwater quality has been monitored by monitoring wells. To date, there is no evidence that there is any significant connection between the mine workings and either the underlying Trout Creek Sandstone or the overlying Twentymile Sandstone. TC has an existing ground water monitoring system. It is used to document and assess any mining-related impacts to ground water. Monitoring has shown that mining has had no effect on the Twentymile Sandstone aquifer or Trout Creek Sandstone and water quality data from the mine inflow into the Wadge seam workings does not indicate any significant connection to either the overlying Twentymile Sandstone or the underlying Trout Creek Sandstone. Periodic evaluation of the existing monitoring system would be conducted to adequately monitor impacts resulting from mining coal from the proposed action.

There are monitoring wells in the Twentymile Sandstone, the Trout Creek Sandstone, the Fish Creek Sandstone, and alluvial deposits. Upon completion of mining of the Wolf Creek seam, mined-out areas would be sealed and allowed to flood, with gradual reestablishment of a stable piezometric surface within the water-bearing units and the mined-out units. TC conducts continual hydrologic monitoring and submits annual hydrology reports. The 2013 Annual Hydrology Report of the mine shows no significant ground water hydrology impacts from activities at the Foidel Creek Mine. Leasing would have no effect on groundwater.

*Environmental Consequences of the No Action Alternative:*

Direct, Indirect, and Cumulative Effects: None. Not issuing the lease modification would have no impacts on ground water quality as there would be no mining.

*Mitigation:* None.

### 3.1.9 Hydrology, Surface

*Affected Environment:* The SMCRA and Colorado Surface Coal Mining Reclamation Act contain provisions for protection of water resources from effects of underground coal mining. Parts of these acts and enabling regulations provide for no disruption of the hydrologic balance (i.e. impart no material damage to these resources). All of the impacts presented in this analysis would be expected to occur as a result of the approved current mining operations, regardless of the decision to modify lease COC54608. There is no surface water within the proposed 310 acre lease modification; Fish Creek is to the north of the lease modification, Foidel Creek is to the south. Runoff from the area affected by the proposed action would flow to Fish Creek, a perennial tributary to Trout Creek; Trout Creek is a perennial tributary to the Yampa River. The water quality of Fish Creek must support Aquatic Life Cold 1, Recreation E, and Agricultural beneficial uses. The water quality of Trout Creek must support Recreation, Water Supply, and Agricultural beneficial uses. Fish Creek and Trout Creek meet standards, and are not listed as impaired.[21] The Yampa River from Elkhead Creek to the Green River is impaired for total recoverable iron.[21] EPA'S Effluent Limitations Guidelines for coal mining ( 40 CFR Part 434) include iron, but note that high concentrations of total iron can be found in western coal regions. The development document (EPA 2001) notes that "In natural undisturbed conditions, surface water samples

[21] https://www.colorado.gov/pacific/sites/default/files/Regulation-93.pdf

in the arid/semiarid western United States can register values for total iron as high as 40,000 mg/L (4%) due to the sediment that is collected as part of the water sample."

Longwall mining in the vicinity has occurred since approximately 1988 and runoff water from the subsided areas as well as some mine inflow water, has flowed or been released into Fish Creek or Foidel Creek after treatment in accordance with all state and federal regulations. Surface flows from disturbed and reclaimed areas are intercepted and treated in sedimentation ponds prior to discharge to meet the EPA's National Pollutant Discharge Elimination System (NPDES) standards. The State of Colorado CDPHE Water Quality Control Division (WCQD) administers the NPDES for the EPA and the Colorado Discharge Permit System (CDPS) issues discharge permits. TC's hydrologic monitoring program is subject to ongoing review under CDPHE's WQCD required Discharge Monitoring Reports. TC has five CDPS permits; each permit has 1-6 outfalls or monitoring sites. The outfalls are as follows: Foidel Creek, 6 sites; Fish Creek, 6 sites; Middle Creek, 1 site; Trout Creek, 4 sites. Fish Creek flows into Trout Creek, a tributary of the Yampa River. Foidel Creek flows into Middle Creek; Middle Creek flows into Trout Creek which flows into the Yampa River.

Water discharge from the mine inflow water is also managed under TC's CDPS permit. Mine inflow water collects in underground sump rooms and is then pumped to the surface where it passes through the water treatment facility. This water is then either discharged to Fish Creek or returned underground for use in mining activities. Mine water can also be channeled and treated through surface settling ponds prior to discharging into Foidel Creek, or it can be returned for use underground. The discharge sites are rarely used because the Foidel Creek mine makes use of and recycles much of the mine inflow water in various mining activities, especially dust suppression. If necessary, discharges are treated to meet CDPS permit effluent limits.

Water discharged from the mine could contain mercury and selenium. These elements are of concern because of their detrimental effects to the Colorado federally listed fish species. Under NPDES, discharge water is not monitored for mercury or selenium levels. The CDPS permits do not have limits on mercury or selenium. However, DRMS does require mercury and selenium analyses of samples from the discharge water. TC is required to report thirty day averages and daily maximums of both total mercury and potentially dissolved selenium. Selenium samples were below detection limits or within the state standards. Samples tested for mercury have been below the detectable limit for mercury. Samples are also required to be tested for iron. From 2011- 2014 there was one exceedance for iron during a high stream flow in March 2012.

**Environmental Consequences of the Proposed Action:**

<u>Direct and Indirect Effects</u>

Leasing would have no direct effect on surface water. If the lease modification is approved and mining were to occur, subsidence over the longwall panel would occur. Mining would not damage the quantity and quality of surface water. Subsidence related impacts would be of limited magnitude, would occur progressively during and shortly after longwall mining and would be effectively mitigated by the natural response of the dynamic stream system. Subsidence of the Fish Creek valley could result in potential seasonal flooding of low-lying areas and an increase in groundwater levels relative to the subsided surface along the margins of drainage channels. These subsidence effects have the potential to result in beneficial increases in riparian vegetation and habitat along the margins of the affected drainages. The flooded area would be dictated by the surface flows in Fish Creek. During the spring runoff more of the valley floor could be flooded. Flows and water levels would decline as the runoff decreases. If there is discharge due to mine dewatering, it could have a positive effect during years of low stream flow. Since there would not be very much mine water inflow while mining the Wolf Creek seam, it is anticipated that the water would not be discharged and therefore not affect the water quality or quantity.

Short term effects from subsidence of the ground surface likely would cause localized gradient changes stream channels and potential pooling. Ninety-five to 98 percent of subsidence from longwall mining occurs during active mining. Long-term subsidence effects are not expected with longwall mining since such effects occur in a fairly short time. Based on subsidence monitoring from previous mining in the overlying Wadge seam, the maximum the stream gradient is anticipated to temporarily increase is 1.1 per cent. This increase should not result in any significant changes to the stream profile. Similar changes in the gradient were documented in the Northern and Eastern Mining Districts without resulting in additional erosion. Temporary formation of broad, trough-shaped swales and ponding would be expected to occur over the longwall panels. The ponding would reduce the velocity of the stream due to the temporary gradient increase resulting in deposition of the suspended sediment. The stream would gradually adjust to a dynamic equilibrium once subsidence has stopped. Additional sediments could be generated in the short term from overland flow across soil surfaces; however localized deposition is expected to occur within the stream channel, except during high runoff events. Slightly higher levels of total dissolved solids (TDS) and Total Suspended Solids could result from sediment transport in the short term.

Surface cracking or fissuring formed from subsidence has occurred in areas where the Twentymile sandstone either outcrops or is located relatively close to the surface. This condition does not occur in the lease modification area. The thick marine shale covering the Twentymile sandstone would decrease the potential for surface cracking or fissuring. The potential for water loss is extremely low due to the low permeability of the marine shale.

Mine water discharge into surface streams as a consequence of future mining could impact the quality of water in the receiving streams Handling and holding in sumps of the mine water could tend to increase the total dissolved solids (TDS) levels. Mine effluent would be regulated, and any discharge to receiving streams would have to meet permitted effluent requirements. Concentrations of TDS, iron and manganese could increase. All mine inflow water encountered during mining activities is currently being recycled for use in mining activities. This practice would continue if mining of the lease modification occurs and so no discharge would occur.

Combustion of the coal from this lease modification would result in emissions that contain mercury and selenium. In 2014,the Foidel Creek mine sold coal to 11[22] different power plants. The destination of the coal from the lease modification is not known. Foidel Creek Mine does sell coal to the Hayden Generating Station, however, the Yampa River is not impaired for mercury or selenium. Water quality

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22 http://www.eia.gov/beta/coal/data/browser/#/shipments/mine/503836?freq=Q&start=200801&end=201402&ctype=columnchart&ltype=pin&map=COAL.SHIPMENT_QTY.503836-47-TOT.Q&columnchart=COAL.SHIPMENT_QTY.5

data collected from the Yampa River below Craig (USGS Station 09247600) between 1991 and 2003 showed that the majority of mercury values were reported at less than the laboratory reporting level, and the maximum reported was 0.10 micrograms per liter (USGS 2015b). The State of Colorado chronic aquatic life water quality standard for mercury is 0.01 micrograms per liter (0.00001 mg/L) (CDPHE 2012b).

Selenium is another product of coal combustion. Water quality data collected from the Yampa River below Craig (USGS Station 09247600) between 1991 and 2011 showed that close to half of the values were reported at less than the laboratory reporting level, and the maximum reported was 17.0 micrograms per liter (0.017 mg/L) (USGS 2015b). The chronic aquatic life standard for total selenium is 0.005 mg/L (CDPHE 2012b).

The Yampa River, Trout Creek, Middle Creek, and  Fish Creek are not on the CDPHE Section 303(d) List of Impaired Waters and Monitoring Evaluation List for mercury or selenium.

Cumulative Effects

An increase in erosion and deposition would continue until Fish Creek adjusts to the changes that could be caused by subsidence. The discharge of mine inflow water to surface water drainage from the sediment ponds could affect` the water quality.  The quality of surface water could possibly be affected by water handling and treatment methods under the planned operations of the mine.  The effects of leaching in exposed spoil and waste rock piles, detention of water in sedimentation ponds, and pumping water out of pits and underground mine workings have the potential to increase TDS concentrations and change ionic composition of surface waters.

Agricultural use of surface water would continue and is expected to remain at present and past levels.

*Environmental Consequences of the No Action Alternative:*

Direct, Indirect, and Cumulative Effects: Surface water quality would not be affected.

**Mitigation: None.**

## CHAPTER 4 – PUBLIC LAND HEALTH STANDARDS

### 4.1 Standards for Public Land Health

In January 1997, Colorado BLM approved the Standards for Public Land Health. The five standards cover upland soils, riparian systems, plant and animal communities, threatened and endangered species, and water quality. Standards describe conditions needed to sustain public land health and relate to all uses of the public lands. Environmental analyses of proposed projects on BLM land must address whether the Proposed Action or alternatives being analyzed would result in impacts that would maintain, improve, or deteriorate land health conditions identified in the applicable Land Health Assessment (LHA). Since there is no BLM surface within this project area, none of the Standards apply.

## CHAPTER 5 - COORDINATION AND CONSULTATION

### 5.1 Tribes, Individuals, Organizations, or Agencies Consulted:

Tribal consultation was not initiated for this undertaking. The scope of this undertaking is addressed in the annual letter to the Tribes regarding current projects in the LSFO.

Under Section 7 of the ESA, federal agencies must consult with the USFWS when any action the agency carries out, funds, or authorizes *may affect* a listed endangered or threatened species. The Little Snake Field Office initiated consultation by requesting a species list from the local USFWS office for federally listed, federally proposed, or current federal candidate species that may be present in the planning area. The LSFO subsequently prepared a biological assessment (Attachment A) based on the species list in which a determination is made, in accordance with Section 7 of the ESA, that the proposed action "may affect, is not likely to adversely affect" federally listed, proposed, or candidate species. Section 7 consultation under the Endangered Species Act (ESA) is being completed for this action. The BLM determined that the Proposed Action "may affect, but is not likely to adversely affect" the yellow-billed cuckoo and the lineage greenback cutthroat trout. In addition, the Proposed Action is not likely to destroy or adversely modify proposed critical habitat for the yellow billed cuckoo. In the draft Biological Opinion (BO), the FWS concurred with these determinations. A "may affect, likely to adversely affect" determination was found for the four Colorado River Fish. However, in the FWS's draft BO, it is the Service's biological opinion that the Proposed Action is not likely to jeopardize the continued existence of the four endangered fish. In addition, the Proposed Action is not likely to destroy or adversely modify any of the critical habitats designated for the four endangered fish.

Section 7(d) of the ESA prohibits federal agencies and applicants from making any irreversible or irretrievable commitment of resources which could foreclose the formulation and implementation of reasonable and prudent alternatives that could avoid jeopardy to listed species or destruction or adverse modification of critical habitat. Since a no jeopardy decision is expected from the FWS, and the project would not destroy or adversely modify critical habitat, no reasonable or prudent alternatives would be needed or developed for this action.

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## APPENDIX A

**Example Calculations for Emission Sources**

**1.) Horsepower-hour Calculations for Underground Mobile Sources**

**Example Parameters:**

1.) Foidel Creek Mine's annual diesel fuel use 489,368 (Underground Equip.) gal *source: Peabody
2.) The average density of the diesel fuel is 7.11 lb/gal *source: LSD MSDS
3.) The LHV based energy density of the diesel fuel is 18,500 btu/gal *source: Ave. of literature
4.) Conversion: btu/hp-hr = 2,544.43 *source: Common conversion
5.) $CO_2$ EF = 643.29 g $CO_2$/hp-hr *source: EPA Nonroad (2008a)
6.) Carbon content of diesel fuel = 2,778 g C/gal *source: 40 CFR 600.113
7.) $CO_2$ : C Molecular Weight Ratio = 44/12 = 3.667 (unit less) *source: Periodic Table

**Calculate Parameters** (Underground Equipment Example)**:**

1.) Total Available Energy of fuel =
489,368 gal x 7.1 lb/gal x 18,500 btu/lb. = 64,278.48MMbtu

2.) Energy Converter to HP (Energy IN) =
64,278,486,800 btu / 2,544.43 btu/hp-hr = 25,262,430 hp-hr

3.) Convert $CO_2$ EF of Diesel Fuel to C EF =
643.29 g $CO_2$/hp-hr x 3.667-1 =175.443 g C/hp-hr

4.) Derived hp-hr/gal of fuel from know Carbon Content of fuel =
2,778 g C/gal / 175.443 g C/hp-hr = 15.834 hphr/Gal

5.) Derived hp-hr from fuel use (Energy Out) =
15.834 hp-hr/gal x 489,368 gal =7,748,653 hp-hr

6.) TE = Energy Out / Energy IN x 100% =7,748,653 hp-hr / 25,262,430 hp-hr x 100% = 30.67%

**Conclusions:**

The Thermal Efficiency of the underground equipment is approximately 30.67% based on the EPA Model data for $CO_2$. The value is realistic for working engines where hp is developed at various RMPs (based on loading and work cycles). Further the EPA Model takes this into account when developing the EFs (see Nonroad Technical Document NR009d "Exhaust and Crankcase Emission factors for Nonroad Engine Modeling – Compression- Ignition"). All 43emissions estimates are based on the EPA Nonroad Model emissions factors and the total hphrs derived in calculated parameter 5 for all underground equipment.

**2.) Example Emissions Calculations for Underground Diesel Mobile Sources**
**General Equation for all Emissions:**

Emissions (tons) = Total hp-hr (Energy Out1) x NR EF*E* g/hp-hr x 453.6-1 g/lb x 2000-1 lb/ton
Where:
EF*E* = Underground Equipment Emissions Factor
1 For $N_2O$, substitute (Energy In). EF based on fuel use only.

**A.) For NOX (underground)**
7,748,653 hp-hr x 8.561 g/hp-hr x 453.6-1 g/lb x 2000-1 lb/ton = 73.12 tons

**3.) Example Emissions Calculations for Gasoline Mobile Sources**

**Example Parameters:**

1.) Foidel Creek Mine's estimated annual unleaded fuel use 12,983 gal *source: Peabody Energy
2.) 2004 CAFE for LDGT = 20.7 miles per gallon (mpg) *source: NHTSA (2004)
3.) Emissions Factors (grams per vehicle mile traveled (g/VMT) are from 2003 IERA Mobile Source
Emissions Tables 4.5, 4.6, 4.7, & 4.50
4.) Gasoline carbon content per gallon = 2,421 g C/gal *source: EPA 420-F-05-001,2005
5.) $CO_2$ : C Molecular Weight Ratio = 44/12 = 3.667 (unit less) *source: Periodic Table

**Calculate Parameters:**

1.) Total Vehicle Miles Traveled (theoretical) =
12,983 gal x 20.7 mpg =268,745.8
miles

2.) $CO_2$ Emissions Factor =
12,983 gal x 2,421 g C/gal x 3.667 x 268,745.8-1 miles = 428.87 g/VMT

**General Equation for all Emissions:**
Emissions (tons) = Total Annual Fuel Use (gal) x CAFE (mi/gal) x EF g/mi x 453.6-1 g/lb
x 2000-1 lb/ton

**A.) CO**
12,983 gal x 20.7 mi/gal x 2.9 g/mi x 453.6-1 g/lb x 2000-1 lb/ton = 0.859 tons

**B.) $CO_2$**
12,983 gal x 20.7 mi/gal x 428.84 g/mi x 453.6-1 g/lb x 2000-1 lb/ton = 127 tons

## APPENDIX B

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## APPENDIX C

### Abbreviations and Acronyms

| | |
|---|---|
| ACEC | Area of Critical Environmental Concern |
| APE | Area of Potential Effect |
| BLM | Bureau of Land Management |
| BMP | Best Management Practices |
| BO | Biological Opinion |
| BTU | British Thermal Unit |
| CAA | Clean Air Act |
| CCR | Code of Colorado Regulations |
| CDPHE | Colorado Division of Public Health and Environment |
| CEQ | Council on Environmental Quality |
| CFR | Code of Federal Regulations |
| CMOP | Coalbed Methane Outreach Program |
| CWA | Clean Water Act |
| DCH | Designated Critical Habitat |
| DOI | Department Of Interior |
| LBA | Lease by Application |
| DRMS | Division of Reclamation, Mining and Safety |
| EA | Environmental Analysis |
| EIA | Energy Information Administration |
| EPA | Environmental Protection Agency |
| FCLAA | Federal Coal Leasing Amendment Act |
| FEMA | Federal Emergency Management Agency |
| FLPMA | Federal Land Policy Management Act |
| FONSI | Finding of No Significant Impact |
| G | Grams |
| GAL | Gallon |
| HP | Horsepower |
| HR | Hour |
| IM | Instructional Memo |
| LSFO | Little Snake Field Office |
| LUP | Land Use Plan |
| MBTA | Migratory Bird Treaty Act |
| MLA | Minerals Leasing Act |
| MOA | Memorandum of Agreement |
| MPG | Miles per Gallon |
| MSHA | Mine Safety and Health Administration |
| NEPA | National Environmental Policy Act |
| NHPA | National Historic Preservation Act |
| ONRR | Office of Natural Resources Revenue Data Warehouse Portal |

| | |
|---|---|
| OSM | Office of Surface Mining |
| PA | Programmatic Agreement |
| PDCH | Proposed Designated Critical Habitat |
| RMP | Resource Management Plan |
| ROD | Record of Decision |
| SHPO | State Historic Preservation Officer |
| SMCRA | Surface Mining Control and Reclamation Act |
| T&E | Threatened and Endangered |
| TC | Twentymile Coal |
| TDS | Total Dissolved Solids |
| VAM | Ventilation Air Methane |
| VMT | Vehicle Miles Traveled |
| VRM | Visual Resource Management |
| WO | Washington Office |
| WSA | Wilderness Study Area |

## ATTACHMENT A

### Biological Assessment

### I. Introduction

Threatened and endangered species are managed under the authority of the Endangered Species Act of 1973 (PL 93-205, as amended). The Endangered Species Act requires Federal agencies to ensure that all actions which they authorize, fund, or carry out are not likely to jeopardize the continued existence of any endangered or threatened species, or result in the destruction or adverse modification of their critical habitat.

This Biological Assessment will analyze the effects of the COC54608 Coal Lease Modification on eight threatened, endangered or candidate species. The COC54608 Coal Lease Modification is located near Hayden, CO in Routt County. Federally listed species occurring in Routt County and species that could be indirectly affected downstream are listed below in Table 1.

**Table 1. List of Threatened, Endangered and Proposed Species**

| Common Name | Scientific Name | Federal Status |
|---|---|---|
| Bony-tailed chub | *Gila elegans* | Endangered |
| Colorado pikeminnow | *Ptychocheilus lucius* | Endangered |
| Humpback chub | *Gila cypha* | Endangered |
| Razorback sucker | *Xyrauchen texanus* | Endangered |
| Black-footed ferret | *Mustela nigripes* | Endangered |
| Canada lynx | *Lynx candensis* | Threatened |
| Yellow-billed cuckoo | *Coccyzus americanus* | Threatened |
| Greenback cutthroat trout | *Oncorhynchus clarki stomias* | Threatened |

### II. Consultation History

Consultation has not been completed for this coal lease modification. Typically, the Office of Surface Mining, Reclamation and Enforcement (OSMRE) completes consultation regarding water depletions at the mine plan stage and therefore, this consultation will not consider water depletions.

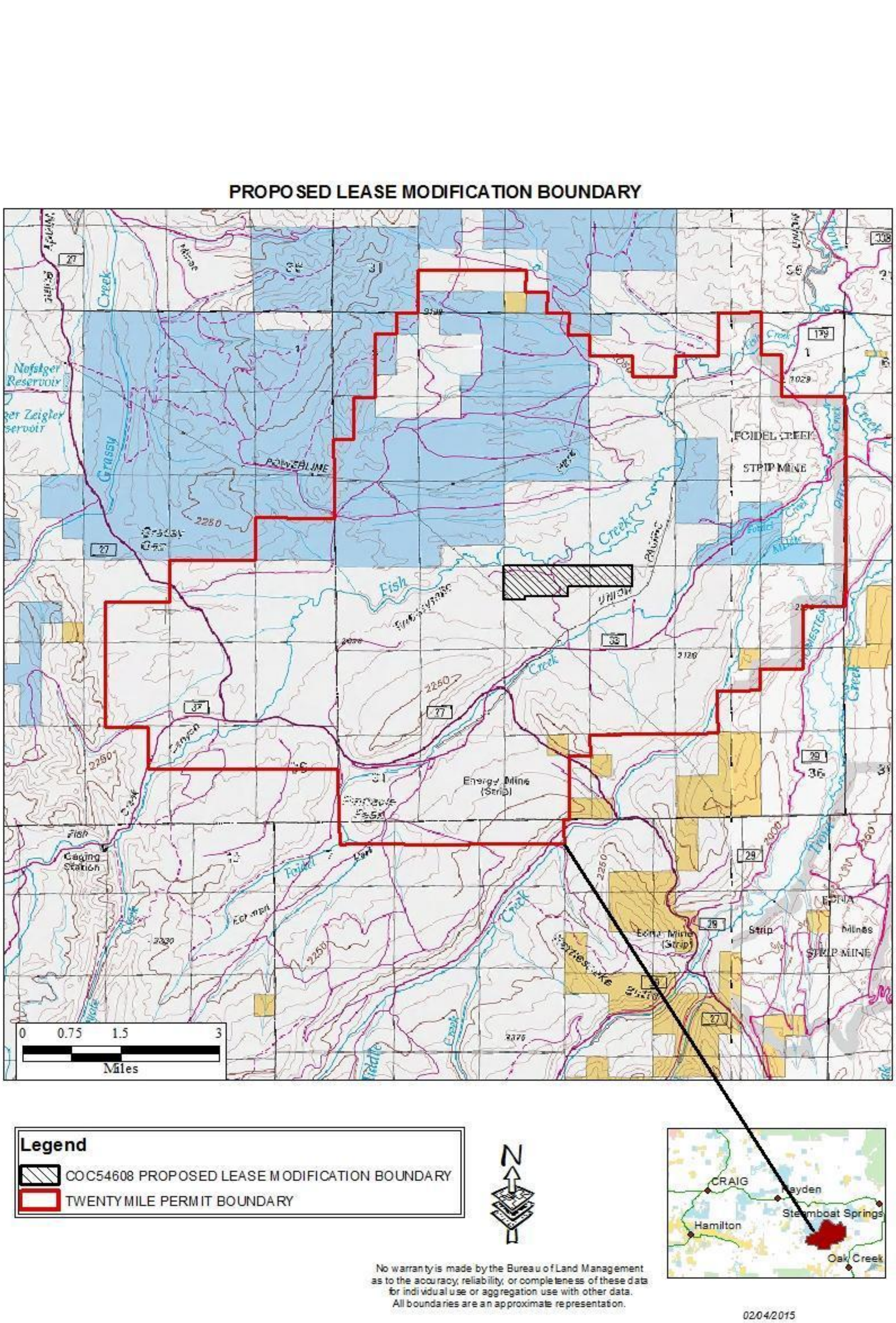
### III. Proposed Action

The Bureau of Land Management (BLM), Little Snake Field Office (LSFO) is preparing an environmental assessment to analyze the environmental effects of a coal lease modification. Peabody Energy's Twentymile Coal, LLC (TC) has submitted a lease modification to the BLM seeking to modify an existing coal lease, COC54608. TC has operated the Foidel Creek mine, which is an underground longwall coal mine, since 1983. The Foidel Creek Mine is made up of 6 federal coal leases, private coal leases and state coal leases and produces approximately 4 million tons of coal per year.

The Foidel Creek Mine is located in the central portion of Routt County, Colorado (Township 5 North, Range 86 West, and Township 5 North, Range 87 West), approximately 21 miles Southeast of Hayden, Colorado (population approx. 1,600), and south of State Highway 40 between the towns of Steamboat Springs to the east and Craig to the west. Topography in the project area and adjacent lands ranges in elevation from approximately 6,600 feet to 7,800 feet. The average elevation of the project area is approximately 7,040 feet. Terrain varies from rolling hills with agricultural fields and rangeland in the northwestern, central, and extreme southern extents of the project area to high ridges and steep slopes within the eastern and southwestern portions of the project area. The normal temperatures (min and max) for the area range from 4.8 to 29.1 ˚F in January to 46.9 to 83.7 ˚F in July. The regional average annual precipitation amounts to approximately 19.01 inches, which according to historical records shows the lower elevations receiving relatively higher precipitation amounts in summer, while the higher elevations receive relatively higher amounts of precipitation in winter.

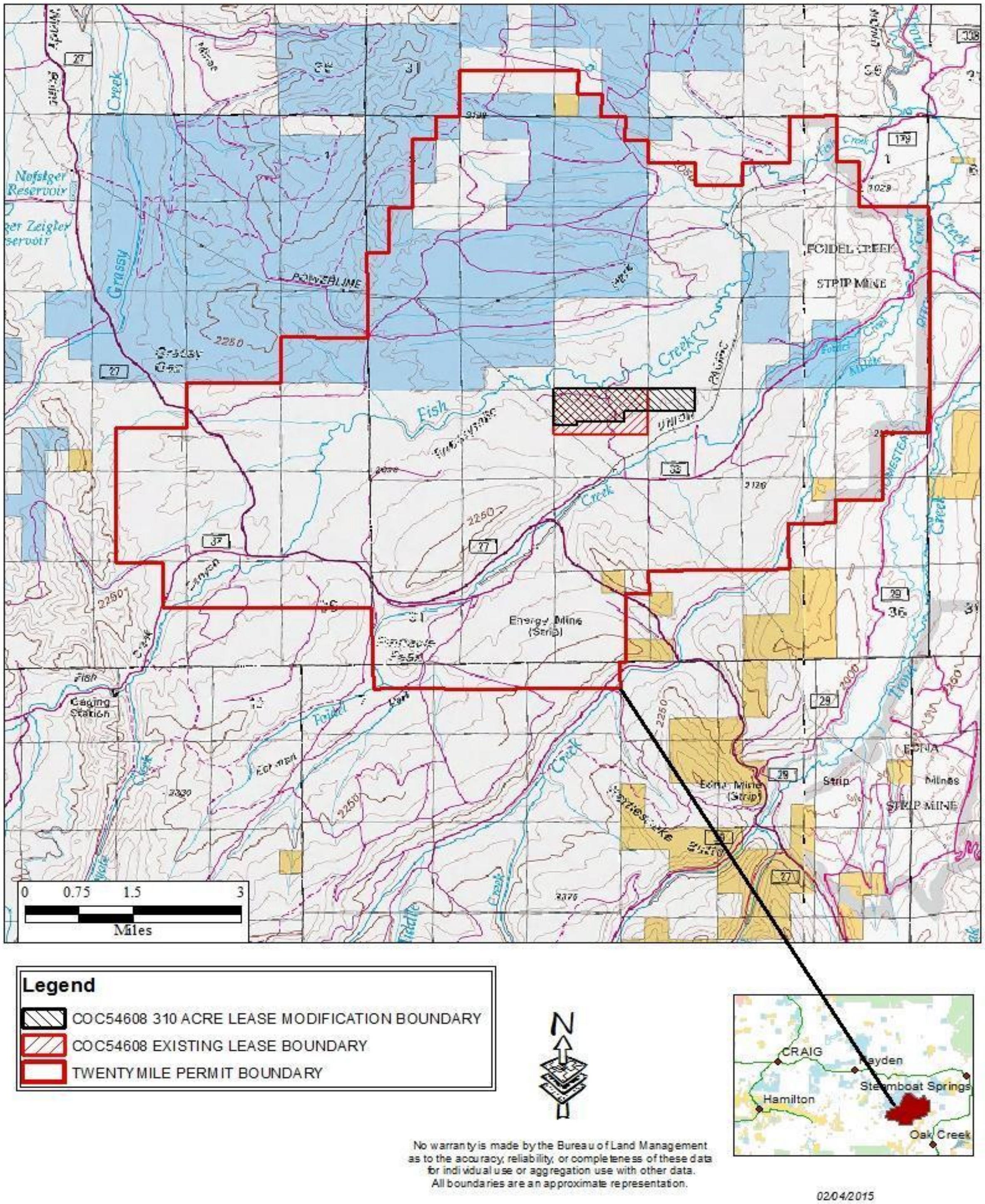
The modification to lease COC54608 proposes to add 310 acres of un-leased federal coal under privately owned surface at the TC Foidel Creek Mine. The lease modification application is for the Wolf Creek seam, a coal seam below the Wadge seam. It is estimated that the federal coal reserves included in this lease modification would total approximately 340,000 recoverable tons of high volatile, group B, bituminous coal.

Coal is a federal asset, and the BLM is required by law to consider leasing federally-owned minerals for economic recovery. The Minerals Leasing Act (MLA) of 1920, as amended by the Federal Coal Leasing Amendments Act (FCLAA) of 1976; and the Code of Federal Regulations Title 43 Part 3400, et seq. provide the legal foundation for the leasing and development of federal coal resources. BLM is the federal agency delegated the authority to offer federal coal resources for leasing and to issue leases. The Mining and Minerals Policy Act of 1920 (MMPA) declares that it is the continuing policy of the federal government to foster and encourage the orderly and economic development of domestic mineral resources. BLM complies with the Federal Land Policy and Management Act of 1976 (FLPMA) to plan for multiple uses of public lands and determine those lands suitable and available for coal leasing and development.


PROPOSED LEASE MODIFICATION BOUNDARY
Legend
COC54608 PROPOSED LEASE MODIFICATION BOUNDARY
TWENTYMILE PERMIT BOUNDARY
0 0.75 1.5 3
Miles
N
CRAIG
Hayden
Steamboat Springs
Hamilton
Oak Creek
No warranty is made by the Bureau of Land Management as to the accuracy, reliability, or completeness of these data for individual use or aggregation use with other data. All boundaries are an approximate representation.
02/04/2015

**MAP 1**

OVERLAY OF EXISTING COC54608 LEASE WITH PROPOSED LEASE MODIFICATION BOUNDARY




**MAP 2**

### Reasonably Foreseeable Actions

If the lease modification is approved, development of the coal resources of the Wolf Creek seam would occur in a similar manner as the current operations and would use existing surface facilities. No new surface disturbance would result from subsequent mining of the federal coal. Leasing conveys rights to the mineral resource; however, leasing does not authorize coal mining. Subsequent permitting actions would be required to allow mining. Impacts, if any, to listed species from the mine plan would be evaluated by OSMRE at the mine plan stage.

In addition to underground mining, combustion of federal coal is a reasonably foreseeable action. However, the BLM has no discretion or decisions regarding this action. This is an independent, but reasonably foreseeable future activity.

## IV. Threatened and Endangered Species

Of the eight potential species noted in Table 1 above, two were dropped from further consideration because their range distributions are outside the proposed action area, habitats necessary for their life requirements are not found within the proposed action area, or no effects will occur with regard to the proposed actions. These species are discussed briefly below:

### A. Black-Footed Ferret

Black-footed ferrets historically occurred throughout much of the western United States where large colonies of prairie dogs were present. Black-footed ferrets are heavily dependent on prairie dogs as prey and on prairie dog burrows for shelter. The only known possible population of black-footed ferrets in Colorado was re-introduced in Moffat and Rio Blanco Counties, over 60 miles from the mine. There are no prairie dog towns located in or near the project area and no indirect impacts are expected from the Proposed Action. Therefore, there would be No Effect to black-footed ferrets and this species was dropped from further consideration.

### B. Canada Lynx

Canada lynx historically occurred throughout much of the Southern Rockies. Habitats consist of coniferous forests and prey is primarily snowshoe hares. Habitat for this species within the LSFO primarily occurs adjacent to forest service lands. The action area does not support coniferous forests and the closest mapped lynx habitat is over 10 miles away. No indirect impacts are expected from the Proposed Action. Therefore, there would be No Effect to Canada lynx and this species was dropped from further consideration.

## V. Evaluated Species

### A. Colorado Pikeminnow (*Ptychocheilus lucius*)

**Species Description**

The Colorado pikeminnow is the largest cyprinid fish endemic to the Colorado River system (Tyus 1991). Its common name was changed from Colorado squawfish by the American Fisheries Society (Nelson et. al 1998). This species can reach a maximum length of approximately 6 feet total length (TL) and a maximum weight of 80 pounds (Miller 1961). Young are silvery and usually have a dark, wedge-shaped spot at the base of the caudal fin. Adults are strongly counter shaded with a dark, olive back and a white belly.

**Life History**

The following information is from the Colorado Pikeminnow Recovery Goals (2002).

The Colorado pikeminnow is a long-distance migrator; adults move hundreds of kilometers to and from spawning areas and require long sections of river with unimpeded passage. Adults require pools, deep runs, and eddy habitats maintained by high spring flows. These high spring flows maintain channel and habitat diversity, flush sediments from spawning areas, rejuvenate food production, form gravel and cobble deposits used for spawning, and rejuvenate backwater nursery habitats. Spawning occurs after spring runoff at water temperatures typically between 18 and 23°C. After hatching and emerging from spawning substrate, larvae drift downstream to nursery backwaters that are restructured by high spring flows and maintained by relatively stable base flows. Flow recommendations have been developed that specifically consider flow-habitat relationships in habitats occupied by Colorado pikeminnow in the upper basin and were designed to enhance habitat complexity and to restore and maintain ecological processes.

Colorado pikeminnow live in warm-water reaches of the Colorado River mainstem and larger tributaries, and require uninterrupted stream passage for spawning migrations and dispersal of young. The species is adapted to a hydrologic cycle characterized by large spring peaks of snowmelt runoff and low, relatively stable base flows. High spring flows create and maintain inchannel habitats, and reconnect floodplain and riverine habitats, a phenomenon described as the spring flood-pulse (Junk et al. 1989; Johnson et al. 1995). Throughout most of the year, juvenile, subadult, and adult Colorado pikeminnow utilize relatively deep, low-velocity eddies, pools, and runs that occur in nearshore areas of main river channels (Tyus and McAda 1984; Valdez and Masslich 1989; Tyus 1990, 1991; Osmundson et al. 1995). In spring, however, Colorado pikeminnow adults utilize floodplain habitats, flooded tributary mouths, flooded side canyons, and eddies that are available only during high flows (Tyus 1990, 1991; Osmundson et al. 1995). Such environments may be particularly beneficial for Colorado pikeminnow because other riverine fishes gather in floodplain habitats to exploit food and temperature resources, and may serve as prey. Such low-velocity environments also may serve as resting areas for Colorado pikeminnow. River reaches of high habitat complexity appear to be preferred. Because of their mobility and environmental tolerances, adult Colorado pikeminnow are the most widely distributed life stage. During most of the year, distribution patterns of adults are stable (Tyus 1990, 1991; Irving and

Modde 2000), but distribution of adults changes in late spring and early summer, when most mature fish migrate to spawning areas (Tyus and McAda 1984; Tyus 1985, 1990, 1991; Irving and Modde 2000). High spring flows provide an important cue to prepare adults for migration and also ensure that conditions at spawning areas are suitable for reproduction once adults arrive. Specifically, bankfull or much larger floods mobilize coarse sediment to build or reshape cobble bars, and they create side channels that Colorado pikeminnow sometimes use for spawning (Harvey et al. 1993).

Colorado pikeminnow spawning sites in the Green River subbasin have been well documented. The two principal locations are in Yampa Canyon on the lower Yampa River and in Gray Canyon on the lower Green River (Tyus 1990, 1991). These reaches are 42 and 72 km long, respectively, but most spawning is believed to occur at one or two short segments within each of the two reaches. Another spawning area may occur in Desolation Canyon on the lower Green River (Irving and Modde 2000), but the location and importance of this area has not been verified. Although direct observation of Colorado pikeminnow spawning was not possible because of high turbidity, radio telemetry indicated spawning occurred over cobble-bottomed riffles (Tyus 1990). High spring flows and subsequent post-peak summer flows are important for construction and maintenance of spawning substrates (Harvey et al. 1993).

After hatching and emerging from the spawning substrate, Colorado pikeminnow larvae drift downstream to backwaters in sandy, alluvial regions, where they remain through most of their first year of life (Holden 1977; Tyus and Haines 1991; Muth and Snyder 1995). Backwaters and the physical factors that create them are vital to successful recruitment of early life stages of Colorado pikeminnow; it is the early life stages of Colorado pikeminnow in backwaters that have received much research attention (e.g., Tyus and Karp 1989; Haines and Tyus 1990; Tyus 1991; Tyus and Haines 1991; Bestgen et al. 1997). It is important to note that these backwaters are formed after cessation of spring runoff within the active channel and are not floodplain features. Colorado pikeminnow larvae occupy these in-channel backwaters soon after hatching. They tend to occur in backwaters that are large, warm, deep (average, about 0.3 m in the Green River), and turbid (Tyus and Haines 1991). Recent research (Day et al. 1999a, 1999b; Trammell and Chart 1999a, 1999b) has confirmed these preferences and suggested that a particular type of backwater is preferred by Colorado pikeminnow larvae and juveniles. Such backwaters are created when a secondary channel is cut off at the upper end, but remains connected to the river at the downstream end. These chute channels are deep and may persist even when discharge levels change dramatically. An optimal river-reach environment for growth and survival of early life stages of Colorado pikeminnow has warm, relatively stable backwaters, warm river channels, and abundant food (Muth et al. 2000).

Young Colorado pikeminnow remain near nursery areas for the first 2–4 years of life, then move upstream to recruit to adult populations and establish home ranges (Osmundson et al. 1998). Adult Colorado pikeminnow remain in home ranges during fall, winter and spring and may move considerable distances to and from spawning areas in summer. Individuals move to spawning areas shortly after runoff in early summer, and return to home ranges in August and September (Tyus 1990; Irving and Modde 2000).

**Status and Distribution**

The Colorado pikeminnow is currently listed as endangered under the ESA (16 U.S.C. 1531 et. seq.). It was first included on the *List of Endangered Species* issued by the USFWS on March 11, 1967 (32 FR 4001) and was considered endangered under the provisions of the Endangered Species Conservation Act of 1969 (16 U.S.C. 668aa). It was included in the United States *List of Endangered Native Fish and Wildlife* issued on June 4, 1973 (38 FR No. 106) and received protection as endangered under Section 4(c)(3) of the ESA. The final rule for determination of critical habitat was published on March 21, 1994 (59 FR 13374). The latest version of the Colorado pikeminnow recovery plan was approved on August 1, 2002 (USFWS 2002a).

The Colorado pikeminnow is endemic to the Colorado River Basin, where it was once widespread and abundant in warm-water rivers and tributaries (Kirsch 1889; Jordan and Evermann 1896; Tyus 1991; Quartarone 1995). It was common in the lower basin in California and Arizona, where it was commercially harvested in the early 1900s (Minckley 1973). Numbers in the lower basin declined in the 1930s (Miller 1961), with few caught in the 1960s (Minckley 1973), and the last specimens reported in the mid-1970s (Moyle 1976; Minckley 1985).

The species was first reported in the upper basin in 1825 by Colonel William H. Ashley (Morgan 1964) and it was common to abundant in the Green and upper Colorado rivers and their tributaries (Banks 1964; Vanicek 1967; Holden and Stalnaker 1975; Seethaler 1978). It was found from Rifle, Colorado, downstream in the mainstem upper Colorado River (Beckman 1963); from Delta, Colorado, downstream on the Gunnison River (Burdick 1995); and from Paradox Valley downstream on the Dolores River (Lynch et al. 1950). In the Green River, it was reported as far upstream as Green River, Wyoming (Ellis 1914; Baxter and Simon 1970); from Craig, Colorado, downstream on the Yampa River; from Rangely, Colorado, downstream and in the White, lower Price, and Duchesne rivers (Tyus and Haines 1991; Cavalli 1999; Muth et al. 2000).

Colorado pikeminnow are presently restricted to the Upper Colorado River Basin and inhabit warm water reaches of the Colorado, Green and San Juan rivers and associated tributaries. The Colorado pikeminnow recovery goals (USFWS 2002) identify occupied habitat of wild Colorado pikeminnow as follows:

> The Green River from Lodore Canyon to the confluence of the Colorado River, the Yampa River downstream of Craig, Colorado, the Little Snake River from its confluence with the Yampa River upstream into Wyoming, the White River downstream of Taylor Draw Dam and Kenney Reservoir, the lower 89 miles of the Prices River, the lower Duchesne River, the Upper Colorado River from Palisade, Colorado, to Lake Powell, the lower 34 miles of the Gunnison River, the lower mile of the Dolores River and the San Juan River downstream from Shiprock, New Mexico to Lake Powell. Natural reproduction of Colorado pikeminnow is currently known from the Green, Yampa, upper Colorado, Gunnison, and San Juan rivers.

The current downlisting demographic criteria for Colorado pikeminnow (USFWS 2002a) in the Upper Colorado River Subbasin is a self-sustaining population of at least 700 adults maintained over a 5-year period, with a trend in adult point estimates that does not decline significantly. Secondarily, recruitment of age-6 (400–449 mm TL; Figure 3), naturally produced fish must equal or exceed mean adult annual mortality (estimated to be about 20%). The average of all adult estimates (1992 – 2010) is 644. The average of the five most recent annual adult population estimates is 658. Osmundson and White (2013) determined that recruitment rates were less than annual adult mortality in six years and exceeded adult mortality in the other six years when sampling occurred. The estimated net gain for the 12 years studied was 32 fish > 450 mm TL. Whereas the Colorado River population appears to meet the trend or 'selfsustainability' criterion, it has not met the abundance criteria of 'at least 700 adults' during the most recent five year period (USFWS 2014).

**Environmental Baseline**

Critical habitat was designated in 1994 within the 100-year floodplain of the Colorado pikeminnow's historical range in the following areas of the upper Colorado River (50 F.R. 13374). Critical habitat within the LSFO is as follows:

Colorado, Moffat County. The Yampa River and its 100-year flood plain from state highway 394 bridge in T.6N., R.91W., sec. 1 (6th Principal Meridian) to the confluence with the Green River in T.7N., R.103W., sec. 28 (6th Principal Meridian).

The USFWS has identified water, physical habitat and the biological environment as the primary constituent elements of critical habitat for Colorado pikeminnow. This includes a quantity of water of sufficient quality delivered to a specific location in accordance with a hydrologic regime required for the particular life stage for each species. The physical habitat includes areas of the Colorado River system that are inhabited by Colorado pikeminnow or potentially suitable for spawning, feeding, nursery use, or corridors between these areas. In addition, oxbows, backwaters, and other areas in the 100-year flood plain, when inundated, provide access to spawning, nursery, feeding, and rearing habitats. Food supply, predation and competition are important elements of the biological environment.

Pikeminnow found in the Yampa River are part of the Green River population. The Yampa River is considered occupied from the town of Craig, downstream to the confluence with the Green River. Two principal spawning sites have been identified in the Green River subbasin (Tyus 1990). One site is near Three Fords Canyon in Gray Canyon of the lower Green River and one site is in the Lower Yampa. Young produced in the lower Yampa River drift downstream and nurse primarily in alluvial backwaters upstream of Desolation/Gray Canyons.

Despite a positive trend in the sub-basin population from 2006 – 2008, Bestgen et al. (2010) expressed concern that adult pikeminnow numbers in the Yampa River remained low from 2006 – 2008. They suspected that nonnative northern pike may have been suppressing numbers of pikeminnow (USFWS 2014). Preliminary results from the 2011 – 2013 analysis indicate adults and sub-adults are in decline throughout the entire Green River sub-basin. Preliminary results from 2011 and 2012 indicate that the Yampa River portion of the sub-basin population remains low and may be in further decline. Only eight pikeminnow were captured in the Yampa River during surveys in 2013 (USFWS 2013).

**Threats**

The primary threats to Colorado pikeminnow are stream flow regulation and habitat modification; competition with and predation by nonnative fishes; and pesticides and pollutants (USFWS 2002a). The existing habitat, altered by these threats, has been modified to the extent that it impairs essential behavior patterns, such as breeding, feeding and sheltering. These impairments are described in further detail below.

Stream flow regulation includes mainstem dams that cause the following adverse effects to Colorado pikeminnow and its habitat:

1. block migration corridors;
2. changes in flow patterns reduced peak flows and increased base flows;
3. release cold water, making temperature regimes less than optimal;
4. change river habitat into lake habitat; and
5. retain sediment that is important for forming and maintaining backwater habitats.

In the Upper Basin, 435 miles of Colorado pikeminnow habitat has been lost by reservoir inundation from Flaming Gorge Reservoir on the Green River, Lake Powell on the Colorado River, and Navajo Reservoir on the San Juan River. Cold water releases from these dams have eliminated suitable habitat for native fishes, including Colorado pikeminnow, from river reaches downstream for approximately 50 miles below Flaming Gorge Dam and Navajo Dam. In addition to main stem dams, many dams and water diversion structures occur in and upstream from critical habitat that reduce flows and alter flow patterns, which adversely affect critical habitat. Diversion structures in critical habitat divert fish into canals and pipes where the fish are permanently lost to the river system. It is unknown how many endangered fish are lost in irrigation systems, but in some years, in some river reaches, a majority of the river flow is diverted into unscreened canals. The high spring flows which maintain habitat diversity, flush sediments from spawning habitat, increase invertebrate food production, form gravel and cobble deposits important for spawning, and maintain backwater nursery habitats have been reduced by flow regulation of dams and by water diversions (McAda 2003; Muth et al. 2000).

Predation and competition from nonnative fishes have been clearly implicated in the population reductions or elimination of native fishes in the Colorado River Basin (Dill 1944; Osmundson and Kaeding 1989; Behnke 1980; Joseph et al. 1977; Lanigan and Berry 1979; Minckley and Deacon 1968; Meffe 1985; Propst and Bestgen 1991; Rinne 1991). Data collected by Osmundson and Kaeding (1991) indicated that during low water years nonnative minnows capable of preying on or competing with larval endangered fishes greatly increased in numbers.

More than 50 nonnative fish species were intentionally introduced in the Colorado River Basin prior to 1980 for sport fishing, forage fish, biological control, and ornamental purposes (Minckley 1982; Tyus et al. 1982; Carlson and Muth 1989). Nonnative fishes compete with native fishes in several ways. The capacity of a particular area to support aquatic life is limited by physical habitat conditions. Increasing the number of species in an area usually results in a smaller population of most species. The size of each species population is controlled by the ability of each life stage to compete for space and food resources and to avoid predation. Some life stages of nonnative fishes appear to have a greater ability to compete for space and food, and to avoid predation in the existing altered habitat than do some life stages of native fishes. Tyus and Saunders (1996) cite numerous examples of both indirect and direct evidence of predation on razorback sucker eggs and larvae by nonnative species.

Threats from pesticides and pollutants include accidental spills of petroleum products and hazardous materials; discharge of pollutants from uranium mill tailings; and high selenium concentration in the water and food chain (USFWS 2002a). Accidental spills of hazardous material into critical habitat can cause immediate mortality when lethal toxicity levels are exceeded. Pollutants from uranium mill tailings cause high levels of ammonia that exceed water quality standards. High selenium levels may adversely affect reproduction and recruitment (Hamilton and Wiedmeyer 1990; Stephens et al. 1992; Hamilton and Waddell 1994; Hamilton et al. 1996; Stephens and Waddell 1998; Osmundson et al. 2000).

The Service's status review of Colorado pikeminnow was completed in 2011. Although a good portion of the recovery factor criteria (USFWS 2002a) are being addressed, nonnative fish species continue to be problematic and researchers now speculate that mercury may pose a more significant threat to Colorado pikeminnow populations of the upper Colorado River basin than previously recognized. Osmundson and Lusk (2012) have recently reported elevated mercury concentrations in Colorado pikeminnow muscle tissue; the highest concentrations were from the largest adults collected from the Green and Colorado river sub-basins. The San Juan River Recovery Implementation Program is conducting a population viability analysis for Colorado pikeminnow to determine how impaired reproduction (cause - heavy metal or selenium) would affect population dynamics and therefore, potentially influence adult demographic recovery criteria. Mercury is a global pollutant and remediation is obviously beyond the scope of the Recovery Program (USFWS 2014).

### B. Razorback Sucker (*Xyrauchen texanus*)

### Species Description

The razorback sucker is the only sucker with a sharp-edged dorsal keel behind its head. Razorback suckers are large in size and slightly compressed laterally. These fish have reached lengths of over 3 feet and weigh as much as 10 pounds in the Lower Colorado River Basin (Bestgen 1990, Minckley et al. 1991). Fish in the upper Colorado River basin tend to be smaller than those in the Lower Colorado River Basin. Mature female razorback sucker are generally larger than males throughout the entire range of the species. In riverine habitats, razorback sucker mature in 3 to 6 growing seasons (McAda and Wydoski 1980).

### Life History

The following information is from the Razorback Sucker Recovery Goals (2002).

The razorback sucker evolved in warm-water reaches of larger rivers of the Colorado River Basin from Mexico to Wyoming. Habitats required by adults in rivers include deep runs, eddies, backwaters, and flooded off-channel environments in spring; runs and pools, often in shallow water associated with submerged sandbars in summer; and low-velocity runs, pools and eddies in winter. Spring migrations of adult razorback sucker were associated with spawning in historic accounts and a variety of local and long-distance movements and habitat-use patterns have been documented. Spawning in rivers occurs over bars of cobble, gravel and sand substrates during spring runoff at widely ranging flows and water temperatures (typically greater than 14$^{o}$C). Spawning also occurs in reservoirs over rocky shoals and shorelines. Young require nursery environments with quiet, warm, shallow water such as tributary mouths, backwaters, or inundated floodplain habitats in rivers, and coves or shorelines in reservoirs. Flow recommendations have been developed that specifically consider flow-habitat relationships in habitats occupied by razorback sucker in the upper basin and were designed to enhance habitat complexity and to restore and maintain ecological processes. The following is a description of observed uses in various parts of the Colorado River Basin.

Adult razorback sucker tend to occupy different habitats seasonally (Osmundson et al. 1995; Table A-1), and can do well in both lotic and lentic environments (Minckley et al. 1991). In rivers, they usually are captured in lower velocity currents, more rarely in turbulent canyon reaches (Tyus 1987; Lanigan and Tyus 1989; Tyus and Karp 1990; Bestgen 1990; Minckley et al. 1991). An exception may be in the San Juan River, where hatchery-reared, radio-tagged adults preferred swifter mid-channel currents during summer–autumn base-flow periods (Ryden 2000). In the upper basin, bottomlands, low-lying wetlands, and oxbow channels flooded and ephemerally connected to the main channel by high spring flows appear to be important habitats for all life stages of razorback sucker (Modde et al. 1996; Muth et al. 2000). These areas provide warm water temperatures, low-velocity flows and increased food availability (Tyus and Karp 1990; Modde 1997; Wydoski and Wick 1998).

Razorback sucker breed in spring, when flows in riverine environments are high. During that time of year, researchers in the upper basin have documented movement of adults into flooded bottomlands and gravel pits, backwaters and impounded tributary mouths near spawning sites (Holden and Crist 1981; Valdez and Wick 1983; Tyus 1987; Osmundson and Kaeding 1989; Tyus and Karp 1990; Modde and Wick 1997; Modde and Irving 1998; Osmundson et al. 1995). Temperature is an important aspect of habitat for razorback sucker. Thermal preference for adults is 22.9–24.8°C, based on electronic shuttle box studies; lower avoidance temperature is 8.0–14.7°C and upper avoidance temperature is 27.4–31.6°C (Bulkley and Pimentel 1983).

During breeding season (mostly April–June), when river flows are high, adult razorback sucker congregate in flooded bottomlands and gravel pits, backwaters and impounded tributary mouths near spawning sites (Holden and Crist 1981; Valdez and Wick 1983; Tyus 1987; Osmundson and Kaeding 1989; Tyus and Karp 1990; Osmundson et al. 1995; Modde and Wick 1997; Modde and Irving 1998). Within the last 20 years, relatively large aggregations of razorback sucker have been observed in these types of environments, usually upstream of areas with broad floodplains (Tyus et al. 1982; Valdez et al. 1982; Modde et al. 1996; Muth 1995). Razorback sucker adults occupy such habitats both before and after spawning, presumably for feeding, resting, gonadal maturation, and other activities associated with their reproductive cycle (Tyus and Karp 1990; Osmundson and Kaeding 1991; Modde and Wick 1997; Modde and Irving 1998). On the upper Colorado River, peak use of backwater and gravel pit habitats occurred in June (Osmundson et al. 1995). Ryden (2000) recorded somewhat similar behavior among introduced razorback sucker in the San Juan River, where radiotelemetered adults chose habitats warmer than the main channel in March–April; eddies during the ascending limb of the hydrograph in May; and low-velocity habitats along the river margin, including inundated vegetation, during the highest flows in June. The fish moved back into eddies on the descending limb of the hydrograph in July.

Spawning has not been observed directly in the upper basin, but aggregations of ripe razorback sucker indicate that spawning occurs in broad alluvial, flat-water regions over large gravel-cobble bars and coarse sand substrates at water temperatures of 6–19°C in velocities <1.0 meters/second and depths of <1.0 meter (McAda and Wydoski 1980; Tyus 1987; Tyus and Karp 1990; Bestgen 1990; Snyder and Muth 1990). Studies suggest a linkage between egg survival and cleansing of substrates by high spring flows. Eggs deposited on substrates with moderate to high sediment have lower survival because of suffocation (Wick 1997). Young razorback sucker are thought to occupy shallow, warm, low-velocity habitats in littoral zones, backwaters and inundated floodplains and tributary mouths downstream of spawning bars. This inference is based on the few larval and young juveniles collected in the upper basin, observations of hatchery-reared fish and analogy with other native fish in the Colorado River system (Smith 1959; Sigler and Miller 1963; Taba et al. 1965; Minckley 1973; Tyus 1987; Modde 1996, 1997; Muth et al. 1998). Young-of-year appear to stay in these sheltered habitats for several weeks after hatching, then disperse to deeper water (Minckley et al. 1991). In lakeside rearing ponds in the lower basin, juvenile razorback sucker hide during the day in dense aquatic vegetation, under debris and in rock cavities (U.S. Bureau of Reclamation 1996).

During non-reproductive times of the year (summer–winter), adult razorback sucker in lotic environments have been found in deeper eddies, slow runs, backwaters, and other types of pool habitats with silt or sand substrate, depths ranging from 0.6 to 3.4 m, and velocities ranging from 0.3 to 0.4 m/s (Valdez et al. 1982; Tyus 1987; Tyus et al. 1987; Tyus and Karp 1990; Minckley et al. 1991; Osmundson et al. 1995).

**Status and Population Distribution**

The razorback sucker was listed as endangered under the ESA on October 23, 1991. The marked decline in populations of razorback sucker has been attributed to construction of dams and reservoirs, introduction of nonnative fishes, removal of large quantities of water from the Colorado River system, and degraded water quality (Miller 1961, Minckley and Deacon 1991). The decline of razorback sucker populations was first reported following a period of dam construction throughout the Colorado River basin. Dams have fragmented and inundated riverine habitat; released cold, clear waters; altered ecological processes; affected seasonal availability of habitat; and blocked fish passage. Stream flow regulation and habitat modification, primarily from dams, are listed as the two primary threats to the continued persistence of this species in the recovery goals (USFWS 2002c).

Historically, the razorback sucker occupied the mainstem Colorado River and many of its tributaries from northern Mexico through Arizona and Utah into Wyoming, Colorado and New Mexico. In the late 19$^{th}$ and early 20$^{th}$ centuries, it was reported as being abundant in the Lower Colorado River Basin and common in parts of the Upper Colorado River Basin, with numbers apparently declining with distance upstream (Jordan and Evermann 1896; Minckley et al. 1991).

In the lower basin, razorback sucker were found in abundance in the lower Colorado River (LCR) from the delta in Mexico north to what is now Lake Mohave in Arizona, and in the Gila, San Pedro, Verde, and Salt rivers (Miller 1961; Minckley 1983; Minckley et al. 1991). Early accounts place these fish in the Gila River from its confluence with the Colorado River (Evermann and Rutter 1895) almost to the Arizona-New Mexico border (Minckley 1973), and in the San Pedro River as far south as Tombstone, Arizona. Archaeological remains document occurrence in the Verde River as far upstream as Perkinsville, Arizona (Miller 1961). Razorback sucker were so numerous in the Salt River above Lake Roosevelt, in Saguaro Lake, and in irrigation canals near Phoenix, Arizona, that they were removed by the wagon load and sold commercially for food and fertilizer (Minckley 1983). Large numbers were also taken from the Salton Sea of southern California (Evermann 1916).

Although razorback sucker occupied the mainstem Colorado River in the reach now inundated by Lake Mead and in the Grand Canyon, few records exist; this is possibly because these regions were relatively remote and inaccessible for sampling (Minckley et al. 1991). Only 10 razorback sucker were documented from the Grand Canyon between 1944 and 1995 (Valdez 1996), and the species is considered to be transient through this region to reach more suitable habitats upstream and downstream (Bestgen 1990; Douglas and Marsh 1998). A number of hybrids between flannelmouth sucker and razorback sucker are reported from Grand Canyon (Suttkus et al. 1976; Maddux et al. 1987; Valdez and Ryel 1995; Douglas and Marsh 1998).

Historic distribution of razorback sucker in the upper basin included the Colorado, Green and San Juan River drainages (Minckley et al. 1991; Holden 1999; Muth et al. 2000). Evidence suggests that the species was common and possibly locally abundant in the lower, flat-water reaches of the Green and Colorado rivers and in the lower reaches of some tributaries (Minckley et al. 1991; Muth et al. 2000). This species was reported from the White, Duchesne, Little Snake, Yampa, and Gunnison rivers (Burdick 1995) and, although evidence is sparse and anecdotal, as far up the San Juan River drainage as the Animas River (Jordan 1891; Minckley et al. 1991; U.S. Fish and Wildlife Service 1998).

**Environmental Baseline**

In the Upper Colorado River Basin, the razorback sucker has declined in distribution and abundance until it is now found in small numbers only in the middle Green River, between the confluences of the Duchesne and Yampa rivers, and in the lower reaches of those two tributaries (Tyus 1987; Bestgen 1990). According to Modde and Irving (1998), tag capture and telemetry data support the hypothesis that razorback sucker in the middle Green River constitute a single reproductive population. Known spawning sites are located in the lower Yampa River and in the Green River near Escalante Ranch between river kilometer 492 and 501, but other, less-used sites are probable (Tyus and Karp 1990; Modde and Wick 1997; Modde and Irving 1998).

Abundance estimates of razorback suckers varied dramatically across years. Abundance was highest in the lower Green River, ranging from nearly 1600 fish in 2006 to 5153 in 2007, and then declining to 2597 in 2008. Razorback sucker abundance was lowest in the Desolation-Gray Canyon reach of the Green River, ranging from nearly 474 fish in 2006 to 3011 in 2007, and then declining to 836 in 2008. Abundance was intermediate in the middle Green River reach, ranging from nearly 600 fish in 2006 to

3146 in 2007, and then declining to about 1200 in 2008 (USFWS 2012). In 2011, researchers documented spawning by razorback sucker in the White River for the first time (USFWS 2014).

Critical habitat was designated in 1994 within the 100-year floodplain of the razorback sucker's historical range in the following area of the upper Colorado River (50 F.R. 13374). The primary constituent elements are the same as those described for the Colorado pikeminnow. Critical habitat within the LSFO is as follows:

Colorado, Moffat County. The Yampa River and its 100-year flood plain from the mouth of Cross Mountain Canyon in T.6N., R.98W., sec. 23 (6$^{th}$ Principal Meridian) to the confluence with the Green River in T.7N., R.103W., sec. 28 (6$^{th}$ Principal Meridian).

### Threats

The abundance and distribution of the razorback sucker have been dramatically reduced because of water developments such as dams and water diversions. Dams have altered the timing, magnitude and duration of flows that characterize the variation in annual runoff in unaltered, large rivers; altered flows resulting from dam operation can also affect the abundance and distribution of spawning and rearing habitats preferred by the razorback sucker. Historical water depletions and any new water depletions are likely to negatively affect population and habitat conditions downstream, although assessing the effects on species viability may be difficult. In addition, the introduction of non-native trout to the historical habitats of the razorback sucker has almost eliminated their recruitment and survival (Minckley et al. 2003). Incidental catch by recreational anglers may pose a threat resulting from stress-caused direct and delayed mortality.

## C. Bonytail chub (*Gila elegans*)

### Species Description

The bonytail chub is a large cyprinid fish endemic to the Colorado River basin (Valdez and Clemmer 1982). Bonytails are medium sized (less than 600 mm) in length. Adult bonytails are gray or olive colored on the back with silvery sides and a white belly. Adult bonytails have an elongated body with a long, thin caudal peduncle. The head is small and compressed compared to the rest of the body. The mouth is slightly overhung by the snout and there is a smooth low hump behind the head that is not as pronounced as on the humpback chub. Adults attain a maximum size of about 550 mm total length (Bozek et al. 1984) and 1.1 kg in weight (Vanicek 1967).

### Life History

The following information is from the Bonytail Recovery Goals (2002).

Little is known about the specific habitat requirements of bonytail because the species was extirpated from most of its historic range prior to extensive fishery surveys. The bonytail is considered adapted to mainstem rivers where it has been observed in pools and eddies. Similar to other closely related *Gila* spp., bonytail in rivers probably spawn in spring over rocky substrates; spawning in reservoirs has been observed over rocky shoals and shorelines. It is hypothesized, based on available distribution data, that flooded bottomland habitats are important growth and conditioning areas for bonytail, particularly as nursery habitats for young. Flow recommendations have been developed that specifically consider flow-habitat relationships within historic habitat of bonytail in the upper basin, and were designed to enhance habitat complexity and to restore and maintain ecological processes. The following is a description of observed habitat uses in various parts of the Colorado River Basin.

It has been suggested that the large fins and streamlined body of the bonytail is an adaptation to torrential flows (Miller 1946; Beckman 1963). Of five specimens captured recently in the upper basin, four were captured in deep, swift, rocky canyon regions (i.e., Yampa Canyon, Black Rocks, Cataract Canyon, and Coal Creek Rapid), but the fifth was taken in a reservoir (Lake Powell). Also, all fish taken from the lower basin since 1974 were caught in reservoirs. Specimens encountered in reservoirs are believed to be inhabiting their former habitats now inundated by these impoundments. Vanicek (1967), who handled numerous bonytail, detected no difference in habitat selection from roundtail chub. These fish were generally found in pools and eddies in the absence of, although occasionally adjacent to, strong currents and at varying depths generally over silt and silt-boulder substrates. No quantitative data are available for the habitat of this species. It is hypothesized, based on historic and present distributions, that flooded bottomlands provide important nursery, growth and conditioning habitats for bonytail. Adult bonytail captured in Cataract Canyon and Desolation/Gray Canyons were sympatric with humpback chub in shoreline eddies among emergent boulders and cobble, and adjacent to swift current (Valdez 1990).

Natural reproduction of bonytail was last documented in the Green River in Dinosaur National Monument for the year classes 1959, 1960 and 1961 (Vanicek and Kramer 1969). Ripe spawning fish were captured from mid-June to early July at a water temperature of 18°C. Spawning by bonytail and roundtail chub was believed to be spatially separated because ripe adults of both species were never captured in the same net.

Jonez and Sumner (1954) described the spawning act of bonytail in Lake Mohave. Approximately 500 bonytail were observed spawning over a gravel shelf up to 30 feet in depth. Each female had three to five male escorts and adhesive eggs were broadcast over the gravel shelf. A gill net in the spawning area captured 42 males and 21 females ranging from about 280 to 350 mm (fork length); a 300 mm female contained an estimated 10,000 eggs. Vanicek (1967) reported wild bonytail of age groups V–VII in spawning condition. Hamman (1985) found that hatchery-reared bonytail began to sexually mature at age two.

Little is known of the food habits of the bonytail. McDonald and Dotson (1960) reported that "Colorado chub" were largely omnivorous with a diet of terrestrial insects, plant matter and fish. Several chubs were observed feeding on floating masses of debris washed by heavy rainfall. Vanicek (1967) reported that "Colorado chubs" fed mainly on terrestrial insects (mostly adult beetles and grasshoppers), plant debris, leaves, stems, and woody fragments.

**Status and Distribution**

The bonytail is currently listed as endangered under the ESA, under a final rule published on April 23, 1980 (45 FR 27710). The final rule for determination of critical habitat was published on March 21, 1994 (59 FR 13374). The latest version of the recovery plan for this species was approved on August 1, 2002 (USFWS 2002b).

Captures of wild adult bonytail have occurred in Lakes Powell, Mohave and Havasu, as well as in rivers of the Upper Colorado River Basin. Of the 34 adult bonytail captured in Lake Mohave between 1976 and 1988 (Minckley et al. 1989), 11 were used as the original brood stock (Hamman 1981, 1982, 1985). Progeny of these fish have been released into several locations in upper and lower basin habitats, with variable survival rates. Approximately 130,000 hatchery-produced $F_1$ and $F_2$ fish were released into Lake Mohave between 1981 and 1987 as part of an effort by the USFWS to prevent extinction and promote eventual recovery of the species. Younger bonytail of adult size and spawning ability have been collected from the reservoir in the 1990s along with the old adults of the founder population. It is unknown whether these younger adults are from the original stockings or a result of natural reproduction. Releases of hatchery-reared adults into riverine reaches in the upper basin have resulted in low survival (Chart and Cranney 1991), with no evidence of reproduction or recruitment. Recent releases into repatriated, predator-free riverside ponds near Parker, Arizona, have produced up to three year classes (Pacey and Marsh 1998; personal communication, C. Minckley, U.S. Fish and Wildlife Service). Since 1977, only 11 wild adults have been reported from the upper basin (Valdez et al. 1994), but no upper basin fish have been transferred to hatchery facilities.

**Environmental Baseline**

Surveys from 1964 to 1966 found large numbers of bonytail in the Green River in Dinosaur National Monument, downstream of the Yampa River confluence (Vanicek and Kramer 1969). Surveys from 1967 to 1973 found far fewer bonytail (Holden and Stalnaker 1975a). Few bonytail have been captured after this period and the last recorded capture in the Green River was in 1985 (USFWS 2002). A stocking program is being implemented to reestablish populations in the Upper Colorado River Basin.

Critical habitat was designated in 1994 within the 100-year floodplain of the bonytail's historical range in the following areas of the upper Colorado River (50 F.R. 13374). The primary constituent elements are the same as those described for the Colorado pikeminnow. Critical habitat within the LSFO is as follows:

Colorado, Moffat County. The Yampa River from the boundary of Dinosaur National Monument in T.6N., R.99W., sec. 27 ($6^{th}$ Principal Meridian) to the confluence with the Green River in T.7N., R.103W., sec. 28 ($6^{th}$ Principal Meridian).

Utah, Uintah County; and Colorado, Moffat County. The Green River from the confluence with the Yampa River in T.7.N., R.103W., sec. 28 ($6^{th}$ Principal Meridian) to the southern boundary of Dinosaur National Monument in T.6N., R.24E., sec. 30 (Salt Lake Meridian).

## Threats

The primary threats to bonytail are stream flow regulation and habitat modification; competition with and predation by non-native fishes; hybridization with other native *Gila* species; and pesticides and pollutants (USFWS 2002d). The existing habitat, altered by these threats, has been modified to the extent that it impairs essential behavior patterns, such as breeding, feeding and sheltering. The threats to bonytail in relation to flow regulation and habitat modification, predation by non-native fishes, and pesticides and pollutants are essentially the same threats identified for the Colorado pikeminnow. Threats to bonytail in relation to hybridization are essentially the same threats identified for the humpback chub.

### D. Humpback Chub (*Gila cypha*)

## Species Description

The humpback chub is a large cyprinid fish endemic to the Colorado River basin (Miller 1946). Adults have a pronounced dorsal hump, a narrow, flattened head, a fleshy snout with an inferior-subterminal mouth, and small eyes. The body tapers very suddenly from the dorsal fin to the insertion of the caudal fin. Its coloration is silvery with a brown or olive back. Adults attain a maximum size of about 1 ½ feet and about 2 ½ pounds in weight (Valdez and Ryel 1997). The fish is omnivorous, feeding on aquatic arthropods, smaller fishes and algae.

## Life History

The following information is from the Humpback Chub Recovery Goals (2002).

The humpback chub evolved in seasonally warm and turbid water and is highly adapted to the unpredictable hydrologic conditions that occurred in the pristine Colorado River system. Adults require eddies and sheltered shoreline habitats maintained by high spring flows. These high spring flows maintain channel and habitat diversity, flush sediments from spawning areas, rejuvenate food production, and form gravel and cobble deposits used for spawning. Spawning occurs on the descending limb of the spring hydrograph at water temperatures typically between 16 and 22°C. Young require low-velocity shoreline habitats, including eddies and backwaters, that are more prevalent under base-flow conditions. Flow recommendations have been developed that specifically consider flow-habitat relationships in habitats occupied by humpback chub in the upper basin, and were designed to enhance habitat complexity and to restore and maintain ecological processes. The following is a description of observed habitat uses in various parts of the Colorado River Basin.

Humpback chub live and complete their entire life cycle in canyon-bound reaches of the Colorado River mainstem and larger tributaries. These reaches are characterized by deep water, swift currents and rocky substrates (Valdez et al. 1990). Subadults use shallow, sheltered shoreline habitats, whereas adults use primarily offshore habitats of greater depths (Valdez and Ryel 1995; Karp and Tyus 1990; Childs et al. 1998; Chart and Lentsch 1999). In the Grand Canyon, nearly all fish smaller than 100 mm TL were captured near shore, whereas most fish larger than 100 mm TL were captured in offshore habitats

(Valdez and Ryel 1995). Highest densities of subadults in the Colorado River in the Grand Canyon were from shorelines with vegetation, talus and debris fans (Converse et al. 1998).

As young humpback chub grow, they exhibit an ontogenic shift toward deeper and swifter offshore habitats. In Westwater Canyon during summer, fish smaller than 40 mm TL used low velocity areas, including backwaters and shorelines. Later in summer and fall, as fish attained sizes of 40–50 mm TL, their habitat use shifted toward higher-velocity, flowing-water habitats (Chart and Lentsch 1999). Karp and Tyus (1990) reported similar habitat use by larger humpback chub, noting that fish 88–228 mm TL in the Yampa and Green rivers used habitats consisting of rocky shoreline runs and small shoreline eddies. Average depths selected by larvae, young-of-year, juveniles, and adults in the upper basin were 0.4, 0.6, 0.7, and 3.1 meters, respectively (Valdez et al. 1990), and average velocities were 0.03, 0.06, 0.18, and 0.18 meter/second, respectively. Dominant substrates were silt and sand for Young-of-year, and boulders, sand and bedrock for juveniles and adults.

In the LCR, larval and early juvenile humpback chub used shallow, low velocity habitats, different than those used by young of other native species, indicating resource partitioning (Childs et al. 1998). Gorman (1994) found that juveniles or early stages less than 50 mm TL occupied near-benthic to mid-pelagic positions in shallow, nearshore areas that were less than 10 cm deep and had low-velocity flow, small substrate particle sizes, moderate cover, and vertical structure. Larger juveniles or fish 50–100 mm TL used similar habitats of moderate depth (less than 20 cm) that had small to large substrate particle size, moderate to high cover and vertical structure. Juveniles (100–150 mm TL) used shoreline and offshore areas of moderate to deep water (less than 30 cm during the day; less than 20 cm at night) that had slow currents, small and large substrate particle size, moderate to high levels of cover, and vertical structure.

Little is known about spawning habitats of adult humpback chub during high spring-runoff flows. Habitats where ripe humpback chub have been collected are typically deep, swift and turbid. As a result, spawning in the wild has not been directly observed. Gorman and Stone (1999) reported that ripe male humpback chub in the LCR aggregated in areas of complex habitat structure (i.e., matrix of large boulders and travertine masses combined with chutes, runs and eddies, 0.5–2.0 m deep) and were associated with deposits of clean gravel. Valdez and Ryel (1995, 1997) reported that during the spring, adult humpback chub in the Colorado River in the Grand Canyon primarily used large recirculating eddies, occupying areas of low velocity adjacent to high-velocity currents that deliver food items. They also reported that adults congregated at tributary mouths and flooded side canyons during high flows.

In the Upper Colorado River Basin during spring runoff, spawning adult humpback chub appear to utilize cobble bars and shoals adjacent to relatively low-velocity shoreline habitats that are typically described as shoreline eddies (Valdez et al. 1982; Karp and Tyus 1990; Valdez et al. 1990; Valdez and Ryel 1995, 1997). Tyus and Karp (1989) reported that humpback chub in the Yampa River occupy and spawn in or near shoreline eddy habitats. They also hypothesized that spring peak flows were important for reproductive success because availability of these habitats is greatest during spring runoff; loss or reduction of spring peak flows could potentially reduce availability of spawning habitat.

The humpback chub is an obligate warm-water species that requires relatively warm temperatures for spawning, egg incubation and survival of larvae. Highest hatching success is at 19–20°C, with an incubation time of 3 days, and highest larval survival is slightly warmer at 21–22°C. Humpback chub are broadcast spawners with a relatively low fecundity rate, compared to cyprinids of similar size (Carlander 1969). Male to female ratios for mainstem adults captured near the LCR, based on external morphological examination of papillae and expression of gametes, ranged by sample from 41:59 to 53:47, for an overall average of 49:51 (Valdez and Ryel 1995). Observed male to female ratio of humpback chub in Westwater Canyon was 58:42 (Chart and Lentsch 1999).

Unlike larvae of other Colorado River fishes (e.g., Colorado pikeminnow and razorback sucker), larval humpback chub show no evidence of long-distance drift (Robinson et al. 1998). At hatching, larvae have nonfunctional mouths and small yolk sacs (Muth 1990). The larvae swim up about 3 days after hatching but tend to remain close to spawning sites. Robinson et al. (1998) found small numbers of larvae drifting in the LCR from May through July, primarily at night.

The presence of juveniles in populations with complete size structure suggests successful reproduction in all or portions of the six populations; i.e., Black Rocks (Kaeding et al. 1990), Westwater Canyon (Chart and Lentsch 1999), the LCR in the Grand Canyon (Douglas and Marsh 1996, Gorman and Stone 1999), Cataract Canyon (Valdez 1990), Desolation/Gray Canyons (Chart and Lentsch 2000), and Yampa Canyon (Karp and Tyus 1990). Reproduction in the mainstem Colorado River in the Grand Canyon is precluded by cold-water temperatures, and the only documented evidence of reproduction (i.e., post-larvae) is in a thermal riverside spring located 72 km downstream of Glen Canyon Dam (Valdez and Masslich 1999). The large size structure of the humpback chub aggregation associated with this spring indicates little or no recruitment (Valdez and Ryel 1995).

**Status and Distribution**

The humpback chub is currently listed as endangered under the ESA. It was first included in the *List of Endangered Species* issued by the USFWS on March 11, 1967 (32 FR 4001) and was considered endangered under provisions of the Endangered Species Conservation Act of 1969 (16 U.S.C. 668aa). The humpback chub was included in the United States *List of Endangered Native Fish and Wildlife* issued on June 4, 1973 (38 FR No. 106) and received protection as endangered under Section 4(c)(3) of the ESA. The final rule for determination of critical habitat was published on March 21, 1994 (59 FR 13374). The latest humpback chub recovery plan was approved on August 1, 2002 (USFWS 2002c).

Historic abundance of the humpback chub is unknown; historic distribution is surmised from various reports and collections that indicate the species presently occupies about 68% of its historic habitat of about 756 km of river. The species exists primarily in relatively inaccessible canyons of the Colorado River Basin and was rare in early collections (Tyus 1998). Common use of the name "bonytail" for all six Colorado River species or subspecies of the genus *Gila* confounded an accurate early assessment of distribution and abundance (Holden and Stalnaker 1975a, 1975b; Valdez and Clemmer 1982; Minckley 1996). Of three closely related and sympatric *Gila* species, the roundtail chub (*G. robusta*) and bonytail (*G. elegans*) were described in 1853 by Baird and Girard (Sitgreaves 1853; Girard 1856), but the humpback chub was the last big-river fish species to be described from the Colorado River Basin in 1946 (Miller 1946).

Extensive human alterations throughout the basin prior to faunal surveys may have also depleted or eliminated the species from some river reaches before its occurrence was documented. It is surmised that the humpback chub speciated from a *G. robusta*-like form in canyons of northern Arizona (i.e., Grand Canyon) about 3–5 million years ago (Miller 1946; Uyeno and Miller 1965; Holden 1968; Minckley et al. 1986) during the mid-Pliocene and early Pleistocene epochs. Earliest evidence of the species are skeletal remains from 4,000-year old flood deposits in Stanton's Cave in Grand Canyon (Miller 1955; Euler 1978; Miller and Smith 1984), from a 750–1,100-year old archeological site in Catclaw Cave near present-day Hoover Dam (Miller 1955; Jones 1985), and from 1,000-year old archeological sites in Dinosaur National Monument, Colorado (Tyus 1998).

Humpback chub were first reported in the Upper Colorado River Basin in the 1940s from Castle Park, Yampa River, Colorado, in June and July 1948 (Tyus 1998). Pre-impoundment surveys of Flaming Gorge Dam on the Green River in 1958–1959 (Bosley 1960; Gaufin et al. 1960; McDonald and Dotson 1960) treated all *Gila* as "bonytail," which were common downstream of Green River, Wyoming. Humpback chub were reported from Hideout Canyon in the upper Green River (Smith 1960), although a checklist of fish killed by a massive rotenone operation from Hideout Canyon to Brown's Park in September 1962 stated that "no humpback chub were collected" (Binns 1967). Post-impoundment investigations (Vanicek et al. 1970) reported three humpback chub from the Green River downstream of Flaming Gorge Dam, and one each from Echo Park, Island Park and Swallow Canyon. Specimens were collected in Desolation Canyon on the Green River in 1967 (Holden and Stalnaker 1970), in Yampa Canyon in 1969 (Holden and Stalnaker 1975b), in Cross Mountain Canyon of the Yampa River in the 1970s (personal communication, C. Haynes), and an individual specimen was reported from the White River in Utah in the 1950s (Sigler and Miller 1963). Seven suspected humpback chub were captured in the Little Snake River, a tributary of the Yampa River, in 1988 (Wick et al. 1991). Surveys downstream of Flaming Gorge Dam, including Lodore Canyon, have not yielded humpback chub in that region of the Green River, despite warmer dam releases (Holden and Crist 1981; Bestgen and Crist 2000).

Five specimens were reported from Lake Powell in the late 1960s (Holden and Stalnaker 1970) following completion of Glen Canyon Dam in 1963 and impoundment of the upper Colorado River through Glen, Narrow and Cataract canyons. Reproducing populations of humpback chub were first reported from Black Rocks, Colorado in 1977 (Kidd 1977), and from Westwater and Cataract canyons, Utah, in 1979 (Valdez et al. 1982; Valdez and Clemmer 1982).

Six humpback chub populations are currently identified: (1) Black Rocks, Colorado; (2) Westwater Canyon, Utah; (3) LCR and Colorado rivers in the Grand Canyon, Arizona; (4) Yampa Canyon, Colorado; (5) Desolation/Gray Canyons, Utah; and (6) Cataract Canyon, Utah (Valdez and Clemmer 1982; U.S. Fish and Wildlife Service 1990a). Each population consists of a discrete group of fish, geographically separated from the other populations, but with some exchange of individuals. River length occupied by each population varies from 3.7 km in Black Rocks to 73.6 km in Yampa Canyon.

**Environmental Baseline**

Five populations of humpback chub exist in the upper Colorado River basin and one occurs in the lower Colorado River basin in canyon-bound reaches of the river system (USFWS 2014). The Yampa River humpback chub population exists in the lower Yampa River Canyon and into the Green River through Split Mountain Canyon. This population is small, with an estimate of about 400 wild adults in 1998-2000. Sampling during 2003-2004 caught only 13 fish, too few to estimate population size. In 2007, humpback chub and roundtail chub hybrids were found in Yampa Canyon and it is not currently known if pure humpback chubs now exist in Yampa Canyon (USFWS 2014).

Critical habitat was designated in 1994 within the 100-year floodplain of the humpback chub's historical range in the following areas of the upper Colorado River (50 F.R. 13374). The primary constituent elements are the same as those described for the Colorado pikeminnow. Critical habitat within the LSFO is as follows:

Colorado, Moffat County. The Yampa River from the boundary of Dinosaur National Monument in T.6N., R.99W., sec. 27 ($6^{th}$ Principal Meridian) to the confluence with the Green River in T.7N., R.103W., sec 28 ($6^{th}$ Principal Meridian).

Utah, Uintah County; and Colorado, Moffat County. The Green River from the confluence with the Yampa River in T.7N., R.103W., sec. 28 ($6^{th}$ Principal Meridian) to the southern boundary of Dinosaur National Monument in T.6N., R.24E., sec. 30 (Salt Lake Meridian).

### Threats

The primary threats to the humpback chub are stream flow regulation and habitat modification; competition with and predation by non-native fishes; parasitism; hybridization with other native *Gila* species; and pesticides and pollutants (USFWS 2002c). The existing habitat, altered by these threats, has been modified to the extent that it impairs essential behavior patterns, such as breeding, feeding and sheltering. Threats to humpback chubs in relation to flow regulation and habitat modification, predation by non-native fishes and pesticides and pollutants are essentially the same threats identified for the Colorado pikeminnow.

The humpback chub population in the Grand Canyon is threatened by predation from non-native trout in the Colorado River below Glen Canyon Dam. This population also is threatened by the Asian tapeworm reported in humpback chubs in the Little Colorado River (USFWS 2002c). No Asian tapeworms have been reported in the Upper Basin populations.

Hybridization with the bonytail and the roundtail chub where they occur together is recognized as a threat to the humpback chub. A larger proportion of roundtail chubs have been found in Black Rocks and Westwater Canyon during low flow years (Kaeding et al. 1990; Chart and Lentsch 1999), which increase the chances for hybridization.

## E. Lineage Greenback Cutthroat Trout (*Oncorhynchus clarki stomias*)

### Species Description

True greenback cutthroat trout are unlikely to reside in the project area. Fish that are currently called Lineage GB cutthroat trout do reside in Routt County and are being treated as greenback until such time as the genetics and management of these cutthroat trout are determined.

Lineage GB cutthroat trout are a small salmonid fish (member of the salmon family) native to the headwaters of the South Platte River drainage. It is one of three subspecies of cutthroat that are currently recognized in Colorado. Adult greenbacks are greenish brown to olive colored on the back with silvery to yellow sides and a white belly (red during spawning). They have a crimson slash under the lower jaw and low numbers of large spots concentrated toward the caudal fin (USFWS 1998).

**Life History**

Greenbacks, like all cutthroat subspecies, inhabit cold water streams and lakes with adequate spawning habitat present in the spring of the year. Spawning generally occurs when water temperatures reach 5ºC-8ºC. Greenbacks feed on a wide variety of organisms but their primary source of food is aquatic and terrestrial insects. Size and growth of greenbacks varies, based on elevation and population size. However, greenbacks typically do not reach a large size, with a maximum weight of 1 to 2 pounds (USFWS 1998).

**Population Distribution and Genetics**

Greenback distribution and numbers of fish declined rapidly beginning in the 1800s. By 1973, when the ESA was passed into law, greenbacks were believed to only exist in two small headwater streams (Como Creek and South Fork, Cache La Poudre River). The subspecies was listed under the ESA as endangered in 1973 and downlisted to threatened in 1978. Cooperative efforts between the CPW, USFS, BLM, USFWS and Rocky Mountain National Park have led to a large recovery effort for the greenback cutthroat trout. Today, it appears that only one true greenback population exists in Bear Creek near Colorado Springs, CO.

As of November 2012, 60 populations of Lineage GB cutthroat trout have been identified in western Colorado (Rogers 2012b). One population occurs in Routt County in Deadman Gulch on the Routt National Forest.

As prized sport fish and one of only two salmonids native to Colorado, cutthroat trout have long held the interest of anglers and managers alike (Behnke 2002, Trotter 2008). Ever since greenback cutthroat trout (*Oncorhynchus clarkia stomias*) were listed as endangered under the Endangered Species Act in 1974, there has been strong interest in developing methods to distinguish them from closely related subspecies with confidence. Prior to recent molecular testing, phenotypic traits associated with greenback cutthroat trout were larger spots, and higher scale counts above the lateral line and in the lateral series when compared to Colorado River cutthroat trout (*O. c. pleuriticus*; Behnke 1992). However, these two subspecies cannot be separated consistently on the basis of those characteristics (Behnke 1992, 2002). As a result, geographic range had become the default approach for establishing subspecies designation. Early molecular work did not distinguish between these two subspecies (Behnke 2002), but in 2007 Metcalf et al. (2007) used mitochondrial and nuclear molecular markers to suggest that indeed there was a genetic basis for separating greenback from Colorado River cutthroat trout. The primary concern raised by that paper was five of the nine greenback cutthroat trout populations they examined actually displayed genetic fingerprints more similar to cutthroat trout of Trappers Lake origin than they did with many of the other greenback populations such as those found in Severy Creek. This was particularly troubling since mechanisms were in place to deliver Trappers Lake fish to the East Slope. From 1903 through 1938, at least 80 million pure Colorado River cutthroat trout were produced at Trappers Lake (Rogers 2012a). Millions more were produced on the south slope of Pikes Peak (Rogers and Kennedy 2008). Although the fate of many of those fish remains a mystery, it is clear that they were stocked in virtually every county east of the Divide that would support trout (Metcalf et al. 2012).

A finding of Metcalf et al. (2007) that attracted less attention was the discovery of a “greenback” cutthroat trout population west of the Continental Divide near Gunnison in West Antelope Creek. Intensive survey work since that time indicated that in fact the West Antelope Creek population is not unique, and that populations with similar genetic fingerprints are pervasive across Colorado’s western slope (Rogers 2010). That finding lead the Recovery Team to question whether the West Antelope Creek fish were really greenback cutthroat trout as suggested by Metcalf et al. (2007), or whether they simply represented diversity within Colorado River cutthroat trout (Rogers 2010). In an effort to avoid confusion, trout with this genetic fingerprint are hereafter referred to as Lineage GB, while cutthroat trout displaying the genetic signature commonly associated with those from Trappers Lake are referred to as Lineage CR.

The native distribution of different lineages of cutthroat trout in Colorado was clarified greatly with recent work published by a University of Colorado led research team that examined DNA from 150 year old museum specimens collected prior to large scale stocking activities (Metcalf et al. 2012). This work funded by the Greenback Cutthroat Trout Recovery Team, confirmed that indeed, Lineage GB is at least native to the Colorado, Gunnison basin. Additional work suggests they were likely found in the Dolores basin as well (Rogers 2010), with every other remaining major basin represented by its own distinct lineage. Since the subspecies were described using phenotypic characters (Cope 1871), and recent court cases have affirmed that visual characteristics should be central to the description of taxa (Kaeding 2003), the Recovery Team launched an additional research project with the Larval Fish Lab at Colorado State University to explore if distinct phenotypes can be predicted from these underlying genetic fingerprints.

While the taxonomy of these fish has yet to be resolved, the USFWS is urging federal agencies to treat Lineage GB cutthroat trout as if they are greenback cutthroat trout. If an action may affect a Lineage GB population, then initiation of Section 7 consultation is appropriate (USFWS 2009c). The USFWS also believes that implementation of the CRCT Conservation Strategies (CRCT Coordination Team 2006) in place to conserve and protect Colorado River cutthroat trout populations will also adequately protect any that happen to display the Lineage GB genetic fingerprint. Agencies should therefore include these activities in their Biological Assessments as conservation measures for lineage GB populations (USFWS 2009c).

**Environmental Baseline**

Cutthroat trout of greenback lineage are known to reside in only one stream within the boundary of the LSFO. BLM does not manage any surface portions of the creek or surrounding area but does administer the subsurface federal mineral estate within portions of the watershed. The Routt National Forest manages most of the land within the Deadman Gulch watershed. The closest BLM land is approximately five miles south/west of Deadman Gulch.

**Threats**

The primary threat to greenback cutthroat trout is the presence and stocking of non-native salmonids for sport fishing, resulting in predation and competitive exclusion, as well as potential for hybridization with other *Oncorhynchus* species or subspecies.

Other threats include:

- Climate change;
- Livestock grazing;
- Water diversions and reduced flows;
- Disease; and
- Toxicity

### F. Yellow-billed cuckoo

Listing Status: Federal –Threatened October 2013

**Species Description**

Yellow-billed cuckoo (cuckoo) is a medium-sized bird about 12 inches (30 cm) in length and weighing about 2 ounces (57 grams [g]). Morphologically, cuckoos throughout the western continental United States and Mexico are generally larger, with significantly longer wings, longer tails, and longer and deeper bills compare to their eastern counterparts (Franzreb and Laymon 1993). The species has a slender, long-tailed profile, with a fairly stout and slightly down-curved bill, which is blue-black with yellow on the basal half of the lower mandible. Plumage is grayish-brown above and white below, with rufous primary flight feathers. The tail feathers are boldly patterned with large white spots on a black background on the underside of the tail. The legs are short and bluish-gray, and adults have a narrow, yellow eye ring. Juveniles resemble adults, except the tail patterning is less distinct, and the lower bill may have little or no yellow. Males and females differ slightly. Males tend to have a slightly larger bill and the white in the tail tends to form oval spots, whereas in females the white spots tend to be connected and less distinct (USFWS 2011).

**Life History**

The breeding range of the entire yellow-billed cuckoo species formerly included most of North America from southeastern and western Canada (southern Ontario and Quebec and southwestern British Colombia) to the Greater Antilles and northern Mexico (AOU 1998). Western populations of cuckoos breed in dense riparian woodlands, primarily of cottonwood, willow, and mesquite (Prosopis spp.), along riparian corridors in otherwise arid areas (Laymon and Halterman 1989, Hughes 1999). Dense undergrowth may be an important factor in selection of nest sites. Narrow bands of riparian woodland can contribute to the overall extent of suitable habitat. Adjacent habitat on terraces or in the upland (such as mesquite) can enhance the value of these narrow bands of riparian woodland.

In the Lower Colorado River this species occupies riparian areas that have higher canopies, denser cover in the upper layers of the canopy, and sparser shrub layers when compared to unoccupied sites. Although this species is generally associated with breeding and nesting in large wooded riparian areas dominated by cottonwood trees, they have been documented nesting in salt cedar between Albuquerque and Elephant Butte Reservoir and along the Pecos River in southeastern New Mexico.

Throughout the cuckoo's range, a large majority of nests are placed in willow trees, but alder (Alnus spp.), cottonwood, mesquite, walnut (Juglans spp.), box elder, sycamore, netleaf hackberry (Celtis laevigata var. reticulata), soapberry (Sapindus saponaria), and tamarisk are also used (Laymon 1980, Hughes 1999, Corman and Magill 2000 , Corman and Wise-Gervais 2005, Holmes et al. 2008

Cuckoos reach their breeding range later than most other migratory breeders, often in June (Rosenberg et al. 1982). They construct an unkempt stick nest on a horizontal limb in a tree or large shrub. Nest height ranges from 4 ft to (rarely) 100 ft, but most are typically below 30 ft (Hughes 1999). The incubation period for cuckoo is 9 to 11 days, and young leave the nest at 7 to 9 days old. Nesting usually occurs between late June and late July, but can begin as early as late May and continue until late September (Hughes 1999).

The cuckoo primarily breeds in riparian habitat along low-gradient (surface slope less than 3 percent) rivers and streams, and in open riverine valleys that provide wide floodplain conditions (greater than 325 ft [100 m]). In the southwest, it can also breed in narrower reaches of riparian habitat. The moist conditions that support riparian plant communities that provide cuckoo habitat typically exist in lower elevation, broad floodplains, as well as where rivers and streams enter impoundments.

The optimal size of habitat patches for the species are generally greater than 200 ac (81 ha) and have dense canopy closure and high foliage volume of willows and cottonwoods (Laymon and Halterman 1989) and thus provide adequate space for foraging and nesting. Tamarisk, a nonnative tree species, may be a component of the habitat, especially in Arizona and New Mexico. Sites with a monoculture of tamarisk are unsuitable habitat for the species. The association of breeding with large tracts of suitable riparian habitat is likely related to home range size. Individual home ranges during the breeding season average over 100 ac (40 ha), and home ranges up to 500 ac (202 ha) have been recorded (Laymon and Halterman 1987, Halterman 2009, Sechrist et al. 2009, McNeil et al. 2011, McNeil et al. 2012).

In addition to the dense nesting grove, western yellow-billed cuckoos need adequate foraging areas near the nest. Foraging areas can be less dense or patchy with lower levels of canopy cover and often have a high proportion of cottonwoods in the canopy. Optimal breeding habitat contains groves with dense canopy closure and well-foliaged branches for nest building with nearby foraging areas consisting of a mixture of cottonwoods, willows, or mesquite with a high volume of healthy foliage (USFWS 2010).

Cuckoos forage primarily by gleaning insects from vegetation, but they may also capture flying insects or small vertebrates such as tree frogs and lizards (Hughes 1999). They specialize on relatively large invertebrate prey, including caterpillars (Lepidoptera sp.), katydids (Tettigoniidae sp.), cicadas (Cicadidae sp.), and grasshoppers (Caelifera sp.)(Laymon et al. 1997). Minor prey includes beetles (Coleoptera sp.), dragonflies (Odonata sp.), praying mantis (Mantidae sp.), flies (Diptera sp.), spiders (Araneae sp.), butterflies (Lepidoptera sp.), caddis flies (Trichoptera sp.), crickets (Gryllidae sp.), wild berries, and bird eggs and young (Laymon et al. 1997, Hughes 1999). Prey species composition varies geographically. Their breeding season may be timed to coincide with outbreaks of insect species, particularly tent caterpillars (Hughes 1999, USFWS 2001a) or cicadas (Johnson et al. 2007, Halterman 2009).

Cuckoos spend the winter in South America, east of the Andes, primarily south of the Amazon Basin in southern Brazil, Paraguay, Uruguay, eastern Bolivia, and northern Argentina (Ehrlich et al. 1992, AOU 1998, Johnson et al. 2008b). The species as a whole winters in woody vegetation bordering fresh water in the lowlands to 1,500 m (4,921 ft), including dense scrub, deciduous broadleaf forest, gallery forest, secondary forest, subhumid and scrub forest, and arid and semiarid forest edges (Hughes 1999). Wintering habitat of the cuckoo is poorly known.

**Status and Distribution**

Since 1980, statewide surveys from New Mexico, Arizona, and California indicate an overall estimated 52 percent decline with numbers too low to establish trends from Idaho, Montana, Utah, Nevada, and Colorado. Trend information is also lacking from west Texas and Mexico. Yellow-billed cuckoo has been extirpated as a breeding bird in Washington, Oregon, and British Columbia (USFWS 2011). Comparisons of historic and current information suggest that the western yellow-billed cuckoo's range and population numbers have declined substantially across much of the western U.S. over the past 50 years.

Although the overall population size of this species remains large, western populations in many areas have decreased dramatically. Major declines among western populations in the 20th century are attributed to habitat loss and fragmentation. Although once considered a common nester in Arizona river bottoms, fewer than 50 pairs were estimated present in the state in the early 1990s. The greatest declines have been in California, from an estimated 15,000 pairs in the late 19th century to a few dozen pairs by the mid-1980s (New Mexico Partners in Flight 2014).

Based on historic accounts, the species was widespread and locally common in California and Arizona, locally common in a few river reaches in New Mexico, locally common in Oregon and Washington, generally local and uncommon in scattered drainages of the arid and semiarid portions of western Colorado, western Wyoming, Idaho, Nevada, and Utah, and probably uncommon and local in British Columbia (USFWS 2011). The largest remaining breeding areas are in southern and central California, Arizona, along the Rio Grande in New Mexico, and in northwestern Mexico (USFWS 2010). The current breeding population is low, with estimates of approximately 350 to 495 pairs north of the

Mexican border and another 330 to 530 pairs in Mexico for a total of 680 to 1,025 breeding pairs (USFWS 2010).

**Environmental Baseline**

On August 15, 2014 and again on November 12, 2014 the USFWS announced a proposal to designate critical habitat for the western distinct population segment of the yellow-billed cuckoo under the Endangered Species Act of 1973. The comment period for the proposed critical habitat rule closed on January 12, 2015. There is one unit of proposed critical habitat located in north west Colorado, within the LSFO:

> Unit 54: CO–1 Yampa River; Moffat and Routt Counties
>
> Proposed critical habitat unit CO–1 is 6,938 ac (2,808 ha) in extent and is a 20-mi (32-km)-long continuous segment of the Yampa River from near the Town of Craig in Moffat County to near the Town of Hayden in Routt County, Colorado. Approximately 5,739 ac (2,322 ha), or 83 percent, of proposed unit CO–1 are privately owned, and 1,199 ac (485 ha), or 17 percent, are located on Yampa River State Wildlife Area managed by the Colorado Parks and Wildlife. This high-elevation site is near the current northern limit of the current breeding range of the species.

**Threats**

Threats to yellow-billed cuckoos include loss or degradation of riparian habitat from water management (dams, flow control), urbanization, grazing, conversion to non-native species and agricultural conversion.

## VII. Effects of the Proposed Actions on Species Evaluated

The proposed coal lease modification would have no direct effect to any listed species. The actual mine plan would be approved by OSMRE and is therefore a federal action. Details of the mine plan are not available at the leasing stage and effects (if any) to listed species from the mine plan would be consulted on by OSMRE. Combustion of federal coal may result in indirect impacts to listed species. The primary impact from coal combustion to T&E species and/or critical habitat is the emission and subsequent deposition of mercury and selenium.

### A. Listed Fish Species

***Mercury***

Mercury is a naturally occurring element. It can be found in soils and the atmosphere, as well as water bodies. Atmospheric transport and deposition is an important mechanism for the global deposition of mercury (EPRI 2014), as it can be transported over large distances from its source regions and across continents. It is considered a global pollutant. Atmospheric mercury is primarily inorganic and is not biologically available. However, once mercury is deposited to the earth, it can be converted into a biologically available form, methylmercury (MeHg), through a process known as methylation. MeHg bioaccumulates in food chains, and particularly in aquatic food chains, meaning that organisms exposed to MeHg in their food can build up concentrations that are many times higher than the ambient concentrations in the environment.

Mercury is emitted by both natural and anthropogenic sources. Natural sources include volcanoes, geothermal sources, and exposed naturally mercury-enriched geological formations. These sources may also include re-emission of historically deposited mercury as a result of evasion from the surface back into the atmosphere, fires, meteorological conditions, as well as changes in land use and biomass burning. Anthropogenic sources of mercury include burning of fossil fuels, incinerators, mining activities, metal refining, and chemical production facilities. Anthropogenic sources currently account for 30% of the mercury being emitted into the environment. The global emissions inventory for 2010 estimated that 1960 metric tons 4,319,840 lbs) of mercury was emitted into the atmosphere as a direct result of human activity (UNEP 2013), with approximately 61 metric tons supplied by North America. East and Southeast Asia were by far the highest contributors, with 777 metric tons of mercury released (UNEP 2013).

Aquatic systems receive mercury by direct deposition from the atmosphere and from overland transport from within the watershed (EPA 1997). Once mercury is converted to methyl mercury, it can bioaccumulate in endangered fish and is a potent neurotoxin that affects their fitness and reproductive health (Crump and Trudeau 2009). Once Hg enters the body, it poses the highest threats of toxicity because it can be absorbed into living tissues and blood. Once in the blood it crosses into the brain and accumulates, there is no known way to be expelled from the brain (Gonzalez et al. 2005).

The accumulation of Hg from water occurs via the gill membranes as well as through ingestion (Beckvar 1996; USEPA 1997). MeHg is eventually transferred from the gills to muscle and other tissues where it is retained for long periods of time (Julshamn et al. 1982; Riisgård and Hansen 1990). Probably less than 10 percent of the Hg in fish tissue residues is obtained by direct (gill) uptake from water (Francesconi and Lenanton 1992; Spry and Wiener 1991). Hg taken up with food initially accumulates in the tissues of the posterior intestine of fish (Boudou et al. 1991). Hg ingested in food is transferred from the intestine to other organs including muscle tissues (Boudou et al. 1991). MeHg has been reported to constitute from 70 to 95 percent of the total mercury in skeletal muscle in fish (Huckabee et al. 1979; EPA 1985; Riisgård and Famme 1988; Greib et al. 1990; Spry and Wiener 1991). MeHg accounted for almost all of the Hg in muscle tissue in a wide variety of both freshwater and saltwater fish (Bloom 1992).

The effects of mercury on fish are numerous. Lusk (2010) describes the potential affects as:

4. Potent neurotoxin:
    a. Affects the central nervous systems (reacts with brain enzymes, then lesions)
    b. Affects the hypothalamus and pituitary, affects gonadotropin-secreting cells
    c. Altered behaviors: Reduced predator avoidance, reproduction timing failure

   d. Reduced ability to feed (emaciation and growth effects)
5. Endocrine disruptor
   a. Suppressed reproduction hormones in male and female fish
   b. Reduce gonad size and function, reduced gamete production
   c. Altered ovarian morphology, delayed oocyte development
   d. Reduced reproductive success
   e. Transfer of dietary Hg of the maternal adult during oogenesis and into the developing embryo
6. Inability to grow new brain cells or significantly reduce brain mercury.

To protect human health, the EPA developed a methyl mercury water quality criteria of 3.0 micrograms per gram (µg/g) wet weight (WW) in edible fish and shellfish. Beckvar et al. (2005) suggested a threshold-effect level of 0.2 µg/g WW mercury in whole body fish as being generally protective of juvenile and adult fish. However, Yeardley et al. (1998) suggested that mercury concentrations greater than 0.1 µg/g WW may be harmful to predators eating contaminated fish.

Since Colorado pikeminnow are a long lived, top predator species, mercury would be most likely to impact this species. Osmundson and Lusk (2012) reported on the collection, locations, methods, chemical analyses, laboratory quality assurance and quality control, and interpretation of Hg in Colorado pikeminnow from Upper Colorado River Basins, including from the Yampa and White Rivers during 2008-2009. The Hg in Colorado pikeminnow muscle tissues collected from the San Juan, Green, Upper Colorado, White, and Yampa Rivers are summarized in the table below.

**Average and range of mercury (Hg mg/kg WW) in Colorado pikeminnow muscle tissues from Upper Colorado River Basins 2008-2009 (Osmundson and Lusk 2012).**

| River Basin | Average Hg in Muscle Tissue (min - max) |
|---|---|
| San Juan River ( > 400 mm TL) | 0.37 (0.31 - 0.43) |
| Green River | 0.77 (0.68 - 0.87) |
| Upper Colorado River | 0.60 (0.31 – 1.04) |
| White River | 0.95 (0.43 – 1.83) |
| Yampa River | 0.49 (0.44 – 0.53) |

There are currently two fish consumption advisories within the LSFO for mercury. One of the advisories applies to Elkhead Reservoir, northeast of Craig, CO and one applies to Catamount Reservoir, east of Steamboat Springs, CO. There is currently not a fish consumption advisory for either the Yampa or White Rivers.

Data from the Colorado Department of Public Health and Environment, Water Quality Control Division maintains a list of all waters in Colorado that exceed the total maximum daily loads for a variety of contaminants. The Water Quality Control Division does not list the Yampa or White Rivers as impaired for mercury levels. It should be noted, however, that impairment under this program relates to human effects and not necessarily to impacts to aquatic species.

It is expected that about one-third (112,000 tons) of the coal from this lease modification would be combusted at the Hayden Generating Station. The combustion location for the additional two-thirds of coal is speculative at this time. Coal from the Foidel Creek Mine is shipped to several power plants across the nation, with several contracts only lasting a year and destination plants often changing from year to year. Ultimately, any near or far field impacts from criteria or mercury emissions associated with coal combustion sources will have already received analysis as part of the permitting process or rule implementation from their respective regulatory agencies (state or EPA).

The Hayden Generating station has two combustion units, one which went online in 1965 and the second in 1976. Both units have several components designed to decrease air emissions, including: low NOx burners, fabric filter dust collectors (baghouses) and lime spray dryers (scrubbers). In addition, selective catalytic reduction units (SRCs) for the control of NOx emissions will be installed on both units. Although not specifically designed to reduce mercury emissions, the SRC units will oxidize elemental mercury and allow better collection of mercury in the scrubbers and baghouses. Therefore, once the SCRs go into service (November 2015 and November 2016), mercury emissions from the Hayden Station will decrease, however, to what degree is unknown. The units qualify as low emitting electric generating units (LEE) for mercury under the new EPA Mercury and Air Toxic Standards (MATS).

The 112,000 tons of federal coal from this lease modification would supply the Hayden Station from approximately 26 days. The Hayden Station emitted 9.1 lbs of mercury in 2014. If mercury emissions remain constant, the 112,200 tons of coal expected to be burned at the Hayden Station would emit ~0.65 lbs (or 0.000295 metric tons) of mercury. If 2010 numbers were used for total global emissions of mercury, this would represent an insignificant amount of mercury when compared to the global pool (1960 metric tons).

A mercury deposition network (MDN) monitoring site (Buffalo Pass – Summit Lake) is located east of Steamboat Springs, CO in the Routt National Forest. Based on mapped mercury deposition products from the MDN, the region within the regional air quality study area has seen little change in total annual average mercury wet deposition during the period from 2007 through 2013. An interesting occurrence, however, shows that deposition monitoring values for total wet deposition at the Routt Monitoring Station increased approximately 2 micrograms per square meter (µg/m2) from 7.8 µg/m2 in 2008 to 9.8 µg/m2 in 2013 even in the face of declining regional mercury emissions. One explanation for this could possibly be the increasing amount of mercury emitted from other global or regional sources.

No current data or modeling is available to indicate how much of the mercury emitted by the Hayden Station is deposited annually within local airshed. However, in the 1997 Mercury Study Report to Congress, the EPA undertook a modeling exercise to estimate the local deposition of mercury and subsequent impacts. Deposition is dependent upon a variety of factors, including the chemical species of mercury (elemental, oxidized or particulate-bound), atmospheric conditions, climate, air quality and stack height. Elemental mercury can be transported over very long distances and the global pool of mercury is primarily composed of elemental mercury. Oxidized mercury and particulate-bound mercury are deposited by wet or dry deposition up to 500 miles from sources. According to the EPA's modeling, the Hayden Station would fall in between a small and medium coal-fired utility boiler based on stack height (Unit 1 – 250 ft and Unit 2 – 395 ft). Dry deposition for this type of facility would range from 2.8% to 7.5% of emissions within 31 miles (50 km) of the facility. Wet deposition would be predicted to range from 0.9% to 1.0% of emissions within 31 miles of the facility. This would result in an expected 0.291 to 0.78 ounces of dry deposition within 31 miles of the Hayden Station from the 112,200 tons of federal coal and 0.094 to 0.104 ounces of wet deposition. The remaining mercury would be deposited over 31 miles from the Hayden Generating Station, or would be vertically diffused to the free atmosphere to become part of the global cycle. Prevailing winds in the Hayden area are predominantly from the west, therefore, the majority of deposition would be expected to occur east of the station, towards the mountains east of Steamboat Springs, CO. Wet deposition maps from the Mercury Deposition Network illustrate the majority of deposition in the local airshed does occur in mountainous areas.

Of the amount of mercury emitted from the federal coal, it is reasonable to assume that some portion would deposit directly or indirectly into the Yampa River or its tributaries. Some of this mercury would be converted into methyl mercury and thereby has the potential to affect the Colorado River fish.

In addition to impacts to individual Colorado River fish, impacts would also potentially occur to those species designated critical habitats in the region. As with any other listed species with designated critical habitat, the critical habitat for the four fish species all contain the primary constituent elements (PCEs) that are required to be present and are determined to be necessary for the survival and recovery of the species. All four species' critical habitat contains the following PCEs (50 CFR 13378):

4. Water: This includes a quantity of water of sufficient quality (i.e. temperature, dissolved oxygen, lack of contaminants, nutrients, turbidity, etc.) that is delivered to a specific location in accordance with a hydrologic regime that is required for the particular life stage for each species;
5. Physical Habitat: This includes areas of the Colorado River system that are inhabited or potentially habitable by fish for use in spawning, nursery, feeding, and rearing, or corridors between these areas. In addition to river channels, these areas also include bottom lands, side channel, secondary channels, oxbows, backwaters, and other areas in the 100-year floodplain, which when inundated provide spawning, nursery, feeding and rearing habitats, or access to these habitats;
6. Biological Environment. Food supply, predation, and competition are important elements of the biological environment and are considered components of this constituent element. Food supply is a function of nutrient supply, productivity, and availability to each life stage of the species. Predation and competition, although considered normal components of this environment, are out of balance due to introduced nonnative fish species in many areas.

Mercury from the combustion of federal coal at the Hayden Generating Station that is deposited either directly or indirectly into the designated critical habitat for these species would have the potential to impact the critical habitat. This would occur primarily by increasing the amount of contaminates present in those areas (PCE #1). It is difficult to quantify the level of this impact from the proposed action to critical habitats given the lack of information on how much mercury would make its way to critical habitat and how much would be converted to methyl mercury. However, if it predicted that only 0.884

ounces of mercury would be deposited in the local airshed, the amount of this mercury that eventually finds its way into critical habitat and is converted to methyl mercury may be negligible.

***Selenium***

In addition to mercury, impacts to listed fish species from increases in selenium from the combustion of coal could occur. Selenium, a trace element, is a natural component of coal and soils in the area and can be released to the environment by the irrigation of selenium-rich soils and the burning of coal in power plants with subsequent emissions to air and deposition to land and surface water. Contributions from anthropogenic sources have increased with the increases of world population, energy demand, and expansion of irrigated agriculture. Selenium, abundant in western soils, enters surface waters through erosion, leaching, and runoff.

Selenium is a micro-nutrient, necessary for proper cellular function of structural proteins and cellular defenses against oxidative damage. While small amounts of selenium are essential for proper cellular functioning, excess amounts can be toxic. Excess dietary selenium causes elevated selenium concentrations to be deposited into developing eggs, particularly the yolk (Buhl and Hamilton 2000). If concentrations in the egg are sufficiently high, developing proteins and enzymes become dysfunctional or result in oxidative stress, conditions that may lead to embryo mortality, deformed embryos, or embryos that may be at higher risk for mortality.

Reporting limits for selenium in water is generally one microgram per liter (µg/L) while the EPA has set the maximum contaminant level goal of 0.05 mg/L (50 µg/L) for human consumption. During sampling of the Yampa River between 1997 and 1998, levels between less than one and 4.8 µg/L were found near Craig, between less than one and 4.9 µg/L near Maybell, and less than one and 3.6 µg/L near Deerlodge Park (USGS 2001). The peak reported levels for these sites all occurred in March, possibly during the beginning of the snow runoff. Concentrations were less than 1 µg/L during May through October. However, it should be noted that selenium in water may be less important than dietary exposure when determining the potential for chronic effects to a species (USFWS 2014).

While the reportable limit of selenium in water is 1 µg/L, the safe level of selenium for protection of fish and wildlife in water is considered to be below 2 µg/L and chronically toxic levels are considered to be greater than 2.7 µg/L (USFWS 2014). Excess selenium in fish have been shown to have a wide range of adverse effects including mortality, reproductive impairment, effects on growth, and developmental and teratogenic effects including edema and finfold, craniofacial, and skeletal deformities.

Of the four Colorado River fish species, selenium would disproportionately affect the razorback sucker more than the other three species. As with all sucker species, the razorback sucker is a bottom feeder and more likely to ingest selenium that has precipitated to the river bottoms.

If combustion of coal from the lease modification occurs at the Hayden Station, selenium could be emitted and subsequently deposited. However, as it is not monitored as it is emitted, unlike mercury, there is no information as to how much is released. When selenium is present in flue gas, it tends to behave much like sulfur and is removed to some extent via the SO2 air scrubbers in place (EPRI 2008). Since the amount of selenium in emissions from the Hayden Station is not measured, impacts cannot be measured or detected in a manner that permits meaningful evaluation. However, the coal lease adjustment is extremely small when compared to the amount of coal that is combusted within the Colorado River Basin and since the Hayden Station is over 60 miles away from razorback critical habitat, the likelihood of selenium from this coal reaching DCH may be minimal.

### B. Yellow-billed cuckoo

***Mercury***

Mercury is an environmental contaminant that can also have adverse effects on riparian wildlife (Scheuhammer et al. 2012; Wentz et al. 2014). For riparian birds such as cuckoos, Hg is accumulated via ingestion of aerial insects emerging from benthic life stages in aquatic environments containing Hg or from associated predatory spiders (Cristol et al. 2008; Edmonds et al. 2012; Evers et al. 2012; Buckland-Nicks et al. 2014; Gann et al. 2014). Dietary total Hg concentrations associated with adverse effects to birds are generally greater than 0.1 mg/kg WW (DOI 1998). Once ingested, MeHg rapidly moves into the bird’s central nervous system, resulting in behavioral and neuromotor disorders (Tan et al. 2009; Scheuhammer et al. 2012). The developing central nervous system in avian embryos is especially sensitive to this effect, and permanent brain lesions and spinal cord degeneration are common (DOI 1998, Bryan et al. 2003, Scheuhammer et al. 2007). Therefore, adverse effects are described for the eggs, embryos, nestlings and/or fledglings associated with elevated Hg burdens in the female parent and due to foraging.

Uptake of mercury by birds has been shown to generally impact fish eating birds more severely than insectivorous birds (Zolfaghari et al. 2009, Boening 2000). Additionally, Howie (2010) found that the lateral extent of elevated mercury levels in birds and invertebrate prey species varied from approximately 250 to 650 meters from an affected water body. After this distance, mercury levels in the blood and feathers could not be distinguished from background levels, indicating that only those individuals that forage adjacent to affected water bodies show signs of bioaccumulation of mercury.

No information is available on the levels of mercury in the Yampa River invertebrates within the analysis area. Any yellow-billed cuckoos present in the analysis area would be at risk for mercury contamination. The risk would be low considering that the primary food sources for the cuckoo are generally not aquatic. If it predicted that only 0.884 ounces of mercury would be deposited in the local airshed, the amount of this mercury that eventually finds its way into critical habitat or into cuckoo prey would likely be negligible.

## VIII. Cumulative Effects

As it pertains to Section 7 Consultation, cumulative effects are defined as: *those effects of future State or private activities, not involving Federal activities that are reasonably certain to occur within the action area of the Federal action subject to consultation. [50 CFR 402.02]*. Cumulative effects do not include any past or ongoing action, but “involve only future non-Federal actions”. Future Federal actions requiring separate consultation (unrelated to the proposed action) are not considered in the cumulative effects section.

Declines in the abundance or range of many special status species have been attributed to various human activities on federal, state, and private lands, such as human population expansion and associated infrastructure development; construction and operation of dams along major waterways; water retention, diversion, or dewatering of springs, wetlands, or streams; recreation, including off-road vehicle activity; expansion of agricultural or grazing activities, including alteration or clearing of native habitats for domestic animals or crops; and introductions of non-native plant, wildlife, or fish or other aquatic species, which can alter native habitats or out-compete or prey upon native species. Many of these activities are expected to continue on state and private lands within the range of the various federally protected wildlife, fish, and plant species, and could contribute to cumulative effects to the species within the action area of the Proposed Actions. Species with small population sizes, endemic locations, or slow reproductive rates, or species that primarily occur on non-federal lands where landholders may not participate in recovery efforts, would be generally be highly susceptible to cumulative effects.

Reasonably foreseeable future activities that may affect river-related resources within the Yampa and White River watersheds include coal mining and combustion, oil and gas exploration and development, irrigation, urban development, recreational activities, livestock grazing and activities associated with the Upper Colorado River Endangered Fish Recovery Program. Implementation of these projects affects the environment including but not limited to, water quality, water rights, socioeconomic and wildlife resources.

**VIIII. Effects Determination**

*Yellow-billed Cuckoo*

While proposed critical habitat exists within the analysis area, there have been no confirmed sightings of the yellow-billed cuckoo in the analysis area since 2008. Additionally, it is not known if the previous sightings represented nesting pairs or migrants. As this species is a migrant that may not return to previous nesting locations in subsequent years, the potential to suffer adverse impacts from mercury would be less than non-migrant species. Therefore it is determined that the Proposed Action **May Affect, but is not Likely to Adversely Affect** yellow-billed cuckoos or proposed critical habitat for this species. Additionally, while mercury deposition may affect aquatic insects, these are not the primary prey item for yellow-billed cuckoos. Therefore, it is determined that the Proposed Action is **not likely to destroy or adversely modify** the proposed critical habitat for cuckoos.

*Lineage Greenback Cutthroat Trout*

One linage greenback cutthroat trout population exists in Routt County, within the boundaries of the LSFO. This population is outside of the 31 mile analysis area for local deposition of mercury from coal combustion at the Hayden Station. Since mercury would be deposited outside the local airshed, mercury from the federal coal could conceivably reach the one greenback stream that occurs in Routt County. However, with the small amount of mercury expected to be emitted from this coal, this impact would be negligible. In addition, this population of trout lives in a cold water stream and its main food is insects, even further reducing potential impacts. Therefore it is determined that the Proposed Action **May Affect, but is Not Likely to Adversely Affect** lineage greenback cutthroat trout.

*Colorado River Fish*

The four fish that collectively make up the Colorado River fish species all occur within the Yampa River to the west of the Hayden Station. Continued combustion of federal coal from the Foidel Mine at the Hayden Generating Station would release both mercury and selenium into the environment. However the Hayden Generating Station would continue to operate without the 112,200 tons of federal coal by using state or fee coal or by purchasing coal from various sources. Of the amounts emitted annually, it can be reasonably assumed that some would deposit either directly or indirectly into the Yampa River. However, as stated above, the amount that would actually enter the river or be available for bioaccumulation in the fish species is not known without detailed modeling.

In the future, mercury and selenium, which are globally transmitted pollutants, would continue to accumulate within the Yampa River Basin from both local and global sources. Given the potential for the release of mercury from the combustion of federal coal in the local airshed and the subsequent deposition in the Yampa River, the Proposed Action **May Affect, is Likely to Adversely Affect** the Colorado River fish. Additionally, while potentially not significant alone, the deposition of mercury into critical habitat from the Proposed Action along with other regional and global sources of mercury may be affecting the PCEs for that critical habitat. Therefore, the Proposed Action **May Affect, is Likely to Adversely Affect** the critical habitat for the four Colorado River fish species.

Conservation Measures

The BLM, LSFO is partnering with the U.S. Geological Survey (USGS) to conduct a mercury study related to fish in the Yampa and White River Basins. The purpose of this study is to determine the level of mercury in higher trophic level fish and apply this knowledge to Colorado River Fish conservation and management. Sampling is scheduled to begin in the summer of 2016. BLM has contributed $65,000 to this effort.

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## ATTACHMENT B

### Comments and Comment Responses

| Commenter | Comment Summary | Comment Response |
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| Sam Baker | After reading the Steamboat Today article about Twentymile requesting to add the 310 acres to their lease, I thought it appropriate to submit a comment. I think the lease modification should be approved, especially after having interned at Twentymile this past summer. The impacts from the mine will no doubt be minimal if any, the land above is mainly used as grazing land, and in my personal experience the engineering staff at Twentymile embody the idea of professionalism. I have no doubt they can mine the land in a safe and environmentally responsible manner, and therefore feel the lease ought to be approved. | Thank you for your comment. |
| Patrick Sollars, Peabody Twentymile Mine | The proposed modification application for the Wolf Creek seam adds a contiguous tract of unleased federal coal covering approximately 310 acres and including 340,000 tons recoverable tons of bituminous coal. The modification has been requested to allow Twentymile Coal to add longwall panels in the Wolf Creek seam and provide an extension of development of the Wadge seam, ensuring maximum recover of federal coal. The modification allows the life of the current mine to be extended by approximately one and a half to two years. This minor modification does not entail any new or additional surface disturbance. If approved, Foidel Creek will request a permit modification from DRMS in accordance with regulatory requirements. Twentymile Coal annually produces between 6 and 8 million tons of coal and has a long-standing reputation for managing safe and environmentally responsible operations. The proposed lease modification is not expected to | Thank you for your comment. The Socioeconomic section addresses the beneficial impacts of the lease modification. |

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| | create incremental environmental or cultural consequences. The social and economic benefit associated with the lease medication includes the extension of employment opportunities at Foidel Creek Mine and the associated secondary jobs created by labor, services and goods needed to operate a mine. Twentymile Coal is a significant employer in the region, providing a high-level wage and benefit package to more than 325 direct employees. In addition, as the top taxpayer in Routt County, Twentymile Coal accounts for more than six percent of the County's property tax revenue. The mine and its employees contribute to local charities such as United Way, local 4H programs and other civic and community initiatives. Approval of the proposed lease modification will result in continued lease, tax and royalty payments to local, state and federal entities. Fair Market Value will be paid for lease of the 340,000 tons of recoverable coal and when mined, additional royalties will be paid at 8 % of the gross sales prices. Local property, sales and use tax will be assessed on mining operations and applicable purchases. Additional tax payments include federal assessments for the Abandoned Mine Fund and Black Lung Fund. Twentymile Coal requests favorable consideration and approval of the proposed lease modification. The proposals add social and economic value to the region and will allow for maximum recovery of federal<br>coal creating additional taxable value at the federal, state and local levels. | |
| Leslie Glustrom/1 | While this is not a large amount of coal under consideration (about 340,000 tons), the key to thinking about climate change is the cumulative impact of our actions and decisions.<br>We only have one atmosphere and every ton of carbon dioxide that is added to it by our generation is a ton of carbon dioxide that will impact the climate for generations to come.<br>As you've noted, the accumulation of carbon dioxide and the warming of the planet could have "massive deleterious impacts | This is a prediction of The Intergovernmental Panel on Climate Change (IPCC). The IPCC also is one of the sources disclosing the slower rate of increasing surface temperatures over the past 15 years. Massachusetts Institute of Technology atmospheric scientist David Ridley and NASA scientist Dr. Allegra LeGrande also |

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| | on the natural and human environments." (EA, pages 24-25 and detailed on 33.) You then proceed to "undo" that concern by extracting a single sentence (which is also repeated on page 33) from a single Climate Wire article about a reduced rate of surface warming over the last 15 years. The sentence you have extracted completely misses the point of the Climate Wire article--which is that much of the warming occurring on the planet is occurring in the oceans--and not on the surface--which is what you've focused on. The critical truth about the warming on the planet is that the oceans and the surface are all part of one system and the impacts are cumulative--and extremely serious.<br>I've copied the Climate Wire article below my contact information with some of the key sentences highlighted. You have also attempted to minimize the release of approximately 19 million tons of carbon dioxide (page 30) by saying that climate change will happen anyways (pages 32 and 39). This is flawed thinking. Everyone is going to die anyways, so does that justify murder?<br>Obviously not--and so it is with the planet.<br>It is true that the planet is warming, the implications are massive and deleterious and a lot of it we can't avoid--but that doesn't justify adding even more to the problem--especially when we have such good alternatives and they are cost effective as demonstrated by many utilities including Xcel and Black Hills in Colorado--both of which have found that adding wind (and in the case of Xcel, solar) to their system saves ratepayers money. (Documentation available on request.)<br>Please rewrite the EA to take out the parts where you have attempted to minimize the impacts of climate change and please recognize that 19 million tons of carbon dioxide equivalent can--and should be--avoided for the public interest. | concurred global warming has slowed since 2000 and is less than predicted by the model.<br><br>http://www.livescience.com/48839-small-volcanoes-slow-global-warming.html<br><br>http://dailycaller.com/2015/04/29/irreversible-arctic-ice-loss-seems-to-be-reversing-itself/<br><br>http://newsbusters.org/blogs/matthew-balan/2015/04/24/shocker-cbs-earth-not-warmas-climate-models-predicted<br><br>The EA discloses that the $CO_{2e}$ of the combustion of the coal is 0.29% of all gross GHG emission from the U.S and that predicting the degree of impact any single emitter of GHGs may have on global climate change, or on the changes to biotic and abiotic systems that accompany climate change, is not possible at this time.<br>The climate change impacts contained within the EA and referenced in the comment are based on global modeling scenarios that predict potential impacts relative to various atmospheric concentrations of GHGs resulting from a multitude of manmade or induced (climatic feedback) causes. Mitigating potential climate change impacts and finding viable engineering based solutions for controlling GHG emissions that are both economical and can be practically implemented is a rapidly evolving sector within the scientific, political, engineering, and grass roots communities. However, the |

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| | | scale of the problem and the lack of viable solutions reasonable alternatives, or policy (at present), put climate change mitigation options clearly within the realm of research and development and continuous debate/negotiations. Avoidance as a mitigation option is equally ineffective unless implemented on a unilateral basis and on a global scale. For this action, avoidance of the projected GHG emissions would still result in those climatic changes and impacts described in the EA, assuming the models are accurate, solely by virtue of the cumulative and global nature of the problem.<br>No change was made to the text. |
| Leslie Glustrom/2 | The term "multiple use" means the management of the public lands and their various resource values so that they are utilized in the combination that will best meet the present and future needs of the American people; making the most judicious use of the land for some or all of these resources or related services over areas large enough to provide sufficient latitude for periodic adjustments in use to conform to changing needs and conditions; the use of some land for less than all of the resources; a combination of balanced and diverse resource uses that takes into account the long-term needs of future generations for renewable and nonrenewable resources, including, but not limited to, recreation, range, timber, minerals, watershed, wildlife and fish, and natural scenic, scientific and historical values;<br>and harmonious and coordinated management of the various resources without permanent impairment of the productivity of the land and the quality of the environment with consideration being given to the relative values of the resources and not necessarily to the combination of uses that will give the greatest economic return or the greatest unit output.<br>Clearly—Multiple Use does not mean to mine everything to the | The coal in the lease modification would be mined by underground methods. There would be no surface disturbance providing for a combination of balanced and diverse resource uses and enabling the long –term needs of future generations for nonrenewable resources to be met. The EA considered the relative value of all the affected resources, complying with the multiple use mission of the BLM and is responsive to distinct resource values including the renewable, non-renewable and socio-economic implications.<br><br>Not all the coal in the lease modification area would be recovered. It is not feasible to recover all the coal. Some coal pillars must be left for controlled subsidence. |

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| | maximum. Rather the Multiple Use directive to the BLM clearly means to consider future needs and to avoid the permanent impairment of the quality of the environment. | Based on the analysis of potential environmental impacts in the EA, and considering the significance criteria in 40 CFR 1508.27, a FONSI was prepared determining that there would be no significant impacts to the environment from the proposed action. |
| Wild Earth Guardians/1 | Our primary concern over the BLM's proposal is that the agency has never fully analyzed the impacts of the mine operations together with the operations of the Hayden coal-fired power plant, which is the primary consumer of coal produced from Foidel Creek and has been for many years. Operations of the Hayden coal-fired power plant are both a connected action and a reasonably foreseeable consequence of issuing the lease modification. The agency has thus failed to demonstrate that the impacts of offering the coal lease modification, including the indirect and cumulative impacts, would not be significant and that an environmental impact statement ("EIS") is not required.<br><br>The BLM has recognized that the impacts of coal-fired power plants are significant. The agency has prepared many EISs in conjunction with proposing to approve coal-fired power plant operations on public lands, including most recently for the proposed Toquop power plant in Nevada (*see* http://www.blm.gov/pgdata/etc/medialib/blm/nv/field_offices/ely_field_office/energy_projects/toquop_energy/toquop_eis.Par.56289.File.dat/Executive%20Summary.pdf) and the proposed White Pine power plant also in Nevada (*see*, http://www.blm.gov/pgdata/etc/medialib/blm/nv/field_offices/ely_field_office/energy_projects/white_pine_energy1/feis_wpes_volumes.Par.47685.File.dat/00%20-%20WPEnergyStation%20Volume1%2009252008.pdf).<br>Here, we are concerned that the BLM has not analyzed or assessed the impacts of air emissions, including greenhouse gas | Operations at the Hayden power plant are not a connected action. Hayden Station would continue to operate without the lease modification.<br><br>Combustion of coal at power plants could have an indirect effect. The EA has been modified to analyze the impacts of coal combustion. See Sections 3.1.1, Air Quality and 3.1.2, Special Status Animal Species.<br><br>The purpose and need are to respond to a lease modification application, not the construction of a coal fired power plant. |

<table>
<tr><td></td><td>emissions, water pollution, and fish and wildlife impacts associated with operating the Hayden power plant.</td><td></td></tr>
<tr><td>Wild Earth Guardians/2</td><td>We are further concerned that the reasonably foreseeable impacts of combustion at other coal-fired power plants fueled by Foidel Creek have not been analyzed or assessed in accordance with the National Environmental Policy Act (“NEPA”). According to data readily available from the U.S. Energy Information Administration (“EIA”), in 2014 coal from Foidel Creek fueled 13 power plants. Although some plants burned small amounts of Foidel Creek coal, others, including the Cherokee and Valmont plants in Colorado, burned considerable amounts. The data also confirms that the Hayden plant is the largest consumer of Foidel Creek coal. Although the BLM may assert that where coal from the Foidel Creek will be burned in the future is uncertain, it is reasonably foreseeable that the coal will be burned and the agency therefore has a duty under NEPA to analyze and assess the reasonably foreseeable impacts of combustion.<br><br>Coal-fired Power Plants Fueled by Foidel Creek Mine in 2014
<table>
<tr><th>Coal-fired Power Plant</th><th>Location</th><th>Tons of Foidel Creek Coal Burned in 2014</th></tr>
<tr><td>Apache</td><td>Arizona</td><td>36,776</td></tr>
<tr><td>Bull Run</td><td>Tennessee</td><td>36,659</td></tr>
<tr><td>Cherokee</td><td>Colorado</td><td>1,460,546</td></tr>
<tr><td>Colbert</td><td>Alabama</td><td>282,674</td></tr>
<tr><td>Cumberland</td><td>Tennessee</td><td>288,857</td></tr>
<tr><td>Gallatin</td><td>Tennessee</td><td>25,797</td></tr>
<tr><td>Green Bay West Mill</td><td>Wisconsin</td><td>108,466</td></tr>
<tr><td>Hayden</td><td>Colorado</td><td>1,509,385</td></tr>
<tr><td>Herbert A.</td><td>Maryland</td><td>12,325</td></tr>
</table></td><td>Indirect effects are those effects “which are caused by the action and are later in time or farther removed in distance but are still reasonably foreseeable.” (40 CFR 1508.8(b)). To be considered, the effect must be reasonably foreseeable and caused by the proposed action. Courts have concluded that NEPA requires agencies to analyze effects that bear a “reasonably close causal relationship” to the proposed action. The BLM has determined that this coal lease modification would not result in additional coal emissions from client power plants for reasons listed below; however, an estimate of emissions caused by the burning of coal mined from this modification has been included in the EA in Section 3.1.1, Air Quality. The EA takes a hard look at coal combustion impacts and determines there would be no significant impact on the environment.<br>The Hayden Generating Station Unit 1 has operating since 1965; Unit 2 has been operating since 1976. Tri-State’s Craig Station Unit 1, Unit 2 and Unit 3 have been operating since 1980, 1979, 1984 respectively. Hayden Generating Station has been operating for 50 years, Craig Station for 36 years and the Yampa River has never been impaired.<br>The power plants in question were in operation before the Foidel Creek Mine</td></tr>
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<tr><td>Wagner</td><td></td><td></td></tr>
<tr><td>R. Gallagher</td><td>Indiana</td><td>219,313</td></tr>
<tr><td>Shawnee</td><td>Kentucky</td><td>77,218</td></tr>
<tr><td>Valmont</td><td>Colorado</td><td>229,907</td></tr>
<tr><td>Victor J. Daniel</td><td>Mississippi</td><td>98,240</td></tr>
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<td>began production, and are projected to continue to operate after the reserves at the Foidel Creek mine are depleted. These power plants have and will continue to operate with or without the existence of the Foidel Creek mine, using coal from other sources.<br>Furthermore, most, if not all of the plants in question blend coal from various sources. Mine contracts with power plants are of one to two year duration. It would be speculative to assume that Foidel Creek would continue to supply these power plants past a two year period. Hayden Station is undergoing a $160 million dollar Selective Catalytic Converter (SCR) emissions reduction upgrade and will have some of the lowest air emissions in the nation.<br><br>http://www.pennenergy.com/articles/pennenergy/2013/02/coal-fired-hayden-power-plant-taps-hitachi-for-scr-systems.html<br>http://www.steamboattoday.com/news/2014/apr/21/hayden-station-coal-power-plant-get-emissions-redu/.</td>
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| Wild Earth Guardians/3 | We are also greatly concerned that the BLM made no effort to estimate costs of projected carbon emissions that would result from issuing the proposed lease modification. It is particularly disconcerting that the agency did not analyze and assess costs using the social cost of carbon protocol, a valid, well-accepted, credible, and interagency endorsed method of calculating the costs of greenhouse gas emissions and understanding the potential significance of such emissions.<br>The social cost of carbon protocol for assessing climate impacts is a method for "estimat[ing] the economic damages associated with a small increase in carbon dioxide (CO2) emissions, conventionally one metric ton, in a given year [and] represents the value of damages avoided for a small emission reduction (i.e. the benefit of a CO2 reduction)." Exhibit 1, U.S. Environmental Protection Agency ("EPA"), "Fact Sheet: Social Cost of Carbon" (Nov. 2013) at 1, available online at http://www.epa.gov/climatechange/Downloads/EPAactivities/scc-factsheet.pdf. The protocol was developed by a working group consisting of several federal agencies, including the U.S. Department of Agriculture, EPA, CEQ, and others, with the primary aim of implementing Executive Order 12866, which requires that the costs of proposed regulations be taken into account. In 2009, an Interagency Working Group was formed to develop the protocol and issued final estimates of carbon costs in 2010. *See* Exhibit 2, Interagency Working Group on Social Cost of Carbon, "Technical Support Document: Social Cost of Carbon for Regulatory Impact Analysis Under Executive Order 12866" (Feb. 2010), available online at https://www.whitehouse.gov/sites/default/files/omb/inforeg/for-agencies/Social-Cost-of-Carbonfor-RIA.pdf.<br>These estimates were then revised in 2013 by the Interagency Working Group, which at the time consisted of 13 agencies, including the Department of Agriculture. *See* Exhibit 3, Interagency Working Group on Social Cost of Carbon, "Technical Support Document: Technical Update of the Social Cost of Carbon for Regulatory Impact Analysis Under Executive | The social cost of carbon protocol (SCC) was developed by an Interagency Working Group (IWG), including the EPS and others, for use in cost-benefit analyses of proposed regulations that could impact cumulative global emissions (Technical Support Document: Social Cost of Carbon for Regulatory Impact Analysis Under Executive Order 12866, http://www.whitehouse.gov/sites/defualt/files/omb/inforeg/for-agencies/Social-Cost-of-Carbon-for-RIA.pdf.<br><br>BLM is aware of the High Country Conservation Advocates v. United States Forest Service., 2014 U.S. Dist. LEXIS 87820 (D. Colo. 2014) (West Elk II) District Court of Colorado decision that commenters reference. The Judge acknowledged that federal agencies are not required to conduct a cost benefit analysis when preparing a NEPA document , nor are they required to quantify the cost of GHG emissions. The Judge provided that: "The agencies might have justifiable reasons for not using (or assigning minimal weight to) the social cost of carbon protocol to quantify the cost of GHG emissions from the Lease Modifications. Unfortunately, they did not provide those reasons in the FEIS, and their post-hoc attempts to justify their actions, even if the Court were permitted to consider them, are unpersuasive. Therefore I find that the FEIS's proffered explanation for omitting the protocol was arbitrary and capricious in |

Order 12866" (May 2013), available online at https://www.whitehouse.gov/sites/default/files/omb/inforeg/social_cost_of_carbon_for_ria_2013_update.pdf.

Depending on the discount rate and the year during which the carbon emissions are produced, the Interagency Working Group estimates the cost of carbon emissions, and therefore the benefits of reducing carbon emissions, to range from $11 to $220 per metric ton of carbon dioxide. *See* Chart Below. In July 2014, the U.S. Government Accountability Office ("GAO") confirmed that the Interagency Working Group's estimates were based on sound procedures and methodology. *See* Exhibit 4, GAO, "Regulatory Impact Analysis, Development of Social Cost of Carbon Estimates," GAO-14-663 (July 2014), available online at http://www.gao.gov/assets/670/665016.pdf.

**Revised Social Cost of $CO_2$, 2010 – 2050 (in 2007 dollars per metric ton of $CO_2$)**

| Discount Rate Year | 5.0% Avg | 3.0% Avg | 2.5% Avg | 3.0% 95th |
|---|---|---|---|---|
| 2010 | 11 | 32 | 51 | 89 |
| 2015 | 11 | 37 | 57 | 109 |
| 2020 | 12 | 43 | 64 | 128 |
| 2025 | 14 | 47 | 69 | 143 |
| 2030 | 16 | 52 | 75 | 159 |
| 2035 | 19 | 56 | 80 | 175 |
| 2040 | 21 | 61 | 86 | 191 |
| 2045 | 24 | 66 | 92 | 206 |
| 2050 | 26 | 71 | 97 | 220 |

**Most recent social cost of carbon estimates presented by Interagency Working Group on Social Cost of Carbon. The 95th percentile value is meant to represent "higher-than expected" impacts from climate change. *See* Exhibit 3 at 3.**

The requirement to analyze the social cost of carbon is supported by the general requirements of NEPA, specifically supported in federal case law, and by Executive Order 13,514. As explained, NEPA requires agencies to analyze the consequences of proposed

violation of NEPA."

NEPA does not require a cost-benefit analysis. CEQ NEPA regulations allow agencies to use it in NEPA analyses in certain circumstances (40 CFR 1502.23. The EA includes an economic impact assessments, to be distinguished from a cost-benefit analysis. A cost-benefit analysis examines the economic efficiency of a proposed action - the net change in social welfare resulting from the costs and benefits of a proposal, including consideration of market and non-market values. The economic impact assessment estimates the distributional effects of an action on sectors of a regional economy, primarily by measuring the changes in employment and income within the geographic area where workers or businesses are most affected by the action. The economic impact assessment in the EA evaluated the economic impacts to Routt and Moffat Counties for different alternatives. However, this economic impact analysis was not a cost-benefit analysis, nor was it intended to quantify the social costs or benefits of fossil fuel development.

Presenting the SCC cost estimates quantitatively, without a complete monetary cost-benefit analysis which includes the social benefits of energy production would be misleading.

The EA does not ignore the effects of carbon emissions. The EA evaluated the climate change impacts of the proposed action in qualitative terms and quantified the estimated greenhouse gas emissions that would result

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| | agency actions and consider include direct, indirect, and cumulative consequences. In terms of oil and gas leasing, an analysis of site-specific impacts must take place at the lease stage and cannot be deferred until after receiving applications to drill. *See New Mexico ex rel. Richardson v. Bureau of Land Management*, 565 F.3d 683, 717-18 (10th Cir. 2009); *Conner v. Burford,* 848 F.2d 1441 (9th Cir.1988); *Bob Marshall Alliance v. Hodel,* 852 F.2d 1223, 1227 (9th Cir.1988).<br>To this end, courts have ordered agencies to assess the social cost of carbon pollution, even before a federal protocol for such analysis was adopted. In 2008, the U.S. Court of Appeals for the Ninth Circuit ordered the National Highway Traffic Safety Administration to include a monetized benefit for carbon emissions reductions in an Environmental Assessment prepared under NEPA. *Center for Biological Diversity v. National Highway Traffic Safety Administration*, 538 F.3d 1172, 1203 (9th Cir. 2008). The Highway Traffic Safety Administration had proposed a rule setting corporate average fuel economy standards for light trucks. A number of states and public interest groups challenged the rule for, among other things, failing to monetize the benefits that would accrue from a decision that led to lower carbon dioxide emissions. The Administration had monetized the employment and sales impacts of the proposed action. *Id*. at 1199. The agency argued, however, that valuing the costs of carbon emissions was too uncertain. *Id*. at 1200. The court found this argument to be arbitrary and capricious. *Id*. The court noted that while estimates of the value of carbon emissions reductions occupied a wide range of values, the correct value was certainly not zero. *Id*. It further noted that other benefits, while also uncertain, were monetized by the agency. *Id*. at 1202. More recently, a federal court has done likewise for a federally approved coal lease. That court began its analysis by recognizing that a monetary cost-benefit analysis is not universally | from an assumed production and combustion scenario (0.29% and 15.17% , US and Colorado respectively) of all the gross GHG emissions (does not consider GHG sinks, i.e. "net emissions") from the U.S. (2012 – 6,525.6Tg) and Colorado (2010 – 126.57Tg), respectively on an annualized basis. If the calculated GHG emissions were compared with the global figures (estimated 2010 $CO_2$ equivalent emissions of 46,000Tg (EPA 2013)[23]), the relative significance of the impact to the global scale of GHG emissions would be even further negligible.<br><br>The EA qualitatively describes the potential increases in GHG emissions on the environment using climate projections and found them to be negligible. This information is at a scale that is relevant and useful to the decision-maker and meets the requirements of NEPA. Additionally, this approach is consistent with the approach that federal courts have upheld when considering NEPA challenges to BLM federal coal leasing decisions. See WildEarth Guardians v. Jewell, 738 F.3d 298, 309 n.5 (D.C. Circuit 2013); WildEarth Guardians v. BLM, 8 F.Supp. 3d 17 (D.D.C. 2014). |

[23] http://www.epa.gov/climatechange/science/indicators/ghg/global-ghg-emissions.html

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| | required by NEPA. *See* High *Country Conservation Advocates v. U.S. Forest Service*, ---F. Supp.2d---, 2014 WL 2922751 (D. Colo. 2014), citing 40 C.F.R. § 1502.23. However, when an agency prepares a cost-benefit analysis, "it cannot be misleading." *Id*. at 3 (citations omitted). In that case, the NEPA analysis included a quantification of benefits of the project. However, the quantification of the social cost of carbon, although included in earlier analyses, was omitted in the final NEPA analysis. *Id*. at p. 19. The agencies then relied on the stated benefits of the project to justify project approval. This, the court explained, was arbitrary and capricious. *Id*.<br>Such approval was based on a NEPA analysis with misleading economic assumptions, an approach long disallowed by courts throughout the country. *Id*. at pp. 19-20. In addition to case law, Executive Order 13,514 makes the "reduction of greenhouse gas emissions a priority for federal agencies." Executive Order 13,514 at Preamble. The reduction of emissions includes emissions from both direct and indirect activities. *Id*. at Section 1. This Executive Order requires that, "[i]n order to create a clean energy economy that will increase our Nation's prosperity, promote energy security, protect the interests of taxpayers, and safeguard the health of our environment," it is the "policy of the United States" that agencies "shall prioritize actions based on a full accounting of both economic and social benefits and costs." *Id*.<br>When quantifying greenhouse gas emissions, the USFS is specifically instructed to "accurately and consistently quantify and account for greenhouse gas emissions" from sources controlled by the agency, including "emissions of greenhouse gases resulting from Federal land management practices." *Id*. at Section 9(a). The results of quantifying emissions from proposed federal land management actions, of fully accounting for all economic and social costs and benefits of those proposed actions, and the resulting prioritization of actions based on this quantification and accounting must be fully disclosed on publically available websites. *Id*. at Section 1. | |

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| | In light of all this, it appears more than reasonable to have expected the BLM to take into account carbon costs as part of its EA. The agency did not, thus there is no basis for any assertion that the impacts of the proposed coal lease modification would not be significant. | |