United States Department of the Interior
Office of Surface Mining Reclamation and Enforcement

Environmental Assessment
Antelope Mine
Converse County, Wyoming
Mining Plan
for
Federal Coal Lease WYW-177903

May 2020

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1.0 Purpose and Need

1.1 Introduction

Antelope Coal, LLC (AC) is seeking to modify its current federal mining plan to allow recovery of the additional federal coal associated with WYW-177903. This Environmental Assessment (EA) for the Antelope Mine Federal Mining Plan Modification for a portion of Federal Coal Lease WYW-177903 (West Antelope II South Modification tract) has been prepared by the U.S. Department of the Interior (DOI) Office of Surface Mining Reclamation and Enforcement (OSMRE), Western Region. OSMRE is the lead federal agency responsible for development of this EA because, under the Surface Mining Control and Reclamation Act of 1977 (SMCRA) and Mineral Leasing Act (MLA), OSMRE is responsible for preparing a mining plan decision document (MPDD) in support of its recommendation to the Assistant Secretary, Lands and Minerals Management (ASLM) regarding federal mining plan modifications (OSMRE 1999). The ASLM will decide whether the mining plan modification is approved, disapproved, or approved with conditions. Using criteria outlined in OSMRE's National Environmental Policy Act (NEPA) Handbook (OSMRE 2019a), the DOI's Departmental Manual (DM) Part 516 (DOI 2004), and the Council on Environmental Quality (CEQ) Regulations for Implementing the Procedural Provisions of NEPA (40 Code of Federal Regulation [CFR] 1500-1508), OSMRE determined that this EA could incorporate by reference analyses included in the 2008 West Antelope II EIS (hereafter 2008 WAII EIS) and the 2014 West Antelope II South Lease Modification EA (hereafter 2014 WAII South EA) prepared by the Bureau of Land Management (BLM). These documents are publicly available at the following links:

2008 WAII EIS: https://eplanning.blm.gov/epl-front-office/eplanning/legacyProjectSite.do?methodName=renderLegacyProjectSite&projectId=73240

2014 WAII South EA: https://eplanning.blm.gov/epl-front-office/eplanning/legacyProjectSite.do?methodName=renderLegacyProjectSite&projectId=67029

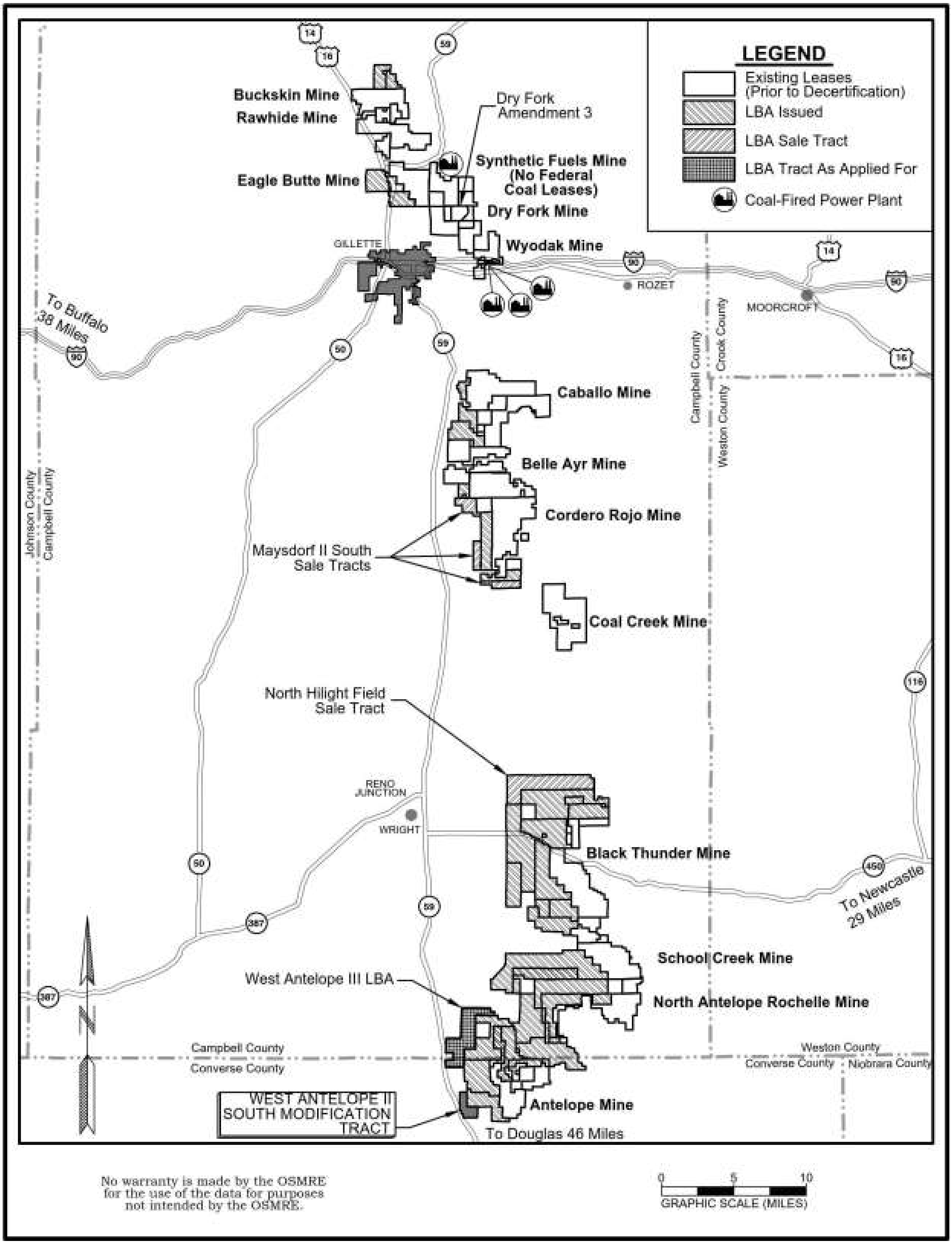
This approach is consistent with Secretarial Order 3355, which is intended to streamline the NEPA process. This EA review has been conducted in accordance with the NEPA and the CEQ regulations for implementing NEPA (40 CFR 1500-1508); the DOI's regulations for implementation of NEPA (43 CFR Part 46); the DOI's DM Part 516; Secretarial Order 3355; and OSMRE's Directive REG-1, NEPA Handbook (OSMRE 2019a). Information gathered from federal, state, and local agencies, AC publicly available literature, and in-house OSMRE sources, such as the Antelope Mine Permit Application Package (PAP), were used in the preparation of this EA.

1.2 Background

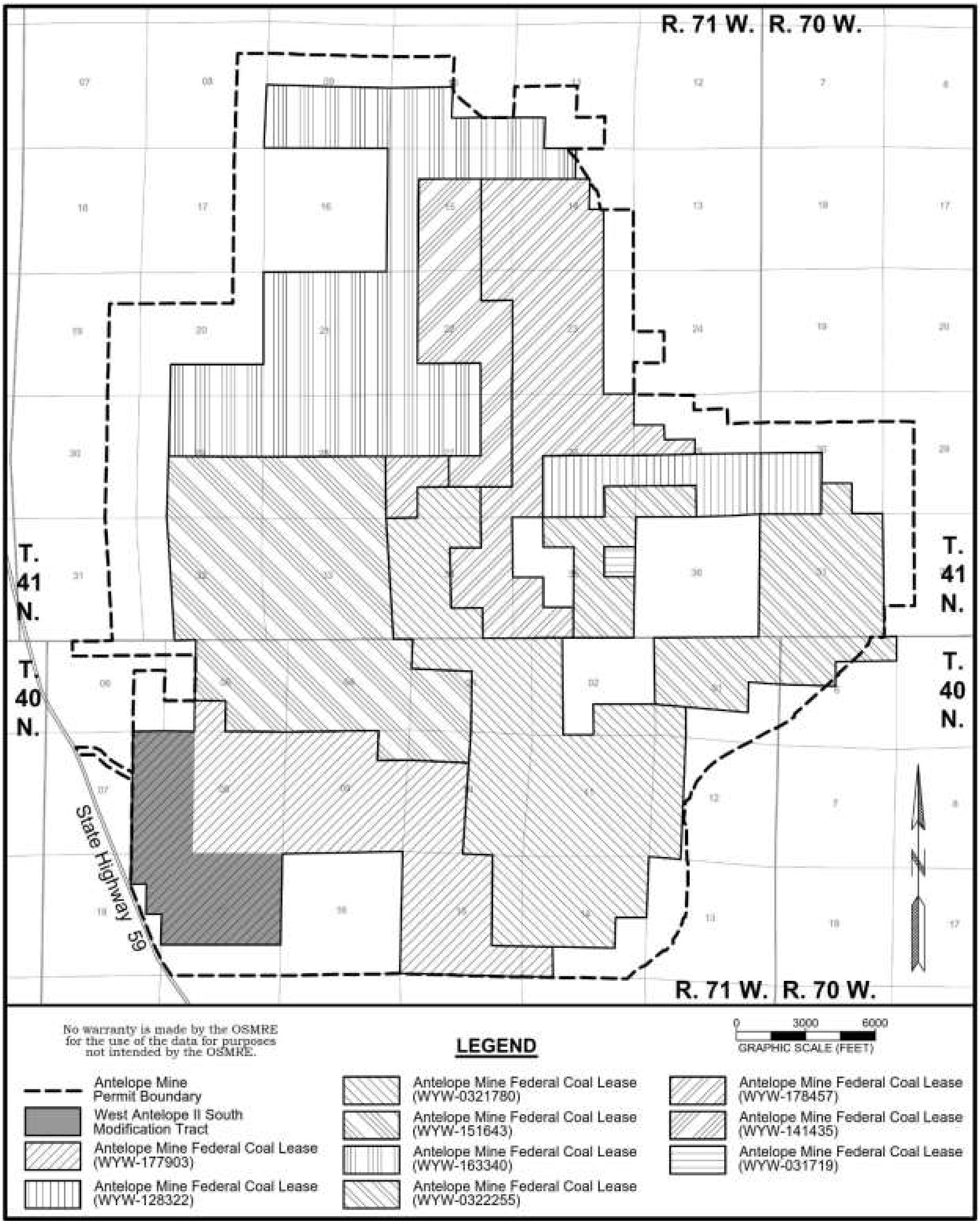
1.2.1 Site History

AC, a subsidiary of Navajo Transitional Energy Corp (NTEC), operates the Antelope Mine. The mine is located in Converse County, Wyoming, approximately 20 miles south-southeast of Wright, Wyoming (**map 1-1**). According to information provided by NTEC, the Antelope Mine is currently authorized to recover coal under four distinct federal, state, and various private coal leases, as indicated below. The federal leases are shown on **map 1-2.**

The Antelope Mine is currently seeking approval from the ASLM to recover coal associated with the modified lease WYW-177903. AC filed an application for a coal lease modification with the BLM on November 29, 2012. The modified coal lease was issued by BLM on February 1, 2018.



Map 1-1. General Location Map with Federal Coal Leases



Map 1-2. Antelope Mine's Federal Coal Leases

The Antelope Mine is located in the southern portion of the Wyoming Powder River Basin (PRB), a coal basin that spans from northeast Wyoming to southeast Montana. In 2018, Campbell and Converse counties produced approximately 84 percent of the coal mined from federal government-owned coal leases in the U.S. (DOI Natural Resources Revenue Data 2019). The region also has been heavily developed for oil and gas recovery, including coal bed natural gas (CBNG). The West Antelope II South Modification tract is within coal lease (WYW-177903) and is bounded by Antelope Creek to the north, existing leases (federal and state) to the east, pipelines to the south, State Highway 59, and a no coal zone to the west.

Coal at the Antelope Mine is mined using conventional surface-mining methods and shipped from an onsite railroad loading facility to electric utilities and industrial customers in the U.S. In 2018, 100 percent of coal from the Antelope Mine was shipped to U.S. markets. However, due to changes in coal prices the exact destinations of the coal to be mined under the federal mining plan modification is unknown. Based on existing federal coal leases, mining operations (mining, processing, and shipping coal) could continue at the Antelope Mine through approximately 2034 at a rate of 30 million tons per year (Mtpy).

AC operates the Antelope Mine under Wyoming Department of Environmental Quality, Land Quality Division (WDEQ-LQD) Permit No. 525 in accordance with the approved Wyoming State Coal Regulatory Program (30 CFR Part 950). The currently approved mine permit boundary includes the entire West Antelope II South Modification tract. WDEQ-LQD approved the most recent version of Permit No. 525 with the condition that AC may not mine coal from any federal coal lease prior to receiving approval from the ASLM. The most recent revision to Permit No. 525 was approved by WDEQ-LQD on October 17, 2019. WDEQ-LQD permits are issued based on the life-of-mine (LOM) plans for the mining operation, under the Wyoming Environmental Quality Act of 1973 (WEQA), permits must be renewed every 5 years (Wyoming Statute [W.S.]. § 35-11-405 (c)). This EA considers potential effects from mining the West Antelope II South Modification tract and does not reevaluate existing federal mining areas and operation, except for cumulative effects.

The most recent Resource Recovery and Protection Plan (R2P2) for the Antelope Mine was approved by the BLM Casper Field Office in July 2019. The R2P2 outlines the mining sequence including specific bench lengths and bench orientations. These specific pit lengths, orientations, and other mine design factors are necessary to optimize the coal haul distances and to improve coal drying at the benches. As explained in the R2P2, interruptions to the mine plan sequence will disrupt these strategic decisions, resulting in illogical sequences, more overburden rehandle, longer haul distance, delayed reclamation, and lower coal recovery.

1.2.2 Project Background

In anticipation of needed additional coal reserves, AC filed an application in 2012 with BLM to lease a tract of federal coal under leasing by modification regulations (also known as LBM regulations) at 43 CFR § 3432.0-3 and the provisions of the Energy Policy Act of 2005 (Government Publishing Office [GPO] 1982 and U.S. Congress Public Law No: 109-58 2005, respectively). The tract was applied for as a maintenance tract for the Antelope Mine to maintain operation at the mine's current average annual level of production. BLM prepared the 2014 WAII South EA to satisfy the NEPA requirements for the LBM. The 2014 WAII South EA analyzed the potential impacts associated with coal recovery and reclamation of 856.6 acres of additional federal coal associated with WYW-177903, which would allow the Antelope Mine to continue producing coal at the current rate instead of ceasing production as recoverable coal reserves were nearly exhausted. OSMRE was a cooperating agency on the 2014 WAII South EA. Federal coal lease WYW-177903 as leased is shown on map 1-2.

BLM's Casper Field Office issued a decision record (DR) on August 15, 2014, recommending modification of federal coal lease WYW-177903 to add approximately 856.6 acres of federal coal associated with the Proposed Action (BLM 2019) and the lease of 15.8 Mt of mineable federal coal. BLM prepared a determination of NEPA adequacy in response to the February 7, 2017 Interior Board of Land Appeals decision, which set aside and remanded the August 15, 2014 DR (see *WildEarth Guardians*, 189 IBLM 274 [2017]).The remand was based on a procedural point associated with the interpretation of BLM's internal delegations of authority. BLM determined that the previous analyses from the 2014 WAII EA and the 2008 WAII EIS were valid. Challenges to the lease modification decision resulting in the remand and the Office of Hearings and Appeals denial of BLM's Petition for Director's Review (52 OHA 204, September 11, 2017) did not address any substantive challenges to the lease modification decision, but only held that the High Plains District Manager was not authorized to sign the DR for the lease modification. Therefore, BLM issued a new DR on November 30, 2017, signed by the BLM Wyoming Deputy State Director for Minerals and Lands.

1.2.3 Statutory and Regulatory Background

For existing, approved federal mining plans that are proposed to be modified, pursuant to 30 CFR Part 746, OSMRE prepares a federal MPDD. The MPDD recommends approval, disapproval, or approval with conditions of a federal mining plan modification (OSMRE 1999). The ASLM reviews the MPDD and decides whether or not to approve the federal mining plan modification, and if approved, what, if any, conditions may be needed. Under 30 CFR § 746.13, OSMRE will prepare and submit a recommendation to the ASLM regarding the federal mining plan modification, which will be based, at a minimum, on:

1. the PAP;
2. the R2P2;
3. information prepared in compliance with NEPA, including this EA;
4. documentation demonstrating compliance with the applicable requirements of federal laws, regulations, and executive orders (EOs) other than NEPA;
5. comments and recommendations or concurrence of other federal agencies and the public;
6. findings, recommendations, and contractual commitments and requirements of BLM with respect to lease WYW-177903, the R2P2, and the MLA;
7. findings and recommendations of WDEQ-LQD with respect to the mine permit amendment application and the Wyoming State program; and
8. findings and recommendations of OSMRE with respect to the additional requirements of 30 CFR Chapter VII, Subchapter D (30 CFR Parts 740 to 746).

In compliance with other federal laws, regulations, and EOs, OSMRE also conducts consultation with other agencies before it makes its recommendation to the ASLM. This consultation includes the U.S. Fish and Wildlife Service (USFWS) Section 7 consultation for threatened and endangered (T&E) species potentially affected by the proposed mining plan under the Endangered Species Act of 1973 (ESA) and Section 106 consultation under the National Historic Preservation Act (NHPA).

OSMRE will not reevaluate all potential impacts previously analyzed as part of the 2014 WAII EA and 2008 WAII EIS, which included analysis of all federal coal lands identified in the proposed mining plan modification. Rather, this EA considers potential changes to the extent or nature of those impacts based on information included in Permit No. 525 (including the current revision) and new information specific to this action.

1.3 Purpose and Need

As described in 40 CFR § 1502.13, the purpose and need statements briefly specify the purpose and need to which the agency is responding in proposing the alternatives, including the Proposed Action.

1.3.1 Purpose

The purpose of the action is established by the MLA, which requires the evaluation of AC's proposed mining plan modification before conducting surface mining and reclamation operations to develop the West Antelope II South Modification tract. OSMRE is the agency responsible for making a recommendation to the ASLM to approve, disapprove, or approve with conditions the proposed mining plan modification. The ASLM will decide whether the mining plan modification is approved, disapproved, or approved with conditions.

1.3.2 Need

The need for this action is to provide AC the opportunity to exercise its valid existing rights granted by the BLM under federal coal lease WYW-177903 to access and mine the federal coal reserves located in the tract. ASLM approval of the federal mining plan modification is necessary to mine the reserves.

1.4 Regulatory Framework and Necessary Authorizations

The following key laws, as amended, establish the primary authorities, responsibilities, and requirements for developing federal coal resources:

1. MLA,
2. NEPA,
3. Mining and Minerals Policy Act of 1970,
4. Federal Coal Leasing Act Amendment, 1976,
5. Federal Land Policy Management Act of 1976,
6. Energy Policy Act;
7. SMCRA,
8. Multiple-Use Sustained Yield Act of 1960,
9. ESA,
10. Clean Air Act (CAA),
11. Clean Water Act (CWA),
12. Safe Drinking Water Act (SDWA),
13. NHPA,
14. American Indian Religious Freedom Act,
15. Paleontological Resources Preservation Act of 2009,
16. Migratory Bird Treaty Act (MBTA), and
17. Bald and Golden Eagle Protection Act of 1940.

In addition, this EA follows guidance in DOI 516 DM (DOI 2004), which, as outlined in 43 CFR Part 46, is the DOI manual guiding the implementation of the NEPA process. OSMRE will prepare a recommendation regarding the MPDD for the federal mining plan modification and will submit it to the ASLM.

1.5 Outreach and Issues

Following a review of the 2008 WAII EIS and 2014 WAII South EA, OSMRE determined that further analyses were appropriate based on newly available information and changes to the environmental consequences of the Proposed Action that have occurred since the 2008 and 2014 analyses. Internal discussions within OSMRE identified a preliminary set of issues to be considered during the NEPA analysis. OSMRE also published a notice of intent (NOI) to prepare this EA in the Gillette News Record on November 5, 2019 and the Douglas Budget on November 6, 2019 (**appendix A**), initiating a comment period ending on December 3, 2019. Substantive issues identified during public scoping were considered during the document preparation. The public scoping comment letters are summarized in **appendix B**. The further summarized issues and the number of comments received associated with each issue (in parentheses) include:

1. water resources (1),
2. air quality (1),
3. level of NEPA/ NEPA process (1),
4. reclamation (1),
5. climate change/global warming (1), and
6. cumulative impacts (1).

1.6 Crosswalk of Resource Areas

Appendix C includes a crosswalk that identifies the location of resource discussions presented in the 2008 WAII EIS, 2014 WAII South EA, and their location in this EA, where present. While all of the resources have been considered, not all have been brought forward for analysis in this EA. OSMRE determined that those resources and potential impacts not brought forward for analysis were sufficiently documented in the 2008 WAII EIS or 2014 WAII South EA or that new information will not affect the decision-making process. Information presented in the 2008 WAII EIS and 2014 WAII South EA that adequately described the affected environment for specific resources is incorporated by reference into this EA.

1.7 Public Involvement

On November 4, 2019, OSMRE posted an announcement of the EA on their *Initiatives* webpage (OSMRE 2019b). The announcement initiated a comment period that extended from November 4, 2019 through December 3, 2019. OSMRE also published a notice of intent (NOI) to prepare this EA in the Gillette News Record on November 5, 2019 and the Douglas Budget on November 6, 2019 (**appendix A**) initiating a comment period, ending on December 3, 2019. Public outreach and tribal consultation letters were also sent out to stakeholders and tribes that could be affected by the project. OSMRE received written and e-mailed comments from four entities. Lists of agencies, tribes, and individuals included on mailing lists, and a summary of the public scoping comment letters received are included in **appendix B**.

2.0 Proposed Action and Alternatives

Under the requirements of NEPA, an EA must evaluate the environmental impacts of a reasonable range of alternatives that meet the project's purpose and need. The DOI's NEPA implementing regulations define reasonable alternatives as those that are "technically and economically practical or feasible and meet the purpose and need of the proposed action" (43 CFR § 46.420). This chapter describes the Proposed Action and the No Action Alternative considered and analyzed in detail in this EA. In addition, it identifies alternatives considered but eliminated from detailed analysis.

2.1 Description of Alternatives

The Proposed Action and No Action Alternative reflect the proposal for a federal mining plan modification to add approximately 15.8 Mt of federal coal to the federal mining plan within the 856.6-acre West Antelope II South Modification tract. **Table 2-1** summarizes coal production, surface disturbance, mine life, and employees for the No Action Alternative and the Proposed Action. The No Action Alternative would leave operations as described in the currently approved federal mining plan. The Proposed Action would add additional coal associated with federal lease WYW-177903.

Table 2-1. Comparison of Coal Production, Surface Disturbance, Mine Life, and Employees for the No Action Alternative and Proposed Action

Item	No Action Alternative (Existing Mine)	Proposed Action
Mineable Federal Coal	437.2 Mt	453.0 Mt (15.8 Mt added)
Recoverable Federal Coal	409.6 Mt	424.1 Mt (14.5 Mt added)
Coal Lease Area - Federal Coal Leases Only	15,411.8 acres	16,268.4 acres (856.6 acres added)
Total Affected Area	19,390.6 acres	20,270.1 acres (879.5 acres added)[1]
Approved Permit Area	22,538.4 acres	22,538.4 acres (no change)
Average Annual Coal Production	30 Mtpy	30 Mtpy (no change)
LOM of Federal Coal	13.7 years	14.2 years (0.5 year added)
Average Number of Employees	650	650 (no change)

[1] Affected area includes the tract as well as the area between the tract and the permit boundary not currently included in the Antelope Mine affected area boundary.

2.1.1 Proposed Action

The Proposed Action would modify the federal mining plan and authorize Antelope Mine to conduct coal removal on approximately 856.6 acres of federal coal to recover approximately 14.5 Mt of the 15.8 Mt of mineable federal coal. Approximately 879.5 acres of disturbance would be as a result of the proposed federal mining plan modification. Antelope Mine estimates that at the projected average annual production rate of 30 million tons per year, mining this coal would extend the mine's life by about 0.5 year. All of the federal coal included in the Proposed Action would be shipped to electric utilities and industrial customers in the U.S. (AC 2019a).

Under the Proposed Action, the West Antelope II South Modification tract would be mined as an integral part of the Antelope Mine. Because the tract would be an extension of the existing Antelope Mine, the facilities and infrastructure would be the same as those identified in Permit No. 525, as approved in October 2019, and the BLM R2P2, approved in July 2019.

2.1.2 No Action Alternative

Under the No Action Alternative, OSMRE would not recommend and the ASLM would not approve AC's proposed mining plan modification request and 14.5 Mt of federal coal related to WYW-177903 would not be recovered. Under this alternative, AC would mine its remaining 409.6 Mt of recoverable coal reserves on the existing Antelope Mine federal leases in approximately 13.7 years, at an average annual production rate of approximately 30 Mtpy.

The No Action Alternative discloses the potential consequences of not mining the West Antelope II South Modification tract, under the assumption that the additional coal within the tract would not be mined in the foreseeable future if the No Action Alternative is selected. Under the No Action Alternative, AC would be limited to recovering the remaining federal coal reserves associated with existing federal, state, and private leases. All of the federal coal included in the No Action Alternative would continue to be shipped to electric utilities and industrial customers in the U.S. Selection of the No Action Alternative would not preclude approval of a federal mining plan modification in the future to include mining the coal within the West Antelope II South Modification tract.

2.1.3 Alternatives Considered but Eliminated from Detailed Analysis

The following alternatives were considered but eliminated from detailed analysis. The discussions include reasons the alternatives were eliminated from detailed analysis.

2.1.3.1 Underground Mining Alternative

Public comments on other EAs in the Wyoming PRB suggested an alternative to use underground mining methods to extract the coal. OSMRE eliminated this alternative from detailed study because WDEQ-LQD has approved a surface mining permit for this project using surface mining techniques, and underground mining is inconsistent with the approved permit. The purpose and need for this EA is predicated upon review of a surface mining plan included as part of the WDEQ-LQD-approved surface mining permit. An underground mining alternative would, thus, be inconsistent with the purpose and need for this action.

This alternative is also economically infeasible at current permitted production rates. Initiating an underground longwall mining operation in the Antelope Mine are not cost effective. The facilities and equipment needed for underground mining are different from surface mining. Because the infrastructure for underground mining is not in place at the Antelope Mine, new infrastructure for underground mining would need to be constructed. The capital expenditure to develop an underground mine would be prohibitive. In addition, new surface facilities would need to be constructed, including, but not limited to, conveyors, coal stock piles, a wash plant, and maintenance and support facilities. In addition, all new underground mining equipment would need to be purchased such as, a long wall mining system, conveyor systems/drives/power stations, vehicles for transporting employees and supplies, continuous miners, shuttle cars, large and small ventilation fans, and roof bolters.

In addition, approval by WDEQ-LQD of an application for a permit revision would be required to authorize underground mining. It would take years for AC to design and engineer a new underground mine and for WDEQ-LQD to process a new permit application. These factors also support the conclusion that this potential alternative is economically unreasonable.

This alternative was not brought forward for detailed analysis because underground mining does not respond to the purpose and need for this action and the economic burden to shift to underground mining would be prohibitive.

2.1.3.2 Low or No Pollutant Emitting Equipment

Public comments on other Wyoming PRB EAs suggested considering an alternative that required reduced air emissions by changing or modifying mining related equipment to that which would produce lower air emissions. The Antelope Mine is a relatively small contributor of the emissions related to engine combustion (primarily carbon dioxide [CO_2] and oxides of nitrogen [NO_X]) in the region.

The cost to make the switch to equipment powered by a different fuel (such as natural gas or solar powered equipment) for approximately 15.8 Mt of federal coal would be cost prohibitive for the minimal benefit to the regional air quality. In addition, the use of natural gas powered engines in mining equipment is relatively new, and some types of equipment would not be available for replacement with natural gas powered engines. The use of solar power to run large equipment has not been tested and is not considered technologically feasible at this time. Similarly, retrofitting existing equipment with additional emission control devices would be expensive and would have limited effect on regional air emissions.

OSMRE has not brought forward this alternative for full analysis because requiring natural gas and solar powered engine technology and retrofitting existing equipment is not economically or technically feasible for all equipment at the Antelope Mine.

2.1.3.3 Air Quality Mitigation Alternatives

Some public comments on other Wyoming PRB EAs suggested that OSMRE consider alternatives that mitigate air quality impacts, specifically by imposing more stringent emission limits at power plants fueled by coal from the Antelope Mine and by requiring oil and gas operators in the region to reduce their emissions. These proposals are not alternatives to the mining plan being considered. The effects of coal combustion are analyzed in the Proposed Action and No Action Alternative because they are considered to be indirect effects. CEQ regulations at 40 CFR § 1508.8(b) define indirect effects as those "which are caused by the action and are later in time or farther removed in distance but are still reasonably foreseeable." These indirect effects would occur as a result of burning the coal that is mined. The analysis concludes there would not be significant impacts to air resources under the Proposed Action, and no mitigation is required. Given these factors, bringing this alternative forward for further review would not be reasonable.

2.2 Existing Conditions (Conditions Common to the Proposed Action and the No Action Alternative)

The 2008 WAII EIS presented a thorough description of the existing conditions to support the analysis presented therein. The following summary of updated existing conditions, including ongoing permitted mining operations, describes notable changes since the 2008 WAII EIS was prepared. This update is provided to support the evaluation of potential impacts contained in **chapter 4** of this EA.

Mining and reclamation activities have continued at the Antelope Mine as approved by WDEQ-LQD Permit No. 525 since the 2008 WAII EIS was prepared and federal coal lease WYW-177903 was issued. The PAP, including approved revisions, provides the most complete descriptions of mining, environmental protection measures, and reclamation activities within the project area for the LOM and, as such, is used and referenced for the purpose of this EA.

AC currently employs 650 people at the Antelope Mine (AC 2019a). From 2014-2018, the mine produced an average of 30.1 Mt of coal per year (Wyoming Department of Workforce Services [WDWS] 2014, 2015, 2016, 2017, 2018). In the future, AC anticipates mining 30 Mt annually, which is under the 52 Mt of coal per year permitted by WDEQ Air Quality Division (AQD) Air Permit MD-13361. Approximately 409.6 Mt of recoverable coal remains in the federal mining plan area after October 1, 2019, excluding the federal coal identified in Proposed Action. AC continues to use conventional surface mining techniques described in section 2.1 of the 2008 WAII EIS. Coal is shipped from an onsite railroad loading facility to electric utilities and industrial customers in the U.S. (AC 2019a). However, due to changes in coal prices the exact destinations of the coal to be mined under the mining plan modification is unknown.

In 1975, in response to the requirements set forth in SMCRA and in the WEQA, WDEQ-LQD published a set of rules and regulations that require coal mine permittees to restore the land to a condition equal to or greater than its highest previous use and required permittees to restore wildlife habitat commensurate with or superior to premining habitat (WDEQ-LQD 2012). Reclamation activities under the Proposed Action would be consistent with those currently used at the Antelope Mine. Mined-out areas would be reclaimed according to an approved post mine plan and would be reclaimed to reestablish the drainage system. In-channel stockponds and playas (shallow topographic depressions that are internally drained) would be replaced to provide livestock and wildlife watering sources. All postmining topography, including reconstructed drainages, must be approved by the WDEQ-LQD. After mining, the land would be reclaimed to support the approved postmining land uses.

2.2.1 Current Bonding and Bond Release Status

SMCRA provides that, as a prerequisite for obtaining or modifying a coal mining permit, permittees must post a reclamation bond to ensure that the regulatory authority would have sufficient funds to reclaim the site if the permittee fails to complete obligations set forth in the approved reclamation plan (OSMRE 2019c). The current bond amount for the Antelope Mine is $124.5 million in the form of a surety bond. It was approved by WDEQ-LQD on April 10, 2019. **Appendix D** includes the current bond release summary for Antelope Mine.

3.0 Affected Environment

This chapter discusses the existing conditions of the physical, biological, cultural, and human resources that could be affected by implementation of the alternatives described in **chapter 2**. **Table 1-1** in chapter 1 is a crosswalk table between resource discussions presented in the 2008 WAII EIS, 2014 WAII South EA, and this EA. The determination of adequacy of the description of baseline conditions in the 2008 WAII EIS and 2014 WAII South EA, as related to the West Antelope II South Modification tract was made if conditions have not substantively changed, no new data are available, or the resource conditions have only been minimally affected as a result of current mining operations and further presentation of information would not affect the decision-making process. Baseline information in the 2008 WAII EIS and 2014 WAII South EA that has not substantively changed is incorporated by reference. Updated baseline information is presented in this chapter, when applicable.

3.1 General Setting

The general setting of the West Antelope II South Modification tract is described in section 3.1 of the 2008 WAII EIS. The tract is located in the Wyoming PRB, which has a semi-arid, high plains environment with relatively large seasonal and diurnal variations in temperature and seasonal variation in precipitation.

3.2 Topography and Physiography

Topography and physiography of the West Antelope II South Modification tract are described in section 3.2.1 of the 2008 WAII EIS. The structural basin is an elongated, asymmetrical syncline that is bounded in Wyoming by the Black Hills on the northeast; the Casper Arch on the southwest, and the Laramie Mountains on the south. Geologic strata along the eastern limb of the structural PRB dip to the west at 1 to 2 degrees toward the axis of the basin.

3.3 Geology, Mineral Resources, and Paleontology

General geology and coal resources are described in section 3.3.1 of the 2008 WAII EIS. Stratigraphic units within the West Antelope II South Modification tract include, in descending order, recent (Holocene age) alluvial and eolian deposits, Eocene age Wasatch Formation (overburden), and Paleocene age Fort Union Formation. The targeted coal seam lies within the Tongue River Member of the Fort Union Formation. There are four mineable coal seams in the West Antelope II South Modification tract (referred to by AC as the Anderson, Lower Anderson, Canyon/Upper Canyon, and Lower Canyon).

Other mineral resources are described in section 3.3.2 of the 2008 WAII EIS. According to the Wyoming Oil and Gas Conservation Commission (WOGCC), as of November 2019, 38 oil and gas well are permitted within 2 miles of the tract (WOGCC 2019). There are no CBNG or oil and gas wells completed within the tract.

Paleontology is described in section 3.3.3 of the 2008 WAII EIS. No significant or unique paleontological resource localities were recorded on federal lands in the 2008 WAII EIS resource report area. All Class III surveys conducted since the 2008 WAII EIS have included a reconnaissance for outcrops that might contain paleontological remains. No outcrops or paleontological remains within or adjacent to the West Antelope II South Modification tract were identified (2008 WAII EIS, GCM 2009, 2011, 2014, and 2015).

3.4 Air Quality and Climate Change

Air quality regulations applicable to surface coal mining include the National Ambient Air Quality Standards (NAAQS), Wyoming Ambient Air Quality Standards (WAAQS), Prevention of Significant Deterioration (PSD), National Source Performance Standards (NSPS), and the Federal Operating Permit Program (Title V). These regulatory programs are described in detail in appendix F of the 2008 WAII EIS.

Air quality information specific to the Antelope Mine is included in AC's air quality permit MD-13361 (WDEQ-AQD 2012). Section 3.4 of the 2008 WAII EIS includes detailed air quality discussions regarding the leasing and mining of coal related to a portion of the West Antelope II South Modification tract. Additional air quality discussions were included in section 3.3.1 of the 2014 WAII South EA. The analysis presented herein includes discussion of recent air quality monitoring findings; updated discussions on particulate matter (PM_{10}), fine particulate matter ($PM_{2.5}$), nitrogen dioxide (NO_2), ozone (O_3), sulfur dioxide (SO_2), mercury (Hg), lead (Pb), air quality related values (AQRVs), and hazardous air pollutants (HAPs); and discussion of greenhouse gases (GHGs).

3.4.1 Existing Antelope Mine Air Quality Summary

Baseline air quality data for the surface facilities area at the Antelope Mine are found in section 3.4 of the 2008 WAII EIS and section 3.3.1 of the 2014 WAII South EA. The climate in the general area is semi-arid with relatively short, warm summers and longer cold winters. Evaporation exceeds annual precipitation. The following discussions include updated (2014-2018) air quality monitoring results. PM_{10}, $PM_{2.5}$, and NO_2 are the only criteria pollutants monitored at the Antelope Mine. Nearby monitors are used to present baseline air quality data for all other criteria pollutants.

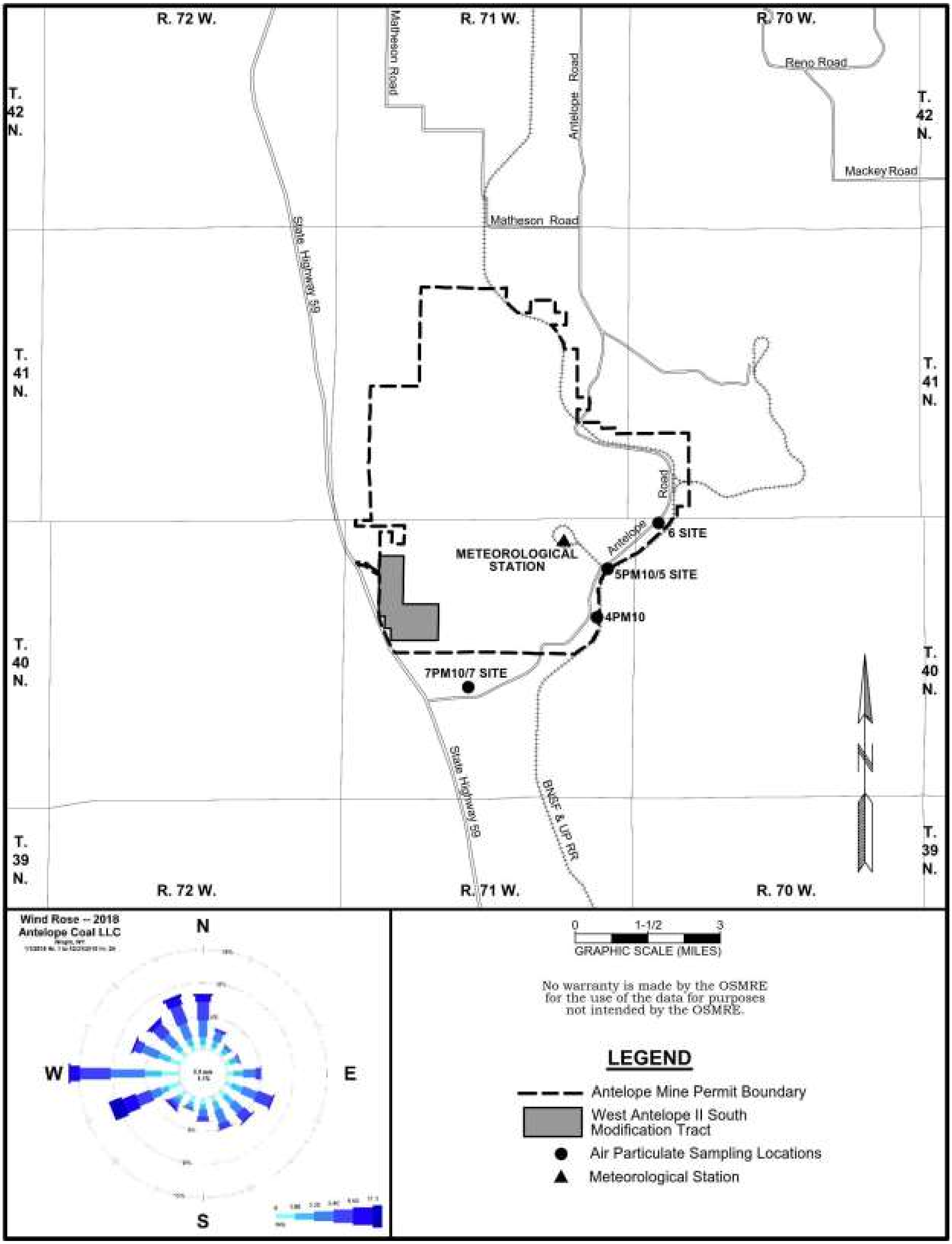
3.4.1.1 Air Quality-Monitoring Values

AC has monitored particulate matter levels around the mine throughout its life. Current (2019) air monitoring consists of three sites (5 Site, 6 Site, and 7 Site) that monitor continuous concentrations of PM_{10} (**map 3-1**). **Table 3-1** lists the annual mean and high PM_{10} concentrations for the Antelope Mine from 2014-2018.

Table 3-1. Average Annual and Maximum 24-hr PM_{10} Concentrations (μg/m^3)

	2014		2015		2016		2017		2018	
Site Name[1]	Avg Annual	Max 24-hr	Avg Annual	Max 24-hr	Avg Annual	Max 24-hr	Avg Annual	Max 24-hr	Avg Annual	Max 24-hr
4PM10	18.4	61.1	16.3	65.7	13.0	42.4	16.3	118.6	13.0	46.1
5PM10[4]	24.3	65.4	21.3	108.9	17.4	62.5	21.6	130.3	15.2	39.3
7PM10[3]	--	--	13.7	54.0	11.2	35.4	16.5	103.7	10.2	28.4
5 Site[4]	--	--	--	--	--	--	--	--	22.9	69.5
6 Site[2]	29.9	124.8	31.4	*174.9*	27.1	87.2	27.2	*196.1*	22.4	74.5
7 Site[4]	--	--	--	--	--	--	--	--	18.7	74.9

[1] See **map 3-1** for site locations.
[2] Site 6PM10 was replaced with a Thermo 1405A TEOM PM_{10} continuous monitor (6 Site) on April 15, 2014
[3] Site 7PM10 began operating February 5, 2015
[4] On July 30, 2018 samplers 4PM10, 5PM10, and 7PM10 were shut down and taken out of service. Site 4PM10 was decommissioned and sites 5PM10 and 7PM10 were replaced with Thermo 1405A TEOM PM_{10} continuous monitoring samplers (5 Site and 7 Site, respectively).
-- Site not active
Value in black italics denotes exceedances/exceptional events
Source: IML 2014, 2015, 2016, 2017, 2018



Map 3-1. Wind Rose and Air Quality and Meteorological Monitoring Stations at the Antelope Mine and Surrounding Mines

The average annual PM_{10} concentration from 2014-2018 ranged between 10.2 and 31.4 µg/m^3 (about 20 to 63 percent of the annual WAAQS of 50 µg/m^3). The 24-hour high PM_{10} exceeded the WAAQS and NAAQS of 150 µg/m^3 at 6 Site in 2015 and 2017. The 2015 exceedance was deemed an exceptional event and it is believed that the 2017 occurrence was also related to an exceptional event. WDEQ-AQD is working with EPA on this event (AC 2019a). Excluding the exceedance at 6 Site in 2017, the 24-hour high PM_{10} values ranged between 28.4 and 130.3 µg/m^3, or about 19 to 87 percent of the WAAQS and NAAQS of 150 µg/m^3.

Antelope Mine measures $PM_{2.5}$ at one site (7 Site). **Table 3-2** lists the annual mean and 98th percentile 24-hour $PM_{2.5}$ concentrations for the Antelope Mine from 2014-2018. On-site monitoring demonstrated that ambient concentrations of $PM_{2.5}$, as determined by the 98th percentile 24-hour standard and annual average NAAQS and WAAQS values, were below the established 24-hour (35 µg/m^3) and annual (12 µg/m^3) standards.

Table 3-2. Measured $PM_{2.5}$ Concentrations (µg/m^3)

Site ID[1,2]	Year	24-hour	Annual
Antelope Site 7 (56-009-0009)	2015	19	4.2*
	2016	10	2.7
	2017	20	5.8*
	2018	8	3.4*

[1] See **map 3-1** for location.
[2] Antelope 7 Site began operating February 5, 2015
* Indicates the mean does not satisfy minimum data completeness criteria (not enough samples were collected throughout the year)
Source: EPA 2019a

3.4.1.2 Emissions of Nitrogen Dioxide (NO_2), Ozone (O_3), Sulfur Dioxide (SO_2), Mercury (Hg), and Lead (Pb)

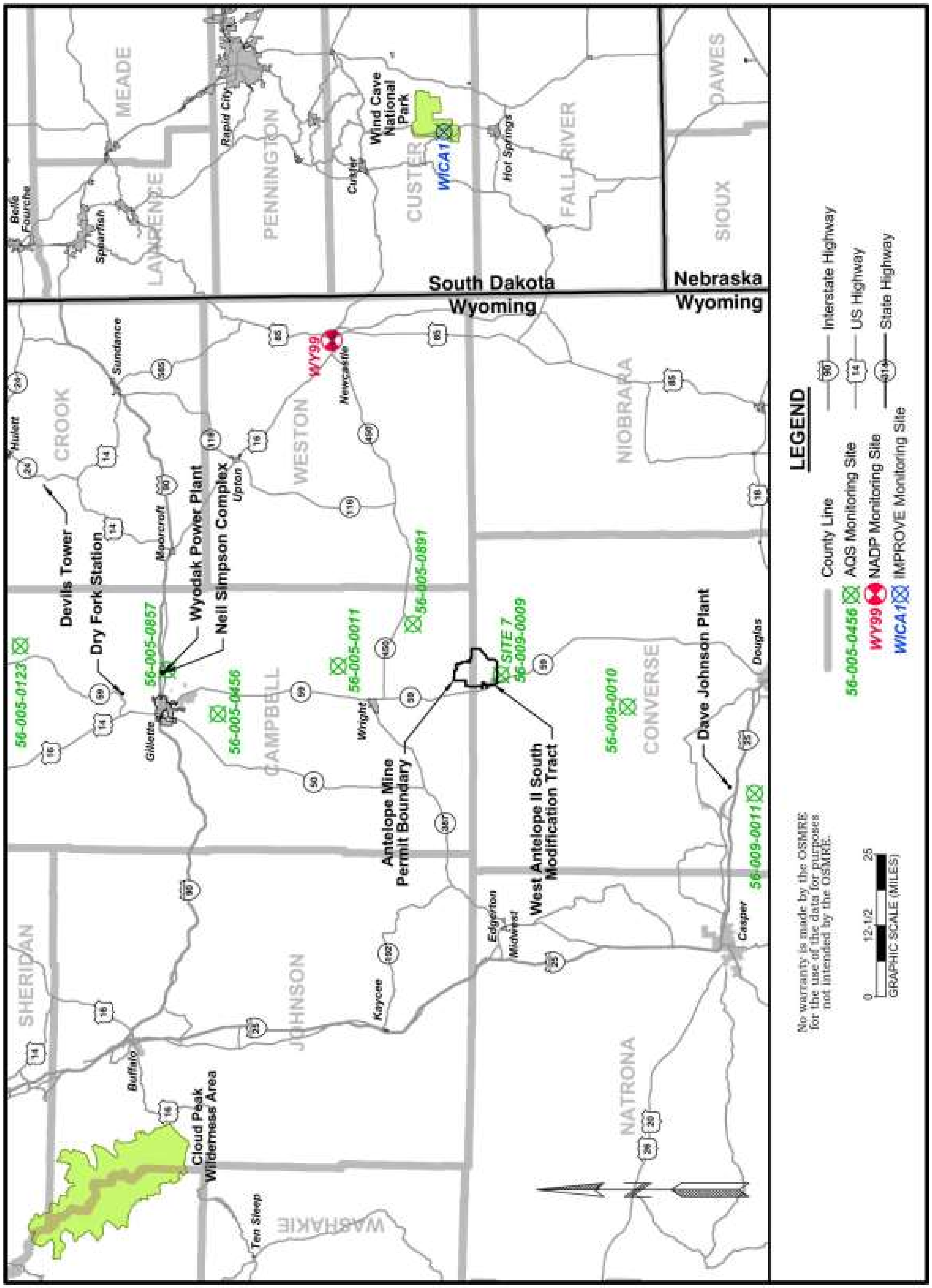
NO_2 concentrations (98th percentile, 1-hour) from the three nearest Air Quality System (AQS) monitoring sites in Converse and Campbell counties are provided in **table 3-3**. These monitoring sites are depicted on **map 3-2**. All monitored NO_2 values were well below the WAAQS of 100 ppb.

Table 3-3. Measured NO_2 Concentrations (ppb)

AQS Site ID[1]	Sampler ID	2014	2015	2016	2017	2018
56-005-0011	Hilight-Reno Junction Gas Plant	55	41	No data	No data	No data
56-009-0009	Antelope Site 7	No data	35	30	32	31
56-009-0010	Converse County Long-Term	No data	8	8	9	9

[1] See **map 3-2** for site locations. Site 56-005-0011 was shut down in 2016 and sites 56-009-0009 and 56-009-0010 began operation in 2015.
Source: EPA 2019a

Under the CAA, EPA has set protective health-based standards for O_3. O_3 monitoring is not required by WDEQ-AQD at Antelope Mine. However, O_3 levels have been monitored at WDEQ-AQD monitoring sites in Campbell County and Converse County. Data (4th-highest daily maximum value) from the nearest WDEQ-AQD sites to the Antelope Mine are provided in **table 3-4**. An exceedance of the current O_3 8-hour standard occurs if the 4th-highest daily maximum value is above the level of the current NAAQS and WAAQS standard (0.075 ppm prior to October 2015, 0.070 ppm after October 2015). No violations of the NAAQS or WAAQS 8-hour O_3 standards where measured at the two monitoring sites during 2014-2018.



Map 3-2. Regional Air Quality Monitoring Sites

Table 3-4. Measured O_3 Concentrations (µg/m^3)

AQS Site ID[1]	Sampler ID	2014	2015	2016	2017	2018
56-005-0456	South Campbell County	0.059	0.062	0.060	0.068	0.055
56-009-0010	Converse County Long-Term	No data	0.060	0.059	0.066	0.064

[1] See **map 3-2** for site locations. Site 56-009-0010 began operation in 2015.
Source: EPA 2019a

SO_2 concentrations (99th percentile, 1-hour) are currently being monitored at one AQS monitoring site in Campbell County and one AQS monitoring site in Converse county (**table 3-5**). All monitored SO_2 values were well below the NAAQS and WAAQS of 75 ppb.

Table 3-5. Measured SO_2 Concentrations (µg/m^3)

AQS Site ID[1]	Sampler ID	2014	2015	2016	2017	2018
56-005-0857	Wyodak Site 4	32	16	14	11	No data
56-009-0011	Dave Johnson Air Quality Station	No data	No data	No data	14	16

[1] See **map 3-2** for site locations. Site 56-005-0857 shut down on August 31, 2017. Site 56-009-0011 began operation in 2017.
Source: EPA 2019a

Annual Pb (a criteria pollutant), Hg (a HAP), and CO (an indirect GHG) monitoring values are not collected at the Antelope Mine. **Table 3-6** shows the Pb emissions from three coal-fired power plants in Campbell County, one coal-fired power plant in Converse County, and one AQS monitoring site in northern Campbell County. The Pb values from the Thunder Basin AQS site were well below the NAAQS and WAAQS of 0.15 µg/m^3.

Table 3-6. Measured Annual Pb Air Emissions

Power Station or AQS Site	2013	2014	2015	2016	2017
Campbell County					
Wyodak Plant (pounds)	43.1	35.3	33.2	19.7	27.3
Dry Fork Station (pounds)	9.0	21.0	8.6	14.0	10.0
Neil Simpson Complex (pounds)	60.0	31.0	24.0	24.0	23.0
Converse County					
Dave Johnson Plant (pounds)	166	122.5	116.1	121.2	100.3
Thunder Basin (56-005-0123) (µg/m^3)[1]	0.002	0.001	0.002	0.002	0.001

[1] Pb monitoring at the Thunder Basin AQS site is presented as annual 1st maximum value.
Source: EPA 2019b

CO is created when carbon-containing fuels are burned incompletely. CO concentrations are currently being monitored at one AQS monitoring site in Converse county (**table 3-7**). All monitored CO values were well below the 8-hr NAAQS and WAAQS of 9 ppm and the 1-hr NAAQS and WAAQS of 35 ppm.

Table 3-7. Measured CO Concentrations

Site ID[1]	Year	8-hour (ppm)	1-hour (ppm)
Converse County Long-Term 56-009-0010	2017	0.1	0.1
	2018	0.3	0.3

[1] See **map 3-1** for location. Sites 56-009-0010 began operation in 2015
Source: EPA 2019a

Table 3-8 shows the Hg emissions from three coal-fired power plants in Campbell County and one coal-fired power plant in Converse County, none of which receive coal from the Antelope Mine. Although Hg is not a criteria pollutant the EPA has finalized standards to reduce mercury from coal- and oil-fired power plants.

Table 3-8. Measured Annual Hg Stack (Air) Emissions (Pounds)

Power Station[1]	2013	2014	2015	2016	2017
Wyodak Plant					
Total Emissions	338.3	347.2	319.0	261.7	464.3
Stack (Air) Emissions	204.3	301.1	111.2	22.6	28.3
Percent of Total Emission Emitted to Air	60%	87%	35%	9%	6%
Dry Fork Station					
Total Emissions	86.0	69.0	66.7	45.0	48.0
Stack (Air) Emissions	67.0	50.0	38.3	28.0	29.0
Percent of Total Emission Emitted to Air	78%	72%	57%	62%	60%
Neil Simpson Complex					
Total Emissions	13,086.0[2]	653.0	711.0	759.0	1,017.0
Stack (Air) Emissions	378.0	354.0	351.0	358.0	433.0
Percent of Total Emission Emitted to Air	3%[2]	54%	49%	47%	43%
Total of Three Campbell County Power Stations					
Total Emissions	13,510.3[2]	1,069.2	1,096.7	1,065.7	1,529.3
Stack (Air) Emissions	649.3	705.1	500.5	408.6	490.3
Percent of Total Emission Emitted to Air	5%[2]	66%	46%	38%	32%
Dave Johnson Plant					
Total Emissions	411.7	268.8	501.2	420.6	399.8
Stack (Air) Emissions	240	175.6	74.2	40.7	39.4
Percent of Total Emission Emitted to Air	58%	65%	15%	10%	10%

[1] See **map 3-2** for site locations.
[2] 2013 Neil Simpson total emissions value on the EPA website appears to be incorrect given the significantly higher values compared to other years, so the percent of stack emissions compared to total emissions for 2013 calculations appears to be invalid.
Source: EPA 2019b

3.4.1.3 Air Quality Related Values (AQRVs)

AQRVs, as related to the West Antelope II South Modification tract, were discussed in section 3.4.4.1 of the 2008 WAII EIS. Updated information regarding AQRVs is included below. AQRVs are evaluated by the land management agency responsible for a PSD Class I area, according to the agency's Level of Acceptable Change (LAC). These AQRVs include potential air pollutant effects on visibility and the acidification of lakes and streams. The AQRVs, and the associated LAC, are applied to PSD Class I and Class II areas. They are the land management agency's policy and are not legally enforceable as a standard. WDEQ-AQD WAAQS do include a standard for visibility. Class I areas are afforded specific AQRV protection under the CAA. The Class I designation allows very little deterioration of air quality. The nearest Class I area is approximately 95 miles east of the tract at Wind Cave National Park in South Dakota (**map 3-2**). The AQRVs associated with this action include visibility and acidification of lakes.

3.4.1.3.1 Visibility

Surface coal mines are not considered to be major emitting facilities in accordance with the WDEQ Rules and Regulations (chapter 6, section 4). Therefore, the State of Wyoming does not require mines to evaluate their impacts on Class I areas, although OSMRE considers such issues during the federal mining plan modification review process. The current visibility discussions have been inferred from the currently permitted mining activities related to the existing coal leases at the Antelope Mine. Visibility can be defined as the distance one can see and the ability to perceive color, contrast, and detail. $PM_{2.5}$ is the main cause of visibility impairment. Visibility impairment is expressed in terms of deciview (dv). The dv index was developed as a linear perceived visual change (Pitchford and Malm 1994) and is the unit of measure used in the EPA's Regional Haze Rule to achieve the National Visibility Goal. A change in visibility of 1.0 dv represents a "just noticeable change" by an average person under most circumstances. Increasing dv values represent proportionately larger perceived visibility impairment. **Figure 3-1** shows the clearest days, the haziest days, and the natural conditions (i.e., the visibility conditions as they were before human activities) for the Wind Cave monitoring site for 2000-2018 (IMPROVE 2019). The long-term trend in visibility at Wind Cave National Park appears to be relatively stable.

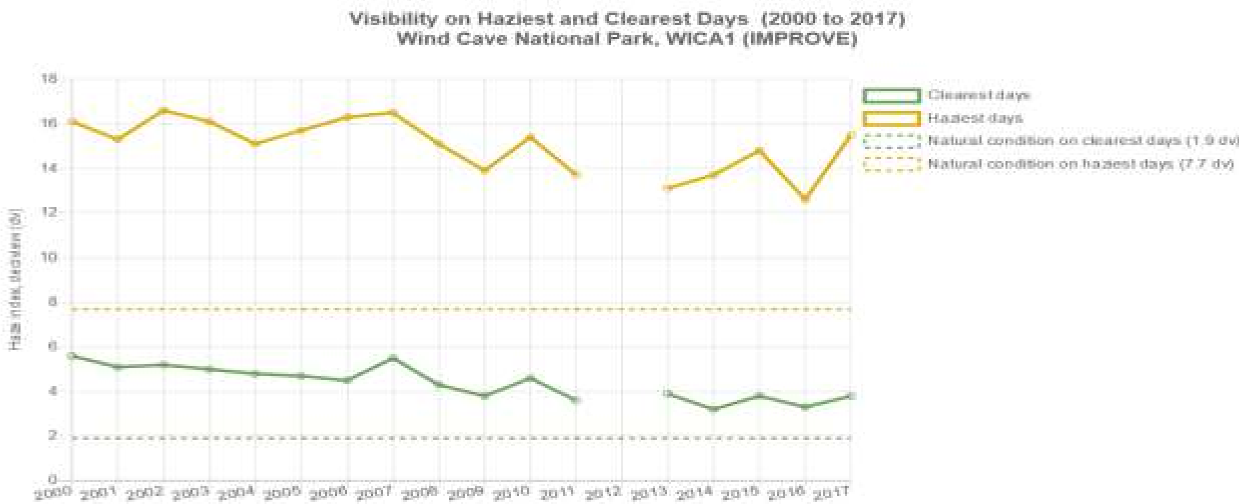


Figure 3-1. Visibility in the Wind Cave National Park

3.4.1.3.2 AQRVs Related to Coal Combustion and Transport

Emissions that affect air quality also result from combustion of fossil fuels from power plants and locomotive emissions from transporting coal to power plants throughout the country. **Table 3-9** presents the estimated emissions from combustion of coal mined at the Antelope Mine. Combustion emissions are estimated since Antelope Mine supplies coal to coal combustion facilities throughout the U.S, although facilities vary annually based on demand and contracts.

Table 3-9. Estimated Annual Emissions from Combustion of Antelope Mine Coal

Source	Mt Coal Recovered	PM_{10} (Tons)	$PM_{2.5}$ (Tons)	SO_2 (Tons)	NO_x (Tons)	Hg (Tons)
2014-2018 Annual Average Antelope Mine	30.1	6,719	2,049	123,908	47,878	0.48
2014-2018 Average Annual Wyoming PRB	322	71,988	21,956	1,327,525	512,958	5.2
2014-2018 Average Percent of Wyoming PRB	--	9.3	9.3	9.3	9.3	9.3
Total U.S. Coal Emissions (2017)	756	169,040	51,557	3,117,271	1,204,518	12.1
2014-2018 Average Percent of U.S.	--	4.0	4.0	4.0	4.0	4.0

Source: WWC 2019, calculations are provided in **appendix F**

Table 3-10 presents the estimated emissions from locomotive transport of coal mined at the Antelope Mine to power plants throughout the country for power generation.

Table 3-10. Estimated Annual Emissions (tons) from Locomotive Transport

Year	Mt Coal Transported	Average Rail Miles	CO	NO_x	PM10	$PM_{2.5}$	SO_2	VOC
2014	33.6	1,142	1,779	11,953	445	431	6.4	703
2015	35.2	1,087	1,769	11,891	442	429	6.4	699
2016	29.8	1,046	1,444	9,699	361	350	5.2	570
2017	28.5	1,098	1,449	9,737	362	351	5.2	572
2018	23.2	1,123	1,204	8,089	301	292	4.3	475

Source: WWC 2019, calculations are provided in **appendix F**

3.4.1.3.3 Acidification of Lakes/Acid Deposition

Acid deposition causes acidification of lakes and streams, which can have direct impacts on aquatic habitats and contribute to the damage of trees at high elevation and many sensitive forest soils. Acid rain is measured as acidity and alkalinity using pH, for which 7.0 is neutral. The lower a substances pH, the more acidic it is. Normal rain has a pH of about 5.6 (EPA 2019c). The National Atmospheric Deposition Program (NADP) monitors precipitation chemistry at various sites around the U.S. The nearest site to the Antelope Mine is Site WY99 (**map 3-2**), which measures free acidity (H^+ as pH). **Table 3-11** provides the measured pH for 2014-2018. The trend in pH at monitoring site WY99 appears to be relatively stable.

Table 3-11. Measured Hydrogen Ion (H+) Concentrations at Monitoring Site WY99

Parameter	2014	2015	2016	2017	2018
pH	5.8	5.9	5.9	5.8	5.7

Source: NADP 2014-2018

3.4.1.4 Greenhouse Gases (GHGs) and Climate Change

GHGs include CO_2, methane (CH_4), nitrous oxide (N_2O), and fluorinated gases (hydrofluorocarbons, perfluorocarbons, nitrogen trifluoride, and sulfur hexafluoride) (EPA 2019d). For consistency between projects, OSMRE describes GHG emissions in terms of "CO_2-equivalents" (CO_2e). For climate, climate change, and GHG analysis, there is no specific analysis area and project emissions are used as a proxy. Appendix E contains estimated average direct and indirect CO_2e emissions from coal mined at Antelope Mine.

3.5 Water Resources

Sections 3.5.1.1, 3.5.2.1, and 3.5.3.1 of the 2008 WAII EIS include detailed discussions of water resources related to the leasing and mining of coal within the West Antelope II South Modification tract. The analyses included herein serve to update discussions with recent groundwater and surface water quality monitoring results and to update water rights discussions.

3.5.1 Groundwater

Section 3.5.1.1 of the 2008 WAII EIS provides a detailed discussion of the groundwater resources of the West Antelope II South Modification tract. The analysis area contains five water-bearing geologic units that have been directly affected by existing mining activities and would be directly affected by mining the West Antelope II South Modification tract. In descending order, these units are the recent alluvium, the Wasatch Formation overburden, the Anderson coal seam, the Fort Union Formation interburdern (where present), and the Canyon coal seam.

As indicated in the 2008 WAII EIS, the underlying, Tullock Member of the Fort Union Formation is used for water supply at local coal mines within the general area. The only shallow aquifer within the tract is the alluvium of Antelope Creek. Active groundwater monitoring well locations are depicted on **map 3-3**.

The Gillette Area Groundwater Monitoring Organization (GAGMO) 35-year report indicates that drawdowns in the Anderson coal near the Antelope mine are tens of feet while larger drawdowns exist to the northwest due to dewatering related to CBNG. Water level declines in the Canyon coal near the Antelope and North Antelope Rochelle mines are greater than 100 feet and caused by mine dewatering and CBNG pumping (Hydro-Engineering 2016). The finding was based on groundwater data collected through 2015 by the coal companies.

Since the publication of the 2008 WAII EIS, 30 new monitoring wells (six alluvial, one Anderson, two Canyon, three interburden, ten overburden, and eight backfill) have been completed within the Antelope Mine permit boundary and added to the WDEQ Water Quality Division (WQD) approved groundwater monitoring network. Thirty-four monitoring wells (five alluvial, eight Anderson, four Canyon, five interburden, nine overburden, and three underburden) have been removed from the WDEQ-WQD monitoring network since the publication of the 2008 WAII EIS. The removal of these wells resulted from pit advancement and was approved by WDEQ-WQD.

The following discussions on groundwater monitoring were taken from the 2018 Antelope Mine Annual Report (AC 2018) and historic monitoring results. **Appendix G** provides a summary of all water quality results for the active wells.

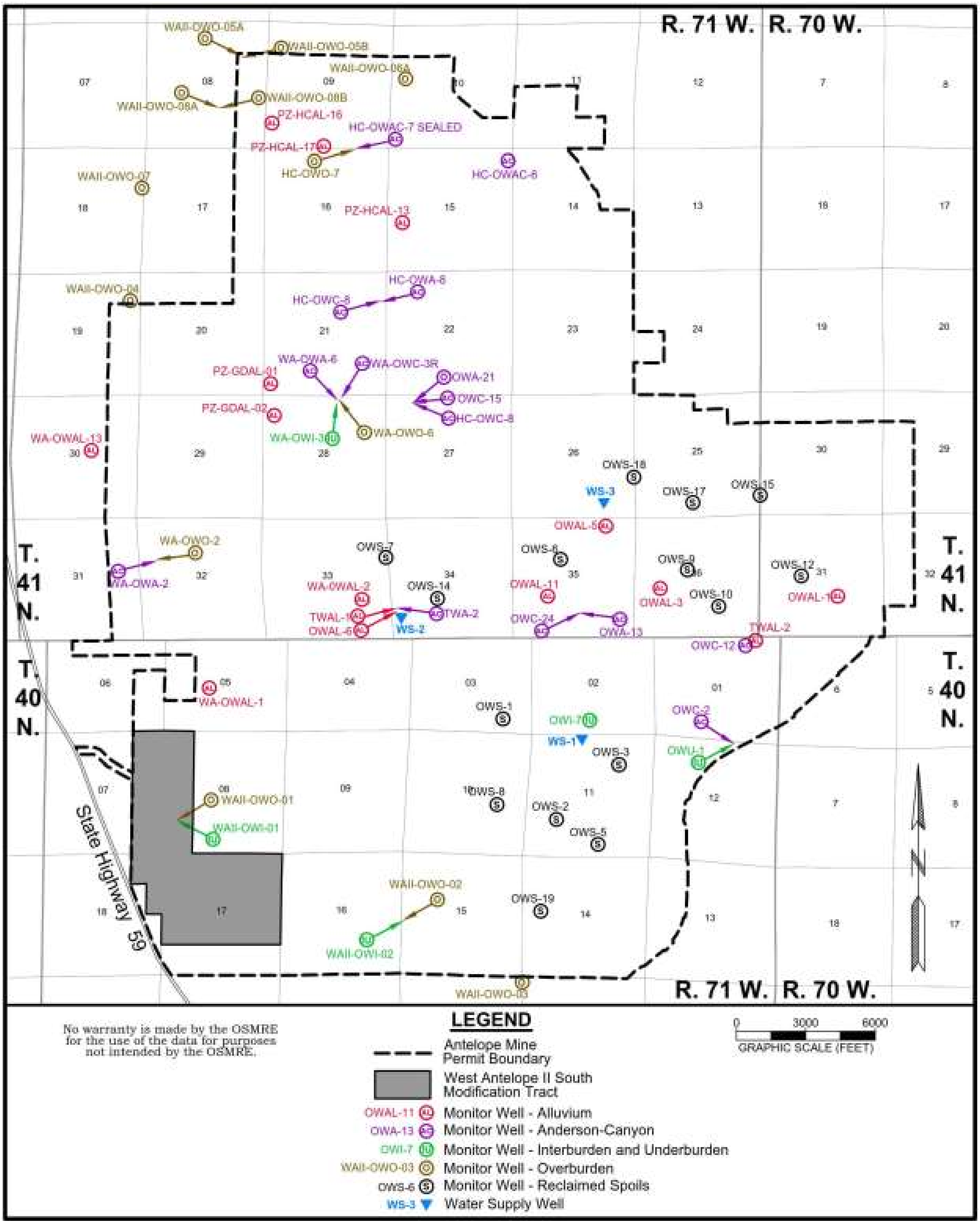
Alluvial Wells – In 2017-2018 groundwater in most alluvial wells experienced slight water level increases, which were potentially a result of two significant precipitation events. Eleven alluvial wells are included in the water quality portion of the Antelope Mine groundwater monitoring program; however, four wells were dry or had insufficient water for sampling during the 2018 annual report period. Overall, the concentrations from the samples collected in 2017-2018 were consistent with historical concentrations. Current and historic parameters that have exceeded WDEQ-WQD Class III livestock standards include cadmium, chromium, manganese, oil and grease, sulfate, and total dissolved solids (TDS).

Overburden Wells – 2018 groundwater levels in the overburden wells were similar to 2017 water levels, with no anomalies occurring. One overburden well was sampled for water quality during 2017-2018. TDS concentrations were consistent with historical concentrations. Current and historic water quality in the overburden well met WDEQ-WQD Class III livestock standards, with the exception of manganese.

Anderson Coal Wells – Groundwater levels in the Anderson coal seam wells have declined through time due to the advancements of pits at the Antelope and North Antelope Rochelle mines, and dewatering related to CBNG production. More recently, water levels in the Anderson wells have increased which is likely a result of CBNG production in the area ceasing. Two Anderson coal wells were sampled for water quality during 2017-2018. TDS concentrations were consistent with historical concentrations. The only water quality parameter that has exceeded WDEQ-WQD Class III livestock standards in the two Anderson coal wells was manganese.

Canyon Coal Wells – Most wells completed in the Canyon coal seam show a downward trend in water levels since 1988. Some of these wells are showing an increase in water levels since CBNG production in the area has ceased. One Canyon coal well (OWC-2) was dry. Two Canyon coal wells were sampled for water quality during 2017-2018. The current and historic water quality water quality in the coal wells exceeded WDEQ-WQD Class III livestock standards for manganese and selenium.

Interburden Wells – Groundwater levels in the interburden wells were similar to those in the Anderson and Canyon coal seams. The changes in water levels are likely due to pit advancement and dewatering related to historical CBNG production. Both interburden wells did not produce enough water for sample collection. The only water quality parameter that has exceeded WDEQ-WQD Class III livestock standards in the interburden wells was manganese.



Map 3-3. Active Groundwater Monitoring Locations and Water Supply Wells at the Antelope Mine

Backfill Wells – Compared to 2017 water levels, the 2018 backfill well water levels decreased in six wells, increased in eight wells, and one well was dry (OWS-7). The changes in water levels are likely attributed to the proximity to and recharge from the alluvium of Antelope, Spring, and Horse Creeks, as well as, variation in annual precipitation. Eight backfill wells were sampled for water quality during 2017-2018. The water quality meets WDEQ-WQD Class III livestock standards, with the exception of wells OWS-10 and OWS-12, which have exceeded the standards for manganese, sulfate, and TDS. The exceedances may be attributed to the volume of water in these wells, since both of these wells are typically bailed dry when sampled. TDS in all backfill wells was consistent with historical concentrations.

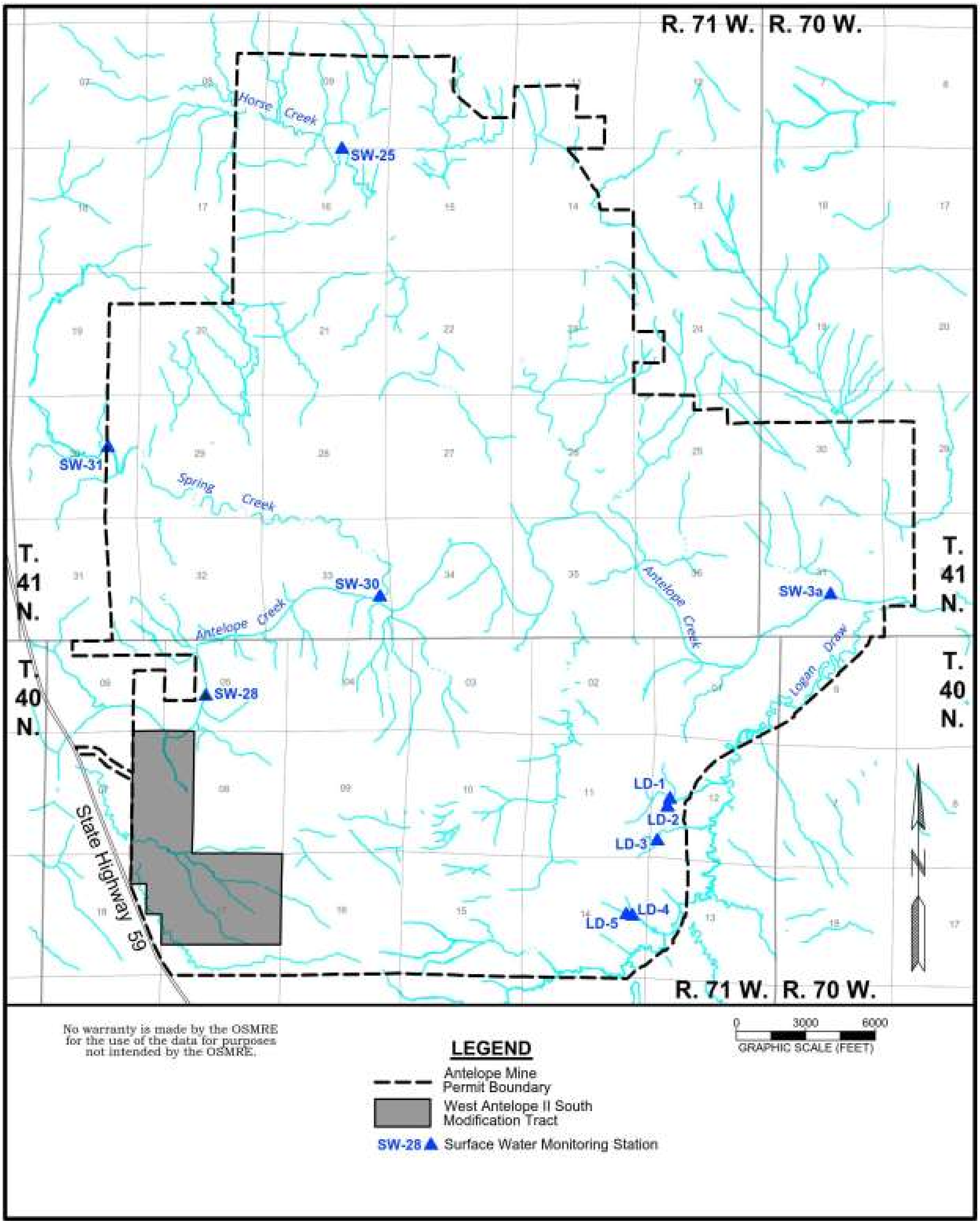
3.5.2 Surface Water

A description of surface water related to the West Antelope II South Modification tract is provided in section 3.5.2.1 of the 2008 WAII EIS. The tract is located within the Antelope Creek drainage, a tributary of the Cheyenne River. Antelope Creek is classified as an intermittent stream. Except for two road crossings, Antelope Creek flows undisturbed from west to east across the permit boundary.

Streamflow and surface water quality associated with the Antelope Mine are currently monitored at five sites, including two sites on Antelope Creek (**map 3-4**). Surface water site SW-28 is located upstream near the permit boundary, while site SW-3A is located downstream near the permit boundary. Flows and water quality data in Antelope Creek have been and continue to be monitored and reported annually to WDEQ-LQD. In 2018, site SW-28 measured flow 34 days out of 166 days monitored. The maximum daily flow rate at site SW-28 was 194 cfs, measured on May 28, 2019. Site SW-3a measured flow 53 days out of 168 days monitored. The maximum daily flow rate at site SW-3a was measured was 861 cfs, measured on May 29, 2018.

Baseline water quality data for Antelope Creek is provided in the 2014 Cumulative Hydrologic Impact Assessment of Coal Mining in the Southern Powder River Basin, Wyoming (2014 CHIA-35; WDEQ-LQD 2014b). The WDEQ-LQD is currently working on an updated CHIA for the Southern Powder River Basin. The Antelope Mine established four baseline surface water monitoring stations on Antelope Creek in 1978 and 1979: SW-1, SW-2, SW-3, and SW-4. Stations SW-2 and SW-3 were continuous streamflow recording and water quality sampling sites located at the original upstream and downstream permit boundaries. In 2004, Antelope Mine established SW-28 to serve as the new upstream surface water monitoring station (Site SW-2 was discontinued in 2006). SW-3 was deactivated in 1996 due to railroad construction and a new downstream station (SW-3a) was established to replace it in 1997.

The flow data recorded at SW-2 and SW-3 indicate that runoff generally increased with increasing precipitation. Over a 24-year period (1981-2004) mean daily flows at site SW-2 ranged from no flow to a maximum mean daily discharge of 300 cfs on May 18, 1997. The WDEQ-WQD has classified Antelope Creek as Class 3B water (WDEQ-WQD 2013). The baseline water quality at SW-2 and SW-3 was characterized using data from the first two years of sampling (1979-1980). The dominant cations and anions at both stations were sodium and sulfate. TDS was slightly higher at SW-2, ranging from 532 to 2,940 mg/L. Total suspended solids (TSS) were very similar at both stations. Dissolved metal concentrations were very low at both stations, with numerous values below detection limits. There were three Class 3B exceedances of selenium and one exceedance each of cadmium, copper, and lead at SW-2. At SW-3, only one exceedance of selenium occurred over the period evaluated. It should be noted that some of the constituents, such as iron, could not be compared to Class 3B standards since only total iron was measured.



Map 3-4. Surface Water Monitoring Sites at the Antelope Mine

3.5.3 Water Rights

Section 3.5.3.1 of the 2008 WAII EIS provide a detailed discussion of the water rights within and surrounding the West Antelope II South Modification tract. SEO records indicate that as of December 2019, there were 15 surface-water rights within the 2-mile search area, of which seven are owned by U.S. Department of Agriculture, three are owned by a corporation, and the remaining five are owned by private surface owners (SEO 2019). All of the surface water rights are permitted for livestock use. SEO records indicate that, as of December 2019, there were 72 permitted groundwater wells within the 2-mile search area, of which 50 are owned by AC (SEO 2019). The other 22 are permitted for CBNG (4), CBNG and Miscellaneous (4), domestic and stock (2), monitoring (2), and stock (10).

3.6 Alluvial Valley Floors

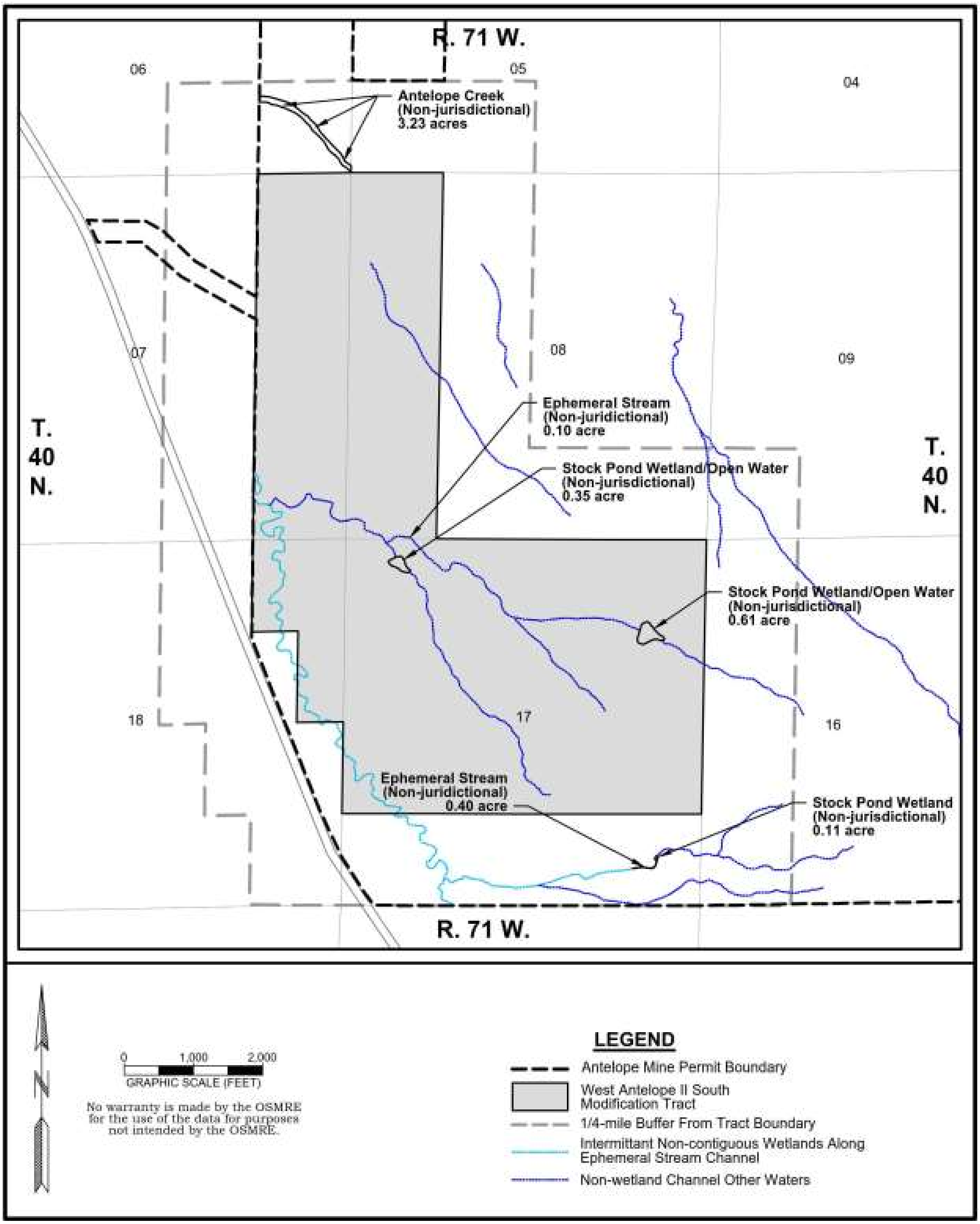
Alluvial valley floors (AVFs) within the West Antelope II South Modification tract are described in section 3.6.1 of the 2008 WAII EIS. Antelope Creek has been investigated for the presence of AVFs including one mile upstream of the 2008 permit boundary, which included a portion of the West Antelope II South Modification tract. A portion of Antelope Creek has been designated by WDEQ-LQD as "possible subirrigated AVF of minor importance to agriculture." The AVF area lies within the 100-foot buffer zone of Antelope Creek.

3.7 Wetlands

As described in section 3.7.1 of the 2008 WAII EIS, a portion of the West Antelope II South Modification tract within the permit area was previously delineated for wetlands. The information provided in the 2008 WAII EIS on wetlands was based on preliminary wetlands mapping conducted in 2006-2007 and on a partial wetland delineation. The remaining portion of the tract and an area adjacent to the tract have subsequently been surveyed for wetlands (Intermountain Resources 2011). A formal wetland determination was issued by the U.S. Army Corps of Engineers (USACE) in 2012 (USACE 2012a and 2012b). As determined by the USACE, none of the aquatic sites within the Antelope Mine are waters of the U.S. and therefore agency authorization is not required for coal mining activities at the Antelope Mine (USACE 2012a and 2012b). As shown on **map 3-5**, there are approximately 4.8 acres of non-jurisdictional aquatic features within and adjacent to the tract (Intermountain Resources 2011).

3.8 Soils

Soils within the West Antelope II South Modification tract are described in section 3.8.1 of the 2008 WAII EIS. The soil types and depths on the tract are similar to soils currently being salvaged and utilized for reclamation at the Antelope Mine and other nearby mines in the southern PRB. The amount of suitable topsoil that would be available for redistribution on all disturbed acres within the tract has an average depth of 19 inches (1.6 feet). The tract includes approximately 76 acres of prime farmland, if irrigated (NRCS 2019). As of December 2019, 79.9 acres within the tract have been disturbed from mining at the Antelope Mine unrelated to coal recovery within the tract (AC 2019a).



Map 3-5. Wetlands within and Surrounding the West Antelope II South Modification Tract

3.9 Vegetation

Vegetation within the West Antelope II South Modification tract is described in section 3.9.1 of the 2008 WAII EIS. The predominant vegetation types within the tract are blue grama upland (*Bouteloua gracilis*), blue grama roughland (*Bouteloua gracilis*), big sagebrush upland (*Artemisia tridentate*), and birdsfoot sagebrush upland (*Artemisia pedatifida*). As described above, 79.9 acres within the tract have been disturbed from mining at the Antelope Mine unrelated to coal recovery within the tract.

3.9.1 Threatened, Endangered, Proposed, and Candidate Plant Species

Plant T&E species were discussed in section 3.9.3 and appendices H and I of the 2008 WAII EIS. The current USFWS list of plant T&E species that may occur in the vicinity of the tract includes the Ute ladies'-tresses (*Spiranthes diluvialis*) (USFWS 2019). No Ute ladies'-tresses have been found during surveys conducted in potential habitats on the Antelope Mine permit area and the tract (AC 2014). In addition, the USFWS has not designated any "critical" habitat for this species in the vicinity of the Antelope Mine at this time (USFWS 2019).

3.10 Wildlife

The occurrence of wildlife related to the mining of the federal coal within the West Antelope II South Modification tract was thoroughly discussed in section 3.10.1 of the 2008 WAII EIS. The information included in the 2008 WAII EIS was derived from the baseline data and the subsequent studies and WDEQ-LQD annual reports. No significant changes to wildlife use areas for big game, other mammals, upland game birds (excluding the Greater sage-grouse [GRSG] [*Centrocercus urophasianus*]), other birds, reptiles and amphibians, or aquatic species populations have been noted from the previous discussion presented. There have been changes in discussions related to raptors; threatened, endangered, and candidate (T&E) species; and species of special interest (SOSI). The status of GRSG has also changed since publication of the 2008 WAII EIS. Therefore, these species discussions have been updated in this EA.

3.10.1 Raptors

The 2018 Antelope Mine Annual Report identified the location and annual status of raptor nests (AC 2018). The location and status of raptor nests monitored at the mine are included on **map 3-6**, including three intact raptor nests within the West Antelope II South Modification tract and two successful nests and one intact nest (GE5b) are within 0.25 mile of the tract.

Raptor species that were observed to be active during the 2017-2018 wildlife monitoring efforts were red-tailed hawks (*Buteo jamaicensis*), golden eagles (*Aquila chrysaetos*), and ferruginous hawks (*Buteo regalis*)). Other raptors that could potentially occur in the area include the burrowing owls (*Athene cunicularia),* Coper's hawks (*Accipiter cooperii),* sharp-shinned hawks *(Accipiter striatus),* rough-legged hawks *(Buteo lagopus),* Swainson's hawks (*Buteo swainsoni*), prairie falcons (*Falco mexicanus*), northern harriers (*Circus cyaneus*), osprey (*Pandion haliaetus*), great horned owls (*Bubo virginianus*), short-eared owls (*Asio flammeus*), long-eared owls (*Asio otus*), bald eagles (*Haliaeetus luecocephalus*), and American kestrels (*Falco sparverius*)(**appendix H**).

3.10.2 Greater Sage-grouse (GRSG)

No core, connectivity, or winter concentrations areas for GRSG have been designated by the State of Wyoming (Executive Order No. 2019-3; Office of the Governor 2019) in the Antelope Mine permit area or 1.0-mile perimeter. The nearest core area is the Thunder Basin core area, approximately 15 miles southeast of the West Antelope II South Modification tract. According to the BLM Buffalo Field Office (BFO) Resource Management Plan (RMP), the tract is within a general habitat management area (GHMA) for GRSG (BLM 2015). This classification prohibits or restricts surface disturbing and disruptive activities within 0.25 mile of the perimeter of occupied GRSG leks. No GRSG leks occur within 0.25 mile of the tract.

In 2000, the WDEQ-LQD approved revisions to Permit No. 525 that eliminated surveys for upland game bird broods from the wildlife monitoring program. The revision was based on recommendations made by the WGFD. In 2014, Antelope Coal voluntarily elected to resume annual GRSG brood surveys. Despite the extremely limited historical presence of GRSG in the area, the Antelope Mine searches for GRSG leks in suitable habitat within the monitoring area (permit area and 1.0-mile perimeter). No new GRSG leks were discovered in or within 1.0 mile of the Antelope Mine permit area during 2017 (AC 2018). The nearest lek (Steckley Road) is approximately 2.7 miles southeast of the permit area.

3.10.3 Vertebrate Threatened, Endangered, and Candidate Species and Species of Special Interest

The information presented in this section was obtained from the USFWS's Information for Planning and Conservation (IPaC) system and the Natural Resource and Energy Explorer (NREX), which is a web GIS-based software tool that supports pre-planning development considerations that facilitates the assessment of energy, environmental, cultural, socioeconomic and infrastructural assets in Wyoming (NREX 2019).

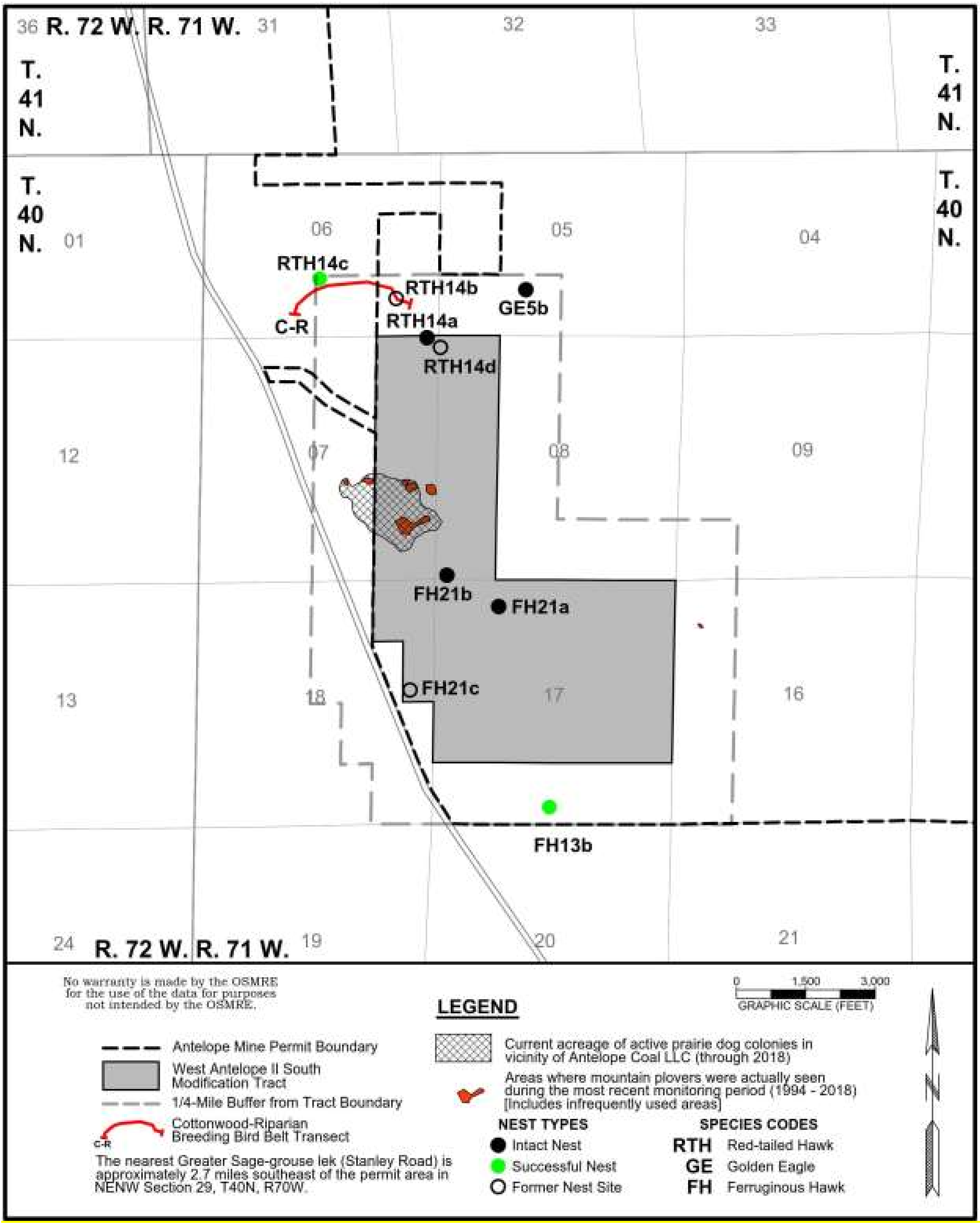
3.10.3.1 Vertebrate Threatened, Endangered, and Candidate Species

Vertebrate T&E species were discussed in section 3.10.8 of the 2008 WAII EIS. The current USFWS IPaC list includes the northern long eared bat (*Myotis septentrionalis*) because the mine extends into Campbell County; however, the northern long eared bat is not located in Converse County and there is no suitable habitat where the West Antelope II South Modification tract is located.

3.10.3.2 Species of Special Interest

NREX information was utilized for the determination of SOSI species that could occur in the area. For the purposes of this discussion, SOSI include BLM sensitive species, Wyoming Natural Diversity Database (WYNDD) species of concern (SOC), species protected under the MBTA, and WGFD species of greatest conservation need (SGCN). USFWS T&E species are not included in this category. As determined from the NREX list, 136 terrestrial-vertebrate SOSI have the potential of occurring within the West Antelope II South Modification tract.

As shown in **appendix H**, 43 WGFD SGCN, 118 species protected under the MBTA, 20 WYNDD SOC, 14 BLM sensitive species, and two WGFD-designated Tier I terrestrial-vertebrate species have the potential of occurring within the West Antelope II South Modification tract. According to wildlife monitoring results, three of these SOSI have been confirmed as occurring within or adjacent to the tract; golden eagle, ferruginous hawk, and mountain plover [*Charadrius montanus*]). The mountain plover is also listed under the WGFD designated Tier I category. A total of five mountain plovers were observed on an active prairie dog colony within the tract, as shown on **map 3-6** (AC 2018).



Map 3-6. Raptor Nest Sites within and Adjacent to the West Antelope II South Modification Tract

3.11 Land Use and Recreation

Land use and recreation on the West Antelope II South Modification tract are described in section 3.11.1 of the 2008 WAII EIS. All of the surface estate on the tract is owned by AC. Livestock grazing and wildlife habitat are the primary land uses. Gas production and recreation are the secondary land uses.

3.12 Cultural Resources

Information regarding background cultural resources was included in section 3.12.1 of the 2008 WAII EIS and section 3.2 of the 2014 WAII South EA. The West Antelope II South Modification tract and surrounding area has been surveyed for cultural resources at a Class III level. There are18 cultural sites located within and adjacent to the tract survey area (**table 3-12**).

Table 3-12. Cultural Sites Within and Adjacent to the West Antelope II South Modification Tract

Site Number	NRHP Status	Author/Org	Report/Project Name	Site Type
48CO0047	NE	OWSA	No Associated Report	P
48CO1709	NE	TRC/Mariah & Associates	WYDOT Linear Survey	H
48CO1710	NE	TRC/Mariah & Associates	WYDOT Linear Survey	H
48CO1716	NE	USFS	Antelope Creek Land Exchange	P
48CO1717	NE	USFS	Antelope Creek Land Exchange	P
48CO1719	NE	USFS	Antelope Creek Land Exchange	P
48CO1720	NE	USFS	Antelope Creek Land Exchange	M
48CO1721	NE	USFS	Antelope Creek Land Exchange	M
48CO1722	NE	USFS	Antelope Creek Land Exchange	P
48CO1723	NE	USFS	Antelope Creek Land Exchange	M
48CO2248	NE	AEC	Antelope Mines Fuel Pipeline	M
48CO2830	NE	GCM Services	West Antelope Drilling Additions	H
48CO2831	NE	GCM Services	West Antelope Drilling Additions	P
48CO2833	NE	GCM Services	West Antelope Drilling Additions	P
48CO2923	NE	GCM Services	West Antelope II & Off Lease Drill	P
48CO3077	E	GCM Services	West Antelope II Buffer	P
48CO3078	E	GCM Services	West Antelope II Buffer	P
48CO3079	NE	GCM Services	West Antelope II Buffer	P

NRHP Status: NE=Not Eligible; E=Eligible, NE (CON)=Not Eligible by Consultant, E (CON)=Eligible by Consultant
Site Type: P=Prehistoric; H=Historic; M=Multi-component
Source: 2008 WAII EIS, GCM 2009, 2011, 2014, and 2015

3.13 Visual Resources

Visual resources on the West Antelope II South Modification tract are described in section 3.13.1 of the 2008 WAII EIS. According to the most recent BLM BFO RMP, the West Antelope II South Modification tract is within visual resource management Class IV (BLM 2015). The objective of Class IV is to provide for management activities that require major modification of the existing character of the landscape. Currently, mine facilities and mining activities at the Antelope Mine are visible from State Highway 59 and County Road 37 (Antelope Coal Mine Road) in Converse County, and Country Road 4 (Antelope Road) in Campbell County.

3.14 Noise

Noise on the West Antelope II South Modification tract is described in section 3.14.1 of the 2008 WAII EIS. Existing noise sources in the tract vicinity include coal mining activities, rail traffic, traffic on the nearby state highway, county and access roads, natural gas compressor stations, and wind. The 2008 WAII EIS describes a noise survey at the two occupied locations closest to the Antelope Mine in 2004. The maximum daily time weighted (L_{eq}) noise reading was 51 A-weighted sound levels (dBA) at the Don Jacobs residence, located directly west of the mine. At the Dyno Nobel West Region office, located northeast of the mine on County Road 37, the L_{eq} was 52.6 dBA. These noise levels are equivalent to an average office environment. The nearest occupied residence to the West Antelope II South Modification tract is approximately 1.5 mile to the west-southwest.

3.15 Transportation

Transportation in the vicinity of the West Antelope II South Modification tract is described in section 3.15.1 of the 2008 WAII EIS. Major roads in the general area of the tract include State Highway 59, County Road 37 (Antelope Coal Mine Road) in Converse County, and Country Road 4 (Antelope Road) in Campbell County. Existing transportation facilities include roads, railroads, and overhead electrical transmission lines associated with the Antelope Mine. All coal mined at the Antelope Mine is transported by rail (BNSF and UP trackage) as described in **section 1.2.1** of this EA.

3.16 Hazardous and Solid Waste

Hazardous and solid waste in the West Antelope II South Modification tract is described in section 3.16.1 of the 2008 WAII EIS. Potential sources of hazardous or solid waste on the tract include spilled, leaked, or dumped hazardous substances, petroleum products, and/or solid waste associated with coal and oil and gas exploration, oil and gas development, the BNSF and UP railroad, utility line installation and maintenance, or agricultural activities.

3.17 Socioeconomics

This section describes existing socioeconomic conditions in Wyoming, Campbell County, and Converse County specific to the state and local economy, population, and employment. The discussions included in section 3.17 of the 2008 WAII EIS described socioeconomic conditions associated with the Antelope Mine in 2006. Demographics in the area have not changed considerably since the preparation of the 2008 WAII EIS, therefore housing, local government services and environmental justice are not reevaluated in this EA. The following includes updated discussions on the local economy, population, and employment.

3.17.1 State and Local Economy

Wyoming's coal mines (surface and underground) produced an estimated 304.1 Mt of coal in 2018, a decrease of about 162.2 Mt (35 percent) from the record 466.3 Mt produced in 2008 and lower than the 316.6 Mt produced in 2017 (WDWS 2008, 2017, and 2018). Coal produced from 12 active mines in Campbell County accounted for approximately 95 percent of total statewide coal production in 2018 (WDWS 2018). Coal produced from Converse County in 2018 accounted for approximately 1.7 percent of the total statewide coal production (WDWS 2018). According to coal production numbers from the U.S. Energy Information Administration (EIA), the coal from Campbell and Converse counties accounted for approximately 39 percent of the coal produced in the U.S. in 2018 (EIA 2018).

The estimated total fiscal impact from coal production in Campbell and Converse counties to the State of Wyoming in 2019 was calculated based on coal produced from the county in 2018. The sale of coal from Campbell County in 2018 resulted in an estimated $391,597,494 of federal revenues and $565,583,048 in state revenues. The sale of coal from Converse County in 2018 resulted in an estimated $6,659,032 of federal revenues and $11,109,229 in state revenues (**appendix I**).

3.17.2 Population

In 2018, Campbell County and Converse County were ranked as the 3rd and 14th most populous of Wyoming's 23 counties, respectively (U.S. Census Bureau [USCB] 2019). The majority of the Campbell County mine employees and support services reside in Gillette, while the majority of those services from Converse County reside in Douglas. **Table 3-13** presents the population changes for Campbell and Converse counties for 2010-2018.

Table 3-13. Campbell County and Converse County Population Change, 2010-2018

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2010-2018 Change	2010-2018 Percent Change
Campbell County	46,245	46,543	47,855	48,038	48,132	49,269	48,746	46,251	46,140	-105	-0.23
Converse County	13,823	13,737	14,028	14,366	14,203	14,299	14,101	13,744	13,640	-183	-1.32

Source: USCB 2019

Employment in mining bottomed out in the third quarter of 2016, with slightly fewer than 18,000 jobs, the lowest level in more than 10 years. Since then, however, mining has seen increases in employment through the second quarter of 2018 (base period used for WDWS most recent projections). Wyoming's employment is expected to grow by 5,461 jobs (2.0 percent) from the second quarter of 2018 to the second quarter of 2020. The largest job growth is expected in mining, including oil and gas, at 1,608 jobs, due to favorable oil prices (WDWS 2018).

Table 3-14 presents the employment changes for Wyoming, Campbell County, and Converse County for 2011-2018.

Table 3-14. State of Wyoming, Campbell, and Converse Counties Employment Rate Change, 2011-2018

	2011	2012	2013	2014	2015	2016	2017	2018
Wyoming (Number Employed)	289,019	290,932	292,131	293,302	291,295	284,681	280,689	277,820
Wyoming (Number Unemployed)	17,796	16,335	14,477	12,668	13,108	16,051	12,234	11,754
Wyoming Unemployment Rate	5.8	5.3	4.7	4.1	4.3	5.3	4.2	4.1
Campbell County (Number Employed)	24,605	24,907	24,607	25,345	24,810	22,667	21,897	21,883
Campbell County (Number Unemployed)	1,267	1,212	1,091	878	1,024	1,760	1,121	938
Campbell County Unemployment Rate	4.9	4.6	4.2	3.3	4.0	7.2	4.9	4.1
Converse County (Number Employed)	7,289	7,634	7,811	8,079	8,015	7,391	7,147	7,276
Converse County (Number Unemployed)	370	342	297	250	307	492	333	278
Converse County Unemployment Rate	4.8	4.3	3.7	3.0	3.7	6.2	4.5	3.7

Source: U.S. Bureau of Labor Statistics 2019

4.0 Environmental Consequences/Cumulative Impacts

4.1 Introduction

This chapter discusses the potential direct, indirect, and cumulative effects of the Proposed Action and the No Action Alternative, as described in **chapter 2**. The discussion is organized by resource areas in the same order as they are described in **chapter 3**.

An impact, or effect, is defined as a modification to the environment brought about by an outside action. Impacts vary in significance from no change, or only a slightly discernible change, to a full modification or elimination of the resource. Impacts can be beneficial (positive) or adverse (negative). Impacts are described by their level of significance (i.e., major, moderate, minor, negligible, or no impact). For purposes of discussion and to enable use of a common scale for all resources, resource specialists considered the following impact levels in qualitative terms.

- **Major**: Impacts that potentially could cause significant depletion, change, or stress to resources or stress within the social, cultural, and economic realm.
- **Moderate**: Impacts that potentially could cause some change or stress to an environmental resource, but the impact levels are not considered significant.
- **Minor**: Impacts that potentially could be detectable but slight.
- **Negligible**: Impacts in the lower limit of detection that potentially could cause an insignificant change or stress to an environmental resource or use.
- **No Effect/Impact**: No discernible or measurable impacts.

Impacts can also be defined as direct, indirect, or cumulative. Terminology presented in this analysis includes the following:

- **Direct** impacts are defined as those impacts which are caused by the action and occur at the same time and place (40 CFR § 1508.8(a)).
- **Indirect** impacts are those that are caused by the action and occur later in time or are farther removed in distance but are still reasonably foreseeable (40 CFR § 1508.8(b)).
- **Cumulative** impacts are those impacts that result from incremental effects of an action when added to other past, present, and reasonably foreseeable future actions regardless of what agency or other entity undertakes such other actions (40 CFR § 1508.7). Cumulative impacts occur over a given time period when the impacts of past, present, and reasonably foreseeable future actions overlap with the time period when project impacts would occur (including the coal recovery and reclamation phases).

The duration of impacts is also presented throughout this chapter, as follows:

- **Short-term** impacts generally occur over a short period and revert to pre-disturbance conditions within a few years after mining occurs.
- **Long-term** impacts are defined as those that would remain beyond mining-related activities (including reclamation), generally lasting the life of the alternative being evaluated (e.g., federal mining plan modification approval) and beyond.

The direct, indirect, and cumulative effects of the Proposed Action and No Action Alternative are comparable to those described in the 2008 WAII EIS, except as noted herein. In addition to addressing the specific issues identified in **chapter 1**, this updated environmental consequences analysis reflects updated descriptions of the affected environment presented in **chapter 3** that have taken place since the 2008 WAII EIS and 2014 WAII South EA.

The environmental and cumulative effects discussions below assume that under the Proposed Action, the federal mining plan modification to mine coal in the West Antelope II South Modification tract would be approved. Coal recovery is projected to continue within Antelope Mine permit area at an estimated annual rate of 30 Mt, which is consistent with the 2014-2018 average annual recovery rate. The recovery of the remaining federal coal would continue for approximately 0.5 additional year over the No Action Alternative. New mine facilities would not be required in connection with the Proposed Action.

Under the No Action Alternative, the mining plan modification to allow mining of the federal coal within the West Antelope II South Modification tract would not be approved. Currently approved mining operations associated with federal coal would continue for approximately 13.7 years within existing federal leases, at a rate of approximately 30 Mtpy. The disturbance would be similar to those under the Proposed Action although the impacts to approximately 879.5 acres to recover federal coal within the tract would not occur.

Cumulative effects discussed in this chapter consider the other activities and processes in the area. The mines included in the cumulative effects analysis include the Black Thunder, North Antelope Rochelle (NAR), School Creek, and Antelope mines, herein referred to as the southern group of mines. These mines are depicted on **map 1-1**.

4.2 Topography and Physiography

4.2.1 Direct and Indirect Effects

4.2.1.1 Proposed Action

The direct and indirect effects to topography and physiography would not be significantly different from those described in section 3.2.2.1 of the 2008 WAII EIS. The Proposed Action would impact the topography and physiography of the West Antelope II South Modification tract, but these impacts would be similar to those currently occurring at the Antelope Mine. After mined-out areas are reclaimed, the land surfaces would be gentler, with more uniform slopes and restored basic drainage networks. The direct effects on topography and physiography resulting from the Proposed Action would be moderate and permanent. There would be no indirect effects under the Proposed Action.

4.2.1.2 No Action Alternative

The impacts to topography under the No Action Alternative would be similar to those under the Proposed Action although the impacts to approximately 879.5 acres to recover federal coal within the West Antelope II South Modification tract would not occur.

4.2.2 Cumulative Effects

The cumulative impacts to topography and physiography would not be significantly different than those described in section 4.2.1 of the 2008 WAII EIS. The cumulative effects would primarily be related to the southern group of mines. Following surface coal mining and reclamation, topography would be modified within the permit boundary of these mines. The cumulative effects on topography and physiography are expected to be moderate and permanent.

4.2.3 Mitigation Measures

No mitigation measures would be necessary for topography and physiography.

4.3 Geology, Mineral Resources, and Paleontology

4.3.1 Direct and Indirect Effects

4.3.1.1 Proposed Action

The direct and indirect effects to geology would not be different than those described in section 3.3.1.2.1 of the 2008 WAII EIS. Under the Proposed Action, the geology from the base of the lowest coal seam mined to the land surface would be subject to permanent change after the coal is removed. As a result, the physical characteristics of the backfill would be different from the physical characteristics of the existing layered overburden. The Proposed Action would result in the recovery of approximately 14.5 Mt of recoverable federal coal within the Anderson and Canyon coal seams. The direct and indirect effects on geology are expected to be moderate and permanent on the West Antelope II South Modification tract.

The direct and indirect effects to other mineral resources would not be different than those described in section 3.3.2.2.1 of the 2008 WAII EIS. There are no oil and gas wells or CBNG wells located on the tract. The direct effects on CBNG resources resulting from the Proposed Action would be moderate and permanent on the tract due to the loss of any remaining CBNG within the Anderson and Canyon coal seams. The effects would be minor and short-term for conventional oil and gas due to the surface disturbance that could temporarily prohibit recovery of the resource.

The direct and indirect effects to paleontology would not be different than those described in section 3.3.3.2.1 of the 2008 WAII EIS. Fossils with scientific significance could be present on the tract but not exposed at the surface. Should previously unknown, potentially significant paleontological sites be discovered, BLM imposed lease and permit conditions require that work in that area stop and measures be taken to assess and protect the site. The effects on paleontological resources resulting from the Proposed Action would be moderate and permanent for non-significant paleontological resources.

4.3.1.2 No Action Alternative

Impacts to the geological resources have resulted from current mining activity on adjacent lands and therefore under this alternative, impacts to geological resources in the area would be similar to those under the Proposed Action. Impacts to the geological, mineral, and paleontological resources, excluding CBNG, would be approximately 879.5 acres less than the Proposed Action. Impacts to CBNG resources would be moderate and permanent as a result of mining activities on adjacent lands.

4.3.2 Cumulative Effects

The cumulative impacts to geology, mineral resources, and paleontology would not be different than those described in section 4.2.2 of the 2008 WAII EIS. Within the southern group of mines, overburden and coal would be removed and replaced with backfill, resulting in a permanent change in the geology of the area and a permanent reduction of coal resources.

According to information from the WOGCC (2019), 32,195 CBNG and conventional oil and gas wells have been drilled in Campbell County and 5,019 CBNG and conventional oil and gas wells have been drilled in Converse County. The WOGCC records indicate that the majority of the wells are privately held or state minerals. Status of these wells includes plugged and abandoned, dormant, completed, monitoring, and notice of intent to abandon. In 2018, only 3,845 wells in Campbell County and 1,390 wells in Converse County were producing.

Impacts to paleontological resources as a result of the already-approved cumulative energy development occurring in the PRB consist of losses of plant, invertebrate, and vertebrate fossil material for scientific research, public education (interpretive programs), and other values. Losses of paleontological resources would continue to result from the destruction, disturbance, or removal of fossil materials from surface-disturbing activities as well as unauthorized collection and vandalism. A beneficial impact of surface mining would be the exposure of fossil materials for scientific examination and collection, which might never occur except as a result of overburden removal, exposure of rock strata, and mineral excavation.

The cumulative effects on the geology, mineral resources, and paleontology are expected to be moderate and permanent.

4.3.3 Mitigation Measures

No mitigation measures would be necessary for geology or mineral resources. Should significant paleontological resources be encountered as a result of the Proposed Action, the inadvertent discoveries would be managed in compliance with the NHPA.

4.4 Air Quality and Climate Change

4.4.1 Particulate Matter

4.4.1.1 Direct Effects (Excluding Coal Combustion)

4.4.1.1.1 Proposed Action

The direct effects to air quality from particulate matter would not be different than those described in section 3.4.2.2.1 of the 2008 WAII EIS and section 4.1.3 of the 2014 WAII South EA. Direct emissions from particulate matter from the Proposed Action would include fugitive emissions generated from coal excavation and reclamation activities and tailpipe emissions from equipment. Fugitive particulate emissions would also result from dust being generated during dragline operation, coal haulage, and the operation of bulldozers, scrapers, loaders, baghouse, and other operating equipment at Antelope Mine. The Antelope Mine triennial emission inventory for 2017 was used to estimate direct particulate matter emissions for the Proposed Action at an estimated annual production rate of 30 Mtpy and at the maximum permitted annual production rate of 52 Mtpy. Particulate matter emissions for the Proposed Action and the State of Wyoming are tabulated in **table 4-1**. Compared to total Wyoming state emissions, the particulate emissions from the Proposed Action would be minor.

Table 4-1. Comparison of Direct to Wyoming Particulate Matter Emissions

	Proposed Action at 30 Mtpy (tons)	Proposed Action at 52 Mtpy (tons)	2017 Wyoming State Tier 1 (tons)	Anticipated % change to State Emissions from Proposed Action
$PM_{2.5}$	586	1,016	38,115	1.5% - 2.7%
PM_{10}	3,994	6,924	195,180	2.0% - 3.5%

Source: AC 2017, EPA 2019f

The most recent air quality modeling for the Antelope Mine was completed in 2012 (McVehil-Monnett 2012). While not current, the modeling conducted in 2012 provides sufficient information for the assessment of impacts since mining methods have not changed and the projected annual production is less than the annual production used in the 2012 modeling (52 Mtpy modeled versus 30 Mtpy proposed).

The 2012 PM_{10} inventory for the mining activities at Antelope Mine was prepared for years 2012-2035. Two years were then selected for worst-case dispersion modeling of PM_{10} based on mine plan parameters, emission inventories, and discussions with WDEQ-AQD. Fugitive emission sources and point sources were modeled using the Industrial Source Complex 3 Long-Term (ISCLT3) dispersion model, which is the model recommended by WDEQ guidance.

The worst-case years for evaluation were based on the highest modeled PM_{10} concentrations. The ISCLT3 model predicted no exceedances of the annual PM_{10} ambient air standard at a 52 Mtpy production rate. At the estimated average annual production rate of 30 Mtpy the particulate matter emissions from the Proposed Action would likely be less than those predicted in the model. The direct effects from particulate matter emissions resulting from the Proposed Action are expected to be minor compared to Wyoming state particulate emissions and moderate and short-term on the tract because modeled particulate matter emissions would be below the NAAQS and WAAQS thresholds. The air quality model did not model $PM_{2.5}$ emissions; however, the report noted that $PM_{2.5}$ concentrations would not approach NAAQS based on monitoring data in the PRB (McVehil-Monnett 2012). The effects of particulate matter emissions from coal combustion are included in **section 4.4.4**.

4.4.1.1.2 No Action Alternative

Impacts from particulate matter emissions have resulted from current mining activity and therefore under this alternative, particulate matter emission impacts in the area would be similar to those under the Proposed Action but would not be extended for an additional 0.5 year. Under the No Action Alternative approximately 283 tons of $PM_{2.5}$ and 1,930 tons of PM_{10} (proportion of emissions from mineable coal under the Proposed Action based on the **table 4-1**) would not be emitted.

4.4.1.2 Cumulative Effects

Concentrations of PM_{10} from monitoring samplers within the southern group of mines are presented in **table 4-2** for the 2014-2018 period. Results demonstrate that ambient concentrations of PM_{10} were generally within the 24-hour PM_{10} NAAQS/WAAQS standard of 150 $\mu g/m^3$. The table shows that a few exceptional events were reported in 2015 and 2016. At the time of this EA, the EPA has not made determinations of exceptional events for 2017 and 2018.

Table 4-2. PM_{10} Concentration Values (24-Hr, First Maximum Value - $\mu g/m^3$)

Location/Site Name/AQS Site ID	2014	2015	2016	2017	2018
Black Thunder Site 15/56-005-0015	**	**	79	114	98
Black Thunder Site 3/56-005-0875	52	75	22	45	40
Black Thunder Site 36/56-005-0891	85	143	*163*	155	179
Black Thunder Site 25/56-005-1877	33	79	**	**	**
Black Thunder Site 9/56-005-1915	55	70	**	**	**
School Creek SC-1/56-005-0084	62	96	67	108	88
School Creek SC-2/56-005-0087	113	151	*183*	143	123
School Creek SC-3/56-005-0086	171	154	127	119	77
NARM NA-9/56-005-0013	**	**	67	107	90
NARM RO-1/56-005-0869	104	*190*	*235*	187	292

** Indicates that the site was inactive.
Value in black italics denotes exceedances/exceptional events
Source: EPA 2019a

The 2012 model evaluated annual maximum PM_{10} emissions for years 2012-2035 resulting from mining activities at the southern group of mines (McVehil-Monnett 2012). Based on mine plan parameters and highest emissions inventories, the years 2014 and 2018 were selected as the worst-case years for evaluation, since those years had the highest modeled PM_{10} concentrations.

The results of the modeling are included in **table 4-3**. The model predicted no future exceedances of the annual PM_{10} WAAQS or NAAQS for the combined emissions at the southern group of mines. Based on the information included in **section 3.4.1.1**, the Antelope Mine would not cause or contribute to a violation of the annual PM_{10} WAAQS of 50 µg/m³.

Table 4-3. Annual PM_{10} Dispersion Modeling Results

Year	Modeled Concentration (µg/m³)	Background Concentration (µg/m³)	Total Concentration[1] (µg/m³)	WAAQS (µg/m³)
2014	26.50	12.50	39.00	50[2]
2018	36.80	12.50	49.30	50[2]

[1] The total includes modeled concentrations for the Black Thunder, School Creek, North Antelope Rochelle, and Antelope mines plus background.
[2] WAAQS standard only (no annual standard for NAAQS). Violation occurs with more than one expected exceedance per calendar year.
Source: McVehil-Monnett 2012

Background concentrations should capture PM_{10} emissions from nearby activities which would have a cumulative impact with the mine, but since the modeling was completed in 2012 the background would not include any additional activities since that time. The only activity that has occurred and is reasonably foreseeable is oil and gas development, which could increase short term particulate matter emissions.

The cumulative effects from particulate matter emissions are expected to be moderate and short-term because modeled PM_{10} emissions would be below NAAQS and WAAQS thresholds and would be extended by approximately 0.5 year.

4.4.1.3 Mitigation Measures

No mitigation measures beyond those required by the Antelope Mine air quality permit would be required for emissions of particulate matter. Air quality permit MD-13361 requires AC to operate and maintain all passive enclosure control systems and coal samplers. In addition, the permit requires AC to conduct weekly inspections of the truck dump control systems and demonstrate the effectiveness of the truck dumps using the methodology in 40 CFR § 60.255(h)(l)(i) and (ii) each calendar quarter. The air quality permit also requires treatment of haul roads and compliance with all commitments made in the quality assurance plan for the ambient particulate monitoring network.

4.4.2 Emissions of Nitrogen Oxides (NO_X) and Ozone (O_3)

4.4.2.1 Direct and Indirect Effects (Excluding Coal Combustion)

4.4.2.1.1 Proposed Action

Direct emissions from NO_x from the Proposed Action would include emissions generated from coal excavation and reclamation activities, tailpipe emissions from equipment, and fugitive emissions. The Antelope Mine triennial emission inventory for 2017 was used to estimate direct NO_x emissions for the Proposed Action. NO_x emissions for the Proposed Action and the State of Wyoming are tabulated in **table 4-4**. Actual NO_x emissions would be less than those provided in **table 4-4**, since the tract only includes 14.5 Mt of recoverable coal. Compared to total Wyoming state emissions, the direct NO_x emissions from the Proposed Action would be minor.

Table 4-4. Comparison of Direct to Wyoming NO_x Emissions

	Proposed Action at 30 Mtpy (tons)	Proposed Action at 52 Mtpy (tons)	2017 Wyoming State Tier I (tons)	Anticipated % change to State Emissions from Proposed Action
NO_x	3,706	6,424	144,241	2.6% - 4.5%

Source: AC 2017, EPA 2019f

As presented in **table 3-4**, NO_2 data collected at the currently active AQS monitoring sites in Campbell County and Converse County nearest to the Antelope Mine were below the NAAQS and WAAQS, which indicates that ambient air quality within the vicinity of the West Antelope II South Modification tract is currently in compliance with the NO_2 ambient air standard.

The 2012 air quality modeling for Antelope Mine included modeled results for NO_2 emissions for 2012 through 2035. The results of the modeling are included in **table 4-5**. The ISCLT3 model predicted no exceedances of the NO_2 ambient air standards at a 52 Mtpy production rate. At the estimated average annual production rate of 30 Mt, the NO_2 emissions from the Proposed Action would likely be less than those predicted in the model.

Table 4-5. Annual NO_2 Dispersion Modeling Results

Year	Modeled Concentration (μg/m³)	Background Concentration (μg/m³)	Total Concentration[1] (μg/m³)	NAAQS/ WAAQS (μg/m³)
2014	26.58	14.00	40.58	100
2018	35.07	14.00	49.07	100

[1] The total includes modeled concentrations for the Black Thunder, School Creek, North Antelope Rochelle, and Antelope mines plus background.

Source: McVehil-Monnett 2012

Indirect effects (excluding coal combustion) would include public exposure to NO_X emissions caused by surface mining operations. These effects would most likely occur along publicly accessible roads and highways that pass through the area adjacent to mining operations. Occupants of residences in the area could also be affected. The closest public transportation routes are State Highway 59, County Road 37 (Antelope Coal Mine Road) in Converse County, and Country Road 4 (Antelope Road) in Campbell County. The nearest occupied residence is approximately 1.5 miles west-southwest of the tract. There have been no reported events of public exposure to NO_2 from blasting activities at the Antelope Mine through December 2019 (Jones 2020).

The direct and indirect (excluding coal combustion) effects from NO_2 emissions resulting from the Proposed Action are expected to be moderate and short-term on the tract because modeled NO_2 emissions would be below the NAAQS and WAAQS thresholds.

As indicated in **section 3.4.1.2**, O_3 monitoring is not required by WDEQ-AQD at PRB mines but levels have been monitored at AQS monitoring sites in Campbell and Converse counties. No violations of the 8-hour O_3 NAAQS occurred from 2014-2018.

As stated above, there have been no reported events of public exposure to NO_2 from blasting activities at the Antelope Mine through December 2018 and there have been no violations of the NO_2 or O_3 ambient air standards in Campbell and Converse counties. Under the Proposed Action, coal recovery at the Antelope Mine would continue at an estimated annual rate of 30 Mt, which is less than the annual production rate that was used for modeling NO_x. While the results from ongoing monitoring show no violations of NO_X or O_3 NAAQS or WAAQS standards in Campbell and Converse counties, the slight potential for exposure to NO_X and O_3 emissions resulting from the Proposed Action would be moderate for NO_X and minor for O_3. The effects would be short term.

4.4.2.1.2 No Action Alternative

Impacts from NO_X and O_3 emissions have resulted from current mining activity and therefore the impacts related to NO_X and O_3 emissions under the No Action Alternative would be similar to those under the Proposed Action but would not be extended for an additional 0.5 year. Under the No Action Alternative, approximately 1,791 tons of NO_x would not be emitted (proportion of emissions from mineable coal under the Proposed Action based on **table 4-4**).

4.4.2.2 Cumulative Effects

The southern group of mines would contribute cumulative NO_X and O_3 emissions to the surrounding area. The 2012 model predicted that mining activities at the southern group of mines would not contribute to a violation of the NO_2 NAAQS or WAAQS (McVehil-Monnett 2012). Cumulative impacts from NO_X could be higher in the short-term in this area due to coal mining activities if surface inversion occurs in the southern portion of the PRB. This would be temporary, lasting only during the inversion. NO_X impacts would cease to occur after mining and reclamation are complete. As previously discussed, no exceedances of the O_3 standard have occurred at the AQS monitoring sites in Campbell or Converse counties.

Background concentrations should capture NO_X and O_3 emissions from nearby activities which would have a cumulative impact with the mine, but since the modeling was completed in 2012 the background would not include any additional activities since that time. The only activity that has occurred and is reasonably foreseeable is oil and gas development, which could increase short term NO_X and O_3 emissions.

Overall, the cumulative effects from NO_X and O_3 emissions would be moderate and short term.

4.4.2.3 Mitigation Measures

No mitigation measures beyond those required by the Antelope Mine air quality permit would be required for emissions of NO_X or O_3. The air quality permit limits the maximum coal production and requires AC to comply with the applicable requirements of 40 CFR Part 60, subparts for combustion engines.

4.4.3 Emissions of Sulfur Dioxide (SO_2), Mercury (Hg), Lead (Pb), and Other Non-Greenhouse Gases (Non-GHG)

4.4.3.1 Direct and Indirect Effects (Excluding Coal Combustion)

4.4.3.1.1 Proposed Action

Direct air emissions for SO_2, Hg, Pb, and other non-GHGs from the Proposed Action would include emissions generated from coal excavation and reclamation activities and tailpipe emissions from equipment. Indirect effects would include increased regional haze and decreased plant growth.

The Antelope Mine triennial emission inventory for 2017 was used to estimate direct SO2, Hg, Pb, and other non-GHG emissions for the Proposed Action. SO2, Hg, Pb, and other non-GHG emissions for the Proposed Action and the State of Wyoming are tabulated in **table 4-6**.

Table 4-6. Comparison of Direct to Wyoming SO_2 and Other Non-GHG Emissions

	Proposed Action at 30 Mtpy (tons)	Proposed Action at 52 Mtpy (tons)	2017 Wyoming State Tier I (tons)	Anticipated % change to State Emissions from Proposed Action
VOC	708	1,226	274,481	0.3% - 0.5%
HCOH	6.1	10.6	NA	-
CO	4,683	8,117	250,232	1.9% - 3.2%
SO_2	48.3	83.8	52,354	0.1% - 0.2%
Benzene	4.8	8.4	NA	-
Toluene	2.1	3.7	NA	-
Ethyl-Benzene	0	0	NA	-
Xylene	1.5	2.6	NA	-
N-Hexane	0.02	0.04	NA	-
Other HAPs	4.4	7.6	NA	-
Total HAPs	19.0	32.9	NA	-

Data presented in **section 3.4.1.2** show that SO_2 and Pb in Campbell and Converse counties are in compliance with applicable standards. Under the Proposed Action, coal recovery at Antelope Mine would continue at an estimated annual rate of 30 Mt. Because the direct emissions from the Proposed Action would be minor when compared to Wyoming state emissions and given the results of ongoing SO_2 and Pb monitoring in the area that show no exceedances of these parameters, the effects of emissions of SO_2 and Pb from the Proposed Action would be minor and short term.

The effects from Hg and other non-GHGs would be similar to current conditions under the Proposed Action. The EPA limits Hg from combustion facilities and the control mechanisms implemented have also been shown to reduce other non-GHG emissions.

4.4.3.1.2 No Action Alternative

Impacts from SO_2, Hg, Pb, and other non-GHG emissions have resulted from current mining activity and therefore the impacts related to SO_2, Hg, Pb, and other non-GHG emissions under the No Action Alternative would be similar to those under the Proposed Action but would not be extended for an additional 0.5 year. Under the No Action Alternative, approximately 23.3 tons of SO_2 would not be emitted (proportion of emissions from mineable coal under the Proposed Action based on **table 4-6**).

4.4.3.2 Cumulative Effects

The adjacent southern group of mines and nearby oil and gas development would contribute additional SO_2, Hg, Pb, and other non-GHG emissions to the surrounding area. Based on past monitoring, the permit modification request would not likely increase SO_2, Hg, Pb, and other non-GHG emission rates, although emissions would be extended by 0.5 year. While cumulative impacts from SO_2, Hg, Pb, and other non-GHGs could be higher in the short-term due to coal mining activities if surface inversion occurs in the southern portion of the PRB, this would be temporary, lasting only during periods of inversions. Air quality impacts from mining would cease to occur after reclamation is complete. Therefore, the cumulative effects from SO_2, Hg, Pb, and other non-GHG emissions are expected to be minor and short-term.

4.4.3.3 Mitigation Measures

No mitigation measures beyond those required by air quality permit MD-13361 would be required for emissions of SO_2, Hg, Pb, and other non-GHGs. Air quality permit requirements for emissions of SO_2, Hg, Pb, and other non-GHGs would be the same as those described in Section 4.4.2.3.

4.4.4 Air Quality Related Values (AQRVs)

4.4.4.1 Direct and Indirect Effects

4.4.4.1.1 Proposed Action

Visibility

All blasting would be conducted in compliance will all applicable local, state, and federal laws and regulations, including WDEQ-LQD Rules and Regulations, Chapter 6. All blasting operations are conducted under the direction of a certified blaster. The direct and indirect effects to visibility from blasting under the Proposed Action would be moderate and short term, since pollutants and particulates that effect visibility would be within the approved air quality permit MD-13361. Direct effects (excluding coal combustion) on visibility from the Proposed Action would be minor and short term.

Because WDEQ-LQD does not require the Antelope Mine to evaluate visibility impacts on Class I areas, the mine does not monitor visibility. Therefore, a direct comparison with the Wyoming standards is not possible. The impacts to visibility from mining the West Antelope II South Modification tract have been inferred from the long-term trend in visibility at the Wind Cave National Park. Since the long-term visibility has been stable, the indirect effects (excluding coal combustion) on visibility from the Proposed Action would be minor and short term.

Air Quality Related Values Related to Coal Combustion

Emissions that affect air quality also result from combustion of fossil fuels. **Table 4-7** presents the estimated 2019-2034 PM_{10}, $PM_{2.5}$, SO_2, NO_2, and Hg emissions from the combustion of coal mined at the Antelope Mine. The table presents the emissions based on the estimated annual production rate of 30 Mtpy and the maximum permitted production rate of 52 Mtpy. Using information from **table 4-7**, comparisons can be made between combustion emissions from coal mined at the Antelope Mine and emissions from coal mined in Campbell County and the U.S.

Table 4-7. Estimated Annual Emissions from Coal Combustion

Year	Mt Coal Recovered	PM_{10} (Tons)	$PM_{2.5}$ (Tons)	SO_2 (Tons)	NO_x (Tons)	Hg (Tons)
2020-2034 Estimated Annual Production Antelope Mine	30	6,706	2,045	123,674	47788	0.48
Annual Campbell County[1]	322	71,988	21,956	1,327,525	512,958	5.17
2020-2034 Average Percent of Campbell Co.	--	9.3	9.3	9.3	9.3	9.3
Total U.S. Coal Emissions (2017)	756	169,040	51,557	3,117,271	1,204,518	12.1
2020-2034 Average Percent of U.S.	--	4.0	4.0	4.0	4.0	4.0
2020-2034 Maximum Annual Production	52	11,625	3,545	214,368	82,832	0.83
Annual Campbell County[1]	322	71,988	21,956	1,327,525	512,958	5.17
2020-2034 Average Percent of Campbell Co.	--	16.1	16.1	16.1	16.1	16.1
Total U.S. Coal Emissions (2017)	756	169,040	51,557	3,117,271	1,204,518	12.1
2020-2034 Average Percent of U.S.	--	6.9	6.9	6.9	6.9	6.9

[1] Based on an estimated production of 322.0 Mt (average of 2014 through 2018 production).
Source: WWC 2019, calculations provided in **appendix F**.

Table 4-8 presents the estimated emissions from locomotive transport of coal mined at the Antelope Mine to power plants throughout the country for power generation.

Table 4-8. Estimated Annual Emissions (tons) from Locomotive Transport

Source	2020-2034	2020-2034
Mt Coal Transported	30	52
Average Rail Miles to Power Plant	1,099	1,099
CO	1,526	2,645
NO_X	10,256	17,777
PM_{10}	382	661
$PM_{2.5}$	370	642
SO_2	5.5	9.5
VOC	603	1,045

Source: WWC 2019, calculations are provided in **appendix F**

Impacts to air quality related to coal combustion under the Proposed Action would be similar to the conditions currently experienced at the Antelope Mine. When compared to Campbell County emissions, indirect effects from Antelope Mine-supplied coal-fired power plants would be moderate (approximately 9.3 percent of the Campbell County average emissions) and would be extended by approximately 0.5 year. When compared to emissions from Campbell County mines, indirect effects of coal combustion for the Proposed Action would be moderate and short term.

Acidification of Lakes

Antelope Mine is not required by WDEQ-AQD to monitor H_2S so a direct comparison to WAAQS standards is not possible. Because factors affecting H_2S emissions would not change as a result of the Proposed Action, the direct and indirect effects have been inferred from the currently permitted impacts of mining the existing coal leases at the Antelope Mine. As discussed in **section 3.4.1.3.3**, the pH trend at monitoring site WY99 appears to be relatively stable with values near the pH of normal rain. Based on this comparison of the current information available, the Proposed Action is not expected to contribute to increased direct or indirect effects from acidification of lakes.

4.4.4.1.2 No Action Alternative

Impacts to air quality related values have resulted from current mining activity and therefore the impacts related to AQRVs under the No Action Alternative would be similar to those under the Proposed Action but would not be extended by 0.5 year. Under the No Action Alternative approximately 3,241 tons of PM_{10}, 989 tons of $PM_{2.5}$, 59,776 tons of SO_2, 23,097 tons of NO_x, and 0.23 tons of Hg would not be emitted (proportion of emissions from mineable coal under the Proposed Action based on the **table 4-8**).

4.4.4.2 Cumulative Effects

Mines in Campbell County would affect the cumulative AQRVs. The air quality index (AQI) for Campbell County is used to evaluate the cumulative effects of the Proposed Action on AQRVs. As described by the AirNow website, the AQI provides an index of how clean or polluted the air is within an area and what associated health effects might be a concern (AirNow 2019). The AQI focuses on health affects experienced within a few hours or days after breathing polluted air. EPA calculates the AQI for five major air pollutants regulated by the CAA: ground-level ozone, particle pollution (also known as particulate matter), CO, SO_2, and NO_2. Ground-level ozone and airborne particles are the two pollutants that pose the greatest threat to human health. The

AQI evaluates air quality based on six levels (categories) that correspond to a different level of health concern (**table 4-9)**. The table shows that approximately 99.1 percent of the days in Campbell County between 2014 and 2018 were classified as having a good or moderate AQI and no days were classified as very unhealthy or hazardous.

Table 4-9. Average Annual Campbell County Air Quality Index Values

	Days With AQI	Good	Moderate	Unhealthy for Sensitive Groups	Unhealthy	Very Unhealthy	Hazardous
2014	365	262	102	1	0	0	0
2015	365	252	110	2	1	0	0
2016	366	262	103	1	0	0	0
2017	365	240	118	4	3	0	0
2018	365	266	95	2	2	0	0
Average	--	**256.4**	**105.6**	**2.0**	**1.2**	**0**	**0**
Percent of Total Average	--	70.2%	28.9%	0.5%	0.3%	0.0%	0.0%

Source: AirNow 2019

Blasting, coal crushing, loading and hauling of coal, moving equipment, and other activities associated with surface coal mining and the combustion of coal at power plants produce particulates that can be released into the air, which could impact AQRVs. The cumulative effects on AQRVs are expected to be minor and short-term because estimated emissions would be below the NAAQS and WAAQS thresholds and cumulative effects would only be extended by approximately 0.5 year.

4.4.4.3 Mitigation Measures

No mitigation measures beyond those required by air quality permit MD-13361 would be required to protect AQRVs. Air quality permit requirements would be the same as those described in Sections 4.4.1.3 and 4.4.2.3.

4.4.5 Greenhouse Gas Emissions

4.4.5.1 Direct and Indirect Effects

4.4.5.1.1 Proposed Action

OSMRE has elected to quantify direct and indirect GHG emissions and evaluate these emissions in the context of national GHG emission inventories based on 100-year and 20-year time horizons. Annual CO_2e emissions from combined sources based on annual coal recovered from 2014-2018 at the Antelope Mine were estimated in **section 3.4.1.4**. The same variables were used to calculate annual CO_2e emissions for 2020-2034. **Appendix E** provides the estimated CO_2e emissions for 2020-2034.

4.4.5.1.2 No Action Alternative

The impacts directly resulting from GHG emissions under the No Action Alternative would be less than those under the Proposed Action and would not be extended by approximately 0.5 year. Under the No Action Alternative approximately 25 MMT of CO_2e would not be emitted (proportion of emissions from mineable coal under the Proposed Action based on table 2 of **appendix E**).

4.4.5.2 Cumulative Effects

The analyses provided above include direct and indirect effects analysis for GHGs emissions. Due to the global nature of climate change and the difficulty therefore of predicting climate change impacts caused by an incremental increase in GHG emissions from specific actions separately or together, a separate cumulative impacts analysis for GHG emissions is not appropriate.

4.4.5.3 Mitigation Measures

As indicated in **appendix E**, a majority (approximately 99.7 percent) of the GHG identified in this EA are from non-mining activities, not controlled by Antelope Mine (e.g., rail transportation to and combustion at power plants). The DOI generally has no regulatory authority over GHG emissions from rail transportation and coal combustion. Air emissions, both direct and indirect, are regulated by other regulatory entities, including WDEQ-AQD (for emissions at the Antelope Mine) and other states' regulatory agencies (for emissions from out-of-state power plants), through permit limits. Given these facts, OSMRE has determined that no additional mitigation is required.

4.4.6 Climate Change Cause and Effect

4.4.6.1 Proposed Action/No Action Alternative

Although the effects of GHG emissions and other contributions to climate change in the global aggregate are estimable, it is currently not feasible to determine what effect GHG emissions in a specific area and resulting from a specific activity might have on climate change and the resulting environmental impacts.

Table 3 in **appendix E** shows that the estimated CO_2e emissions in the U.S. decreased by about 12 percent from 2005 to 2017, while the global estimated CO_2e emissions increased by about 19 percent from 2005 to 2015. Because CO_2 emissions have been declining in recent years and because CO_2 from coal mined at the Antelope Mine would remain near current levels, climate impacts associated with direct/indirect emissions from West Antelope II South Modification tract mining, transportation, and combustion would be moderate but short term (0.5 year).

4.4.6.1.2 No Action Alternative

The impacts from GHG emissions under the No Action Alternative would be similar to those under the Proposed Action but would not be extended by approximately 0.5 year. The annual CO_2e emissions would decrease by approximately 25 MMT (proportion of emissions from mineable coal under the Proposed Action based on table 2 of **appendix E**) as a result of the No Action Alternative, based primarily on 0.5 fewer year of combustion of Antelope Mine coal.

4.4.6.2 Cumulative Effects

Cumulative climate change effects from future coal mining and coal combustion are difficult to quantify due to market and regulatory forces that affect the amount of coal produced and the use of coal for U.S. electricity generation. For example, recent increasing supplies of natural gas has led to a decline in the cost of natural gas, making coal less competitive. In addition, regulatory conditions have also affected the coal industry (Wyoming Mining Association 2018). As a result, U.S. electricity generation from coal-fired power plants has declined and is expected to continue to decline. From 2005 to 2017, GHG emissions from U.S. power plants decreased by about 12 percent. Additional discussion on cumulative effects of climate change cause and effect is provided in **appendix E**.

NEPA does not require a cost-benefit analysis (40 C.F.R. § 1502.23) or the presentation of the social cost of carbon estimates; therefore, that analysis was not undertaken in this EA. Without a complete monetary cost-benefit analysis, which would include the social benefits of energy production to society as a whole and other potential positive benefits, inclusion solely of an AC analysis would be unbalanced, potentially inaccurate, and not useful.

Given the uncertainties associated with assigning a specific and accurate social cost of carbon estimate resulting from 0.5 additional year of operation under the mining plan modification, and that the social cost of carbon protocol and similar models were developed to estimate impacts of regulations over long time frames, this EA quantifies direct and indirect GHG emissions and evaluates those emissions in the context of Wyoming, U.S. and global GHG emission inventories, as discussed in **section 4.4.6.1**.

4.4.6.3 Direct and Indirect Cumulative Effects on the Proposed Action/No Action

Climate impacts and trends tend to be realized at local levels but a lack of reliable projections of climate change at the local level remains an impediment (U.S. Global Change Research Program 2018). Therefore, the direct and indirect effects on the Proposed Action/No Action Alternative related to climate change will be discussed on a regional (county and state) scale. A discussion of representative concentration pathways (RCP) is provided in **appendix E**. The potential climate change impacts for the State of Wyoming and Campbell and Converse counties evaluated by the USGS are included in **table 4-10**.

Table 4.10. Potential Climate Change Impacts

Climate Indicator Variable	Wyoming	Campbell County	Converse County
Maximum Temperature Departure (˚F) – RCP4.5	2.9	3.1	3.1
Maximum Temperature Departure (˚F) – RCP8.5	3.2	3.4	3.4
Minimum Temperature Departure (˚F) – RCP4.5	2.9	2.9	2.7
Minimum Temperature Departure (˚F) – RCP8.5	3.2	3.2	3.2
Precipitation Departure (Inches) – RCP4.5	0.0	0.0	0.1
Precipitation Departure (Inches) – RCP8.5	0.0	0.0	0.0
Runoff Amount Departure (Inches/month) – RCP4.5	0.0	0.0	0.0
Runoff Amount Departure (Inches/month) – RCP8.5	0.0	0.0	0.0
Snow Water Equivalent Departure (Inches) – RCP4.5	-0.2	0.0	-0.1
Snow Water Equivalent Departure (Inches) – RCP8.5	-0.3	0.0	-0.1
Soil Water Storage Capacity Departure (Inches) – RCP4.5	0.0	0.0	0.0
Soil Water Storage Capacity Departure (Inches) – RCP8.5	0.0	0.0	0.0
Evaporation Deficit Departure (Inches/month) – RCP4.5	0.2	0.2	0.2
Evaporation Deficit Departure (Inches/month) – RCP8.5	0.2	0.2	0.2

Source: USGS 2019

Since the Proposed Action would extend the Antelope Mine LOM 0.5 year, the Proposed Action would not contribute to the full extent of these potential climate change impacts. However, for analysis purposes, this EA assumes that the maximum impacts would be realized during the LOM.

Hydrology

The potential changes to the annual snowfall, precipitation levels, and streamflow could impact area surface water body levels, groundwater recharge, and soil erosion. Considering the overall climate change timeframe of centuries, it is possible that decreased snowpack may be observable locally. The potential climate change impact predictions in **table 4-10** indicate that precipitation and runoff would not likely change as a result of climate change through 2034. Overall, the Proposed Action would have moderate, short-term impacts to surface water bodies and groundwater; however, the impact from changes to these resources based on climate change would be negligible and long term.

Soils

The Proposed Action would involve new surface disturbance of approximately 879.5 acres. As described in **section 4.8.1.1**, the direct and indirect effects related to the Proposed Action to soils would be moderate and short-term. The USGS climate viewer does not predict any annual mean changes to runoff so erosion impacts from climate changes on soils would be negligible.

The post-reclamation land use would be wildlife habitat and livestock grazing, consisting of vegetation cover of grasses and shrubs. Potential changes to the natural environment, as listed above, could result in the need to consider different plant species during reclamation to account for the higher temperatures and increased precipitation levels. WDEQ-LQD regulates surface coal mining operations, including the surface effects on federal lands within the State of Wyoming. Federal coal leaseholders in Wyoming are required to submit a PAP to OSMRE and WDEQ-LQD for any proposed revisions to reclamation operations on federal lands in the state. Therefore, any change to reclamation practices (i.e., seed mix) at the Antelope Mine would require the approval of WDEQ-LQD. Reestablishment of wildlife and vegetation in areas that have been disturbed is reliant on the reclamation process. Climate change impacts to wildlife and vegetation in reclaimed areas would be long term.

4.5 Water Resources

4.5.1 Groundwater

4.5.1.1 Direct and Indirect Effects

4.5.1.1.1 Proposed Action

The direct and indirect effects to groundwater would be the same as those described in section 3.5.1.2.1 of the 2008 WAII EIS. The general impacts to groundwater as a result of surface coal mining include the following:

1. The removal of the coal aquifer and any overburden and alluvial aquifers within the areas that are mined and the replacement of these aquifers with backfilled overburden material.
2. The lowering of static water levels in the coal and overburden aquifers around the mine due to dewatering associated with removal of these aquifers within the mine boundaries. The reduction in static water levels would be long-term, but not permanent, and recharge to the backfill and adjacent undisturbed aquifers would occur after mined areas are reclaimed.
3. Other groundwater impacts that may or may not occur, or may occur only at specific locations, include changes in water quality (usually deterioration) outside the area that is mined and reclaimed. This would result from communication between the reclaimed aquifer and the unmined aquifer, and changes in recharge-discharge conditions and/or groundwater flow patterns.

Under the Proposed Action additional alluvium, overburden, and Anderson and Canyon coal aquifers would be removed in the West Antelope II South Modification tract during the mining process. These aquifers would be replaced with backfilled overburden materials. The physical characteristics of the reclaimed backfill material would be dependent upon premining overburden lithology.

The Proposed Action would not remove alluvial deposits associated with Antelope Creek since there would be a 100-foot buffer adjacent to the Antelope Creek, as required in Permit No. 525.

Mining in the tract would extend the duration and physical extent of drawdown in the overburden within the Antelope Mine. Monitoring well data used in the 2014 CHIA-35 indicate that predicted drawdown in the overburden aquifer often lie within the permit areas but may extend one-half to one mile from the mine pit. West of the mine pit, the overburden groundwater gradients follow the general topography.

Under the Proposed Action, the duration and physical extent of drawdown in the Anderson and Canyon coal aquifers would also be extended. In 2015, drawdown within the Anderson and Canyon seam aquifer was modeled to determine the extent of drawdown. The modeling included contiguous areas east of the West Antelope II South Modification tract. The extent of drawdown (5-foot contour) in the Anderson and Canyon coal aquifers is depicted in **map 4-1**. Groundwater data from the Anderson and Canyon coal aquifers would continue to be monitored in accordance with the Permit No. 525 groundwater monitoring program and included in the annual reports submitted to WDEQ-LQD. Antelope Mine would update the extent of drawdown as mining continues.

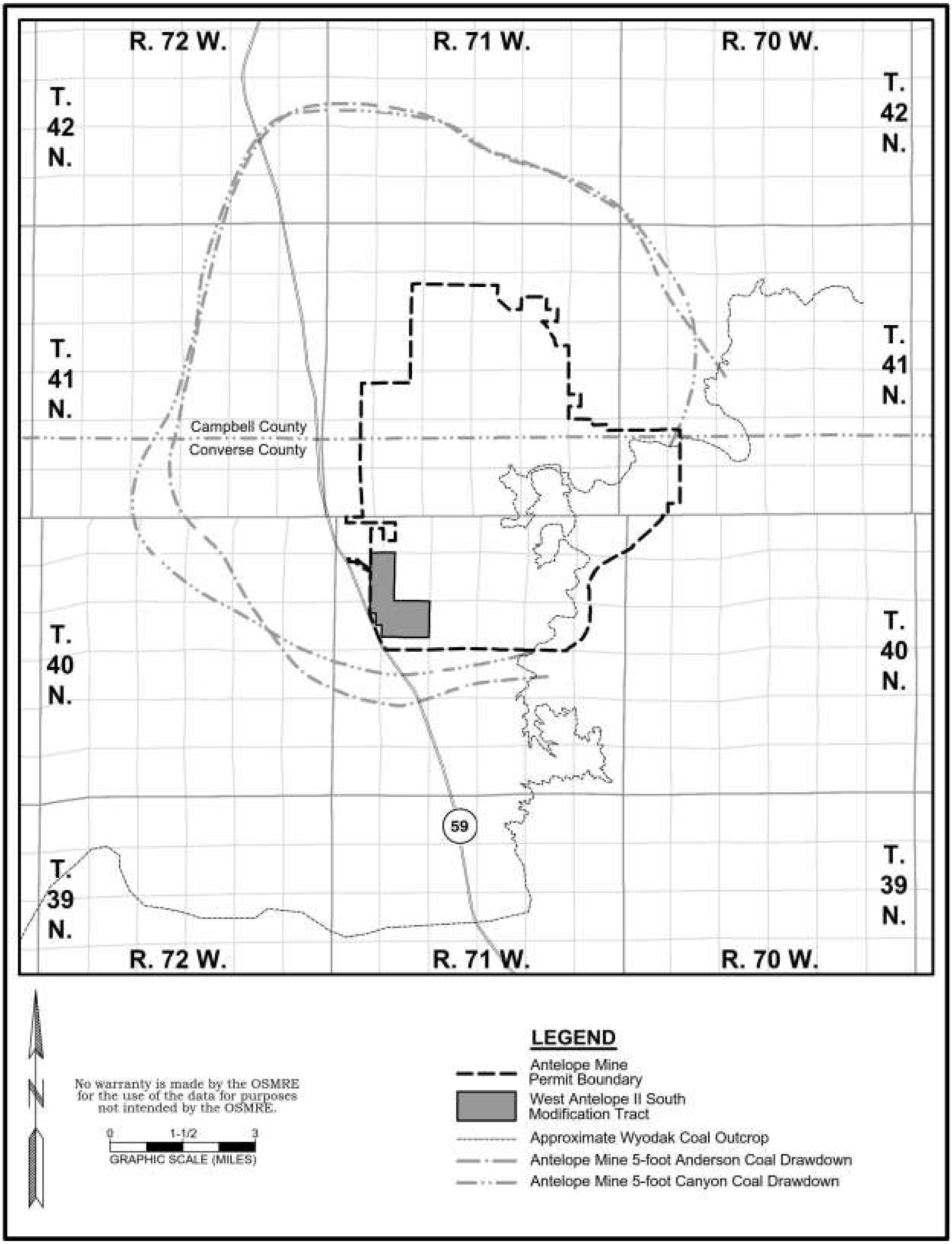
In the 2014 CHIA-35, water levels from 50 monitoring wells were used to characterize groundwater levels in the backfill aquifer. Since most of the wells were located in close proximity to the clinker aquifer and streams (both significant recharge sources), the recovery rates and trends observed cannot be approximated for the entire backfill aquifer. This is consistent with **section 3.5.1**, which indicated that water levels are attributed to the proximity to and recharge from the alluvium of Antelope, Spring, and Horse creeks, as well as, variation in annual precipitation.

The underlying Tullock Member of the Fort Union Formation would not be physically disturbed by mining activities due to the depths. The wells completed in these formations for water supply purposes would continue to be used under the Proposed Action. Impacts would not increase from current conditions; however, the duration and physical extent of drawdown resulting from withdrawals from water supply wells in the Tullock Member of the Fort Union Formation would be extended by 0.5 year.

Overall, the direct and indirect effects to groundwater resources resulting from the Proposed Action would be moderate and long-term due to aquifer removal. Impacts would not increase from current conditions; however, the duration and physical extent of drawdown in the overburden and Anderson and Canyon coal aquifers would be extended. Backfill water levels and groundwater quality indicate that the groundwater would meet WDEQ-WQD Class III standards for livestock use.

4.5.1.1.2 No Action Alternative

Impacts to groundwater under the No Action Alternative would be similar to those under the Proposed Action, but the aerial extent of groundwater aquifer removal would be reduced by approximately 879.5 acres. Impacts to overburden and coal aquifers have already occurred within the West Antelope II South Modification tract related to coal recovery on adjacent federal coal leases, ongoing mining activities at nearby mines, and CBNG recovery. Under the No Action Alternative, the duration of impacts to groundwater would not be extended.



Map 4-1. Modeled Drawdown for the Anderson and Canyon Coal Seams

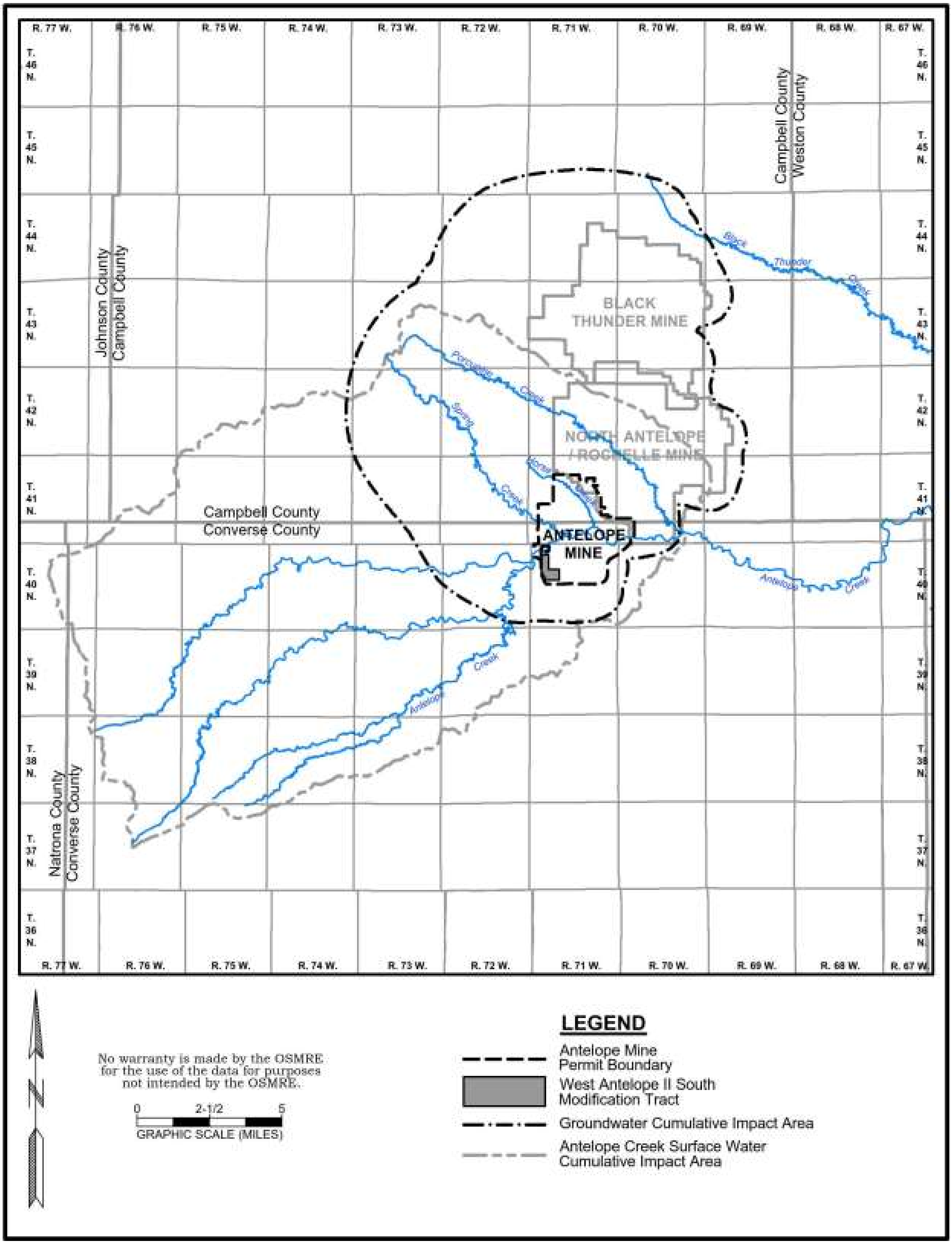
4.5.1.2 Cumulative Effects

The 5-foot drawdown area was selected as the cumulative impact area (CIA) for groundwater since this limit would detect the extent of minor groundwater impacts. This area corresponds to the CIA utilized in the 2014 CHIA-35. The 2014 CHIA-35 analyzed the Anderson and Canyon coal seams as a single unit referred to as the Wyodak-Anderson coal. The area delineated by the maximum cumulative 5-foot drawdown contour in the Wyodak-Anderson coal aquifer for the southern group of mines is included on **map 4-2**. The effects of removal of the coal and overburden aquifers and replacing them with backfilled overburden are the foremost groundwater concern regarding cumulative effects. Mining the tract would increase the cumulative size of the backfill area in the southern group of mines. The extent of water level drawdown in the coal and shallower aquifers in the area surrounding the mines also would be expected to increase slightly as a result of mining the West Antelope II South Modification tract and from dewatering the active mine pits. Where the effects of pumping from the southern group of mines overlap, additional water level declines would result from concurrent operations.

The 2014 CHIA-35 indicates that few to none of the impacts to the alluvial aquifer are cumulative in nature as the individual mines tend to impact different sections of discrete alluvial sediments. In addition, the 2014 CHIA-35 states that cumulative impacts caused by mining of the overburden aquifer would be limited as the sandstone units are thin, discontinuous, and interbedded with claystones and siltstones. Based on the current available data, the model predictions by the mines, and the area geology, it is expected that the cumulative impacts caused by mining on the overburden would be minimal.

Mining impacts to groundwater levels in the Wyodak-Anderson coal aquifer are more extensive than the overburden since the coal seams are mined out and the hydraulic conductivity of the coal aquifer is higher than the overburden and underburden aquifers. As described in the 2014 CHIA-35, CBNG dewatering had more impact on water levels during 2002-2006. If the present trend of CBNG dewatering continues, it is conceivable that the CBNG effects on groundwater in the Wyodak-Anderson coal aquifer would decline over the next several years and the coal mining impacts would be more distinguishable. The 2014 CHIA-35 concluded that the impacts on groundwater levels and groundwater quality in the Wyodak coal aquifer are expected to be minimal and the coal aquifer would be able to support livestock use. The 2014 CHIA-35 included groundwater quality data for 2010 to 2012 from 29 deeper backfill aquifer wells from the southern group of mines and indicated that from the available data, it is difficult to assess, interpret, and predict the groundwater quality of the deeper backfill with a single hypothesis. It is generally expected that over time the backfill would be flushed by groundwater flowing through the reclaimed material and down gradient to the northwest to the native undisturbed aquifers. Thus, the water quality in the backfill is expected to improve over time. The time to flush backfill and improve the water quality varies considerably based on the permeability of the backfill and groundwater flow rates in the aquifers.

Based on the predictions from the mines and the observed data, it is expected that the backfill aquifer would be a viable supply source to support the WDEQ-LQD approved postmining land use of livestock and wildlife. This is consistent with **section 3.5.1**, which indicated that the groundwater quality within the backfill wells have water quality that meet WDEQ-WQD Class III standards for livestock use, with the exception of two wells. Outside the southern group of mine permit boundaries the backfill aquifer is not present and the native existing aquifers would remain structurally undisturbed.



Map 4-2. Cumulative Impact Area for Potential Surface Water and Groundwater Impacts

The 2014 CHIA-35 states that the drawdown observed near the pits is a good indicator of the maximum drawdown caused by coal mining in the underburden aquifer. Outside of the mined areas, the aquifers overlying the underburden aquifer would remain structurally undisturbed. In addition, the relatively lower hydraulic conductivity of the underburden aquifer supports that coal mining would have limited cumulative effects on the underburden groundwater system and these effects would decline with increasing distance from the coal mine permit boundaries to the west.

The cumulative effects of mining on groundwater levels are being reduced as reclamation progresses and as the backfill aquifer saturates. In addition, backfill water quality would be generally suitable for livestock use and wildlife habitat, which are the planned postmining land uses. Therefore, cumulative effects to groundwater resources resulting from the Proposed Action are expected to be moderate and long term.

4.5.1.3 Mitigation Measures

W.S. 35-11-415(b)(xii) requires surface coal mines to replace any domestic, agricultural, industrial, or any other legitimate use groundwater supplies if, as a result of mining, a supply is diminished, interrupted, or contaminated, to the extent of precluding use of the water. The WDEQ-LQD requires surface coal mine permittees to enhance or restore the hydrologic conditions of disturbed land surfaces and minimize adverse impacts to the hydrologic balance. The recharge capacity of the reclaimed lands would be restored to a condition that minimizes disturbance to prevailing hydrologic balance in the permit area and in adjacent areas (WDEQ-LQD 2012).

Under provisions of Permit No. 525, Antelope Mine is required to monitor water levels and water quality in the alluvium, overburden, coal, interburden, underburden, and backfill (AC 2019b). Operational groundwater monitoring programs are dynamic and modified through time as wells are removed by mining, discontinued from monitoring to eliminate redundancy, or added to replace those removed by mining and to facilitate monitoring of future mine expansion areas as mining has progressed. Additional wells have also been installed in the reclaimed backfill to monitor recovering, postmine groundwater conditions. Many groundwater monitoring wells installed by Antelope Mine within and around its current permit area have been used to evaluate groundwater conditions associated with the mine and continue to be monitored to reveal a long term record of groundwater conditions. After the completion of reclamation, a large groundwater monitoring network would remain. This would include not only backfill wells, but also a number of coal, overburden, and alluvial wells in undisturbed areas.

4.5.2 Surface Water

4.5.2.1 Direct and Indirect Effects

4.5.2.1.1 Proposed Action

Additional discussions regarding surface water impacts can be found in section 3.5.2.2.1 of the 2008 WAII EIS. Additional discussions can also be found in the Surface Water portion of the 2014 CHIA-35.

Under the Proposed Action, changes in surface runoff characteristics and sediment discharges would occur because of the mining and reconstruction of drainage channels as mining progresses and because of the use of sediment control structures used to manage discharges of surface water from the mine permit areas. Since the tract would be mined as an extension of the existing Antelope Mine there would not be a significant increase in the size of the area that is disturbed at any given time due to contemporaneous reclamation practices. Reclamation would be ongoing and concurrent with mining.

Under the Proposed Action, the 100-foot buffer along Antelope Creek would limit disturbance and allow drainage. In WDEQ Coal Rules and Regulations, Chapter 1, Section 2(cd), WDEQ-LQD defines material damage to the hydrologic balance as a significant long-term or permanent adverse change to the hydrologic regime (WDEQ-LQD 2014c). WDEQ-LQD Coal Rules and Regulations require surface coal mine permittees to enhance or restore the hydrologic conditions of disturbed land surfaces and minimize adverse impacts to the hydrologic balance (WDEQ-LQD 2012). Based on this and the buffer along Antelope Creek, the direct and indirect effects to surface water are expected to be moderate until final bond release has been obtained.

4.5.2.1.2 No Action Alternative

The impacts to surface water under the No Action Alternative would be similar to those under the Proposed Action because impacts to surface water features have already occurred within the tract related to coal recovery on adjacent federal coal leases, as approved by Permit No. 525. Under the No Action Alternative surface water impacts would be reduced by 0.5 year.

4.5.2.2 Cumulative Effects

The surface water CIA (**map 4-2**) includes the entire Antelope Creek drainage area upstream from USGS Station No. 06364700. The CIA is the area where existing and proposed mining activities may cause measurable changes to the hydrologic environment depending on the characteristics of the surface systems. The 2014 CHIA-35 analyzed the cumulative mining related impacts to surface water resources within Antelope Creek and concluded that there is little change in streamflow in Antelope Creek and that groundwater/surface water interchange has a minor impact on the overall surface flows in Antelope Creek. Precipitation, losses to evaporation, and recharge to the alluvium after the alluvial aquifer had been depleted by transpiration during the summer months are the exception. Therefore, the cumulative effects to surface water are expected to be minor.

4.5.2.3 Mitigation Measures

During mining surface runoff would be controlled by a series of detention berms, diversion ditches, and sedimentation ponds. All necessary hydrologic control facilities would be constructed according to applicable state and federal requirements. All mining related surface water discharges are permitted under a Wyoming Pollutant Discharge Elimination System (WYPDES) program under Permit No. WY0030198, which requires treatment, monitoring, and reporting of all surface discharges.

Permit No. 525 requires AC to reestablish the essential hydrologic functions and hydrologic balances as they existed prior to mining within the permit area. AC would restore runoff and flow characteristics of the reclaimed area to essentially pre-mining conditions. This objective will be accomplished by reestablishing the surface drainage pattern similar to pre-mining conditions and restoring stock water impoundments for which water rights exist. Restoration of Antelope Creek would be limited as a result of the buffer zone. In addition, a number of postmining impoundments would be constructed to replace premining features and to provide opportunities for stock and wildlife watering.

4.5.3 Water Rights

4.5.3.1 Direct and Indirect Effects

4.5.3.1.1 Proposed Action

Impacts to water rights would be the same as those described in section 3.5.3.2.1 of the 2008 WAII EIS. Antelope Mine currently holds the majority of the water rights within 2-miles of the tract.

As stated in section 3.5.3.2.1 of the 2008 WAII EIS, some privately permitted water wells in the vicinity of the West Antelope II South Modification tract have been or would likely be impacted (either by removing the well or by water level drawdown) by mining. Although additional water wells could be affected, under the Proposed Action it is unlikely that any privately permitted water wells would be impacted by water level drawdown to a greater extent than they currently are, although the duration of impacts would be extended.

No changes in normal peak flows downstream of the Antelope Mine is expected under the Proposed Action, since runoff is currently being controlled as a result of mining unrelated to the tract and the 100-foot buffer along Antelope Creek. Therefore, it is unlikely that any of the privately permitted surface water rights would be impacted by removal of surface water features within the tract.

In general, the Proposed Action would contribute to additional, more extensive, mining disturbance that may impact groundwater and surface-water rights in the Antelope Mine permit area. Impacts to groundwater and surface-water rights have already occurred from mining within the Antelope Mine and implementation of the Proposed Action would have negligible effect on increasing the magnitude of impacts. Therefore, the Proposed Action would not result in substantial declines in the groundwater or surface water availability for livestock use and wildlife habitat. Under the Proposed Action impacts to groundwater and surface water rights would be minor and long term.

4.5.3.1.2 No Action Alternative

The impacts to surface and groundwater rights under the No Action Alternative would be similar to those under the Proposed Action since impacts to groundwater and surface water rights have already occurred within the tract related to coal recovery on adjacent federal coal leases. Under the No Action Alternative these impacts would be reduced by 0.5 year.

4.5.3.2 Cumulative Effects

The CIA for water rights impacts are the same as those described above for groundwater and surface water. The type and number of groundwater and surface-water rights within 2 miles of the tract are discussed in **section 3.5.3**. While the approval of the federal mining plan modification request would contribute to additional, more extensive mining disturbance in the southern group of mines, there would be minor additional cumulative water rights impacts because groundwater systems have already been affected by CBNG removal and ongoing mining and because runoff is currently being controlled by the mines. In addition, as discussed in **section 4.5.1.3**, W.S. 35-11-415(b)(xii) requires that mines replace, in accordance with state law, the water supply of an owner of interest in real property, who obtains all or part of his supply of water for domestic, agricultural, industrial, or any other legitimate use from an underground or surface source where the supply has been affected by contamination, diminution, or interruption resulting from the surface coal mine operation.

4.5.3.3 Mitigation Measures

Permit No. 525 requires AC to contact the owners of these groundwater and surface water appropriations prior to disturbance and will, if necessary, negotiate replacement of or compensation for any appropriated water rights that will be destroyed or diminished in quantity or quality by the mining operation (AC 2019b). Generally, this compensation will consist of drilling the appropriator a deeper well outside the mine disturbance area.

4.6 Alluvial Valley Floors

4.6.1 Direct and Indirect Effects

4.6.1.1 Proposed Action

The direct and indirect effects to AVFs would not be different from those described in section 3.6.2.1 of the 2008 WAII EIS. Since the AVFs on Antelope Creek are protected by a 100-foot buffer, there would be no direct and indirect effects to AVFs.

4.6.1.2 No Action Alternative

The impacts to AVFs associated with existing approved mining would continue to occur; therefore, implementation of the No Action Alternative would have a minor effect on AVFs.

4.6.2 Cumulative Effects

The cumulative effects to AVFs would not be significantly different than those described in section 4.2.5 of the 2008 WAII EIS. Areas outside of the permitted mines have generally not been surveyed for the presence of AVFs; therefore, the locations and extent of the AVFs outside of the mine permit areas have not been determined. The cumulative effects on AVFs are expected to be negligible.

4.6.3 Mitigation Measures

To ensure that AVF areas are not disturbed, AC would mark the areas with signs, prior to mining related disturbance.

4.7 Wetlands/Aquatic Features

4.7.1 Direct and Indirect Effects

4.7.1.1 Proposed Action

The direct and indirect effects to wetlands would not be different from those described in section 3.7.2.1 of the 2008 WAII EIS. Follow-up wetlands delineations and USACE determinations have shown that there are no jurisdictional wetlands and only 4.8 acres of aquatic features within and adjacent to the West Antelope II South Modification tract. The Proposed Action would result in the loss of approximately 1.6 acres of aquatic features since approximately 3.2 acres are associated with Antelope Creek, which would have a 100-foot disturbance buffer. Disturbed non-jurisdictional aquatic features would be replaced during the reclamation phase of mining. The direct and indirect effects to aquatic features are expected to be minor and short term.

4.7.1.2 No Action Alternative

Under the No Action Alternative impacts to non-jurisdictional aquatic features would be the same as the Proposed Action, but reduced by 1.6 acres.

4.7.2 Cumulative Effects:

Disturbed jurisdictional and non-jurisdictional features would be restored as required by the authorized federal, state, or private surface landowner, as specified in the mining permits, which are approved by WDEQ-LQD before mining operations would be conducted. Therefore, there would be no net loss of jurisdictional and non-jurisdictional features and cumulative impacts would be negligible.

4.7.3 Mitigation Measures

Disturbed non-jurisdictional aquatic features would be restored as required by the authorized federal, state, or private surface landowner, as specified in the mining permit, which are approved by WDEQ-LQD before mining operations commence.

4.8 Soil

4.8.1 Direct and Indirect Effects

4.8.1.1 Proposed Action

The direct and indirect effects to soils would not be different from those described in section 3.8.2.1 of the 2008 WAII EIS. Soils within the West Antelope II South Modification tract would be altered under the Proposed Action. Following reclamation, the replaced topsoil should support a stable and productive native vegetation community adequate in quantity and quality to support planned postmining land uses (i.e., livestock use and wildlife habitat). The direct and indirect effects related to the Proposed Action to soils would be moderate (879.5 acres of disturbance) and short term.

4.8.1.2 No Action Alternative

The impacts to soils under the No Action Alternative would be similar to those under the Proposed Action although the impacts to approximately 879.5 acres to recover federal coal within the tract would not occur.

4.8.2 Cumulative Effects

The cumulative impacts to soils would not be significantly different than those described in section 4.2.6 of the 2008 WAII EIS. According to the 2014 CHIA-35, from 2011-2013, the LOM disturbed acreage at the southern group of mines totaled approximately 61,366 acres. Of this total, approximately 31 percent was actively mined, 22 percent was in long-term mining or reclamation facilities, and 47 percent had been backfilled and graded. Areas within active mines are progressively disturbed and would progressively be reclaimed by planting appropriate vegetation species to restore soil productivity and prevent soil erosion. The cumulative effects related to soils would be moderate and short-term.

4.8.3 Mitigation Measures

Suitable soil would be salvaged and stockpiled for use in reclamation. Sediment control structures would be built to trap eroded soil and revegetation would reduce wind erosion. Antelope Mine would replace all salvaged topsoil in a manner which ensures successful revegetation and supports the postmining land uses. Regraded overburden would be sampled to verify suitability as subsoil for compliance with root zone criteria as specified by WDEQ-LQD Guideline No. 1A (Topsoil and Subsoil) (WDEQ-LQD 2015). Unsuitable materials would be removed and either treated, reblended, or replaced with the required depth of suitable overburden material or the affected area would be capped such that a minimum of the required depth of suitable material exists.

4.9 Vegetation

4.9.1 Direct and Indirect Effects

4.9.1.1 Proposed Action

The direct and indirect effects to vegetation would not be different from those described in section 3.9.2.1 of the 2008 WAII EIS. Direct effects associated with the removal of vegetation from the West Antelope II South Modification tract would include increased soil erosion and habitat loss for wildlife and livestock. The Proposed Action could also cause the spread of invasive species and noxious weed populations within the West Antelope II South Modification tract. During construction, increased soil disturbance and higher traffic volumes could stimulate the introduction and spread of undesirable and invasive, non-native species. Non-native species often out-compete desirable species, rendering an area less productive as a source of forage for livestock and wildlife.

Indirect effects on reclaimed lands would include loss of habitat for some wildlife species as a result of reduced plant species diversity, particularly big sagebrush. However, grassland-dependent wildlife species and livestock would benefit from the increased grass cover and production. As discussed in **section 3.9.1**, the Ute ladies'-tresses, which is listed as threatened, is the only plant T&E wildlife species with the potential of occurring in the area. This species was not located within the tract during surveys and there are no critical habitats for this T&E species within the West Antelope II South Modification tract.

Reclamation, including revegetation, would occur contemporaneously with mining on adjacent lands (i.e., reclamation would begin after an area is mined). To support the same type of land use by livestock and wildlife after completion of mining, AC would use seed mixes and seeding techniques oriented toward the restoration of upland grassland communities capable of sustained grazing and lowland drainage area grass communities providing winter forage along with special erosion protection. Reestablished vegetation would be dominated by species mandated in the reclamation seed mixtures (to be approved by WDEQ-LQD). AC would apply fertilizer to permanent revegetation areas during the first growing season, as the need is indicated by the topsoil nutrient sampling program. Livestock grazing would be excluded from reclaimed areas for at least two growing seasons following seeding and all revegetated areas would be regularly monitored to determine the need for weed control. The direct and indirect effects related to the Proposed Action on vegetation would be moderate and short term.

4.9.1.2 No Action Alternative

The impacts to vegetation under the No Action Alternative would be similar to those under the Proposed Action although the impacts to approximately 879.5 acres to recover federal coal would not occur.

4.9.2 Cumulative Effects

Cumulative effects would be similar to those described in **section 4.8.2**. The overall contribution of vegetation impacts to cumulative effects would be minor due to the localized effects and the improved productivity on mined lands that have been reclaimed.

4.9.3 Mitigation Measures

Antelope Mine monitors revegetated areas for noxious weeds for a period of at least five years after initial seeding (AC 2019b). Control measures may include cultural, mechanical or chemical treatments and will be evaluated for the most effective, economical method. Specific weed control problems are discussed with the district office of the Wyoming Weed and Pest Control Unit prior to initiation of any action for weed control. If extensive control on reclaimed lands becomes necessary, the program will be submitted to the WDEQ and the USDA - Forest Service for review prior to implementation. Any herbicide use is reported in the Annual Report. Revegetation success would be evaluated until the final reclamation bond is released.

4.10 Wildlife

The direct and indirect effects to wildlife would not be different from those described in section 3.10.1.2 of the 2008 WAII EIS and section 4.1.1 of the 2014 WAII South EA. Impacts to wildlife that would result from mining the West Antelope II South Modification tract have been addressed by the WGFD and WDEQ-LQD when Permit No. 525 was amended to include the tract.

The environmental consequences related to mining the tract for big game, other mammals, upland game birds (excluding the GRSG), other birds, amphibians, reptiles, and aquatic species are not significantly different than those presented in the 2008 WAII EIS and are not presented herein. Updated discussions for raptors, GRSG, T&E species, and SOSI are included below.

4.10.1 Raptors

4.10.1.1 Direct and Indirect Effects

4.10.1.1.1 Proposed Action

Intact raptor nests are located within the tract. Long-term data demonstrate that many raptors nesting in the Antelope Mine raptor monitoring area have developed a high tolerance to mine-related disturbances. Several raptor pairs from at least four different species have illustrated this acceptance by repeatedly nesting in the permit area despite ongoing and/or encroaching mine operations. Based on AC's approved plans and procedures in place to reduce impacts to raptors, the direct and indirect effects related to the Proposed Action on site-specific raptors would be moderate and short term.

4.10.1.1.2 No Action Alternative

Under this alternative, disturbance related impacts to raptors in the area would continue, but the duration of impacts would be reduced by approximately 0.5 year.

4.10.1.2 Cumulative Impacts

The cumulative effects related to the Proposed Action on regional raptor populations would be moderate and short term.

4.10.1.3 Mitigation Measures

AC's general reclamation practices for establishing or enhancing post-mine wildlife habitat are described in the Reclamation Plan of Permit No. 525. AC has developed plans and procedures to minimize impacts to nesting raptors and ensure proper reclamation techniques are implemented to enhance habitat in the postmine landscape for raptors and their primary prey species. In addition, AC has worked with the USFWS and the Migratory Bird Permit Office in Denver, CO, to mitigate the take of avian species protected under the MBTA and Bald and Golden Eagle Protection Act by lawful mine activities. AC designs overhead power lines to meet or exceed current Avian Power Line Interaction Commission (APLIC) guidelines. In addition, AC has developed and adheres to the mine's voluntary Avian Protection Plan (APP).

4.10.2 Greater Sage-grouse (GRSG)

4.10.2.1 Direct and Indirect Effects

4.10.2.1.1 Proposed Action

As discussed in **section 3.10.2**, there is an extremely limited historical presence of GRSG in the area. GRSG were last recorded within the Antelope Mine permit area in 2014 (AC 2018). The closest GRSG core area to the tract is the Thunder Basin core area, which is approximately 15 miles distant, and there are no winter concentration or connectivity areas near the tract. Ongoing operations may adversely impact individual GRSG but are not likely to result in a loss of population viability in the wildlife monitoring area or cause a trend toward federal listing. Potential impacts to GRSG would likely be limited primarily to indirect influences resulting from habitat disturbance though loss of individual birds may occur at times. The use of appropriate timing and spatial buffers, timely implementation of reclamation, and application of targeted conservation measures in suitable habitats both on- and off-property throughout the region are expected to sufficiently reduce overall impacts to maintain a viable population within the area. The direct and indirect effects related to the Proposed Action on GRSG would be minor and short term.

4.10.2.1.2 No Action Alternative

Under this alternative, disturbance related impacts to GRSG in the area would continue, but the duration of impacts would be reduced by approximately 0.5 year.

4.10.2.2 Cumulative Impacts

WGFD information for the southern group of mines indicate that the average number of male grouse per occupied lek (3.0) was down 20 percent in 2018 compared to 2017 (WGFD 2019). However, the average number of males per lek observed in 2018 was equal to the 10-year annual average (3.0) and the 3-year running average rate of change (linear trendline), based on 2009 through 2018 lek average annual counts, increased over the time period. The cumulative effects on regional GRSG populations related to disturbance at the southern group of mines would be moderate and short-term.

4.10.2.3 Mitigation Measures

No mitigation measures specific to GRSG are necessary. AC's general reclamation practices for establishing or enhancing post-mine wildlife habitat are described in the Reclamation Plan of Permit No. 525. The Antelope Mine would incorporate methods to enhance reclaimed areas for GRSG, where appropriate. For example, as required by the WDEQ-LQD, the Antelope Mine has been actively establishing new sagebrush stands in reclamation to recreate suitable shrubland habitats for various shrub-dependent species, including GRSG. Stream-side areas are planted in a lowland mix that could provide brood-rearing and summer habitat for GRSG. Such efforts could enhance post-mining habitat for GRSG by providing important sources of food and cover.

4.10.3 Threatened, Endangered, and Candidate Species and Species of Special Interest

4.10.3.1 Direct and Indirect Effects

4.10.3.1.1 Proposed Action

As discussed in **section 3.10.3.1**, there are no vertebrate T&E wildlife species with the potential of occurring in the area. There are no critical habitats for T&E species within the Antelope Mine permit area or the surrounding 1.0-mile perimeter.

A discussion of SOSI that could potentially occur in the area is included in **section 3.10.3.2** and a list of these species is included in **appendix H**. This impacts assessment related to the Proposed Action focuses on WGFD SGCN and the WGFD tier ranking. Of the 136 SOSI that could occur in the tract, 43 are SGCN, of which 3 have been observed in the area. One of the WGFD SGCN (mountain plover) is classified as Tier I species and has been observed in the area.

If present, these T&E species and SOSI would be temporarily displaced but current mining and reclamation practices in place at the Antelope Mine would protect species and promote the return of these species once reclamation has been completed. In an effort to approximate premining conditions, AC would reestablish vegetation types during the reclamation operation that are similar to the premine types. The direct and indirect effects related to the Proposed Action on T&E species and SOSI would be moderate and short-term.

4.10.3.1.2 No Action Alternative

Under this alternative, disturbance related impacts to T&E species and SOSI would continue, but the duration of impacts would be reduced by approximately 0.5 year.

4.10.3.2 Cumulative Impacts

The cumulative effects on regional T&E species and other species of special interest populations would be related to disturbance at the southern group of mines and would be moderate and short-term.

4.10.3.3 Mitigation Measures

No mitigation measures specific to T&E species and SOSI are necessary. The general reclamation practices for establishing or enhancing postmine wildlife habitat at the Antelope Mine described in the Reclamation Plan of Permit No. 525 are in place.

4.11 Land Use and Recreation

4.11.1 Direct and Indirect Effects

4.11.1.1 Proposed Action

The direct and indirect effects to land use and recreation would not be different from those described in Section 3.11.2.1 of the 2008 WAII EIS. Surface ownership within the West Antelope II South Modification tract is private (AC) and proposed coal removal is managed by the BLM. The primary land use impacts of the Proposed Action would be reduction of livestock grazing and loss of wildlife habitat. Other mineral development would also be directly affected. Livestock grazing has already been prohibited due to the tract being inside the permit boundary and adjacent to active mine areas. Hunting on the tract is currently not allowed because it is within the mine permit boundary and would continue to be disallowed during mining and reclamation. While non-coal mineral development would be curtailed on the tract, much of the CBNG has been depleted in the shallower production areas. Following reclamation, the land would be suitable for livestock grazing and wildlife uses, which are the historical land uses. Therefore, the direct and indirect effects related to land use would be negligible and short term.

4.11.1.2 No Action Alternative

Under the No Action Alternative, impacts on recreation and land use would be the same as the Proposed Action, but disturbance related to the recovery of federal coal within the tract would be reduced by approximately 879.5 acres.

4.11.2 Cumulative Impacts

Cumulative effects would be similar to those described in **section 4.8.2**. The overall contribution to cumulative effects to vegetation would be minor due to the localized effects and the improved productivity on mined lands that have been reclaimed.

Cumulative effects would be related to land use at the southern group of mines. As described in **section 4.8.2**, disturbed acreage at the southern group of mines totaled approximately 61,366 acres. Since the mines own or control the surface within their permit boundaries, the loss of agricultural land would not directly impact other landowners in the area. There is also limited recreational use of the area. Following reclamation, the land would be suitable for historical uses of livestock grazing and wildlife uses. Cumulative impacts from the Proposed Action on land use would be negligible.

4.11.3 Mitigation Measures

No mitigation measures specific to land use and recreation are necessary.

4.12 Cultural Resources

4.12.1 Direct and Indirect Effects

4.12.1.1 Proposed Action

The direct and indirect effects to cultural resources would not be different from those described in section 3.12.2.1 of the 2008 WAII EIS. The West Antelope II South Modification tract has been subjected to Class III cultural resource inventories and only one of the two sites determined to be eligible within the tract has been classified as NRHP eligible. Since this site would not be disturbed under the Proposed Action no mitigation would be required. The direct and indirect effects on cultural resource from the Proposed Action would be negligible but long-term.

Letters of consultation were sent out to 26 Native American tribes/tribal representatives during the scoping process. OSMRE did not receive any responses. OSMRE consulted with the Wyoming State Historic Preservation Officer (SHPO) and on March 27, 2020 SHPO concurred with a finding of ‘no historic properties affected’.

4.12.1.2 No Action Alternative

Under the No Action Alternative, disturbance related impacts would be the same as the Proposed Action, but disturbance related to the recovery of federal coal within the tract would be reduced by approximately 879.5 acres.

4.12.2 Cumulative Impacts

The individual evaluation of cultural resource sites in the southern group of mines suggests that through avoidance of sensitive site types and mitigation through data recovery for all unavoidable disturbance to NRHP eligible sites, the cumulative effects to cultural resources have been minimal. The cumulative impacts on cultural resource would be negligible but long term.

4.12.3 Mitigation Measures

No mitigation measures specific to cultural resources are necessary.

4.13 Visual Resources

4.13.1 Direct and Indirect Effects

4.13.1.1 Proposed Action

The direct and indirect effects to visual resources would not be different from those described in section 3.13.2.1 of the 2008 WAII EIS. Potential direct effects would arise from disturbance associated with the Proposed Action and would cease upon reclamation. Potential indirect effects consist of permanent changes to existing topography and the vegetative component of the area, irrespective of reclamation success. Mining activities would be visible from State Highway 59 and County Road 37 (Antelope Coal Mine Road) in Converse County, and Country Road 4 (Antelope Road) in Campbell County, though the extent and duration of visibility would vary according to the visual perspective from the roads. The nearest occupied residence is approximately 1.5 miles to the west-southwest from the tract boundary. The direct and indirect effects related to visual resources could affect local residences and are therefore listed as moderate and long-term. Reclaimed terrain would be almost indistinguishable from the surrounding undisturbed terrain.

4.13.1.2 No Action Alternative

Under the No Action Alternative, visual resource related impacts would be the same as the Proposed Action, but disturbance within the tract would be reduced by approximately 879.5 acres.

4.13.2 Cumulative Impacts

Cumulative visual resources effects would be related to disturbance at the southern group of mines and from oil and gas development. Human disturbances include, but are not limited to, agriculture, mining, roads, urban areas, and oil and gas development. Given the fact that moderate visual impacts are currently occurring in the area and that the effects from the Proposed Action are not significantly greater than current effects, the cumulative effects related to the visual resources would be moderate and long-term.

4.13.3 Mitigation Measures

Current best available control technology (BACT) measures would continue to be employed at the Antelope Mine to control visibility impacts from particulates, which could affect visibility.

4.14 Noise

4.14.1 Direct and Indirect Effects

4.14.1.1 Proposed Action

The direct and indirect effects to noise would be the same as those described in section 3.14.2.1 of the 2008 WAII EIS. Under the Proposed Action, noise levels would not increase but would be extended by 0.5 year. Because of the remoteness of the West Antelope II South Modification tract and because mining is already on going in the area, noise would have few off-site impacts. Wildlife in the immediate vicinity of the tract may be adversely affected by the noise during mining operations; however, anecdotal observations at surface coal mines in the area suggest that some wildlife species may adapt to increased noise associated with coal mining activity. Although noise levels would not significantly change as a result of the Proposed Action, the direct and indirect effects related to the Proposed Action could affect local residences for a longer period of time and are therefore listed as moderate and long term.

4.14.1.2 No Action Alternative

Under the No Action Alternative, noise impacts would be the same as the Proposed Action, but the extent of the impacts would be reduced by approximately 0.5 year.

4.14.2 Cumulative Effects

Cumulative effects would be related to mining related activities at southern group of mines. Potential sources of noise disturbances include, but are not limited to, agriculture, mining, roads, and oil and gas development. Potential impacts would cease upon project completion and successful reclamation in a given area. Recreational users, local residents, and grazing lessees using lands surrounding active mining areas do hear mining-related noise, but this has not been reported to cause a substantial impact. The cumulative impacts related to noise as discerned by the public would be moderate but short term.

4.14.3 Mitigation Measures

No mitigation measures specific to noise impacts are necessary.

4.15 Transportation Facilities

4.15.1 Direct and Indirect Effects

4.15.1.1 Proposed Action

The direct and indirect effects to transportation facilities would be the same as those described in section 3.15.2.1 of the 2008 WAII EIS. The Proposed Action would not result in increased mine related traffic but would extend impacts by 0.5 year.

All of the coal mined at the Antelope Mine would continue to be transported by rail. Based on the additional 14.5 Mt of recoverable coal shipped by rail and an estimated 15,470 tons of coal per train, the Proposed Action would result in approximately 937 train trips per year (one way). The variation in coal destinations and multiple rail transportation routes make it speculative to analyze the potential impacts to the entire rail corridor in detail.

The 2008 WAII EIS states that coal dust and fines blowing or sifting from moving, loaded rail cars has been linked to railroad track stability problems resulting in train derailments and to rangeland fires caused by spontaneous combustion of accumulated coal dust. While no specific studies of coal dust impacts have been conducted in the PRB, BNSF has been involved in research regarding the impacts of coal dust escaping from loaded coal cars on rail lines in the PRB. BNSF has determined that coal dust poses a serious threat to the stability of the track structure and the operational integrity of rail lines in, and close to, the mines in the PRB. In response to suits brought on by environmental groups alleging that coal spilled from trains pollutes waterways, BNSF Railway has agreed to study the use of physical covers for coal trains to reduce the effects of blowing coal particles (Seattle Times 2016). BNSF has cited studies and experience to demonstrated that shippers can take steps in the loading of coal cars using existing, cost-effective technology that will substantially reduce coal dusting events. BNSF has a Coal Loading Rule, in effect since October 2011, specifically requiring all shippers loading coal at any Montana or Wyoming mine to take measures to load cars in such a way that ensures coal dust losses in transit are reduced by at least 85% compared to cars where no remedial measures have been taken (BNSF 2016).

Two recent Australian studies involved measuring particle concentrations in the air near a coal haul transport corridor to assess whether coal dust was being emitted from the railcars and whether any such emissions would result in particulate matter concentrations that would be considered potentially harmful to human health. The two reports presented strong evidence that, while particulate levels were elevated for the several minutes during and after trains passed the monitoring station, coal trains did not result in any more emissions than any other freight-hauling trains (Ramboll Environ 2016).

Overall, the added direct and indirect effects of the Proposed Action on transportation would be minor and short term.

4.15.1.2 No Action Alternative

Under the No Action Alternative, transportation impacts in the area would be the same as the Proposed Action, but the duration of the impacts would be reduced by approximately 0.5 year.

4.15.2 Cumulative Impacts

Cumulative impacts to transportation are related to coal production levels. If coal production levels increase, cumulative impacts to transportation would increase. Highway traffic accidents and delays at grade crossings could result from train traffic. The transportation facilities for the southern group of mines are already in place and coal production and employment levels would not change. Coal extracted from the existing surface coal mines in the Wyoming PRB is transported in rail cars along the BNSF and Union Pacific (UP) rail lines. The coal mines south of Gillette, including the Antelope Mine, ship most of their coal via the Gillette to Douglas BNSF and UP joint trackage that runs south through Campbell and Converse counties and then east over separate BNSF and UP mainlines for destinations in the Midwest. The Proposed Action would extend the duration of mining by approximately 0.5 year at the Antelope Mine, and thus the duration of utilization of BNSF and UP rail lines would be extended by that amount. The cumulative impacts related to transportation would be minor and short term.

4.15.3 Mitigation Measures

No mitigation measures specific to transportation facilities are necessary.

4.16 Hazardous and Solid Waste

4.16.1 Direct and Indirect Effects

4.16.1.1 Proposed Action

The direct and indirect effects to hazardous and solid waste would not be different from those described in section 3.16.2.1 of the 2008 WAII EIS. Under the Proposed Action hazardous and solid waste would not increase but generation would be extended by 0.5 year. Direct and indirect effects on hazardous and solid wastes would be minor and short term.

4.16.1.2 No Action Alternative

Under the No Action Alternative, hazardous and solid wastes would continue to be generated, but the duration of the impacts would be reduced by approximately 0.5 year.

4.16.2 Cumulative Impacts

Cumulative hazardous and solid wastes effects would be related to mining operations at the southern group of mines. Potential impacts would cease upon project completion and successful reclamation in a given area. The cumulative impacts related to hazardous and solid waste would be minor and short term.

4.16.3 Mitigation Measures

No mitigation measures specific to hazardous and solid wastes are necessary.

4.17 Socioeconomics

4.17.1 Direct and Indirect Effects

4.17.1.1 Proposed Action

State, counties, cities, school districts, and many other governmental entities across the state receive revenues derived directly and indirectly from taxes and royalties on the production of federal coal, including that at the Antelope Mine. Such revenues include ad valorem taxes, severance taxes, royalty payments, sales and use taxes on equipment and other taxable purchases, and portions of required contributions to the federal AML program and Black Lung Disability Trust Fund. A summary of federal and state revenues generated from recovery of federal coal from the Antelope Mine and the Proposed Action are provided in **table 4-11**.

Table 4-11. LOM Federal and State Revenues from Federal Coal Recovery within the Antelope Mine (millions of dollars)

	Total $ Collected[1]		Federal Revenue		State Revenue	
Revenue Source	**Antelope Mine**	**Proposed Action**	**Antelope Mine**	**Proposed Action**	**Antelope Mine**	**Proposed Action**
Federal Mineral Royalties	662.7	22.7	331.3	11.3	331.3	11.3
Abandoned Mine Lands Fund	118.7	4.1	59.4	2.0	59.4	2.0
Severance Tax	276.3	8.6	--[2]	--[2]	276.3	8.6
Bonus Bid Annual Revenues[3]	0.0	0.0	0.0	0.0	0.0	0.0
Ad Valorem Tax	216.1	7.4	--[2]	--[2]	216.1	7.4
Black Lung	17.9	0.6	17.9	0.6	--[2]	--[2]
Sales and Use Tax	24.5	0.8	--[2]	--[2]	24.5	0.8
Totals	**1,316.2**	**44.2**	**408.6**	**13.9**	**907.6**	**30.1**

[1] Total may not equal subtotals due to rounding.
[2] No revenues disbursed.
[3] No bonus bid revenues collected after 2018.
Source: WWC calculation – provided in **appendix F**

Under the Proposed Action, Wyoming revenues generated from LOM Antelope Mine production could be approximately $907.6 million and federal revenues could be $408.6 million. The primary difference between state and federal revenues is related to the fact that severance, ad valorem, and sales and use taxes are only paid to the state of Wyoming. The Proposed Action would extend the duration of the positive economic impacts related to mining the federal coal.

Mining in the tract would not directly create new jobs and therefore, the availability of housing units would not be impacted. No additional employees are anticipated as a result of the Proposed Action, although the duration of employment for current employees would be extended.

No additional changes in the current socioeconomic situation are anticipated. Direct and indirect effects on socioeconomics under the Proposed Action would be moderate and short term.

4.17.1.2 No Action Alternative

Under the No Action Alternative, approximately $30.1 million of Wyoming revenues and approximately $13.9 million of federal revenues would not be realized. The selection of the No Action Alternative would likely not result in direct job losses, but any revenue, state program funding, abandoned mine land fees, and black lung fees that might otherwise be generated by extending the LOM by 0.5 year would not be collected. In addition, the duration of employment for current employees would be reduced by 0.5 year. The No Action Alternative would result in moderate direct and indirect socioeconomic effects.

4.17.2 Cumulative Impacts

Cumulative effects would be related to socioeconomic conditions in Campbell and Converse counties. Cumulative effects are not substantially different than those described in **section 4.17.1.1** because Wyoming, Campbell County, Converse County, Campbell County School District 1, Converse County School District 1 and 2, the City of Gillette, the City of Douglas, and many other governmental entities across the state receive revenues derived directly and indirectly from taxes and royalties on the production of federal coal from the Antelope Mine. The cumulative effects on socioeconomics are expected to be moderate and short-term.

4.17.3 Mitigation Measures

No mitigation measures specific to reducing socioeconomic impacts are necessary.

4.18 Short-Term Uses and Long-Term Productivity

This section relates to the balance or trade-off between short-term uses and long-term productivity for each resource in relation to the Proposed Action. The discussions contained throughout this environmental consequences chapter, in the existing Antelope Mine federal mining plan, and in the 2008 WAII EIS provide adequate analyses and relationships of short-term uses (such as mining coal) and long-term productivity (such as generating electricity for homes, schools, and industry).

4.19 Unavoidable Adverse Effects

Unavoidable adverse impacts are the effects on natural and human resources that would remain after mitigation measures have been applied. These impacts range from negligible to moderate and short to long-term. For the Proposed Action, details regarding these impacts are presented in the preceding resource sections and the 2008 WAII EIS. Unavoidable adverse effects are summarized in **appendix J**.

5.0 Consultation and Coordination

5.1 Public Comment Process

OSMRE developed a project specific website that provided legal notices, outreach notice letters, mailing address, and an email address for comments to be sent. The website is available at: https://www.wrcc.osmre.gov/initiatives/westantelopeMine.shtm.

OSMRE released a public NOI to prepare the Antelope Mine West Antelope II South Modification tract EA in the Gillette News Record on November 5, 2019 and the Douglas Budget on November 6, 2019. Public outreach letters describing the EA and soliciting comments were mailed on November 4, 2019 to a total of 158 recipients, including city governments, adjacent landowners, and other interested parties and 26 tribes/tribal representatives (see **Appendix A**). The legal notices and letters invited the public to comment on issues of concern related to the EA. Written comments were solicited until December 3, 2019. **Appendix B** presents a summary of the scoping comments received by the public. Four comment letters were received during the public scoping period. Comment letters received during the public review period for this EA would be considered during the ASLM approval process.

5.2 Preparers and Contributors

OSMRE personnel that contributed to the development of this EA are listed in **table 5-1**.

Table 5-1. OSMRE Personnel

Name	Organization	Project Responsibility
Gretchen Pinkham	OSMRE	Project Lead
Ed Vasquez	OSMRE	Biological Resources
Roberta Martínez-Hernández	OSMRE	Hydrology and Air Quality
Jeremy Iliff	OSMRE	Cultural/Historical/Paleontological

Third party contractors who contributed to the development of this EA are identified in **table 5-2.**

Table 5-2. Third Party Contractor Personnel

Name	Organization	Project Responsibility	Education
Beth Kelly	WWC Engineering	Primary Author	B.S. Chemical Engineering
John Berry	WWC Engineering	Author, QAQC	B.S. Wildlife Management
Chelsea Winslow	WWC Engineering	Author	B.S. Wildlife Biologist
Wade Filkins	WWC Engineering	Author	B.S. Civil Engineer
Mal McGill	WWC Engineering	AutoCAD	A.S. Engineering

5.3 Distribution of the EA

This EA will be distributed to individuals who specifically request a copy of the document. It will also be made available electronically on the OSMRE website.

6.0 References

AirNow, 2019, Air Quality Index. https://www.airnow.gov/

Antelope Coal, LLC (AC), 2014, 2014-2015 Annual Report Permit No. 525, 2014 Wildlife Monitoring. Electronic copy only, available upon request.

Antelope Coal, LLC (AC), 2017, Triennial Emission Inventory. Electronic copy only, available upon request.

Antelope Coal, LLC (AC), 2018, 2017-2018 Annual Report Permit No. 525-T9. Electronic copy only, available upon request.

Antelope Coal, LLC (AC), 2019a, Personal communication between Gretchen Anderson, Antelope Mine, and Beth Kelly, WWC Engineering, December 10, 2019. Electronic copy only, available upon request.

Antelope Coal, LLC (AC), 2019b, Antelope Mine Permit No. 525. Electronic copy only, available upon request.

BNSF Railway (BNSF), 2016, BNSF Railway Statement on STB Coal Dust Decision, Coal Dust Frequently Asked Questions. http://www.bnsf.com/ship-with-bnsf/energy/coal/coal-dust.html.

Bureau of Land Management (BLM), 2008, BLM Manual 6840 – Special Status Species Management. https://www.blm.gov/sites/blm.gov/files/uploads/mediacenter_blmpolicymanual6840.pdf.

Bureau of Land Management (BLM), 2012, Northwestern Plains Rapid Ecoregional Assessment, 2011 Final Report. https://landscape.blm.gov/geoportal/rest/find/document?searchText=%22BLM%20REA%20NWP%202011%22&start=1&max=10&f=searchpage&contentType=document.

Bureau of Land Management (BLM), 2015, Buffalo Field Office Approved Resource Management Plan, September 2015. https://eplanning.blm.gov/epl-front-office/eplanning/planAndProjectSite.do?methodName=dispatchToPatternPage&currentPageId=48300

Bureau of Land Management (BLM), 2019, West Antelope II South LBM Coal Data Sheet. https://eplanning.blm.gov/epl-front-office/eplanning/legacyProjectSite.do?methodName=renderLegacyProjectSite&projectId=67029.

Commission for Environmental Cooperation (CEC), 2011, North American Power Plant Air Emissions. http://www3.cec.org/islandora/en/item/10236-north-american-power-plant-air-emissions-en.pdf.

Crippa, M., Oreggioni, G., Guizzardi, D., Muntean, M., Schaaf, E., Lo Vullo, E., Solazzo, E., Monforti-Ferrario, F., Olivier, J.G.J., Vignati, E., 2019, Fossil CO2 and GHG emissions of all world countries - 2019 Report. https://ec.europa.eu/jrc/en/publication/eur-scientific-and-technical-research-reports/fossil-co2-and-ghg-emissions-all-world-countries-0

Department of Interior (DOI), 2004, Departmental Manual Part 516. http://www.blm.gov/wo/st/en/prog/planning/nepa/webguide/departmental_manual.html.

GCM Services, Inc., 2009, A Class III Cultural Resource Inventory of the West Antelope II Study Area Buffer, Converse County, Wyoming. Electronic copy only, available upon request.

GCM Services, Inc., 2011, A Class I and Class III Cultural Resource Inventory of the Proposed West Antelope II Mine Permit Area Adjacent to the Antelope Mine, Converse and Campbell Counties, Wyoming. Electronic copy only, available upon request.

GCM Services, Inc., 2014, A Class III Cultural Resource Inventory of the Antelope Coal Mine's Dragline Pad Access Road IBR, Converse County, Wyoming. Electronic copy only, available upon request.

GCM Services, Inc., 2015, A Class III Cultural Resource Inventory of the Antelope Coal Mine's Dragline Pad Access Road IBR, Converse County, Wyoming. Electronic copy only, available upon request.

Hydro-Engineering, LLC. (Hydro-Engineering), 2016, Gillette Area Groundwater Monitoring Organization (GAGMO) 35-year Report. Electronic copy only, available on request from OSMRE.

IML Air Science, 2014, Antelope Coal Ambient Air Monitoring Network, 4th Quarter. Electronic copy only, available on request from OSMRE.

IML Air Science, 2015, Antelope Coal Ambient Air Monitoring Network, 4th Quarter & Annual Report 2015. Electronic copy only, available on request from OSMRE.

IML Air Science, 2016, Antelope Coal Ambient Air Monitoring Network, 4th Quarter & Annual Report 2016. Electronic copy only, available on request from OSMRE.

IML Air Science, 2017, Antelope Coal Ambient Air Monitoring Network, 4th Quarter & Annual Report 2017. Electronic copy only, available on request from OSMRE.

IML Air Science, 2018, Antelope Coal Ambient Air Monitoring Network, 4th Quarter & Annual Report 2018. Electronic copy only, available on request from OSMRE.

Intergovernmental Panel on Climate Change (IPCC), 2014 Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. Edited by R.K. Pachauri and L.A. Meyer. Geneva, Switzerland: IPCC. https://www.ipcc.ch/report/ar5/syr/.

Interagency Monitoring of Protected Environments (IMPROVE), 2019, Data Acquired from Interagency Monitoring of Protected Visual Environments. http://vista.cira.colostate.edu/improve/.

Intermountain Resources, 2011, Appendix D10 Aquatic Resources Inventory (Wetlands) for the West Antelope II Amendment Study Ara, December 2011. Electronic copy only, available on request from OSMRE.

Jones, R., 2020, Personal communication between Robin Jones, WDEQ-AQD, and Beth Kelly, WWC Engineering, January 2, 2020.

McVehil-Monnet Associates, Inc., 2012, Air Quality Permit Application to Modify the Antelope Mine. Electronic copy only, available on request from OSMRE.

Merrill, M.D., Sleeter, B.M., Freeman, P.A., Liu, J., Warwick, P.D., and Reed, B.C., 2018, federal lands greenhouse emissions and sequestration in the United States—Estimates for 2005–14: U.S. Geological Survey Scientific Investigations Report 2018–5131, 31 p., https://doi.org/10.3133/sir20185131.

National Atmospheric Deposition Program (NADP), 2014, National Atmospheric Deposition Program 2013 Annual Summary. NADP Data Report 2014-01. Illinois State Water Survey, University of Illinois at Urbana-Champaign, IL. http://nadp.slh.wisc.edu/lib/dataReports.aspx.

National Atmospheric Deposition Program (NADP), 2015, National Atmospheric Deposition Program 2014 Annual Summary. NADP Data Report 2015-01. Illinois State Water Survey, University of Illinois at Urbana-Champaign, IL. http://nadp.slh.wisc.edu/lib/dataReports.aspx.

National Atmospheric Deposition Program (NADP), 2016, National Atmospheric Deposition Program 2015 Annual Summary. NADP Data Report 2016-02. Illinois State Water Survey, University of Illinois at Urbana-Champaign, IL. http://nadp.slh.wisc.edu/lib/dataReports.aspx.

National Atmospheric Deposition Program (NADP), 2017, National Atmospheric Deposition Program 2016 Annual Summary. NADP Data Report 2017-01. Illinois State Water Survey, University of Illinois at Urbana-Champaign, IL. http://nadp.slh.wisc.edu/lib/dataReports.aspx.

National Atmospheric Deposition Program (NADP), 2018, National Atmospheric Deposition Program 2017 Annual Summary. Wisconsin State Laboratory of Hygiene, University of Wisconsin-Madison, WI. http://nadp.slh.wisc.edu/lib/dataReports.aspx.

Natural Resource and Energy Explorer (NREX), 2019, NREX Map Application. https://nrex.wyo.gov/.

Natural Resources Conservation Service (NRCS), 2019, Web Soil Survey. https://websoilsurvey.sc.egov.usda.gov/App/HomePage.htm.

Natural Resources Revenue Data, 2019, Federal Production. https://revenuedata.doi.gov/?tab=tab-production.

Office of the Governor, 2019, Executive Order 2019-3 Greater Sage-Grouse Core Area Protection. https://wgfd.wyo.gov/Habitat/Sage-Grouse-Management/Sage-Grouse-Executive-Order.

Office of Management and Budget, 2003, Circular A-4, September 17, 2003. https://www.whitehouse.gov/sites/whitehouse.gov/files/omb/circulars/A4/a-4.pdf.

Office of Surface Mining Reclamation and Enforcement (OSMRE), 1999, REG-31 881-Preparation of Mining Plan Decision Documents. https://www.osmre.gov/lrg/directives.shtm.

Office of Surface Mining Reclamation and Enforcement (OSMRE), 2019a, Handbook on Procedures for Implementing the National Environmental Policy Act (NEPA). https://www.osmre.gov/lrg/nepa.shtm.

Office of Surface Mining Reclamation and Enforcement (OSMRE), 2019b, Antelope Mine. https://www.wrcc.osmre.gov/initiatives/westantelopeMine.shtm.

Office of Surface Mining Reclamation and Enforcement (OSMRE), 2019c, Reclamation Performance Bonds - Bonding Overview. https://www.osmre.gov/resources/bonds.shtm.

Office of Surface Mining Reclamation and Enforcement (OSMRE), 2017, Annual Evaluation Report for the Regulatory Program Administered by the Department of Environmental Quality – Land Quality Division of Wyoming, for Evaluation Year 2017. https://www.odocs.osmre.gov/.

Pitchford, M.L., and W.C. Malm, 1994, Development and Applications of a Standard Visual Index. Atmospheric Environment 28(5): 1,049-1,054. Electronic copy only, available on request from OSMRE.

Ramboll Environ, 2016, Coal Dust from Rail Transport. Electronic copy only, available on request from OSMRE.

Seattle Times, 2016, BNSF to study coal covers under tentative lawsuit agreement. https://www.seattletimes.com/seattle-news/environment/enviros-bnsf-railway-reach-agreement-in-coal-dust-lawsuit/.

Shelanski, H. and M. Obstfeld, 2015, Estimating the benefits from carbon dioxide emissions reductions. Office of Management and Budget. https://www.whitehouse.gov/blog/2015/07/02/estimating-benefits-carbon-dioxide-emissions-reductions.

State of Wyoming, 2020, SF0021 – Coal fired electric generation facilities. https://wyoleg.gov/Legislation/2020/SF0021

U.S. Army Corps of Engineers (USACE), 2012a, Letter to Kyle Wendtland Regarding the Aquatic Sites within the Antelope Mine. Electronic copy only, available on request from OSMRE.

U.S. Army Corps of Engineers (USACE), 2012b, Letter to Kyle Wendtland Regarding the Aquatic Sites along Logan Draw, Johnson Draw, and an Unnamed Tributary to Antelope Creek. Electronic copy only, available on request from OSMRE.

U.S. Bureau of Labor Statistics, 2019, Employment Status of the Civilian Non-Institutional Population 1976 to 2018 Averages. https://www.bls.gov/lau/home.htm.

U.S. Census Bureau (USCB), 2019, Community Facts-Find Popular Facts and Frequently Requested Data About your Community. https://factfinder.census.gov.

U.S. Department of State, 2014, United States Climate Action Report 2014. https://www.globalchange.gov/browse/reports/us-climate-action-report-2014

U.S. Energy Information Administration (EIA), 2018, Annual Coal Distribution Reports. https://www.eia.gov/coal/distribution/annual/.

U.S. Environmental Protection Agency (EPA), 2008, Direct Emissions from Stationary Combustion Sources. https://www.epa.gov/climateleadership.

U.S. Environmental Protection Agency (EPA), 2018, Inventory of U.S. Greenhouse Gas Emissions and Sinks 1990-2016. https://www.epa.gov/ghgemissions/inventory-us-greenhouse-gas-emissions-and-sinks-1990-2016.

U.S. Environmental Protection Agency (EPA), 2019a, Outdoor Air Quality Data Monitor Values Report. https://www.epa.gov/outdoor-air-quality-data/monitor-values-report.

U.S. Environmental Protection Agency (EPA), 2019b, Toxics Release Inventory (TRI) Program. https://www.epa.gov/toxics-release-inventory-tri-program/tri-basic-data-files-calendar-years-1987-2017.

U.S. Environmental Protection Agency (EPA), 2019c, What is Acid Rain? https://www.epa.gov/acidrain/what-acid-rain.

U.S. Environmental Protection Agency (EPA), 2019d, Overview of Greenhouse Gases. https://www.epa.gov/ghgemissions/overview-greenhouse-gases.

U.S. Environmental Protection Agency (EPA), 2019e, Overview of Greenhouse Gases. https://www.epa.gov/energy/greenhouse-gases-equivalencies-calculator-calculations-and-references.

U.S. Environmental Protection Agency (EPA), 2019f, State Average Annual Emissions Trends. https://www.epa.gov/air-emissions-inventories/air-pollutant-emissions-trends-data.

U.S. Environmental Protection Agency (EPA), 2019g, Air Quality Index Report. https://www.epa.gov/outdoor-air-quality-data/air-quality-index-report.

U.S. Environmental Protection Agency (EPA), 2019h, U.S. Inventory of Greenhouse Gas Emissions and Sinks, 1990-2017. https://www.epa.gov/sites/production/files/2019-04/documents/us-ghg-inventory-2019-main-text.pdf.

U.S. Fish and Wildlife Service (USFWS), 2019, List of Threatened and Endangered Species that may occur in your Proposed Project Location, and/or may be Affected by your Proposed Project. Electronic copy only, available on request from OSMRE.

U.S. Geological Survey (USGS), 2019, National Climate Change Viewer. https://www2.usgs.gov/climate_landuse/clu_rd/nccv.asp.

U.S. Global Change Research Program (USGCRP), 2018, *Impacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment, Volume II*. https://nca2018.globalchange.gov/downloads/NCA4_2018_FullReport.pdf.

Wyoming Department of Environmental Quality - Air Quality Division (WDEQ-AQD), 2012, Air Quality Permit MD-13361. Electronic copy only, available upon request.

Wyoming Department of Environmental Quality - Land Quality Division (WDEQ-LQD), 2012, Chapter 4 Environmental Protection Performance Standards for Surface Coal Mining Operations. https://rules.wyo.gov/Search.aspx?mode=1.

Wyoming Department of Environmental Quality - Land Quality Division (WDEQ-LQD), 2014a, Guideline No. 20 Bond Release Categories and Submittal Procedures for Coal Mines. http://deq.wyoming.gov/lqd/resources/guidelines/.

Wyoming Department of Environmental Quality - Land Quality Division (WDEQ-LQD), 2014b, Cumulative Hydrologic Impact Assessment of Coal Mining in the Southern Powder

River Basin, Wyoming (CHIA-35), September 2014. Electronic copy only, available upon request.

Wyoming Department of Environmental Quality - Land Quality Division (WDEQ-LQD), 2014c, Chapter 1 Authorities and Definitions for Surface Coal Mining Operations. https://rules.wyo.gov/Search.aspx?mode=1.

Wyoming Department of Environmental Quality - Land Quality Division (WDEQ-LQD), 2015, Guideline No. 1A Topsoil and Subsoil. http://deq.wyoming.gov/lqd/resources/guidelines/.

Wyoming Department of Environmental Quality - Water Quality Division (WDEQ-WQD), 2013, Wyoming Surface Water Classification List. http://deq.wyoming.gov/wqd/surface-water-quality-standards-2/.

Wyoming Department of Workforce Services (WDWS), 2008, Annual Report of the State Inspector of Mines of Wyoming. http://www.wyomingworkforce.org/businesses/mines/info/.

Wyoming Department of Workforce Services (WDWS), 2014, Annual Report of the State Inspector of Mines of Wyoming. http://www.wyomingworkforce.org/businesses/mines/info/.

Wyoming Department of Workforce Services (WDWS), 2015, Annual Report of the State Inspector of Mines of Wyoming. http://www.wyomingworkforce.org/businesses/mines/info/.

Wyoming Department of Workforce Services (WDWS), 2016, Annual Report of the State Inspector of Mines of Wyoming. http://www.wyomingworkforce.org/businesses/mines/info/.

Wyoming Department of Workforce Services (WDWS), 2017, Annual Report of the State Inspector of Mines of Wyoming. http://www.wyomingworkforce.org/businesses/mines/info/.

Wyoming Department of Workforce Services (WDWS), 2018, Annual Report of the State Inspector of Mines of Wyoming. http://www.wyomingworkforce.org/businesses/mines/info/.

Wyoming Game and Fish Department (WGFD), 2019, Wyoming Game and Fish Department Unpublished Data – 1948-2018 Annual Lek Monitoring. Electronic copy only, available on request from OSMRE.

Wyoming Mining Association, 2018, Wyoming Coal September 2018 Concise Guide. https://www.wyomingmining.org/minerals/coal/.

Wyoming Oil and Gas Conservation Commission (WOGCC), 2019, Download.: http://pipeline.wyo.gov/legacywogcce.cfm.

Wyoming State Engineer's Office (SEO), 2019, e-Permit Application and Water Rights Database. https://sites.google.com/a/wyo.gov/seo/.

WWC Engineering (WWC), 2019, GHG, Air Quality, and Socioeconomic Calculations located in Appendices C and D, respectively.

APPENDIX A

LEGAL NOTICES
FOR FEDERAL LEASE MODIFICATION APPROVAL
WYW177903

Public Notice
Antelope Mine Federal Mining Plan Modification
Environmental Assessment

The U.S. Department of the Interior (DOI), Office of Surface Mining Reclamation and Enforcement (OSMRE), Western Region Office, will prepare an environmental assessment (EA) for a federal mining plan modification for the Antelope Mine lease by modification (LBM) to federal coal lease WYW-177903 (the Project). In accordance with the Mineral Leasing Act of 1920 (MLA), the DOI Assistant Secretary for Land and Minerals Management (ASLM) must approve the Project before any mining and reclamation can occur on lands containing leased federal coal. The LBM application was filed with the Bureau of Land Management (BLM) by Antelope Coal, LLC (AC) on November 29, 2012. As a result, the BLM prepared EA# WY-060-EA13-147 in cooperation with the OSMRE, which was published in March 2014. BLM subsequently issued a finding of no significant impact for the lease modification and the LBM was issued on February 1, 2018. AC operates the Antelope Mine under Permit No. PT0525 issued by Wyoming Department of Environmental Quality Wyoming Department of Environmental Quality (WDEQ)-Land Quality Division (LQD) in accordance with the approved Wyoming State Coal Regulatory Program (30 CFR Part 950).

OSMRE is preparing an EA to evaluate the environmental impacts resulting from the Project, pursuant to the requirements of the National Environmental Policy Act of 1969 (NEPA). The Antelope Mine is located approximately 20 miles south of Wright, Wyoming and 55 miles north of Douglas, Wyoming. Antelope Mine uses a truck and shovel and dragline mining method. The amount of remaining recoverable federal coal authorized for removal within the currently approved federal mining plan is approximately 409.6 million tons (Mt). The Project proposes to add approximately 856.6 acres and 15.8 Mt of mineable federal coal to the approved federal mining plan. The annual production rate used to calculate the environmental impacts resulting from the Proposed Action will be 30 million tons per year (Mtpy), which is the estimated future annual production rate suggested by Antelope Mine and is below the maximum permitted production rate of 52 Mtpy set by WDEQ-Air Quality Division (AQD) air quality permit MD-13361. Antelope Mine started operation in 1982 and the mine will continue to operate until 2039 under the current, approved mining plan. Using the estimated 30 Mtpy production rate, the Project would extend the life of the mine by approximately 0.5 year.

The EA will disclose the potential for direct, indirect, and cumulative effects to the environment from the Project. Further, the EA will update, clarify, and provide new and additional environmental information for the Project. Through the EA process, OSMRE will determine whether or not there are significant environmental impacts. An environmental impact statement will be prepared if the EA identifies significant impacts. If a finding of no significant impact is reached, and pursuant to 30 CFR § 746.13, OSMRE will prepare and submit to the ASLM a mining plan decision document recommending approval, disapproval, or conditional approval of the mining plan modification. The ASLM will approve, disapprove, or conditionally approve the mining plan modification, as required under the Mineral Leasing Act of 1920. OSMRE is soliciting public comments on the Project. Your comments will help to determine the issues and alternatives that will be evaluated in the environmental analysis. You are invited to direct these comments to:

ATTN: West Antelope II South Modification EA
C/O: Gretchen Pinkham,

OSMRE Western Region
1999 Broadway, Suite 3320,
Denver, CO 80202-3050

Comments may also be emailed to: osm-nepa-wy@osmre.gov, ensure the subject line reads: ATTN: OSMRE, West Antelope II South Modification EA. Comments should be received or postmarked no later than December 3, 2019 to be considered during the preparation of the EA. Comments received, including names and addresses of those who comment, will be considered part of the public record for this project and will be available for public inspection. Additional information regarding the Project may be obtained from Gretchen Pinkham, telephone number (303) 293-5088 and the Project website provided below. When available, the EA and other supporting documentation will be posted at: http://www.wrcc.osmre.gov/initiatives/westantelopeMine.shtm.

United States Department of the Interior

OFFICE OF SURFACE MINING
RECLAMATION AND ENFORCEMENT
Western Region
1999 Broadway St., Suite 3320
Denver, CO 80202-3050

November 4, 2019

Dear Stakeholders and Interested Parties,

The U.S. Department of the Interior (DOI), Office of Surface Mining Reclamation and Enforcement (OSMRE), Western Region Office, will prepare an environmental assessment (EA) for a federal mining plan modification for the Antelope Mine lease by modification (LBM) to federal coal lease WYW-177903 (the Project). In accordance with the Mineral Leasing Act of 1920 (MLA), The DOI Assistant Secretary for Land and Minerals Management (ASLM) must approve the Project before any mining and reclamation can occur on lands containing leased federal coal. The LBM application was filed with the Bureau of Land Management (BLM) by Antelope Coal, LLC (AC) on November 29, 2012. As a result, the BLM prepared EA# WY-060-EA13-147 in cooperation with the OSMRE, which was published in March 2014. BLM subsequently issued a finding of no significant impact for the lease modification and the LBM was issued on February 1, 2018. AC operates the Antelope Mine under Permit No. PT0525 issued by Wyoming Department of Environmental Quality Wyoming Department of Environmental Quality (WDEQ)-Land Quality Division (LQD) in accordance with the approved Wyoming State Coal Regulatory Program (30 CFR Part 950).

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OSMRE is soliciting public comments on the Project. Your comments will help to determine the issues and alternatives that will be evaluated in the environmental analysis. You are invited to direct these comments to:

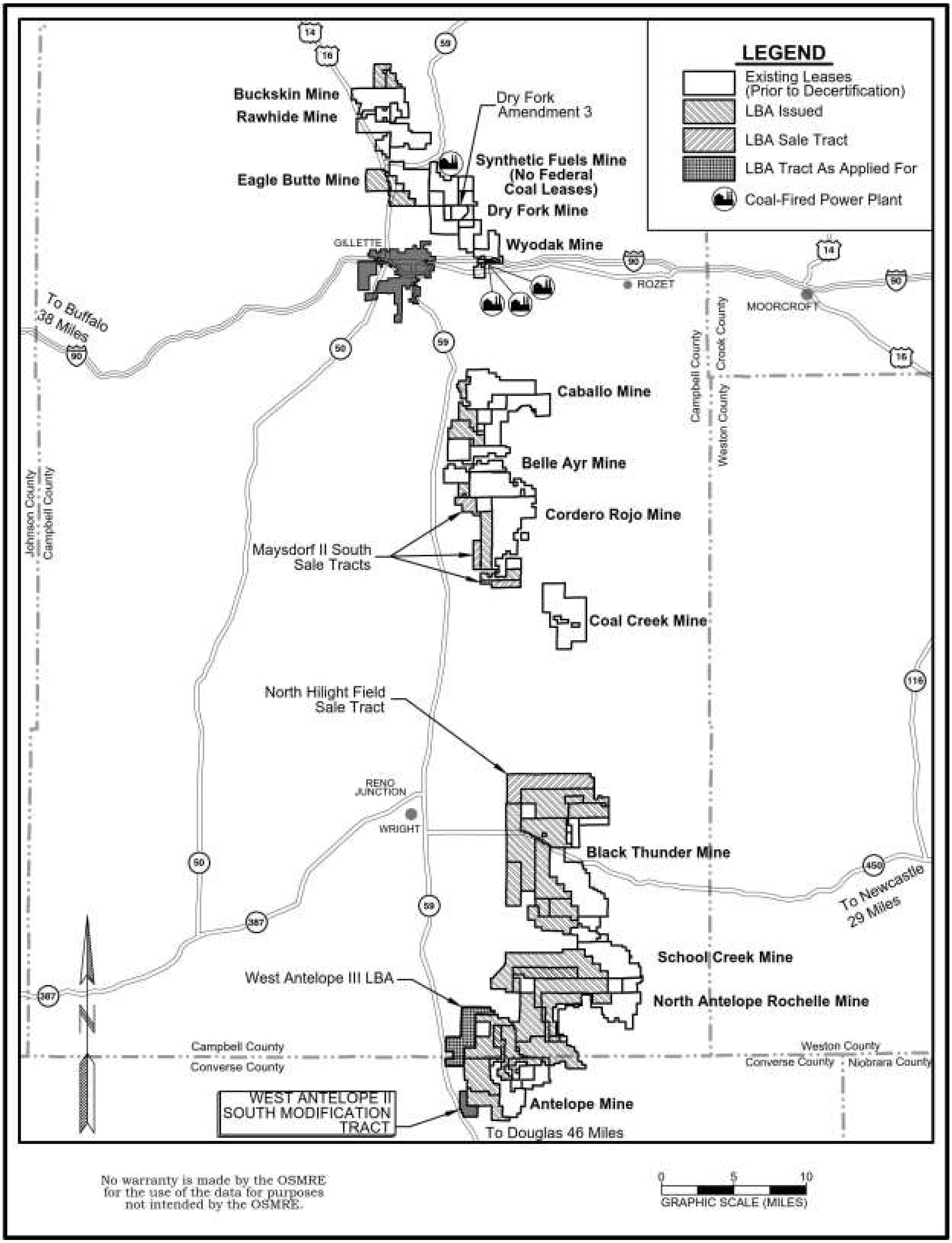
ATTN: West Antelope II South Modification EA
C/O: Gretchen Pinkham,
OSMRE Western Region
1999 Broadway, Suite 3320,
Denver, CO 80202-3050

Comments may also be emailed to: osm-nepa-wy@osmre.gov, ensure the subject line reads: ATTN: OSMRE, West Antelope II South Modification EA. Comments should be received or postmarked no later than December 3, 2019 to be considered during the preparation of the EA. Comments received, including names and addresses of those who comment, will be considered part of the public record for this project and will be available for public inspection. Additional information regarding the Project may be obtained from Gretchen Pinkham, telephone number (303) 293-5088 and the Project website provided below. When available, the EA and other supporting documentation will be posted at:
http://www.wrcc.osmre.gov/initiatives/westantelopeMine.shtm.

Sincerely,

Elizabeth Shaeffer,
Manager
Field Operations Branch

Attachment: Location Map


LEGEND
Existing Leases (Prior to Decertification)
LBA Issued
LBA Sale Tract
LBA Tract As Applied For
Coal-Fired Power Plant
Buckskin Mine
Rawhide Mine
Dry Fork Amendment 3
Synthetic Fuels Mine (No Federal Coal Leases)
Eagle Butte Mine
Dry Fork Mine
Wyodak Mine
GILLETTE
ROZET
MOORCROFT
To Buffalo 38 Miles
Campbell County
Crook County
Weston County
Caballo Mine
Belle Ayr Mine
Cordero Rojo Mine
Johnson County
Campbell County
Maysdorf II South Sale Tracts
Coal Creek Mine
North Hilight Field Sale Tract
RENO JUNCTION
WRIGHT
Black Thunder Mine
To Newcastle 29 Miles
School Creek Mine
West Antelope III LBA
North Antelope Rochelle Mine
Campbell County
Converse County
Weston County
Converse County
Niobrara County
WEST ANTELOPE II SOUTH MODIFICATION TRACT
Antelope Mine
To Douglas 46 Miles
No warranty is made by the OSMRE for the use of the data for purposes not intended by the OSMRE.
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GRAPHIC SCALE (MILES)

APPENDIX B

PUBLIC SCOPING AND NOTICE OF AVAILABILITY MAILING LISTS
and
PUBLIC SCOPING COMMENT SUMMARIES
(INDIVIDUAL LETTERS RECEIVED HAVE NOT BEEN INCLUDED)

Mailing List

Name	Title	
Tribes		
Darwin St. Clair	Chairman	Eastern Shoshone Business Council
Dean Goggles	Chairman	Northern Arapaho Business Council
Shaun Chapoose	Chairperson	The Ute Tribe of the Uintah and Ouray Reservation
Harold C. Frazier	Chairman	Cheyenne River Sioux Tribal Government
Roxanne Sazue	Chairwoman	Crow Creek Sioux Tribe
Wanda Wells	Cultural Affairs	Crow Creek Sioux Tribe
Anthony Reider	President	Flandreau Santee Sioux Tribe
Michael Jandreau	Chairman	Lower Brule Sioux Tribe
Clair Green	Cultural Resources/Public Affairs	Lower Brule Sioux Tribe
John Yellow Bird Steele	President	Oglala Sioux Tribal Council
William Kindle	President	Rosebud Sioux Tribe
Garryl Rousseau Sr.	Vice-Chairman or Acting Chairman	Sisseton-Wahpeton Oyate Tribes
Robert Flying Hawk	Chairman	Yankton Sioux Tribe
Lyman Guy	Tribal Chairman	Apache Tribe of Oklahoma
Lisa Martin	Tribal Council Coordinator	Cheyenne-Arapaho Tribes of Oklahoma
Wallace Coffey	Chairman	Comanche Nation Tribe
Amber Toppah	Lady Chairman	Kiowa Business Committee
Roger Trudell	Chairman	Santee Sioux Tribe of Nebraska
Mark Fox	Chairman	MHA Nation Tribal Council, Three Affiliated Tribes
Dave Archambault II	Chairman	Standing Rock Sioux Tribe
Vernon Finley	Chairman	Confederated Salish and Kootenai Tribes of the Flathead
Floyd Azure	Chairman	Ft. Peck Assiniboine and Sioux Tribes
Harry Barnes	Chairman	Blackfeet Tribal Business Council
Darrin Old Coyote	Chairman	Crow Tribal Council
Llevando “Cowboy” Fisher Sr.	President	Northern Cheyenne Tribal Council
Blaine Edmo	Chairman	Shoshone-Bannock Tribes of the Fort Hall Reservation
Federal, State, and Local Agencies		
Doug Miyamoto	Director	Wyoming Department of Agriculture
Todd Parfitt	Director	Wyoming Department of Environmental Quality
Mark Rogaczewski		WDEQ Land Quality Division
David Waterstreet	Program Director	WDEQ Natural Resources
Scott Talbott	Director	Wyoming Department of Game and Fish
Mary Hopkins	SHPO	Wyoming Historic Preservation Office, SHPO
Milward Simpson	Director	Wyoming Department of Parks and Cultural Resources
Bridget Hill	Director	Office of State Lands and Investment
Bill Crapser	State Forester	Wyoming Forestry Division
John Cox	Director	Wyoming Department of Transportation
Thomas A. Drean	Director/State Geologist	Wyoming Geological Survey
Dan Noble	Director	Wyoming Department of Revenue
Doug Miyamoto	Director	Wyoming Department of Agriculture
Mark W. Watson	State Oil and Gas Supervisor	Wyoming Oil and Gas Conservation Commission

Name	Title	
Pat Tyrrell		WY State Engineer's Office
Sarah Needles		WY State Historic Pres Office
Kyle Wendtland		Wyoming LQD - DEQ
		Wyoming State Board of Land Commissioners
		WY Dept of Employment Research & Planning
Kelly	Bott	WY DEQ Air Quality Division
Milward	Simpson	WY Parks & Cultural Res Dept
Pat	Tyrrell	WY State Engineer's Office
Sarah	Needles	WY State Historic Pres Office
	Natural Resources & Policy Section	Wyoming Dept of Agriculture
Scott	Talbott	Wyoming Game and Fish Department
Al	Minier-Chairman	Wyoming Public Service Comm
Thomas A.	Drean, Director	Wyoming State Geological Survey
Harry	LaBonde	Wyoming Water Dev Comm
Mark Christensen		Campbell County Commissioners
DG Reardon		Campbell County Commissioners
Bob Maul		Campbell County Commissioners
Rusty Bell		Campbell County Commissioners
Del Shelstad		Campbell County Commissioners
		Campbell County Airport
Jed Holder	Chief Building Official	Campbell County Building Division
Kevin King	P.E., Director	Campbell County Engineering Division
Megan Nelms	AICP, County Planner & Zoning	Campbell County Planning & Zoning Division
David King	CCEMA Coordinator	Campbell County Emergency Management
Bill Shank	Fire Chief	Campbell County Fire Department
Dave McCormick	Executive Director	Campbell County Parks and Recreation
Kevin King	P.E., Director	Campbell County Department of Public Works
Kevin F. Geis	P.E., Executive Director	Campbell County Road & Bridge
Quade Schmelzle	Director	Campbell County Weed & Pest
		Campbell County Conservation District
Alex Ayers	Superintendent	Campbell County School District 1
Phil Christopherson	CEO	Energy Capital Economic Development
Jeff Esposito	General Manger	Joint Powers Public Land Board
Robert Short		Converse County Commissioner
Jim Willox		Converse County Commissioner
Mike Colling		Converse County Commissioner
Rick Grant		Converse County Commissioner
Tony Lehner		Converse County Commissioner
Russ Dalgran		Converse County Emergency Management
Jason Wilkinson		Converse County Road and Bridge
Holly S. Richardson		Converse County Special Project
		Converse County Weed & Pest
		Converse County Conservation District

Name	**Title**	
Paige Fenton Hughes		Converse County School District #1
Coley Shadrick		Converse County School District #2
Annie Mayfield	Planning Services Division Manager	City of Gillette
Louise Carter-King	Mayor	City of Gillette
Shawn Neary	City Council	City of Gillette
Tim Carsurd	City Council	City of Gillette
Nathan McLeland	City Council	City of Gillette
Bruce Brown	City Council	City of Gillette
Billy Montgomery	City Council	City of Gillette
Shay Lundvall	City Council	City of Gillette
Ry Muzzarelli	Development Services Director	City of Gillette
Sawley Wilde	Public Works Director	City of Gillette
Mike Cole	Director of Utilities	City of Gillette
Jim Hloucal	Chief of Police	City of Gillette
Pam Boger	Administrative Services Director	City of Gillette
Patrick Davidson	City Administrator	City of Gillette
		Public Works & Utilities Advisory Committee, City of
		City of Gillette Planning Commission
Jonathan Teichert	City Administrator	City of Douglas
John Harbarger	Public Works Director	City of Douglas
Rene' Kemper	Mayor	City of Douglas
John Bartling	City Council	City of Douglas
Monty Gilbreath	City Council	City of Douglas
Karl E. Hertz	City Council	City of Douglas
Clara Chaffin	Community Development Director	City of Douglas
Mark Gordon	Governor	Wyoming Governor
Representative Scott Clem	District HD31	Wyoming Legislature
Representative Roy Edwards	District HD53	Wyoming Legislature
Representative Bill Pownall	District HD52	Wyoming Legislature
Senator Ogden Driskill	District SD01	Wyoming Legislature
Senator Michael Von Flatern	District SD24	Wyoming Legislature
Darryl LaCounte	Regional Director	Rocky Mountain Regional Office, Bureau of Indian Affairs
Carlie Ronca	Area Manager	Wyoming Area Office, Bureau of Reclamation
		Wyoming Regulatory Office, US Army Corps of
Mary Jo Rugwell	State Director	Wyoming State Office, Bureau of Land Management
Stephanie Connolly	High Plains District Manager	High Plains District Office, Bureau of Land Management
Mitchell Leverette	Division Chief	Bureau of Land Management
Duane Spencer		Buffalo Field Office, Bureau of Land Management
Rhen Etzelmiller		Casper Field Office, Bureau of Land Management
		Library, Bureau of Land Management
	Coal Coordinator	Wyoming State Office, Bureau of Land Management
Lawrence S. Roberts	Acting Assistant Secretary	Bureau of Indian Affairs
Mark Sattelberg	Field Supervisor	Wyoming Ecological Services Field Office, US Fish and

Name	Title	
Dennis Jaeger	Forest Supervisor's Office	Thunder Basin National Grassland, USDA Forest Service
		Devils Tower National Monument, National Park Service
Astrid Martinez	State Conservationist	Wyoming State Office, Natural Resources Conservation
	Ecological Services	US Fish and Wildlife Service
	BLM Cooperator Lead	USDA-FS Douglas Ranger District
		US Fish and Wildlife Service, Ecological Services
Businesses and Individuals		
Antelope Coal, LLC	385 Interlocken Cres Ste 400	
H.A. True		President, Belle Fourche Pipeline Company
Mitchell J. Reneau		VP Land, Bill Barrett Corporation
		Biodiversity Conservation Alliance
		BNSF Railway Company
		Buckskin Mine-Kiewit Mining Group
Jason Adrians		Casper Star Tribune
Amy M. Atwood		Center for Biological Diversity
		Navajo Transitional Energy Company, LLC
		Cordero Rojo Mine
		Defenders of Wildlife
		Devils Tower National Monument
Matt Adelman		Publisher, Douglas Budget
		Federation for North American Wild Sheep
Energy Reporter		Gillette News-Record
Scott Child		Interwest Mining Company
Joe Mehl		Kiewit Mining Group Inc
Jim McLeland & Eric Bjordahl		M&K Oil Company Inc
Greg Julian		Mineral Management Service
Hal Quinn		National Mining Association
		National Wildlife Federation
		Natural Resources Defense Council
Shannon Anderson		Powder River Basin Resource Council
Phil Dinsmoor		Powder River Coal Company
James M. Piccone		Resolute Wyoming
Peter Morgan		Sierra Club
Lecia Craft		Thunder Basin Coal Company
Ralph Kingan		Mayor, Town of Wright
Roger Miller		President, Trout Unlimited
Lance Fritz		President, Chief Executive Officer, Union Pacific Railroad
		US West Communications (Qwest Corp.)
Jason M. Ryan		Business Analytics Director, US Western Surface
Wendi Chatman		UW Libraries
Taylor Jones		WildEarth Guardians
Dave Spencer		WY Business Council/NE Region
Bill Schilling		Wyoming Business Alliance

Name	**Title**	
Matt Grant		Wyoming Mining Association
Gary Wilmont		Wyoming Outdoor Council
Niels Hansen		Wyoming Stock Growers Assoc
Steve Kilpatrick		Wyoming Wildlife Federation
Amy Wallop-Hendrickson		Wyoming Wool Growers Association, Executive
Mike McCraken-Publisher		Wyoming-Tribune Eagle
Katie Parker		Yates Petroleum Corp et al

West Antelope II South Modification Tract EA Public Outreach (Scoping) Comments Summary

Comment Date	Water Resources	Air Quality	Level of NEPA/ NEPA Process	Reclamation/ Self Bonding	Climate Change/ Global Warming	Cumulative Impacts	Pro Mining	# of Comments
12/3/19	1	1	1	1	1	1		**6**
12/3/19							1	**1**
12/3/19							1	**1**
11/19/19								**0**
	1	**1**	**1**	**1**	**1**	**1**	**2**	**8**

APPENDIX C

CROSSWALK OF RESOURCES

Crosswalk of Resources Analyzed in the 2008 WAII EIS, 2014 WAII South EA, and This EA

Resource	BLM 2008 West Antelope II EIS		BLM 2014West Antelope II South Lease Modification EA		OSMRE West Antelope II South Modification EA	
	Affected Environment	Environmental Consequences	Affected Environment	Environmental Consequences	Affected Environment	Environmental Consequences
General Setting	3.1	3.1	Not evaluated		3.1	4.1
Topography and Physiography	3.2.1	3.2.2	Not evaluated		3.2	4.2
Geology, Minerals, and Paleontology	3.3.1.1 3.3.2.1 3.3.3.1	3.3.1.2 3.3.2.2 3.3.3.2	Not evaluated		3.3	4.3
Air Quality and Climate Change	3.4.2.1 3.4.3.1 3.4.4.1 3.4.5.1	3.4.2.2 3.4.3.2 3.4.4.2 3.4.5.2	3.3	4.1.3	3.4	4.4
Water Resources	3.5.1.1 3.5.2.1 3.5.3.1	3.5.1.2 3.5.2.2 3.5.3.2	Not evaluated		3.5	4.5
Alluvial Valley Floors	3.6.1	3.6.2	Not evaluated		3.6	4.6
Wetlands	3.7.1	3.7.2	Not evaluated		3.7	4.7
Soils	3.8.1	3.8.2	Not evaluated		3.8	4.8
Vegetation	3.9.1	3.9.2	Not evaluated		3.9	4.9
Wildlife (including T&E and Special Status Species)	3.10.1.1 3.10.2.1 3.10.3.1 3.10.4.1 3.10.5.1 3.10.6.1 3.10.7.1	3.10.1.2 3.10.2.2 3.10.3.2 3.10.4.2 3.10.5.2 3.10.6.2 3.10.7.2	3.1	4.1.1	3.10	4.10
Land Use and Recreation	3.11.1	3.11.2	Not evaluated		3.11	4.11
Cultural Resources	3.12.1	3.12.2	3.2	4.1.2	3.12	4.12
Visual Resources	3.13.1	3.13.2	Not evaluated		3.13	4.13
Noise	3.14.1	3.14.2	Not evaluated		3.14	4.14
Transportation	3.15.1	3.15.2	Not evaluated		3.15	4.15
Hazardous and Solid Waste	3.16.1	3.16.2	Not evaluated		3.16	4.16
Socioeconomics	3.17.1.1 3.17.2.1 3.17.3.1 3.17.4.1 3.17.5.1 3.17.6.1 3.17.7.1	3.17.1.2 3.17.2.2 3.17.3.2 3.17.4.2 3.17.5.2 3.17.6.2 3.17.7.2	Not evaluated		3.17	4.17

APPENDIX D

ANTELOPE MINE BOND RELEASE

There are four types of bond release for areas disturbed and coal removed after May 1978 for which mine operators may apply to reduce their reclamation bond. As outlined in WDEQ-LQD Guideline 20 (Bond Release Categories and Submittal Procedures for Coal Mines [WDEQ-LQD 2014a]), these include:

1. Area Bond Release - Rough backfill verification;
2. Phase 1 - Partial Incremental, which includes stream channel reconstruction verification and soil depth verification;
3. Phase 2 - Partial Incremental, which includes vegetation establishment verification, surficial stability verification, and permanent impoundment construction/renovation and SEO approval verification; and
4. Phase 3 - Full Incremental or Final release, which includes mitigation wetlands verification, revegetation success verification, and tree establishment verification.

All reclaimed areas are monitored for a minimum of 10 years to evaluate the success of vegetation growth and the establishment of a variety of plant species prior to the Phase 3 final release of the reclamation bond. It is important not to equate contemporaneous reclamation with final bond release. There is a difference between lands that are in various stages of reclamation and those that have been reclaimed and released from final bonding requirements. Final bond release on reclaimed lands indicates that the reclamation meeting permit standards has been in place in accordance with permit standards for at least 10 years and that an application for final bond release has been submitted to the WDEQ. In 2017, the OSMRE Denver Field Division evaluated reclamation plans of four approved permits in Wyoming during oversight inspections and determined that all permits evaluated were in compliance with contemporaneous reclamation requirements, as defined within the approved permits (OSMRE 2017). According to Antelope Mine's 2018 Annual Report (AC 2018), the mine had disturbed approximately 11,764 acres, of which approximately 746 acres (6.3 percent) are needed for long-term mining activities and, as such, are considered land not available for reclamation. As of January 31, 2018, the mine had backfilled and graded approximately 6,293 acres. Thus, the mine had backfilled and graded approximately 53.5 percent of the total disturbance and approximately 57.1 percent of land available for reclamation. A summary of phased bond release acreages in the project area is included in the following table.

Summary of Phased Bond Release Acreages in the Project Area

Phased Bond Releases Status[1]	Mine Wide	Percent
Total Areas Disturbed	11,764	--
Acres of Long-term Mining or Facilities and Percent of Total Disturbance	746	6.3
Acres Available for Backfilling or Reclamation and Percent of Total Disturbance	11,018	93.7
Acres of Active Mining and Percent of Available Acres	5,139	46.6
Acres Backfilled and Graded and Percent of Available Acres	6,293	57.1
Total Areas Reclaimed (Soiled and Seeded/Planted) and Percent of Backfilled and Graded	5,243	47.6
Areas Which Have Achieved Phase 1 Bond Release and Percent of Reclaimed Acres	2,856	25.9
Areas Which Have Achieved Phase 2 Bond Release and Percent of Reclaimed Acres	0	0
Areas Which Have Achieved Phase 3 Bond Release and Percent of Reclaimed Acres	0	0

[1] As of January 31, 2018
Source: AC 2018

It should be noted that neither state nor federal regulations require a permittee to file for bond release at any prescribed time. Therefore, only using bond release statistics to evaluate reclamation success can be misleading. Typically, permittees do not file for Phase 2 or Phase 3 bond release until completion of the entire mining operation. As a result, the number of acres released from Phase 2 and Phase 3 bond in Wyoming is relatively small compared to the number of acres actually regraded, topsoiled, and seeded. The standard for determining if mines are meeting their reclamation obligations is related to compliance with contemporaneous reclamation permit commitments. Contemporaneous reclamation specifically refers to the timeliness in which reclamation is occurring. An evaluation is conducted annually by OSMRE and according to the 2017 Annual Evaluation Report for the WDEQ Regulatory Program, all coal mines evaluated were found to be in compliance (OSMRE 2017).

APPENDIX E

CLIMATE CHANGE AND GREENHOUSE GAS DISCUSSIONS

Estimated Average 2014-2018 Direct and Indirect CO_2e Emissions from Coal Mined at the Antelope Mine

CO_2 is emitted from the combustion of fossil fuels, including coal. CH_4 can be emitted during the production and transport of coal. N_2O is emitted during agricultural and industrial activities, as well as during combustion of fossil fuels and solid waste. Fluorinated gases are synthetic, powerful GHGs that are emitted from a variety of industrial processes. CO_2 and other GHGs are naturally occurring gases in the atmosphere; their status as a pollutant is not related to their toxicity, but instead is due to the added long-term impacts they have on climate because of their increased incremental levels in the earth's atmosphere. Because they are non-toxic and non-hazardous at normal ambient concentrations, CO_2 and other naturally occurring GHGs do not have applicable ambient standards or emission limits under the major environmental regulatory programs. Each GHG has a different lifetime in the atmosphere and a different ability to trap heat in the atmosphere. To allow different gases to be compared and added together, emissions can be converted into CO_2e emissions using the global warming potential (GWP) concept developed by the Intergovernmental Panel on Climate Change (IPCC). The EPA uses a 100-year time horizon in its Inventory of Greenhouse Gas Emissions and Sinks: 1990-2017 (EPA 2019h) and Mandatory Greenhouse Gas Reporting rule. Therefore, project-related emissions are shown based on the 100-year GWP values for comparison to state and national GHG emissions. Additionally, total CO_2e from the project based on a 20-year time horizon is also shown for reference. The GWPs used to calculate CO2e emissions presented in this section are based on the IPCC's Climate Change 2014: Synthesis Report (IPCC 2014).

Estimates related to mining include emissions from all sources, including all types of carbon fuels used in the mining operations, electricity used on site (i.e., lighting for facilities, roads, and operations and electrically powered equipment and conveyors), the mining processes (i.e., blasting, coal fires caused by spontaneous combustion, methane released [vented] from exposed coal seams), and coal combustion. Direct CO_2e emissions include emissions directly related to the recovery of coal. Indirect emission result from the transportation of the coal to and combustion of the coal at power plants. Although the Antelope Mine has not completed CO_2e emissions inventories resulting from current coal recovery, these emissions were estimated by applying CO_2e emission ratios (CO_2e per Mt of coal produced, per Mt cubic yards of overburden moved, and CO_2e per acre of disturbance) from the Antelope Mine and adjacent mines (Jacobs Ranch and Cordero Rojo mines) to recent Antelope Mine production (tonnages). This assumes that since mining methods and circumstances are similar, the estimated CO_2e emission ratios for the Antelope Mine would be similar to the calculated ratios at adjacent mines. Average annual direct CO_2e emissions estimates for the Antelope Mine from 2014-2018 are shown in **table 1**. The amount of CO_2e emitted from combustion of the coal was calculated using an emission factor that considered the carbon content and heating value of the fuel used (EPA 2019e).

Table 1. Estimated Annual Average 2014-2018 Direct and Indirect CO_2e Emissions

Source	100-year Time Horizon	20-year Time Horizon
Fuel	59,017	59,312
Electricity consumed in mining process	95,834	96,313
Mining process[1]	17,356	17,422
Total direct emissions	*172,206*	*173,067*
Transport[2]	1,163,284	1,169,100
From coal combustion	50,344,931	50,601,101
Total Indirect Emissions	*51,498,069*	*51,760,107*
Total Estimated CO_2e Production	**51,680,421**	**51,942,408**

1 In metric tons
2 Coal haulage emissions based on 130-car trains with four locomotives; 488.2 kg CO_2e per mile per loaded train, 96.1 kg CO_2e per mile per empty train; and one-way mileage to power plants. Coal haulage emissions calculations includes a loaded train and a returning empty train, per train trip.
Source: WWC 2019, calculations are provided in **appendix C**

The table shows that combustion of coal from the Antelope Mine used for electricity generation accounted for approximately 97.3 percent of the total CO_2e emissions from the coal mined.

Estimated Direct and Indirect CO_2e Emissions from Proposed Action

The estimated annual CO_2e emissions for the Proposed Action were calculated at 30 Mtpy, which was the average annual production over the last 5 years. **Table 2** presents the estimated annual CO_2e for the 100-year and 20-year time horizons.

Table 2. Estimated Annual Average 2020-2034 Direct and Indirect CO_2e Emissions

Source	100-year Time Horizon	20-year Time Horizon
General		
Mt of coal recovered	30.0	30.0
Average transport miles (one way)	1,099	1,099
Number of train trips (loaded and returning empty)	1,923	1,923
Direct emission sources[1]		
Fuel	58,906	59,200
Electricity consumed in mining process	95,653	96,131
Mining process	17,323	17,410
Total direct emissions	*171,882*	*172,741*
Indirect emission sources[1]		
Transport	1,160,879	1,166,683
From coal combustion[2]	50,250,000	50,501,250
Total indirect emissions	*51,410,879*	*51,667,9332*
Total estimated CO_2e production[1]	**51,582,761**	**51,840,674**

1 In metric tons - see **appendix C** for calculations
2 Calculated by WWC (2019)

According to the EPA (2019h) in 2017 (the most recent year of CO_2 data available at this time), estimated CO_2e emissions from fossil-fuel combustion in the U.S. totaled 4,912 MMT. Using the 2017 U.S. estimate for comparison purposes, the estimated annual 100-year CO_2e contribution from the Proposed Action would be 51.7 MMT, or approximately 1.1 percent of the 2017 U.S. total. According to the IPCC 2014 Climate Change Synthesis Report (IPCC 2014), the estimated total 2010 global CO_2e emissions totaled 49,100 MMT. The IPCC report estimated that approximately 78 percent (i.e., 38,298 MMT) of the total global CO_2e emissions are from fossil fuel combustion. Using the 2010 global estimate for comparison purposes, the estimated annual

100-year CO_2e contribution from the Proposed Action would be 51.7 MMT, or approximately 0.13 percent of the 2010 global fossil fuel emissions. The direct and indirect effects of the Proposed Action on annual CO_2e emissions would be moderate but they would be extended by approximately 0.5 year.

Climate Change Cause and Effect

According to the EPA (EPA 2020a), in 2016 (the most recent year of available CO_2 data at this time), CO_2e emissions in the United States. totaled 6,511.3 million metric tons. The estimated CO_2e contribution of U.S. emissions would be approximately 13% of the total global CO_2e emissions. In 2018, the U.S. Geological Survey (USGS) published a report titled Federal Lands Greenhouse Gas Emissions and Sequestration in the United States: Estimates for 2005–14 (Merrill et al. 2018) on GHG emissions from extraction and use of fossil fuels produced on Federal lands and GHG sinks (carbon storage by terrestrial ecosystems) on Federal lands in the United States. In 2014, nationwide emissions from fossil fuels (oil, gas, and coal) extracted from Federal lands were 1,279.0 million metric tons (MMmt) carbon dioxide equivalents (CO_2e) of carbon dioxide, 47.6 MMmt CO_2e of methane, and 5.5 MMT CO2e of nitrous oxide based on 100-year GWPs (Merrill et al. 2018:6). In 2014, carbon storage by terrestrial ecosystems on Federal lands in the conterminous United States (not including Alaska and Hawaii) was 83,600 MMmt CO_2e. Soils stored 63 percent of carbon, with vegetation and dead organic matter storing 26 percent and 11 percent, respectively (Merrill et al. 2018:12). Between 2005 and 2014, the annual rate of net carbon uptake by terrestrial ecosystems in the conterminous United States ranged from a sink (sequestration) of 475 MMmt CO_2e per year to a source (emission) of 51 MMmt CO_2e per year due to changes in climate/weather, land use, land cover change, wildfire frequency, and other factors. Terrestrial ecosystems on Federal lands sequestered an average of 195 MMmt CO_2e per year nationally between 2005 and 2014 (Merrill et al. 2018:13–17).

Historically, the coal mined in the PRB has been used as one of the sources of fuel to generate electricity in power plants located throughout the U.S. The electricity sector involves the generation, transmission, and distribution of electricity. **Table 3** shows the trend in GHG emissions between 2005 and 2017 (the most recent data available). The table also shows the trends in global GHG emissions between 2005 and 2015 (the most recent data available).

Table 3. Trends in U.S. and Global GHG Emissions and Contributing Factors

Gas/Source	2005	2015	2017	% Change
Contributing Factors (Million Metric Tons [MMT])				
Coal Produced in the U.S.	1,026.5		702.1	-32%
Coal Produced in Wyoming PRB	353.9		277.0	-22%
Percent of U.S. Coal from Wyoming PRB	34%		39%	5%
Coal produced at the Antelope Mine	27.2		25.9	-5%
Percent of U.S. Coal from the Antelope Mine	3%		4%	1%
Percent of Wyoming PRB Coal from the Antelope Mine	8%		9%	1%
U.S. GHG Emissions (MMT CO_2e)				
Total GHG Emissions	7,339.0		6,456.7	-12%
GHG Emissions from Power Generation	2,431.0		1,233.0	-49%
GHG Emissions from Coal-fired Power Generation	2,011.2		1,228.5	-39%
Global GHG Emissions (MMT CO_2e)				
Total GHG Emissions	41,163.3	49,113.3	No Data	19%
Wyoming PRB GHG Contributions (MMT CO_2e)				
GHG Emissions from Coal-fired Power Generation	693.4		484.7	-30%
Antelope Mine GHG Contributions (MMT CO_2e)				
GHG Emissions from Coal-fired Power Generation	53.3		45.3	-15%

Source: EPA 2019h, U.S. EIA 2019, Crippa et. al. 2019

As concluded from the information presented in **table 3**, Wyoming PRB surface coal mines were responsible for approximately 484.7 MMT of the estimated U.S. CO_2e emissions from coal-fired power generation in 2017. The coal mined at the Antelope Mine results in about 45.3 MMT, or about 3.7%, of the estimated 2017 U.S. CO_2e emissions from coal-fired power generation.

Climate Change Cause and Effect Cumulative Effects

The USGS has produced estimates of the GHGs resulting from the extraction and end-use combustion of fossils fuels produced on federal lands in the U.S., as well as, estimates of ecosystem carbon emissions and sequestration on those lands (Merrill et al. 2018). The study reports GHG emissions from extraction, transport, fugitive, and combustion of fuel over a 10-year period (2005-2014). In 2014, nationwide gross GHG emissions (CO_2, CH_4, and N_2O combined) from fossil fuels extracted from federal lands was 1,332.1 MMT CO_2e. Emissions from fossil fuels produced on federal lands represent, on average, 23.7 percent of national emissions for CO_2, 7.3 percent for CH_4, and 1.5 percent for N_2O over the 10 years, included in USGS estimates (Merrill et al. 2018). Trends and the relative magnitude of emissions are roughly parallel to production volumes. Wyoming federal fossil-fuel-related gross emissions in 2014 were 740.8 MMT CO2e, approximately 5% of the CO_2 associated with the extraction and combustion of fossil fuels produced from Federal lands in the 10 States or offshore regions with the highest emissions.

Federal lands also uptake carbon in vegetation, soils, and water. In 2014, carbon storage on federal lands in the conterminous U.S. was 83,600 million metric tons CO_2e. Soils stored 63 percent of carbon with dead organic matter and vegetation storing 26 percent and 10 percent, respectively. Between 2005 and 2014, Federal lands sequestered an average of 343 MMT of CO_2e per year. However, carbon sequestration on Federal lands was highly variable over time due to changes in climate/weather, land use, land cover change, wildfire frequency, and other factors. In Wyoming, the annual average ecosystem carbon storage was 4,812.2 MMT CO2e over the 10 years (2005-2014), with soils accounting for about 68 percent. The annual average sequestration in Wyoming accounted for 2.2 percent of the carbon storage on federal lands (Merrill et al. 2018).

In 2017, coal-fired power generation accounted for approximately 19 percent of U.S. GHG emissions. However, state and federal regulations will decrease GHG emissions from power plants. And as of January 2013, 29 states had a renewable portfolio standard, which requires utilities to supply a certain amount of electricity to customers from renewable energy sources or install a certain amount of electricity-generating capacity from renewable energy sources in a set time frame (U.S. Department of State 2014). In addition, the EPA recently proposed amendments to the 2015 Rule, which added new regulations to reduce CO_2 emissions from new, existing, and modified or reconstructed power plants (83 FR 65424). Wyoming Governor Mark Gordon signed Senate File 21 into law on March 10, 2020. The bill will require electric public utilities to "first make a good faith effort" to sell coal-fired electric generation facilities before retiring such facilities. The rules will go into effect July 1, 2021 and will allow non-utilities to purchase otherwise retiring coal fired power plants and sell energy to industrial customers (State of Wyoming 2020).

Another approach to address possible climate change impacts is to calculate the so-called "social cost of carbon". A protocol to estimate the social cost of carbon associated with GHG emissions was developed by a federal Interagency Working Group (IWG) to assist agencies in addressing EO 12866, which required federal agencies to assess the cost and the benefits of intended regulations as part of their regulatory impact analyses. The social cost of carbon protocol was also developed for use in cost-benefit analyses of proposed regulations that could impact cumulative global emissions (Shelanski and Obstfeld 2015). However, EO 13783, issued March

28, 2017, directed that the IWG be disbanded and that technical documents issued by the IWG be withdrawn as no longer representative of federal policy. The 2017 EO further directed that when monetizing the value of changes in GHG emissions resulting from regulations, agencies follow the guidance contained in Circular A-4 (Office of Management and Budget 2003). It was determined that a federal agency should ensure that its consideration of the information and other factors relevant to its decision be consistent with applicable statutory or other authorities, including requirements for the use of cost-benefit analysis.

Direct and Indirect Cumulative Effects on the Proposed Action/No Action

The Fifth Assessment Report of the IPCC (AR5) includes a summary of data from 30 different global climate models that evaluate the natural systems and feedback mechanisms contributing to climate variability. A range of global GHG emissions scenarios known as representative concentration pathways (RCP) were considered in the modeling analysis to assess potential degrees of climate change impacts. A stringent mitigation scenario (RCP2.6), a low emissions scenario (RCP4.5), an intermediate emissions scenario (RCP 6.0), and an aggressive emissions scenario (RCP8.5) were evaluated in the report. These scenarios correspond to atmospheric concentrations of CO_2 by the year 2100 of 421 ppm for RCP2.6, 538 ppm for RCP4.5, 670 ppm for RCP6.0, and 936 ppm for RCP8.5. The range of likely change in global surface temperature by 2050 ranges from 0.3 to 1 degree Celsius for the RCP2.6 scenario and from 0.5 to 2.0 degrees Celsius for the RCP8.5 scenario. Generally, the more stringent climate change mitigation, the lower the projected change in global surface temperatures. When discussing regional impacts, however, it is important to note that degrees of surface temperature increases vary from region to region.

To discuss the cumulative impacts of GHG emissions for the project area, regional-scale projected impacts are discussed for the state of Wyoming. The USGS National Climate Change Viewer (USGS 2016) can be used to evaluate potential climate change at the state level. The viewer provides data showing projections of future climate trends under RCP emission scenarios RCP4.5 and RCP8.5. Data presented in the USGS Climate Change Viewer data can also be extrapolated to get a general understanding of impacts under RCP2.6 and RCP6.0. Generally, the RCP2.6 scenario can be assumed to contribute to a lesser degree of climate change impacts in the region, while the RCP6.0 can be assumed to contribute to impacts that are of lesser magnitude than RCP8.5 but of greater magnitude than RCP4.5. Projected changes to the maximum and minimum temperature and precipitation for Wyoming are presented for RCP4.5 and RCP8.5 to assess regional cumulative impacts from GHG emissions in **Figures 1** through **3** below. **Figure 1** shows a seasonal average time series of maximum 2-meter air temperature for historical (black), RCP4.5 (blue), and RCP8.5 (red) for Wyoming. **Figure 2** shows a seasonal average time series of minimum 2-meter air temperature for historical (black), RCP4.5 (blue), and RCP8.5 (red) for Wyoming. **Figure 3** shows a seasonal average time series of precipitation for historical (black), RCP4.5 (blue), and RCP8.5 (red) for Wyoming.

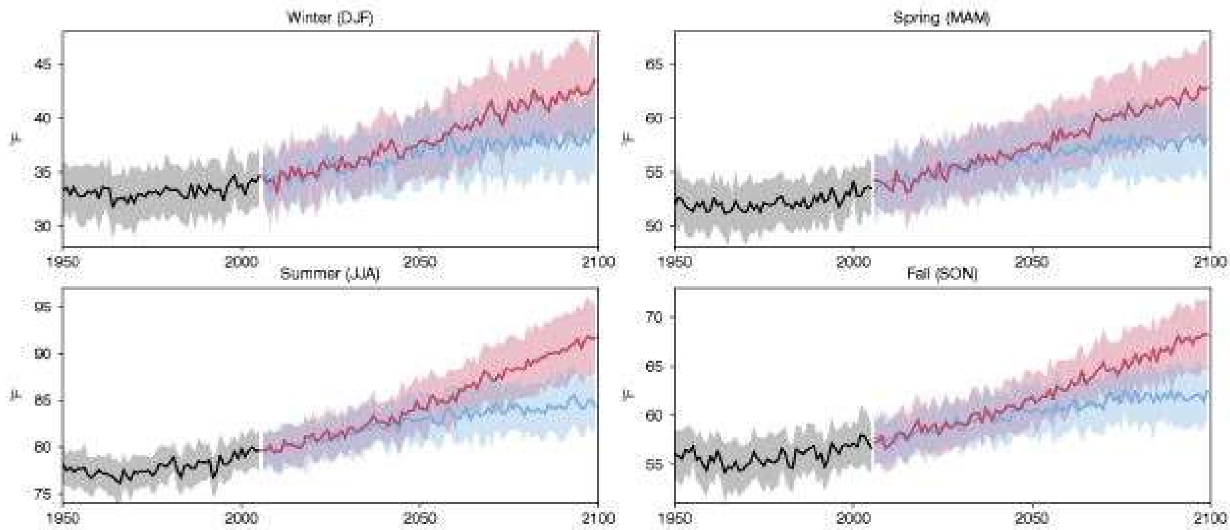

Figure 1. Wyoming climate change viewer, maximum 2-meter air temperature

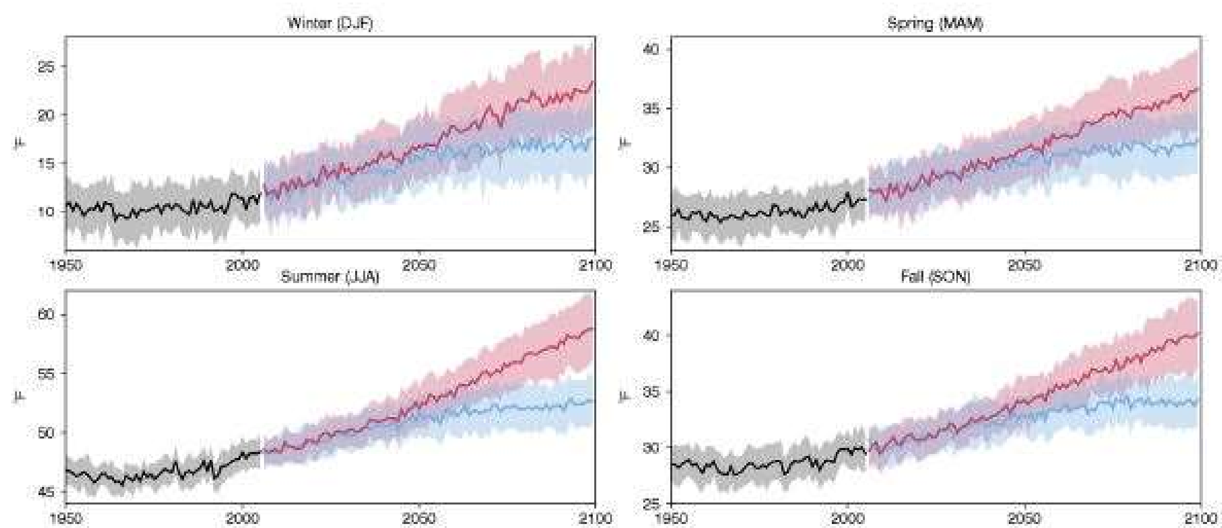

Figure 2. Wyoming climate change viewer, minimum 2-meter air temperature

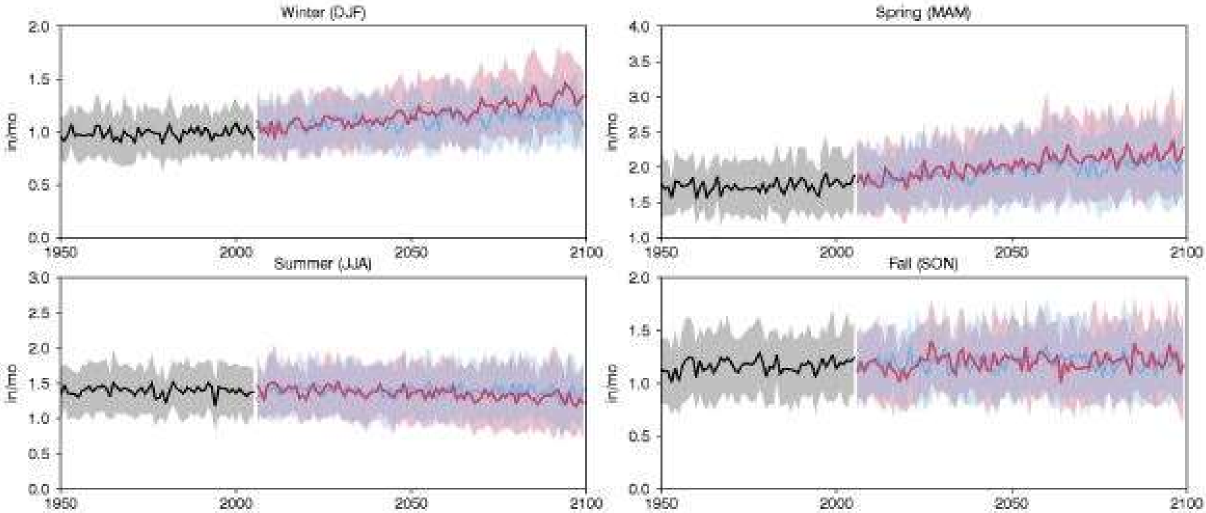

Figure 3. Wyoming climate change viewer, precipitation

The RCP4.5 and RCP8.5 scenarios forecast similar levels of climate impacts in the region over the next few decades; however, impacts over the next century diverge significantly. Because of uncertainties in the climate models, especially toward the end of the century, the impacts projected represent a forecast but are not certain to occur at the magnitudes projected.

APPENDIX F

GREENHOUSE GAS EMISSIONS CALCULATIONS

PM_{10}, $PM_{2.5}$, SO_2, NO_X, Hg, CO, and CO_2 CONTRIBUTIONS FROM COAL COMBUSTION CALCULATIONS
(Completed by WWC Engineering)

GHG Calculations Assumptions

Direct Emissions Variables

Source	CO_2e/Mt Coal Mined
Fuel Subtotal	1,963.5
Electricity Subtotal	3,188.4
Process Subtotal	577.4

Source: WWC Calculation 2019

Indirect Transportation Emissions Assumptions

120	Tons of Coal/Car
130	Cars/Train
15,600	Tons of Coal/Train
24	Tons/car empty1/2 are 22 tons and 1/2 are 26 tons
200	Tons/locomotivehttp://www.4rail.net/reference_nam_bnsf_locos1.php
3,920	Weight of empty 130/car train (tons)
19,520	Weight of loaded coal train (tons)

Transportation Emissions Variables (Locomotives)

Emission Rate	(kg/gal)	100-year Time Horizon CO_2e Conversion Rate	20-year Time Horizon CO2e Conversion Rate	Kg CO_2e/Gal Diesel	Kg CO_2e/Mile/Ton
CO_2	10.21	1	1	10.21	0.023417431
CH_4	0.0008	28	84	0.0200	0.000001
N_2O	0.00026	264	265	0.07748	0.000016
Total				**10.30748**	**0.0234**

Source: Conversion Rate – EPA 2017a
Emission Rate – EPA 2014

Transportation Variables (Locomotives)

	Miles/gal/1 Ton[1]	Miles	Kg CO_2e/Mile/Ton[2]	Tons	Kg CO_2e /Mile	Kg CO_2e/Trip	Metric Tons CO_2e/Trip
Loaded	436	1,099	0.0234	19,520.0	457.4	502,795.7	502.8
Empty	436	1,099	0.0234	3,920	91.9	100,971.3	101.0

1 FactCheck 2008
2 EPA 2014

Antelope Mine Production, 2014-2018

	2014	2015	2016	2017	2018	2014-2018 Average
Production (Tons)	33,646,960	35,167,152	29,807,165	28,506,357	23,155,742	30,056,675

Estimated 2014-2018 Average Annual Antelope Mine CO_2e (in metric tons)

Source	**Coal (Mt)**	**Ave. Known Ratio (metric tons CO_2e/Mt coal)**	**100-year Time Horizon Metric Tons CO_2e**	**20-year Time Horizon Metric Tons CO_2e**
Direct				
Fuel	30.06	1,963.5	59,017	59,312
Electricity		3,188.4	95,834	96,313
Mining Process		577.4	17,356	17,422
Total Direct			*172,206*	*173,067*
Indirect				
Transport	100-year Time Horizon	20-year Time Horizon		
2014-2018 Coal Production	30,056,675	30,056,675		
Tons Coal/Train	15,600	15,600		
Empty Train Tons	3,920	3,920		
Loaded Train Tons	19,520	19,520		
# Loaded Trains/year	1,927	1,927		
# Empty Trains/year	1,927	1,927		
Average Rail miles to power plant	1,099	1,099		
Kg CO_2e/Mi/Loaded Train	457.4	459.7		
Kg CO_2e/Mi/Empty Train	91.86	92.32		
Kg CO_2e/year Empty	194,542,336.0	195,515,047.7		
Kg CO_2e/year Loaded	968,741,428.2	973,585,135.4		
Rail Kg CO_2e/year Total	1,163,283,764.2	1,169,100,183.0		
Rail Metric CO_2e/year Total	1,163,284	1,169,100		
Combustion (Tons CO_2e)	50,344,931	50,601,101		
Total Indirect CO_2e (Tons)	*51,508,215*	*51,770,202*		
Total Direct + Indirect CO_2e	**51,680,421**	**51,942,408**		

Estimated 2020-2034 Antelope Mine CO_2e (in metric tons)

Source	Coal (Mt)	Ave. Known Ratio (tons CO_2e/Mt coal)	100-year Time Horizon Metric Tons CO_2e	20-year Time Horizon Metric Tons CO_2e
Direct				
Fuel	30.0	1,963.5	58,906	59,200
Electricity		3,188.4	95,653	96,131
Mining Process		577.4	17,323	17,410
Total Direct			*171,882*	*172,741*
Indirect				
Transport	100-year Time Horizon	20-year Time Horizon		
2020-2031 Coal Production	30,000,000	30,000,000		
Tons Coal/Train	15,600	15,600		
Empty Train Tons	3,920	3,920		
Loaded Train Tons	19,520	19,520		
# Loaded Trains/year	1,923	1,923		
# Empty Trains/year	1,099	1,099		
Average Rail miles to power plant	1,099	1,099		
Kg CO_2e/Mi/Loaded Train	457.4	459.7		
Kg CO_2e/Mi/Empty Train	91.86	92.32		
Kg CO_2e/year Empty	194,140,174.5	195,110,875.4		
Kg CO_2e/year Loaded	966,738,828.0	971,572,522.2		
Rail Kg CO_2e/year Total	1,160,879,002.5	1,166,683,397.5		
Rail Metric CO_2e/year Total	1,160,879	1,166,683		
Combustion (Tons CO_2e)	50,250,000	50,501,250		
Total Indirect CO_2e (Tons)	*51,410,879*	*51,667,933*		
Total Direct + Indirect CO_2e	**51,623,420**	**51,840,674**		

100% Coal shipped to U.S. power plants

Parameters Used to Calculate Combustion Emissions

Btu per short ton tons per kilogram	24,930,000 0.00110231
tons to generate 1Kilowatt-Hour	0.00052
tons to generate 1 Megawatt-Hour	0.52
PM10 Emissions per Btu (kilogram per Megawatt-Hour) PM10 Emissions per Btu (ton per Megawatt-Hour)	0.39 0.000429901
PM2.5 Emissions per Btu (kilogram per Megawatt-Hour) PM2.5 Emissions per Btu (ton per Megawatt-Hour)	0.305 0.00013112
SO2 Emissions per Btu (kilogram per Megawatt-Hour) SO2 Emissions per Btu (ton per Megawatt-Hour)	7.192 0.007927814
NOx Emissions per Btu (kilogram per Megawatt-Hour) NOx Emissions per Btu (ton per Megawatt-Hour)	2.779 0.003063319
Hg Emissions per Btu (kilogram per Megawatt-Hour) Hg Emissions per Btu (ton per Megawatt-Hour)	0.000028 0.00000003
CO Emissions (lb) per ton	0.50000000

Combustion Emissions Values

Emissions Combustion	**Past Production**						**Proposed Action 30 Mtpy**	**No Action**	**Total U.S. Emissions**	**2020-2034 Average % of U.S.**
Years	**2014**	**2015**	**2016**	**2017**	**2018**	**2014-2018**	**2020-2034**	**2020-2033**	--	--
Tons mined (From Antelope Mine)	33,646,960	35,167,152	29,807,165	28,506,357	23,155,742	30,000,000	30,000,000	30,000,000	756167000	--
mw-h from coal mined	17,496,419	18,286,919	15,499,726	14,823,306	12,040,986	15,600,000	15,600,000	15,600,000	393,206,840	--
PM_{10} Emissions (Tons)	7,521.7	7,861.6	6,663.3	6,372.6	5,176.4	6,706.5	6,706.5	6,706.5	169,040	3.97%
$PM_{2.5}$ Emissions (Tons)	2,294.1	2,397.8	2,032.3	1,943.6	1,578.8	2,045.5	2,045.5	2,045.5	51,557	3.97%
SO_2 Emissions (Tons)	138,708.3	144,975.3	122,878.9	117,516.4	95,458.7	123,673.9	123,673.9	123,673.9	3,117,271	3.97%
NO_X Emissions (Tons)	53,597.1	56,018.7	47,480.6	45,408.5	36,885.4	47,787.8	47,787.8	47,787.8	1,204,518	3.97%
Hg Emissions (Tons)	0.54	0.56	0.48	0.46	0.37	0.48	0.48	0.48	12.14	3.97%
CO Emissions (Tons)	8,411.7	8,791.8	7,451.8	7,126.6	5,788.9	7,514.17	7,500.0	7,500.0	189,041.8	3.97%

APPENDIX G

GROUNDWATER MONITORING NETWORK
WATER QUALITY SUMMARY

Well: OWAL-01 Date Range: 1/24/1979-8/14/2018

Parameter	Class III Standard	Units	#	Min	Max	Avg	Std Dev
Acidity		mg/l	2	<1	<5	*	*
Acidity, Total (As CaCO3)		mg/l	2	<5	<5	*	0.001
Alkalinity (as CaCO3)		mg/l	25	232	666	468.41	*
Alkalinity, Hydroxide		mg/l	1	<1	<5	*	*
Aluminum, dissolved	5	mg/l	1	<0.1	1.7	*	*
Aluminum, Total		mg/l	51	<0.1	21.6	*	*
Ammonia		mg/l	3	<.05	1.32	*	*
Anion Sum		meq/L	57	36.43	82.134	58.99	107.34
Arsenic (III), Dissolved		mg/l	57	<0.005	<0.005	*	*
Arsenic (III), Total		mg/l	3	0.005	0.007	0.01	0.01
Arsenic, dissolved	0.2	mg/l	31	0.003	0.03	*	*
Arsenic, Dissolved/Total *100		%	3	<35.71	<35.71	*	*
Arsenic, Total		mg/l	57	0.014	0.014	0.01	71.01
Barium, dissolved		mg/l	18	<.01	0.5	*	*
Barium, Total		mg/l	4	<0.5	<0.5	*	*
Bicarbonate		mg/l	53	284	813	572.32	9.64
Boron, dissolved	5	mg/l	57	<0.01	0.4	*	16.96
Boron, Total		mg/l	52	0.1	0.12	0.11	*
Cadmium, dissolved	0.05	mg/l	3	<0.002	0.05	*	*
Cadmium, Total		mg/l	2	<0.002	0.002	*	*
Calcium		mg/l	2	85	508	325.92	*
Carbonate		mg/l	2	<1	<5	*	5656.15
Cation Sum		%	52	0.05	<18.904	*	*
Cation Sum		meq/L	3	28.712	72.452	57.21	0.03
Chloride	2000	mg/l	2	21.45	117	59.01	*
Chromium, dissolved	0.05	mg/l	29	<.01	0.06	*	1.60
Chromium, Total		mg/l	7	<0.02	0.02	*	220.13
Cobalt, Dissolved	1	mg/l	52	<0.02	<0.02	*	980.45
Cobalt, Total		mg/l	51	<0.02	<0.02	*	0.42
Coliform, Total		Unknown	5	1	8000	4000.5	324.81
Copper, dissolved	0.5	mg/l	56	<0.01	0.04	*	0.19
Copper, Total		mg/l	57	0.1	0.16	0.12	265.97
Cyanide, Total		mg/l	2	<0.005	<0.005	*	*
Depth to Water		ft	1	5.1	11.6	9.06	*
Field Alkalinity		mg/l	8	560	1140	877.14	*
Field Conductivity		umhos/cm	54	2100	7500	4051.38	*
Field pH		s.u.	3	5.5	7.9	7.19	5.48
Field turbidity		NTUs	56	57	875	416.60	704.51
Fluoride		mg/l	56	0.08	1.2	0.69	0.28
Hardness (as CaCO3)		mg/l	51	770.755	1984.66	1431.60	*
Hydroxide as OH		mg/l	3	<5	<5	*	*
Iron (Ferric)		mg/l	1	0.79	0.79	0.79	*
Iron (Ferrous)		mg/l	57	0.1	57.2	*	37.06
Iron, dissolved		mg/l	57	<0.05	118	*	*
Iron, total		mg/l	3	29.16	38.81	32.49	0.77
Laboratory conductivity		umhos/cm	25	3010	6380	4375.89	*
Laboratory pH		s.u.	3	7.1	8.2	7.64	*
Lead, dissolved	0.1	mg/l	48	<0.02	0.02	*	*
Lead, Total		mg/l	3	<0.02	0.03	*	*
Lithium, dissolved		mg/l	51	0.02	0.02	0.02	*
Magnesium		mg/l	3	30	264	150.30	*
Manganese, dissolved	0.00005	mg/l	12	<0.02	2.78	*	*
Manganese, total		mg/l	2	5.04	6.47	5.60	*
Mercury, dissolved		mg/l	2	<0.001	1	*	0.001
Mercury, Total		mg/l	25	<0.001	<0.001	*	*
Molybdenum, dissolved		mg/l	1	<0.02	0.02	*	*
Molybdenum, Total		mg/l	1	<0.02	<0.02	*	*
Nickel, dissolved		mg/l	51	<0.01	0.05	*	*
Nickel, Total		mg/l	3	<0.01	0.04	*	*
Nitrate		mg/l	57	<.03	38	*	107.34

Well: OWAL-01 Date Range: 1/24/1979-8/14/2018

Parameter	Class III Standard	Units	#	Min	Max	Avg	Std Dev
Nitrate/Nitrite	100	mg/l	43	<.01	4.3	*	*
Nitrite	10	mg/l	27	<.01	<1	*	*
Oil and grease	10	mg/l	2	<1	158	*	*
Phenol		mg/l	5	<1	<1	*	*
Phosphorus		mg/l	55	<.01	46	*	*
Phosphorus, Orthophosphate as P		mg/l	2	<0.1	<0.1	*	*
Potassium		mg/l	57	7.4	43	14.00	5.25
Selenium, dissolved	0.05	mg/l	26	0.002	0.017	*	*
Selenium, Total		mg/l	3	<0.005	<0.005	*	*
Silica as SiO2		mg/l	35	4.72	18.5	13.17	3.67
Silicon		mg/l	22	4.4	15.2	6.24	2.88
Silicon, total		mg/l	1	42.54	42.54	42.54	*
Sodium		mg/l	53	208	924	651.46	134.48
Sodium Adsorption Ratio (SAR)		Other	2	6.14	6.48	6.31	0.24
Strontium, Dissolved		mg/l	7	2.59	13.4	5.74	4.71
Sulfate	3000	mg/l	57	1109	2990	2278.05	422.14
Temperature (C)		Deg C	52	6	24	13.16	3.78
Total Anion/Cation Balance		%	53	0.005	<36.604	*	*
Total Anion/Cation Balance		meq/L	4	41.058	63.991	51.80	9.79
Total Dissolved Solids	5000	mg/l	55	350	5120	3587.45	1055.56
Water Elevation		fmsl	20	4505.64	4512.14	4507.90	1.55
Zinc, dissolved	25	mg/l	52	<0.01	0.39	*	*
Zinc, total		mg/l	3	0.19	0.3	*	*

Well: OWAL-03 Date Range: 5/3/1979-8/14/2018

Parameter	Class III Standard	Units	#	Min	Max	Avg	Std Dev
Acidity		mg/l	22	<1	<5	*	*
Acidity, Total (As CaCO3)		mg/l	2	<5	<5	*	*
Alkalinity (as CaCO3)		mg/l	28	292	584	426.57	90.78
Alkalinity, Hydroxide		mg/l	15	<1	<5	*	*
Aluminum, dissolved	5	mg/l	27	<0.1	0.3	*	*
Aluminum, Total		mg/l	2	4.3	4.5	4.40	0.14
Ammonia		mg/l	28	<.05	0.5	*	*
Anion Sum		meq/L	28	10.2	47.39	20.63	8.42
Arsenic (III), Dissolved		mg/l	1	<0.005	<0.005	*	*
Arsenic (III), Total		mg/l	1	0.042	0.042	0.04	*
Arsenic, dissolved	0.2	mg/l	19	<0.005	<0.005	*	*
Arsenic, Dissolved/Total *100		%	1	<9.8	<9.8	*	*
Arsenic, Total		mg/l	1	0.051	0.051	0.05	*
Barium, dissolved		mg/l	27	<0.01	<0.5	*	*
Barium, Total		mg/l	2	<0.5	<0.5	*	*
Bicarbonate		mg/l	0	356	706	519.54	*
Boron, dissolved	5	mg/l	28	<0.01	0.2	*	110.46
Boron, Total		mg/l	28	0.06	0.08	0.07	*
Cadmium, dissolved	0.05	mg/l	2	<0.002	<0.002	*	0.01
Cadmium, Total		mg/l	20	<0.002	<0.002	*	*
Calcium		mg/l	2	24	415	111.51	*
Carbonate		mg/l	28	<1	7	*	80.60
Cation Sum		%	18	1.376	1.376	1.38	*
Cation Sum		meq/L	1	10.12	47.58	20.78	*
Chloride	2000	mg/l	27	9.4	76	33.90	8.36
Chromium, dissolved	0.05	mg/l	28	<0.01	<0.02	*	20.79
Chromium, Total		mg/l	27	<0.02	<0.02	*	*
Cobalt, Dissolved	1	mg/l	2	<0.02	<0.02	*	*
Cobalt, Total		mg/l	1	<0.02	<0.02	*	*
Coliform, Total		Unknown	1				*
Copper, dissolved	0.5	mg/l	27	<0.01	<0.01	*	*
Copper, Total		mg/l	2	0.02	0.06	0.04	0.03
Cyanide, Total		mg/l	1	<0.005	<0.005	*	*
Depth to Water		ft	13	7.16	11.92	9.02	1.48
Field Alkalinity		mg/l	6	460	1000	746.67	203.83
Field Conductivity		umhos/cm	28	925	3730	1730.39	646.33
Field pH		s.u.	27	6.6	8.6	7.46	0.40
Field turbidity		NTUs	1	933	933	933.00	*
Fluoride		mg/l	27	0.31	1.62	0.89	0.27
Hardness (as CaCO3)		mg/l	28	154.596	1580	461.32	302.37
Hydroxide as OH		mg/l	2	<5	<5	*	*
Iron (Ferrous)		mg/l	1	0.1	0.1	0.10	*
Iron, dissolved		mg/l	28	<0.05	4.08	*	*
Iron, total		mg/l	2	69.26	77.15	73.21	5.58
Laboratory conductivity		umhos/cm	28	1020	3500	1757.50	603.93
Laboratory pH		s.u.	28	7.58	8.3	8.03	0.18
Lead, dissolved	0.1	mg/l	27	<0.02	<0.02	*	*
Lead, Total		mg/l	2	<0.02	<0.02	*	*
Magnesium		mg/l	28	16	133	44.54	25.41
Manganese, dissolved	0.00005	mg/l	28	0.02	4.74	0.51	0.87
Manganese, total		mg/l	2	0.76	0.82	0.79	0.04
Mercury, dissolved		mg/l	20	<0.001	<0.001	*	*
Mercury, Total		mg/l	2	<0.001	<0.001	*	*
Molybdenum, dissolved		mg/l	27	<0.02	<0.02	*	*
Molybdenum, Total		mg/l	2	<0.02	<0.02	*	*
Nickel, dissolved		mg/l	27	<0.01	0.02	*	*
Nickel, Total		mg/l	2	<0.01	0.03	*	*
Nitrate		mg/l	4	<0.03	0.6	*	*

Well: OWAL-03 Date Range: 5/3/1979-8/14/2018

Parameter	Class III Standard	Units	#	Min	Max	Avg	Std Dev
Nitrate/Nitrite	100	mg/l	23	0.02	0.8	*	*
Nitrite	10	mg/l	22	<.01	4.8	*	*
Oil & Grease Visual		s.u.	1	7.6	7.6	7.60	*
Oil and grease	10	mg/l	1	<1	<1	*	*
Phenol		mg/l	1	<1	<1	*	*
Phosphorus		mg/l	26	0.01	<.4	*	*
Phosphorus, Orthophosphate as P		mg/l	2	<0.1	<0.1	*	*
Potassium		mg/l	28	4.6	25	13.25	5.51
Selenium, dissolved	0.05	mg/l	20	<0.005	0.02	*	*
Selenium, Total		mg/l	2	<0.005	<0.005	*	*
Silica as SiO2		mg/l	9	4.63	11.38	9.49	2.19
Silicon		mg/l	21	4.63	15.6	6.23	2.37
Silicon, total		mg/l	1	19.29	19.29	19.29	*
Sodium		mg/l	27	150.85	386.01	253.03	58.28
Sodium Adsorption Ratio (SAR)		Other	2	3.83	4.26	4.05	0.30
Strontium, Dissolved		mg/l	1	0.4	0.4	0.40	*
Sulfate	3000	mg/l	28	35	1740	533.61	422.67
Temperature (C)		Deg C	27	6.9	18.3	12.75	3.15
Total Anion/Cation Balance		%	26	0.013	4.79	1.52	1.26
Total Anion/Cation Balance		meq/L	1	13.739	13.739	13.74	*
Total Dissolved Solids	5000	mg/l	27	223	3170	1202.32	600.56
Water Elevation		fmsl	4	4532.92	4533.62	4533.23	0.33
Zinc, dissolved	25	mg/l	27	<0.01	0.01	*	*
Zinc, total		mg/l	2	0.07	0.07	0.07	0

Well: OWAL-05 Date Range: 5/4/1979-8/14/2018

Parameter	Class III Standard	Units	#	Min	Max	Avg	Std Dev
Acidity		mg/l	5	<1	<5	*	*
Acidity, Total (As CaCO3)		mg/l	2	<5	5	*	*
Alkalinity (as CaCO3)		mg/l	8	322	431	368.00	38.66
Alkalinity, Hydroxide		mg/l	3	<5	5	*	*
Aluminum, dissolved	5	mg/l	7	<0.01	0.1	*	*
Ammonia		mg/l	8	<0.1	1	0.28	0.31
Anion Sum		meq/L	8	42.163	58.43	50.09	5.54
Antimony, Dissolved		mg/l	5	<0.005	0.005	*	*
Arsenic, dissolved	0.2	mg/l	7	<0.5	0.5	*	*
Barium, dissolved		mg/l	8	392	526	446.13	48.96
Beryllium		mg/l	8	0.05	0.13	0.09	0.03
Beryllium, dissolved		mg/l	6	<0.002	0.008	*	*
Bicarbonate		mg/l	8	303	506	417.38	82.12
Boron, dissolved	5	mg/l	5	<5	5	*	*
Cadmium, dissolved	0.05	mg/l	1	2.909	2.909	2.91	*
Calcium		mg/l	7	41.859	56.79	49.16	5.89
Carbonate		mg/l	8	14	51	34.25	12.23
Cation Sum		%	7	<0.01	0.02	*	*
Cation Sum		meq/L	1	4000	4000	4000.00	*
Chloride	2000	mg/l	7	<0.01	0.03	*	*
Chromium, dissolved	0.05	mg/l	1	<0.005	0.005	*	*
Cobalt, Dissolved	1	mg/l	7	8.28	10.4	9.52	0.70
Coliform, Total		Unknown	8	2200	4000	3597.63	597.27
Copper, dissolved	0.5	mg/l	7	5.5	7.4	6.70	0.64
Cyanide, Total		mg/l	1	84	84	84.00	*
Depth to Water		ft	8	0.3	0.6	0.47	0.10
Field Conductivity		umhos/cm	8	1229.931	1900	1601.40	268.22
Field pH		s.u.	2	<5	5	*	*
Field turbidity		NTUs	3	0.1	544	226.70	283.07
Fluoride		mg/l	8	<0.05	23	*	*
Hardness (as CaCO3)		mg/l	8	3280	3960	3663.75	292.33
Hydroxide as OH		mg/l	8	7.2	8.1	7.71	0.34
Iron (Ferrous)		mg/l	7	<0.02	0.02	*	*
Iron, dissolved		mg/l	8	114	155	135.88	16.12
Laboratory conductivity		umhos/cm	8	0.26	3.35	1.66	1.06
Laboratory pH		s.u.	5	<0.001	0.001	*	*
Lead, dissolved	0.1	mg/l	7	<0.02	0.02	*	*
Lithium, dissolved		mg/l	7	<0.01	0.02	*	*
Magnesium		mg/l	1	0.7	0.7	0.70	*
Manganese, dissolved	0.00005	mg/l	7	<0.01	0.5	*	*
Mercury, dissolved		mg/l	6	<0.1	2.2	*	*
Molybdenum, dissolved		mg/l	1	<1	1	*	*
Nickel, dissolved		mg/l	1	<1	1	*	*
Nitrate		mg/l	6	0.01	1	0.22	0.38
Nitrate/Nitrite	100	mg/l	2	<0.1	0.1	*	*
Nitrite	10	mg/l	8	12	26	19.50	5.86
Oil and grease	10	mg/l	6	<0.005	0.01	*	*
Phenol		mg/l	3	12.6	17.1	15.03	2.27
Phosphorus		mg/l	5	5.3	7.4	6.44	0.90
Phosphorus, Orthophosphate as P		mg/l	7	291	416	371.43	39.36
Potassium		mg/l	2	3.68	3.74	3.71	0.04
Selenium, dissolved	0.05	mg/l	6	3.1	4.827	4.23	0.62
Silica as SiO2		mg/l	1	3.5	3.5	3.50	*
Silicon		mg/l	5	<1	<5	*	*
Silver, dissolved		mg/l	2	<5	5	*	*
Sodium		mg/l	8	322	431	368.00	38.66
Sodium Adsorption Ratio (SAR)		Other	3	<5	5	*	*
Sodium Adsorption Ratio (SAR)		Unknown	7	<0.01	0.1	*	*
Strontium, Dissolved		mg/l	8	<0.1	1	0.28	0.31

Well: OWAL-05 Date Range: 5/4/1979-8/14/2018

Parameter	Class III Standard	Units	#	Min	Max	Avg	Std Dev
Sulfate	3000	mg/l	8	1660	2400	2006.63	245.44
Temperature		Deg C	8	8	14.5	11.64	2.31
Total Anion/Cation Balance		%	7	0.193	4.63	1.55	1.53
Total Anion/Cation Balance		meq/L	1	45.413	45.413	45.41	*
Total Dissolved Solids	5000	mg/l	8	374	3770	2949.12	1116.92
Total Dissolved Solids (103)		mg/l	2	3720	3890	3805.00	120.21
Total Dissolved Solids (calc)		mg/l	3	3094.824	3430	3301.61	180.82
Water Elevation		fmsl	2	4538.4	4538.41	4538.41	0.01
Zinc, dissolved	25	mg/l	7	<0.01	0.12	*	*

Well: OWAL-11 Date Range: 5/4/1979-12/17/2018

Parameter	Class III Standard	Units	#	Min	Max	Avg	Std Dev
Acidity		mg/l	26	<1	<5	*	*
Acidity, Total (As CaCO3)		mg/l	4	<5	<5	*	*
Alkalinity (as CaCO3)		mg/l	33	273	456	356.94	42.75
Alkalinity, Hydroxide		mg/l	20	<1	<5	*	*
Aluminum, dissolved	5	mg/l	32	<0.1	0.2	*	*
Aluminum, Total		mg/l	4	<0.1	9	*	*
Ammonia		mg/l	33	<0.05	1	*	*
Anion Sum		meq/L	33	29.85	75.8	46.60	10.51
Arsenic (III), Dissolved		mg/l	2	<0.005	<0.005	*	*
Arsenic (III), Total		mg/l	2	<0.005	0.038	*	*
Arsenic, dissolved	0.2	mg/l	27	<0.005	<0.005	*	*
Arsenic, Dissolved/Total *100		%	2	<41.67	<100	*	*
Arsenic, Total		mg/l	2	0.005	0.012	0.01	0.005
Barium, dissolved		mg/l	32	<0.5	<0.5	*	*
Barium, Total		mg/l	4	<0.5	<0.5	*	*
Bicarbonate		mg/l	33	333	556	435.06	52.79
Boron, dissolved	5	mg/l	33	<0.01	0.49	*	*
Boron, Total		mg/l	4	0.03	0.08	0.06	0.02
Cadmium, dissolved	0.05	mg/l	29	<0.002	<0.002	*	*
Cadmium, Total		mg/l	4	<0.002	<0.002	*	*
Calcium		mg/l	33	227	638	380.25	90.60
Carbonate		mg/l	26	<1	<5	*	*
Cation Sum		%	1	0.154	0.154	0.15	*
Cation Sum		meq/L	32	28.84	74	46.16	10.17
Chloride	2000	mg/l	33	1.02	38	24.81	7.34
Chromium, dissolved	0.05	mg/l	32	<0.01	0.02	*	*
Chromium, Total		mg/l	4	<0.01	0.02	*	*
Cobalt, Dissolved	1	mg/l	2	<0.02	<0.02	*	*
Cobalt, Total		mg/l	2	<0.02	<0.02	*	*
Copper, dissolved	0.5	mg/l	32	<0.01	<0.01	*	*
Copper, Total		mg/l	4	<0.01	0.03	*	*
Cyanide, Total		mg/l	1	<0.005	<0.005	*	*
Depth to Water		ft	22	8.58	13.63	10.62	1.48
Dry Well		mg/l	1	0.36	0.36	0.36	*
Field Alkalinity		mg/l	13	440	1260	763.08	242.33
Field Conductivity		umhos/cm	32	2200	4850	3324.47	764.77
Field pH		s.u.	31	6.6	8.7	7.29	0.37
Field turbidity		NTUs	1	246	246	246.00	*
Fluoride		mg/l	32	0.1	1.02	0.39	0.17
Hardness (as CaCO3)		mg/l	33	918	2490	1502.99	339.08
Hydroxide as OH		mg/l	4	<5	<5	*	*
Iron (Ferrous)		mg/l	1	<1	<1	*	*
Iron, dissolved		mg/l	33	0.06	5.47	2.45	1.73
Iron, total		mg/l	4	12.2	81.41	45.90	31.28
Laboratory conductivity		umhos/cm	33	2200	5510	3466.36	748.32
Laboratory pH		s.u.	33	7.3	8.1	7.82	0.23
Lead, dissolved	0.1	mg/l	32	<0.02	<0.02	*	*
Lead, Total		mg/l	4	<0.02	0.03	*	*
Magnesium		mg/l	33	86	217	134.52	29.42
Manganese, dissolved	0.00005	mg/l	33	0.26	6.52	1.44	1.00
Manganese, total		mg/l	4	0.11	1.67	1.02	0.71
Mercury, dissolved		mg/l	29	<0.001	<0.001	*	*
Mercury, Total		mg/l	4	<0.001	<0.001	*	*
Molybdenum, dissolved		mg/l	32	<0.02	<0.02	*	*
Molybdenum, Total		mg/l	4	<0.02	<0.02	*	*
Nickel, dissolved		mg/l	32	<0.01	0.05	*	*
Nickel, Total		mg/l	4	<0.01	0.05	*	*
Nitrate		mg/l	5	<0.03	0.82	*	*
Nitrate/Nitrite	100	mg/l	27	<0.01	0.22	*	*

Well: OWAL-11 Date Range: 5/4/1979-12/17/2018

Parameter	Class III Standard	Units	#	Min	Max	Avg	Std Dev
Nitrite	10	mg/l	31	<0.01	0.1	*	*
Oil & Grease Visual		s.u.	1	7.3	7.3	7.30	*
Oil and grease	10	mg/l	2	<0.5	<1	*	*
Phenol		mg/l	1	<1	<1	*	*
Phosphorus		mg/l	29	<0.02	<1	*	*
Phosphorus, Orthophosphate as P		mg/l	4	<0.1	<0.1	*	*
Potassium		mg/l	33	10	22	16.15	4.37
Selenium, dissolved	0.05	mg/l	29	<0.005	0.015	*	*
Selenium, Total		mg/l	4	<0.005	0.005	*	*
Silica as SiO2		mg/l	6	6.58	15.72	10.55	4.23
Silicon		mg/l	30	5.3	22.9	7.91	3.57
Silicon, total		mg/l	2	11.8	25.58	18.69	9.74
Sodium		mg/l	32	224	683	354.27	95.13
Sodium Adsorption Ratio (SAR)		Other	4	4.13	4.24	4.19	0.05
Sodium Adsorption Ratio (SAR)		Unknown	29	2.8	6.5	3.89	0.78
Strontium, Dissolved		mg/l	1	2.6	2.6	2.60	*
Sulfate	3000	mg/l	33	1140	3170	1858.61	471.36
Temperature		Deg C	31	5.4	25.2	12.85	3.21
Total Anion/Cation Balance		%	32	0.01	4.84	1.46	1.19
Total Anion/Cation Balance		meq/L	1	31.008	31.008	31.01	*
Total Dissolved Solids	5000	mg/l	31	238	4880	2993.71	874.79
Water Elevation		fmsl	11	4550.64	4555.69	4553.72	1.92
Well Purging Volume		Other	2	5	17.5	11.25	8.84
Zinc, dissolved	25	mg/l	32	<0.01	0.03	*	*
Zinc, Total		mg/l	4	<0.01	0.1	*	*

Well: PZ-HCAL-13 Date Range: 6/26/1998-4/12/2011

Parameter	Class III Standard	Units	#	Min	Max	Avg	Std Dev
Acidity		mg/l	15	<1	<5	*	*
Alkalinity (as CaCO3)		mg/l	17	422	780	652.24	98.90
Alkalinity, Hydroxide		mg/l	9	<1	<5	*	*
Aluminum, dissolved	5	mg/l	17	<0.1	<0.1	*	*
Aluminum, Total		mg/l	8	<0.1	7.8	*	*
Ammonia		mg/l	17	0.01	2.4	*	*
Anion Sum		meq/L	17	30.73	80.58	48.76	15.27
Arsenic (III), Dissolved		mg/l	5	<0.005	<0.005	*	*
Arsenic (III), Total		mg/l	5	<0.005	<0.005	*	*
Arsenic, dissolved	0.2	mg/l	12	<0.005	0.005	*	*
Arsenic, Dissolved/Total *100		%	3	<62.5	100	*	*
Arsenic, Total		mg/l	3	<0.005	0.008	*	*
Barium, dissolved		mg/l	17	<0.5	<0.5	*	*
Barium, Total		mg/l	8	<0.5	<0.5	*	*
Bicarbonate		mg/l	17	515	952	799.41	122.12
Boron, dissolved	5	mg/l	17	<0.01	0.2	*	*
Boron, Total		mg/l	8	<0.01	0.41	*	*
Cadmium, dissolved	0.05	mg/l	17	<0.002	<0.002	*	*
Cadmium, Total		mg/l	8	<0.002	0.002	*	*
Calcium		mg/l	17	168.3	510.3	305.87	94.16
Carbonate		mg/l	14	<1	<5	*	*
Cation Sum		meq/L	17	30.45	73.02	45.35	12.33
Chloride	2000	mg/l	17	3.61	23	12.96	4.43
Chromium, dissolved	0.05	mg/l	17	<0.01	<0.02	*	*
Chromium, Total		mg/l	8	<0.02	0.02	*	*
Cobalt, Dissolved	1	mg/l	5	<0.02	0.4	*	*
Cobalt, Total		mg/l	5	<0.02	0.51	*	*
Copper, dissolved	0.5	mg/l	17	<0.01	<0.01	*	*
Copper, Total		mg/l	8	<0.01	0.25	*	*
Depth to Water		ft	7	1.8	4.4	3.22	0.92
Field Alkalinity		mg/l	4	900	1920	1420.00	456.95
Field Conductivity		umhos/cm	16	2.51	4190	2882.41	1180.49
Field pH		s.u.	13	7.1	9.6	7.47	0.65
Fluoride		mg/l	17	0.22	0.8	0.45	0.14
Hardness (as CaCO3)		mg/l	17	921	2690	1504.88	473.88
Iron, dissolved		mg/l	17	<0.05	4.33	*	*
Iron, total		mg/l	8	1.61	35.19	11.50	10.45
Laboratory conductivity		umhos/cm	17	2600	4720	3390.00	667.48
Laboratory pH		s.u.	17	7.04	8.1	7.72	0.32
Lead, dissolved	0.1	mg/l	17	<0.02	<0.02	*	*
Lead, Total		mg/l	8	<0.02	0.88	*	*
Magnesium		mg/l	17	46.56	344.38	180.19	67.94
Manganese, dissolved	0.00005	mg/l	17	0.1	4.66	1.79	1.40
Manganese, total		mg/l	8	0.96	4.04	2.29	1.27
Mercury, dissolved		mg/l	17	<0.001	<0.001	*	*
Mercury, Total		mg/l	8	<0.001	<0.001	*	*
Molybdenum, dissolved		mg/l	17	<0.02	<0.02	*	*
Molybdenum, Total		mg/l	8	<0.02	0.03	*	*
Nickel, dissolved		mg/l	17	<0.01	0.03	*	*
Nickel, Total		mg/l	8	<0.01	0.04	*	*
Nitrate		mg/l	8	<0.03	1.48	*	*
Nitrate/Nitrite	100	mg/l	12	0.04	1.48	*	*
Nitrite	10	mg/l	17	<0.01	<0.1	*	*
Oil & Grease Visual		s.u.	3	6.9	7.3	7.03	0.23
Phosphorus		mg/l	17	<0.05	<0.4	*	*
Potassium		mg/l	17	5.1	12	7.29	1.82
Selenium, dissolved	0.05	mg/l	17	<0.005	0.006	*	*
Selenium, Total		mg/l	8	<0.005	<0.005	*	*
Silica as SiO2		mg/l	5	3.6	5.8	4.50	1.02

Well: PZ-HCAL-13 Date Range: 6/26/1998-4/12/2011

Parameter	Class III Standard	Units	#	Min	Max	Avg	Std Dev
Silicon		mg/l	17	2.3	11.5	5.71	2.51
Silicon, total		mg/l	3	10.1	22.64	18.04	6.91
Sodium		mg/l	17	252	808	393.15	145.53
Sodium Adsorption Ratio (SAR)		Unknown	17	3.7	7.6	4.64	1.10
Sulfate	3000	mg/l	17	896	3250	1699.65	747.36
Temperature		Deg C	16	6.6	21.9	14.80	5.71
Total Anion/Cation Balance		%	17	0.15	3.36	1.38	1.18
Total Dissolved Solids	5000	mg/l	12	1860	5100	3127.17	923.01
Water Elevation		fmsl	1	4674.78	4674.78	4674.78	*
Well Purging Volume		Other	3	2	4	3.00	1.00
Zinc, dissolved	25	mg/l	17	<0.01	0.36	*	*
Zinc, Total		mg/l	8	0.02	0.95	0.30	0.29

Well: TWAL-01 Date Range: 5/1/1979-4/23/2009

Parameter	Class III Standard	Units	#	Min	Max	Avg	Std Dev
Acidity		mg/l	36	<1	1363	*	*
Alkalinity (as CaCO3)		mg/l	45	160	383	235.02	65.62
Alkalinity, Hydroxide		mg/l	8	<1	<5	*	*
Aluminum, dissolved	5	mg/l	41	<0.1	0.3	*	*
Aluminum, Total		mg/l	3	0.1	0.7	0.33	0.32
Ammonia		mg/l	45	0.03	0.9	*	*
Anion Sum		meq/L	45	31.352	62.27	41.42	9.86
Arsenic (III), Dissolved		mg/l	2	<0.005	<0.005	*	*
Arsenic (III), Total		mg/l	2	<0.005	<0.005	*	*
Arsenic, dissolved	0.2	mg/l	16	<0.004	0.006	*	*
Arsenic, Dissolved/Total *100		%	1	100	100	100.00	*
Arsenic, Total		mg/l	1	<0.005	<0.005	*	*
Barium, dissolved		mg/l	40	<0.01	0.5	*	*
Barium, Total		mg/l	3	<0.5	<0.5	*	*
Bicarbonate		mg/l	45	195	467	285.22	79.18
Boron, dissolved	5	mg/l	43	<0.01	0.4	*	*
Boron, Total		mg/l	3	0.04	0.06	0.05	0.01
Cadmium, dissolved	0.05	mg/l	19	<0.002	0.009	*	*
Cadmium, Total		mg/l	3	<0.002	<0.002	*	*
Calcium		mg/l	45	218.71	526	338.54	62.66
Carbonate		mg/l	9	<1	<5	*	*
Cation Sum		%	1	1.107	1.107	1.11	*
Cation Sum		meq/L	44	28.865	57.71	40.88	9.31
Chloride	2000	mg/l	45	12.9	65	35.92	11.89
Chromium, dissolved	0.05	mg/l	41	<0.01	0.05	*	*
Chromium, Total		mg/l	3	<0.02	<0.02	*	*
Cobalt, Dissolved	1	mg/l	2	<0.02	<0.02	*	*
Cobalt, Total		mg/l	2	<0.02	<0.02	*	*
Copper, dissolved	0.5	mg/l	41	<0.01	0.02	*	*
Copper, Total		mg/l	3	<0.01	<0.01	*	*
Cyanide, Total		mg/l	1	<0.005	<0.005	*	*
Depth to Water		ft	18	2.94	5.87	4.01	0.67
Dry Well		mg/l	1	0.34	0.34	0.34	*
Field Alkalinity		mg/l	4	320	680	505.00	191.40
Field Conductivity		umhos/cm	42	790	8200	3128.00	1230.92
Field pH		s.u.	42	6.7	8.3	7.18	0.33
Field turbidity		NTUs	3	54	62	58.17	4.01
Fluoride		mg/l	44	0.04	0.8	0.40	0.14
Hardness (as CaCO3)		mg/l	45	895.485	1918	1322.68	250.34
Iron (Ferric)		mg/l	1	0.26	0.26	0.26	*
Iron (Ferrous)		mg/l	7	0.3	54.4	12.43	19.29
Iron, dissolved		mg/l	45	<0.05	13.9	*	*
Iron, total		mg/l	4	0.27	12.42	8.57	5.60
Laboratory conductivity		umhos/cm	45	2160	5150	3108.49	813.23
Laboratory pH		s.u.	45	6.9	8.3	7.54	0.32
Laboratory turbidity		NTUs	1	6.6	6.6	6.60	*
Lead, dissolved	0.1	mg/l	40	<0.02	0.02	*	*
Lead, Total		mg/l	3	<0.02	<0.02	*	*
Lithium, dissolved		mg/l	1	0.03	0.03	0.03	*
Magnesium		mg/l	45	84	180	116.03	27.55
Manganese, dissolved	0.00005	mg/l	45	<0.02	3.66	*	*
Manganese, total		mg/l	3	2.41	3.36	2.99	0.51
Mercury, dissolved		mg/l	16	<0.001	0.001	*	*
Mercury, Total		mg/l	3	<0.001	<0.001	*	*
Molybdenum, dissolved		mg/l	37	<0.02	0.02	*	*
Molybdenum, Total		mg/l	3	<0.02	<0.02	*	*
Nickel, dissolved		mg/l	41	<0.01	0.04	*	*
Nickel, Total		mg/l	3	<0.01	<0.01	*	*
Nitrate	100	mg/l	10	<0.03	<1	*	*

Well: TWAL-01 Date Range: 5/1/1979-4/23/2009

Parameter	Class III Standard	Units	#	Min	Max	Avg	Std Dev
Nitrate/Nitrite	10	mg/l	36	<0.01	3.78	*	*
Nitrite		mg/l	18	<0.01	1	*	*
Oil & Grease Visual		s.u.	1	7.3	7.3	7.30	*
Oil and grease	10	mg/l	1	<1	<1	*	*
Phenol		mg/l	5	0.02	<2	*	*
Phosphorus		mg/l	45	<0.01	<1	*	*
Potassium		mg/l	45	6	25	10.79	4.05
Pumping Rate		gal/minute	1	0.5	0.5	0.50	*
Selenium, dissolved	0.05	mg/l	16	<0.005	0.028	*	*
Selenium, Total		mg/l	3	<0.005	<0.005	*	*
Silica as SiO2		mg/l	33	4.63	14.33	10.27	2.58
Silicon		mg/l	13	1.8	13.6	5.27	3.49
Silicon, total		mg/l	1	5.95	5.95	5.95	*
Sodium		mg/l	44	207	606	323.85	113.41
Sodium Adsorption Ratio (SAR)		Unknown	45	2.72	7	3.79	1.08
Strontium, Dissolved		mg/l	5	2.7	3.2	2.97	0.18
Sulfate	3000	mg/l	45	1126	2700	1706.26	423.26
Temperature		Deg C	42	2.1	25	14.07	6.30
Total Anion/Cation Balance		%	44	0.0014	7.096	1.24	1.45
Total Anion/Cation Balance		meq/L	1	32.752	32.752	32.75	*
Total Dissolved Solids	5000	mg/l	43	220	4020	2629.35	742.59
Total Dissolved Solids (calc)		mg/l	1	2154.605	2154.605	2154.61	*
Total Suspended Solids		mg/l	1	18	18	18.00	*
Water Elevation		fmsl	17	4573.72	4575.3	4574.29	0.43
Well Purging Volume		Other	2	1.5	15	8.25	9.55
Zinc, dissolved	25	mg/l	43	<0.01	1.13	*	*
Zinc, Total		mg/l	3	0.02	0.04	*	*

Well: TWAL-02 Date Range: 5/4/1979-8/14/2018

Parameter	Class III Standard	Units	#	Min	Max	Avg	Std Dev
Acidity		mg/l	16	<1	<5	*	*
Acidity, Total (As CaCO3)		mg/l	1	<5	<5	*	*
Alkalinity (as CaCO3)		mg/l	25	338	560	427.88	60.83
Alkalinity, Hydroxide		mg/l	1	<5	<5	*	*
Aluminum, dissolved	5	mg/l	19	<0.1	0.6	*	*
Ammonia		mg/l	26	0.05	2.02	0.54	0.61
Anion Sum		meq/L	26	7.234	63.138	14.22	14.64
Arsenic, dissolved	0.2	mg/l	7	<0.005	0.04	*	*
Barium, dissolved		mg/l	20	0.1	0.5	-0.24	0.11
Bicarbonate		mg/l	26	412	639	517.65	68.47
Boron, dissolved	5	mg/l	24	0.01	0.3	0.08	0.07
Cadmium, dissolved	0.05	mg/l	8	<0.002	0.3	*	*
Calcium		mg/l	26	12	392	60.72	114.25
Carbonate		mg/l	2	<5	<5	*	*
Cation Sum		%	3	0.321	5.018	2.05	2.58
Cation Sum		meq/L	23	7.27	62.146	14.59	14.93
Chloride	2000	mg/l	26	8.2	70	13.70	11.73
Chromium, dissolved	0.05	mg/l	19	<0.01	0.1	*	*
Coliform, Total		Unknown	1	10000	10000	10000.00	*
Copper, dissolved	0.5	mg/l	19	<0.01	0.01	*	*
Cyanide, Total		mg/l	1	<0.005	<0.005	*	*
Depth to Water		ft	17	5.21	19.4	7.73	3.51
Field Conductivity		umhos/cm	25	570	5800	1366.28	1389.07
Field pH		s.u.	25	6	8.25	7.50	0.54
Field turbidity		NTUs	5	3.1	77	32.50	32.65
Fluoride		mg/l	26	0.54	4.6	2.08	0.93
Hardness (as CaCO3)		mg/l	26	57.98	1710	265.43	499.43
Hydroxide as OH		mg/l	1	<5	<5	*	*
Iron (Ferrous)		mg/l	8	0.26	255	38.14	88.12
Iron, dissolved		mg/l	24	<0.05	29.3	*	*
Laboratory conductivity		umhos/cm	26	590	4270	1151.69	952.40
Laboratory pH		s.u.	26	7.5	8.2	7.82	0.18
Lead, dissolved	0.1	mg/l	18	<0.02	0.02	*	*
Lithium, dissolved		mg/l	2	0.02	0.02	0.02	0.00
Magnesium		mg/l	26	5	178	27.70	52.26
Manganese, dissolved	0.0005	mg/l	21	0.01	4.67	0.41	1.09
Mercury, dissolved		mg/l	7	<0.001	0.002	*	*
Molybdenum, dissolved		mg/l	16	<0.02	0.02	*	*
Nickel, dissolved		mg/l	18	<0.01	0.04	*	*
Nitrate		mg/l	8	0.02	<1	*	*
Nitrate/Nitrite	100	mg/l	18	0.01	0.27	0.05	0.07
Nitrite	10	mg/l	7	<0.1	<1	*	*
Oil and grease	10	mg/l	1	<1	<1	*	*
Phenol		mg/l	5	0.05	<1	-0.79	0.42
Phosphorus		mg/l	25	<0.01	<1	*	*
Phosphorus, Orthophosphate as P		mg/l	1	<0.1	<0.1	*	*
Potassium		mg/l	26	2.7	16	5.34	3.61
Selenium, dissolved	0.05	mg/l	8	<0.005	0.03	*	*
Silica as SiO2		mg/l	21	3.3	14.8	10.74	2.78
Silicon		mg/l	2	6.7	6.9	6.80	0.14
Sodium		mg/l	23	137	717	200.74	119.29
Sodium Adsorption Ratio (SAR)		Other	1	3.12	3.12	3.12	*
Sodium Adsorption Ratio (SAR)		Unknown	25	3	9.318	7.69	1.10
Strontium, Dissolved		mg/l	7	0.2	1.3	0.48	0.37
Sulfate	3000	mg/l	26	0.1	2500	256.98	666.56
Temperature		Deg C	26	6	18.1	11.97	3.33
Total Anion/Cation Balance		%	23	0.249	3.828	1.07	0.94
Total Anion/Cation Balance		meq/L	3	8.79	12.368	10.14	1.94

Well: TWAL-02 Date Range: 5/4/1979-8/14/2018

Parameter	Class III Standard	Units	#	Min	Max	Avg	Std Dev
Total Dissolved Solids	5000	mg/l	26	157	4109.708	800.75	1010.83
Total Dissolved Solids (103)		mg/l	1	3590	3590	3590.00	*
Total Dissolved Solids (calc)		mg/l	4	497.008	3050	1181.84	1247.82
Water Elevation		fmsl	15	4515.79	4518.48	4517.11	0.89
Zinc, dissolved	25	mg/l	19	<0.01	0.06	*	*
Total Anion/Cation Balance		%	23	0.249	3.828	1.07	0.94
Total Anion/Cation Balance		meq/L	3	8.79	12.368	10.14	1.94
Total Dissolved Solids	5000	mg/l	26	157	4109.708	800.75	1010.83
Total Dissolved Solids (103)		mg/l	1	3590	3590	3590.00	*
Total Dissolved Solids (calc)		mg/l	4	497.008	3050	1181.84	1247.82
Water Elevation		fmsl	15	4515.79	4518.48	4517.11	0.89
Zinc, dissolved	25	mg/l	19	<0.01	0.06	*	*

Well: WA-OWAL-2 Date Range: 5/6/2004-8/14/2018

Parameter	Class III Standard	Units	#	Min	Max	Avg	Std Dev
Acidity		mg/l	3	<1	<5	*	*
Acidity, Total (As CaCO3)		mg/l	2	<5	<5	*	*
Alkalinity (as CaCO3)		mg/l	6	275	408	334.83	63.27
Alkalinity, Hydroxide		mg/l	4	<1	<5	*	*
Aluminum, dissolved	5	mg/l	6	<0.1	<0.1	*	*
Ammonia		mg/l	6	<0.05	0.3	*	*
Anion Sum		meq/L	6	34.35	71.35	52.73	17.48
Arsenic, dissolved	0.2	mg/l	6	<0.005	<0.005	*	*
Barium, dissolved		mg/l	6	<0.5	<0.5	*	*
Bicarbonate		mg/l	6	336	498	408.50	77.28
Boron, dissolved	5	mg/l	6	0.07	0.1	0.08	0.01
Cadmium, dissolved	0.05	mg/l	6	<0.002	<0.002	*	*
Calcium		mg/l	6	281	496	376.00	100.23
Carbonate		mg/l	6	<1	<5	*	*
Cation Sum		meq/L	6	34.91	65.34	49.91	14.85
Chloride	2000	mg/l	6	20	73.6	44.77	26.48
Chromium, dissolved	0.05	mg/l	6	<0.01	<0.01	*	*
Copper, dissolved	0.5	mg/l	6	<0.01	<0.01	*	*
Depth to Water		ft	3	13.6	15.49	14.79	1.04
Field Conductivity		umhos/cm	6	2680	4940	3763.33	953.83
Field pH		s.u.	6	6.6	7.36	7.01	0.29
Fluoride		mg/l	6	0.3	0.6	0.43	0.12
Hardness (as CaCO3)		mg/l	6	1130	2040	1555.00	440.99
Hydroxide as OH		mg/l	2	<5	<5	*	*
Iron, dissolved		mg/l	6	0.32	2.08	1.19	0.72
Laboratory conductivity		umhos/cm	6	2670	4910	3611.67	973.66
Laboratory pH		s.u.	6	7.8	8.1	7.95	0.12
Lead, dissolved	0.1	mg/l	6	<0.02	<0.02	*	*
Magnesium		mg/l	6	103	199	149.67	46.77
Manganese, dissolved	0.0005	mg/l	6	0.2	0.76	0.46	0.20
Mercury, dissolved		mg/l	6	<0.001	<0.001	*	*
Molybdenum, dissolved		mg/l	6	<0.02	<0.02	*	*
Nickel, dissolved		mg/l	6	<0.01	0.01	*	*
Nitrate/Nitrite	100	mg/l	6	0.01	0.1	-0.07	0.04
Nitrite	10	mg/l	6	<0.01	0.4	*	*
Phosphorus		mg/l	4	<0.05	<0.1	*	*
Phosphorus, Orthophosphate as P		mg/l	2	<0.1	<0.1	*	*
Potassium		mg/l	6	10.5	18	13.42	2.69
Selenium, dissolved	0.05	mg/l	6	<0.005	0.008	*	*
Silicon		mg/l	6	4	5	4.63	0.36
Sodium		mg/l	6	274	592	424.83	142.16
Sodium Adsorption Ratio (SAR)		Other	2	3.55	3.75	3.65	0.14
Sodium Adsorption Ratio (SAR)		Unknown	4	4.1	5.8	5.10	0.73
Sulfate	3000	mg/l	6	1230	3060	2148.33	863.51
Temperature		Deg C	6	2	14.1	10.68	4.57
Total Anion/Cation Balance		%	6	0.07	4.89	2.55	1.94
Total Dissolved Solids	5000	mg/l	6	2330	4560	3415.00	1071.29
Total Dissolved Solids (103)		mg/l	2	2420	2620	2520.00	141.42
Total Dissolved Solids (calc)		mg/l	2	2170	2350	2260.00	127.28
Zinc, dissolved	25	mg/l	6	<0.01	<0.01	*	*

Well: WA-OWAL-13 Date Range: 10/5/2004-12/17/2018

Parameter	Class III Standard	Units	#	Min	Max	Avg	Std Dev
Acidity		mg/l	35	<1	<5	*	*
Acidity, Total (As CaCO3)		mg/l	7	<5	<5	*	*
Alkalinity (as CaCO3)		mg/l	42	366	455	416.36	16.69
Alkalinity, Hydroxide		mg/l	35	<5	<5	*	*
Aluminum, dissolved	5	mg/l	42	<0.1	2.1	*	*
Ammonia		mg/l	42	<0.05	0.9	*	*
Anion Sum		meq/L	42	53.1	110.33	68.04	9.34
Arsenic, dissolved	0.2	mg/l	42	<0.005	0.006	*	*
Barium, dissolved		mg/l	42	<0.5	<0.5	*	*
Bicarbonate		mg/l	42	446	556	507.90	20.29
Boron, dissolved	5	mg/l	42	<0.03	0.35	*	*
Cadmium, dissolved	0.05	mg/l	42	<0.002	<0.002	*	*
Calcium		mg/l	42	302	516	391.67	39.96
Carbonate		mg/l	42	<5	<5	*	*
Cation Sum		meq/L	42	53.46	102.08	65.47	8.75
Chloride	2000	mg/l	42	3	80	31.60	11.84
Chromium, dissolved	0.05	mg/l	42	<0.01	<0.01	*	*
Copper, dissolved	0.5	mg/l	42	<0.01	0.07	*	*
Depth to Water		ft	23	4.7	8.83	7.37	1.46
Field Alkalinity		mg/l	15	500	1340	941.33	269.97
Field Conductivity		umhos/cm	42	2770	9190	4742.40	1094.11
Field pH		s.u.	42	6.31	8.14	7.34	0.35
Fluoride		mg/l	42	0.3	0.8	0.43	0.09
Hardness (as CaCO3)		mg/l	42	1310	2470	1703.57	214.66
Hydroxide as OH		mg/l	7	<5	<5	*	*
Iron, dissolved		mg/l	42	<0.05	4.39	*	*
Laboratory conductivity		umhos/cm	42	3340	6180	4837.86	616.37
Laboratory pH		s.u.	42	7.7	8.3	8.03	0.13
Lead, dissolved	0.1	mg/l	42	<0.02	<0.02	*	*
Magnesium		mg/l	42	135	307	176.48	30.77
Manganese, dissolved	0.0005	mg/l	42	<0.02	4.82	*	*
Mercury, dissolved		mg/l	42	<0.001	<0.001	*	*
Molybdenum, dissolved		mg/l	42	<0.02	<0.02	*	*
Nickel, dissolved		mg/l	42	<0.01	0.01	*	*
Nitrate/Nitrite	100	mg/l	31	<0.05	10	*	*
Nitrite	10	mg/l	42	<0.05	0.5	*	*
Phosphorus		mg/l	35	<0.1	0.9	*	*
Phosphorus, Orthophosphate as P		mg/l	7	<0.1	0.5	*	*
Potassium		mg/l	42	9	18	12.24	2.02
Selenium, dissolved	0.05	mg/l	42	<0.005	0.009	*	*
Silicon		mg/l	42	3.5	12	5.08	1.44
Sodium		mg/l	42	566	1200	714.83	110.96
Sodium Adsorption Ratio (SAR)		Other	7	6.83	8.63	7.38	0.61
Sodium Adsorption Ratio (SAR)		Unknown	35	6.4	10.5	7.54	0.81
Sulfate	3000	mg/l	42	2100	4810	2815.71	433.15
Temperature		Deg C	42	6.5	16.4	10.21	2.46
Total Anion/Cation Balance		%	42	0.04	5.76	3.06	1.46
Total Dissolved Solids	5000	mg/l	42	3450	7140	4485.24	681.13
Total Dissolved Solids (103)		mg/l	7	5080	6340	5447.14	435.61
Total Dissolved Solids (calc)		mg/l	7	4410	5420	4695.71	360.96
Zinc, dissolved	25	mg/l	42	<0.01	0.02	*	*

Well: WA-OWO-2 Date Range: 1/27/2004-8/15/2018

Parameter	Class III Standard	Units	#	Min	Max	Avg	Std Dev
Acidity		mg/l	6	<1	<5	*	*
Acidity, Total (As CaCO3)		mg/l	2	<5	<5	*	*
Alkalinity (as CaCO3)		mg/l	10	308	326	319.60	5.78
Alkalinity, Hydroxide		mg/l	8	<1	<5	*	*
Aluminum, dissolved	5	mg/l	10	<0.1	0.7	*	*
Ammonia		mg/l	10	<0.05	3.7	*	*
Anion Sum		meq/L	10	35.6	38.92	37.10	1.15
Arsenic, dissolved	0.2	mg/l	10	<0.005	<0.005	*	*
Barium, dissolved		mg/l	10	<0.5	<0.5	*	*
Bicarbonate		mg/l	10	376	398	390.10	7.23
Boron, dissolved	5	mg/l	10	0.05	0.1	0.08	0.02
Cadmium, dissolved	0.05	mg/l	10	<0.002	<0.002	*	*
Calcium		mg/l	10	214	258	236.50	13.94
Carbonate		mg/l	10	<1	<5	*	*
Cation Sum		meq/L	10	33.55	39.89	36.44	1.69
Chloride	2000	mg/l	10	7	12	8.37	1.41
Chromium, dissolved	0.05	mg/l	10	<0.01	<0.01	*	*
Copper, dissolved	0.5	mg/l	10	<0.01	<0.01	*	*
Depth to Water		ft	7	97.04	99.54	98.32	1.09
Field Alkalinity		mg/l	2	560	560	560.00	0.00
Field Conductivity		umhos/cm	10	2570	3090	2870.00	195.11
Field pH		s.u.	10	6.5	7.6	7.08	0.37
Fluoride		mg/l	10	0.1	0.21	0.19	0.03
Hardness (as CaCO3)		mg/l	10	873	1100	976.30	67.33
Hydroxide as OH		mg/l	2	<5	<5	*	*
Iron, dissolved		mg/l	10	0.48	0.83	0.63	0.13
Laboratory conductivity		umhos/cm	10	2470	3130	2919.00	192.67
Laboratory pH		s.u.	10	7.6	8.2	7.96	0.21
Lead, dissolved	0.1	mg/l	10	<0.02	<0.02	*	*
Magnesium		mg/l	10	82.4	111	94.01	8.34
Manganese, dissolved	0.0005	mg/l	10	0.79	1.03	0.90	0.08
Mercury, dissolved		mg/l	10	<0.001	<0.001	*	*
Molybdenum, dissolved		mg/l	10	<0.02	<0.02	*	*
Nickel, dissolved		mg/l	10	<0.01	0.05	*	*
Nitrate/Nitrite	100	mg/l	10	<0.05	0.12	*	*
Nitrite	10	mg/l	10	<0.01	1.6	*	*
Phosphorus		mg/l	8	<0.05	<0.1	*	*
Phosphorus, Orthophosphate as P		mg/l	2	<0.1	<0.1	*	*
Potassium		mg/l	10	8.8	14	11.02	1.45
Pumping Rate		gal/minute	2	2	2	2.00	0.00
Selenium, dissolved	0.05	mg/l	10	<0.005	<0.005	*	*
Silicon		mg/l	10	3.9	4.6	4.29	0.21
Sodium		mg/l	10	342	442	381.00	31.79
Sodium Adsorption Ratio (SAR)		Other	2	5.54	5.75	5.65	0.15
Sodium Adsorption Ratio (SAR)		Unknown	8	4.7	6.51	5.24	0.58
Sulfate	3000	mg/l	10	1400	1550	1464.00	52.96
Temperature		Deg C	10	12.1	17.4	15.37	1.59
Total Anion/Cation Balance		%	10	0.01	4.21	1.86	1.25
Total Dissolved Solids	5000	mg/l	10	2270	2540	2419.00	84.52
Total Dissolved Solids (103)		mg/l	2	2580	2610	2595.00	21.21
Total Dissolved Solids (calc)		mg/l	2	2310	2380	2345.00	49.50
Water Elevation		fmsl	1	4631.98	4631.98	4631.98	*
Zinc, dissolved	25	mg/l	10	<0.01	0.13	*	*

Well: OWA-13 Date Range: 5/16/1984-8/15/2018

Parameter	Class III Standard	Units	#	Min	Max	Avg	Std Dev
Acidity		mg/l	29	<1	<5	*	*
Acidity, Total (As CaCO3)		mg/l	2	<5	<5	*	*
Alkalinity (as CaCO3)		mg/l	33	313	570	394.79	54.41
Alkalinity, Hydroxide		mg/l	15	<1	<5	*	*
Aluminum, dissolved	5	mg/l	33	<0.1	0.1	*	*
Aluminum, Total		mg/l	3	<0.1	0.5	*	*
Ammonia		mg/l	32	<0.01	0.8	*	*
Anion Sum		meq/L	33	19.72	76.856	36.47	13.77
Arsenic (III), Dissolved		mg/l	2	<0.005	<0.005	*	*
Arsenic (III), Total		mg/l	2	<0.005	<0.005	*	*
Arsenic, dissolved	0.2	mg/l	20	<0.005	0.005	*	*
Arsenic, Dissolved/Total *100		%	1	100	100	100.00	*
Arsenic, Total		mg/l	1	<0.005	<0.005	*	*
Barium, dissolved		mg/l	33	<0.01	0.5	*	*
Barium, Total		mg/l	3	<0.5	<0.5	*	*
Bicarbonate		mg/l	33	381	695	481.15	66.82
Boron, dissolved	5	mg/l	33	<0.01	0.8	*	*
Boron, Total		mg/l	3	<0.01	0.44	*	*
Cadmium, dissolved	0.05	mg/l	22	<0.002	0.002	*	*
Cadmium, Total		mg/l	3	<0.002	<0.002	*	*
Calcium		mg/l	33	138	698	307.76	128.88
Carbonate		mg/l	18	<1	<5	*	*
Cation Sum		meq/L	33	19.33	78.856	36.27	14.55
Chloride	2000	mg/l	33	2.8	58	24.82	16.04
Chromium, dissolved	0.05	mg/l	33	<0.01	0.02	*	*
Chromium, Total		mg/l	3	<0.02	0.02	*	*
Cobalt, Dissolved	1	mg/l	2	<0.02	<0.02	*	*
Cobalt, Total		mg/l	2	<0.02	<0.02	*	*
Copper, dissolved	0.5	mg/l	33	<0.01	0.01	*	*
Copper, Total		mg/l	3	<0.01	0.02	*	*
Depth to Water		ft	16	31.4	50.84	44.67	5.99
Dry Well		mg/l	1	0.3	0.3	0.30	*
Field Alkalinity		mg/l	7	480	960	748.57	212.56
Field Conductivity		umhos/cm	29	1510	5300	2535.69	848.35
Field pH		s.u.	27	5.2	71	9.46	12.31
Fluoride		mg/l	32	<0.08	0.8	*	*
Hardness (as CaCO3)		mg/l	33	557	3215	1346.29	650.78
Hydroxide as OH		mg/l	2	<5	<5	*	*
Iron (Ferric)		mg/l	1	0.23	0.23	0.23	*
Iron, dissolved		mg/l	33	<0.05	1.3	*	*
Iron, total		mg/l	3	<0.05	0.91	*	*
Laboratory conductivity		umhos/cm	33	1730	5150	2782.21	932.73
Laboratory pH		s.u.	33	7	8.3	7.73	0.34
Lead, dissolved	0.1	mg/l	33	<0.02	0.02	*	*
Lead, Total		mg/l	3	<0.02	<0.02	*	*
Magnesium		mg/l	33	52	511	140.54	89.59
Manganese, dissolved	0.00005	mg/l	33	<0.02	1.63	*	*
Manganese, total		mg/l	3	<0.02	1.62	*	*
Mercury, dissolved		mg/l	22	<0.001	0.001	*	*
Mercury, Total		mg/l	3	<0.001	<0.001	*	*
Molybdenum, dissolved		mg/l	33	<0.02	0.02	*	*
Molybdenum, Total		mg/l	3	<0.02	<0.02	*	*
Nickel, dissolved		mg/l	33	<0.01	0.02	*	*
Nickel, Total		mg/l	3	<0.01	<0.01	*	*
Nitrate		mg/l	4	14.68	529.04	153.64	250.61
Nitrate/Nitrite	100	mg/l	29	0.01	529.04	23.84	97.74
Nitrite	10	mg/l	22	0.01	<0.1	*	*
Oil & Grease Visual		s.u.	1	7	7	7.00	*

Well: OWA-13 Date Range: 5/16/1984-8/15/2018

Parameter	Class III Standard	Units	#	Min	Max	Avg	Std Dev
Phosphorus		mg/l	31	<0.01	<0.4	*	*
Phosphorus, Orthophosphate as P		mg/l	2	<0.1	<0.1	*	*
Potassium		mg/l	33	9	30.3	14.13	4.95
Selenium, dissolved	0.05	mg/l	27	<0.005	0.066	*	*
Selenium, Total		mg/l	3	<0.005	<0.005	*	*
Silica as SiO2		mg/l	14	4	14.5	9.59	3.00
Silicon		mg/l	22	1.3	16.2	4.76	2.95
Silicon, total		mg/l	1	5.6	5.6	5.60	*
Sodium		mg/l	33	128	320	206.63	44.62
Sodium Adsorption Ratio (SAR)		Other	2	2.58	2.78	2.68	0.14
Sodium Adsorption Ratio (SAR)		Unknown	31	1.788	3.5	2.55	0.50
Sulfate	3000	mg/l	33	513	3333	1290.45	682.42
Temperature		Deg C	28	11.1	20.6	13.57	2.05
Temperature, Water (Degrees Fahrenheit)		Deg F	1	59.5	59.5	59.50	*
Total Anion/Cation Balance		%	33	0.03	<13.172	*	*
Total Dissolved Solids	5000	mg/l	31	1170	4896.082	2233.87	925.02
Total Dissolved Solids (103)		mg/l	2	2140	2330	2235.00	134.35
Total Dissolved Solids (calc)		mg/l	2	1920	2050	1985.00	91.92
Water Elevation		fmsl	7	4554.54	4573.98	4565.16	6.70
Well Purging Volume		Other	1	72	72	72.00	*
Zinc, dissolved	25	mg/l	33	<0.01	0.07	*	*
Zinc, Total		mg/l	3	0.02	0.07	0.05	0.03

Well: TWA-02 Date Range: 5/1/1979-8/14/2018

Parameter	Class III Standard	Units	#	Min	Max	Avg	Std Dev
Acidity		mg/l	32	<1	<5	*	*
Acidity, Total (As CaCO3)		mg/l	2	<5	<5	*	*
Alkalinity (as CaCO3)		mg/l	45	306	438	374.51	32.80
Alkalinity, Hydroxide		mg/l	14	<1	<5	*	*
Aluminum, dissolved	5	mg/l	38	<0.1	0.4	*	*
Aluminum, Total		mg/l	3	<0.1	0.2	*	*
Ammonia		mg/l	45	<0.01	1.8	*	*
Anion Sum		meq/L	45	23.79	46.7	34.74	4.04
Arsenic (III), Dissolved		mg/l	2	<0.005	<0.005	*	*
Arsenic (III), Total		mg/l	2	<0.005	<0.005	*	*
Arsenic, dissolved	0.2	mg/l	21	<0.005	0.02	*	*
Arsenic, Dissolved/Total *100		%	1	100	100	100.00	*
Arsenic, Total		mg/l	1	<0.005	<0.005	*	*
Barium, dissolved		mg/l	39	<0.01	1.1	*	*
Barium, Total		mg/l	3	0.1	<0.5	*	*
Bicarbonate		mg/l	45	373	534	454.49	38.26
Boron, dissolved	5	mg/l	43	<0.01	0.37	*	*
Boron, Total		mg/l	3	0.05	0.09	0.07	0.02
Cadmium, dissolved	0.05	mg/l	24	<0.002	0.04	*	*
Cadmium, Total		mg/l	3	<0.002	<0.002	*	*
Calcium		mg/l	45	125	327	224.45	36.19
Carbonate		mg/l	17	<1	<5	*	*
Cation Sum		%	3	1.035	2.74	1.78	0.87
Cation Sum		meq/L	42	24.99	43.29	34.47	3.07
Chloride	2000	mg/l	45	6.21	37	22.71	4.29
Chromium, dissolved	0.05	mg/l	39	<0.01	0.05	*	*
Chromium, Total		mg/l	3	<0.02	<0.02	*	*
Cobalt, Dissolved	1	mg/l	2	<0.02	<0.02	*	*
Cobalt, Total		mg/l	2	<0.02	<0.02	*	*
Coliform, Total		Unknown	1	26000	26000	26000.00	*
Copper, dissolved	0.5	mg/l	40	<0.01	0.01	*	*
Copper, Total		mg/l	3	<0.01	<0.01	*	*
Cyanide, Total		mg/l	1	<0.005	<0.005	*	*
Depth to Water		ft	23	2.35	17.55	5.80	4.45
Dry Well		mg/l	1	0.36	0.36	0.36	*
Field Alkalinity		mg/l	7	480	940	708.57	182.16
Field Conductivity		umhos/cm	43	1880	3600	2562.19	415.16
Field pH		s.u.	42	6.1	8.1	7.04	0.31
Field turbidity		NTUs	7	1.05	18.4	5.75	6.19
Fluoride		mg/l	44	0.1	0.64	0.38	0.10
Hardness (as CaCO3)		mg/l	45	564.434	1340	939.96	137.02
Hydroxide as OH		mg/l	2	<5	<5	*	*
Iron (Ferrous)		mg/l	8	0.03	25	3.67	8.61
Iron, dissolved		mg/l	43	<0.05	4.4	*	*
Iron, total		mg/l	3	0.5	0.85	0.65	0.18
Laboratory conductivity		umhos/cm	45	2060	3600	2729.69	292.94
Laboratory pH		s.u.	45	7	8.2	7.64	0.31
Lead, dissolved	0.1	mg/l	40	0.01	0.02	-0.02	0.00
Lead, Total		mg/l	3	<0.02	<0.02	*	*
Lithium, dissolved		mg/l	3	0.07	0.11	0.08	0.02
Magnesium		mg/l	45	7	141	92.32	21.64
Manganese, dissolved	0.00005	mg/l	44	<0.02	1.41	*	*
Manganese, total		mg/l	3	0.05	0.05	0.05	0.00
Mercury, dissolved		mg/l	21	<0.001	0.001	*	*
Mercury, Total		mg/l	3	<0.001	<0.001	*	*
Molybdenum, dissolved		mg/l	36	<0.02	0.02	*	*
Molybdenum, Total		mg/l	3	<0.02	<0.02	*	*
Nickel, dissolved		mg/l	39	<0.01	0.04	*	*

Well: TWA-02 Date Range: 5/1/1979-8/14/2018

Parameter	Class III Standard	Units	#	Min	Max	Avg	Std Dev
Nickel, Total		mg/l	3	<0.01	0.01	*	*
Nitrate		mg/l	12	<0.03	3.7	*	*
Nitrate/Nitrite	100	mg/l	31	<0.01	3.7	*	*
Nitrite	10	mg/l	27	<0.01	<5	*	*
Oil & Grease Visual		s.u.	1	7.5	7.5	7.50	*
Oil and grease	10	mg/l	2	<1	<1	*	*
Phenol		mg/l	5	<1	<2	*	*
Phosphorus		mg/l	43	<0.01	<2	*	*
Phosphorus, Orthophosphate as P		mg/l	2	<0.1	<0.1	*	*
Potassium		mg/l	45	10	30	13.56	3.29
Pumping Rate		gal/minute	1	4	4	4.00	*
Selenium, dissolved	0.05	mg/l	22	<0.005	0.02	*	*
Selenium, Total		mg/l	3	<0.005	<0.005	*	*
Silica as SiO2		mg/l	24	4	15.1	10.73	2.94
Silicon		mg/l	21	4.1	14.9	5.63	2.95
Silicon, total		mg/l	1	4.97	4.97	4.97	*
Silver, dissolved		mg/l	1	0.01	0.01	0.01	*
Sodium		mg/l	42	254.7	381	342.76	25.62
Sodium Adsorption Ratio (SAR)		Other	2	4.92	5.18	5.05	0.18
Sodium Adsorption Ratio (SAR)		Unknown	43	4.14	7.999	4.88	0.59
Strontium, Dissolved		mg/l	7	2.8	338	52.79	125.81
Sulfate	3000	mg/l	45	762	1870	1261.42	185.05
Temperature		Deg C	42	6	23	14.40	3.68
Total Anion/Cation Balance		%	41	0.003	<11.186	*	*
Total Anion/Cation Balance		meq/L	3	23.306	32.999	28.97	5.05
Total Dissolved Solids	5000	mg/l	43	270	2950	2123.63	532.37
Total Dissolved Solids (103)		mg/l	2	2220	2370	2295.00	106.07
Total Dissolved Solids (calc)		mg/l	5	1525.957	2215.509	1954.04	260.17
Water Elevation		fmsl	15	4574.1	4575.81	4574.93	0.58
Well Purging Volume		Other	2	102.63	168	135.32	46.22
Zinc, dissolved	25	mg/l	41	<0.01	0.45	*	*
Zinc, Total		mg/l	3	0.03	0.1	0.07	0.04

Well: OWI-07 Date Range: 5/15/1984-8/15/2018

Parameter	Class III Standard	Units	#	Min	Max	Avg	Std Dev
Acidity		mg/l	7	<1	<5	*	*
Acidity, Total (As CaCO3)		mg/l	2	<5	<5	*	*
Alkalinity (as CaCO3)		mg/l	9	557	881	747.00	123.56
Alkalinity, Hydroxide		mg/l	3	<5	<5	*	*
Aluminum, dissolved	5	mg/l	9	<0.1	0.2	*	*
Ammonia		mg/l	9	0.23	3.58	1.93	1.13
Anion Sum		meq/L	9	28.678	40.67	35.95	3.88
Arsenic, dissolved	0.2	mg/l	5	<0.005	<0.005	*	*
Barium, dissolved		mg/l	9	<0.5	<0.5	*	*
Bicarbonate		mg/l	9	680	1080	912.11	151.80
Boron, dissolved	5	mg/l	9	0.01	0.8	0.34	0.32
Cadmium, dissolved	0.05	mg/l	5	<0.002	<0.002	*	*
Calcium		mg/l	9	87	153	123.89	23.13
Carbonate		mg/l	5	<5	<5	*	*
Cation Sum		meq/L	9	28.557	40.63	35.33	3.81
Chloride	2000	mg/l	9	5.2	10	7.19	1.50
Chromium, dissolved	0.05	mg/l	9	<0.01	<0.02	*	*
Copper, dissolved	0.5	mg/l	9	<0.01	0.01	*	*
Depth to Water		ft	5	56.71	57.2	57.06	0.21
Field Conductivity		umhos/cm	9	2000	3150	2619.56	432.49
Field pH		s.u.	9	5.4	7.3	6.90	0.58
Fluoride		mg/l	9	0.34	0.75	0.45	0.12
Hardness (as CaCO3)		mg/l	9	435.387	782	642.66	95.49
Hydroxide as OH		mg/l	2	<5	<5	*	*
Iron, dissolved		mg/l	9	<0.05	0.29	*	*
Laboratory conductivity		umhos/cm	9	2350	3220	2868.89	294.64
Laboratory pH		s.u.	9	7.2	8.1	7.80	0.34
Lead, dissolved	0.1	mg/l	9	<0.02	<0.02	*	*
Magnesium		mg/l	9	53	98	81.22	12.71
Manganese, dissolved	0.0005	mg/l	9	<0.02	0.04	*	*
Mercury, dissolved		mg/l	5	<0.001	<0.001	*	*
Molybdenum, dissolved		mg/l	9	<0.02	<0.02	*	*
Nickel, dissolved		mg/l	9	<0.01	0.04	*	*
Nitrate/Nitrite	100	mg/l	9	<0.1	0.72	*	*
Nitrite	10	mg/l	5	<0.1	<0.1	*	*
Phosphorus		mg/l	7	0.01	<0.1	*	*
Phosphorus, Orthophosphate as P		mg/l	2	<0.1	<0.1	*	*
Potassium		mg/l	9	11	29	20.79	5.46
Selenium, dissolved	0.05	mg/l	5	<0.005	<0.005	*	*
Silica as SiO2		mg/l	4	8.9	10.4	9.40	0.69
Silicon		mg/l	5	3.5	4.1	3.84	0.24
Sodium		mg/l	9	445	560	502.67	45.78
Sodium Adsorption Ratio (SAR)		Other	2	9.04	9.22	9.13	0.13
Sodium Adsorption Ratio (SAR)		Unknown	7	7.789	9.385	8.51	0.56
Sulfate	3000	mg/l	9	835	1110	1000.56	81.96
Temperature		Deg C	9	11.2	15	13.36	1.21
Total Anion/Cation Balance		%	9	0.04	4.41	1.29	1.51
Total Dissolved Solids	5000	mg/l	9	1786.819	2470	2162.10	203.20
Total Dissolved Solids (103)		mg/l	2	2180	2260	2220.00	56.57
Total Dissolved Solids (calc)		mg/l	2	2300	2310	2305.00	7.07
Zinc, dissolved	25	mg/l	9	<0.01	0.05	*	*

Well: OWC-12 Date Range: 8/23/1994-8/14/2018

Parameter	Class III Standard	Units	#	Min	Max	Avg	Std Dev
Acidity		mg/l	5	<1	<5	*	*
Acidity, Total (As CaCO3)		mg/l	2	<5	<5	*	*
Alkalinity (as CaCO3)		mg/l	7	423	570	475.14	45.85
Alkalinity, Hydroxide		mg/l	3	<5	<5	*	*
Aluminum, dissolved	5	mg/l	7	<0.1	0.1	*	*
Ammonia		mg/l	7	1.51	2.8	2.23	0.41
Anion Sum		meq/L	7	12.58	44.68	32.39	10.02
Arsenic, dissolved	0.2	mg/l	5	<0.005	<0.005	*	*
Barium, dissolved		mg/l	7	<0.5	<0.5	*	*
Bicarbonate		mg/l	7	516	696	577.14	57.46
Boron, dissolved	5	mg/l	7	0.04	0.24	0.10	0.08
Cadmium, dissolved	0.05	mg/l	5	<0.002	<0.002	*	*
Calcium		mg/l	7	43	260	160.86	68.42
Carbonate		mg/l	5	<5	9	*	*
Cation Sum		meq/L	7	12.768	40.89	32.25	9.38
Chloride	2000	mg/l	7	10	21	17.00	4.00
Chromium, dissolved	0.05	mg/l	7	<0.01	<0.02	*	*
Copper, dissolved	0.5	mg/l	7	<0.01	<0.01	*	*
Depth to Water		ft	5	26.32	38.69	32.73	5.34
Field Conductivity		umhos/cm	7	600	3330	2382.86	943.68
Field pH		s.u.	7	7.05	7.7	7.40	0.23
Fluoride		mg/l	7	0.8	1.44	1.03	0.21
Hardness (as CaCO3)		mg/l	7	169	1160	724.14	304.21
Hydroxide as OH		mg/l	2	<5	<5	*	*
Iron, dissolved		mg/l	7	<0.05	0.39	*	*
Laboratory conductivity		umhos/cm	7	1130	3140	2634.29	692.65
Laboratory pH		s.u.	7	7.4	8.3	8.04	0.31
Lead, dissolved	0.1	mg/l	7	<0.02	<0.02	*	*
Magnesium		mg/l	7	15	123	78.14	34.77
Manganese, dissolved	0.0005	mg/l	7	0.15	0.61	0.28	0.15
Mercury, dissolved		mg/l	5	<0.001	<0.001	*	*
Molybdenum, dissolved		mg/l	7	<0.02	<0.02	*	*
Nickel, dissolved		mg/l	7	<0.01	<0.01	*	*
Nitrate/Nitrite	100	mg/l	7	<0.01	<0.1	*	*
Nitrite	10	mg/l	5	<0.1	<0.1	*	*
Phosphorus		mg/l	5	0.02	<0.1	*	*
Phosphorus, Orthophosphate as P		mg/l	2	<0.1	<0.1	*	*
Potassium		mg/l	7	6.5	20	14.79	4.41
Selenium, dissolved	0.05	mg/l	5	0.006	0.056	0.02	0.02
Silica as SiO2		mg/l	2	11.29	12.24	11.77	0.67
Silicon		mg/l	5	4.6	6.1	5.44	0.59
Sodium		mg/l	7	212	485	397.43	86.83
Sodium Adsorption Ratio (SAR)		Other	2	7.05	7.43	7.24	0.27
Sodium Adsorption Ratio (SAR)		Unknown	5	5	7.094	6.47	0.86
Sulfate	3000	mg/l	7	127	1670	1075.57	481.39
Temperature		Deg C	7	12.5	14.7	13.21	0.73
Total Anion/Cation Balance		%	7	0.06	4.42	1.36	1.57
Total Dissolved Solids	5000	mg/l	7	717.984	2760	2072.82	661.65
Total Dissolved Solids (103)		mg/l	2	2050	2460	2255.00	289.91
Total Dissolved Solids (calc)		mg/l	2	1930	2170	2050.00	169.71
Zinc, dissolved	25	mg/l	7	<0.01	<0.01	*	*

Well: OWC-24 Date Range: 5/16/1984-8/15/2018

Parameter	Class III Standard	Units	#	Min	Max	Avg	Std Dev
Acidity		mg/l	29	<1	<5	*	*
Acidity, Total (As CaCO3)		mg/l	2	<5	<5	*	*
Alkalinity (as CaCO3)		mg/l	33	308	428	347.00	33.06
Alkalinity, Hydroxide		mg/l	15	<1	<5	*	*
Aluminum, dissolved	5	mg/l	33	<0.1	0.2	*	*
Aluminum, Total		mg/l	2	0.2	0.4	0.30	0.14
Ammonia		mg/l	33	<0.05	2.1	*	*
Anion Sum		meq/L	33	6.44	13.334	8.07	1.90
Arsenic (III), Dissolved		mg/l	2	<0.005	<0.005	*	*
Arsenic (III), Total		mg/l	2	<0.005	<0.005	*	*
Arsenic, dissolved	0.2	mg/l	21	<0.005	0.008	*	*
Arsenic, Dissolved/Total *100		%	1	100	100	100.00	*
Arsenic, Total		mg/l	1	<0.005	<0.005	*	*
Barium, dissolved		mg/l	33	<0.01	0.5	*	*
Barium, Total		mg/l	3	<0.5	<0.5	*	*
Bicarbonate		mg/l	33	375	522	419.39	36.39
Boron, dissolved	5	mg/l	33	<0.01	0.19	*	*
Boron, Total		mg/l	3	0.02	0.06	0.04	0.02
Cadmium, dissolved	0.05	mg/l	22	<0.002	0.002	*	*
Cadmium, Total		mg/l	3	<0.002	<0.002	*	*
Calcium		mg/l	33	1.2	19	9.36	3.39
Carbonate		mg/l	19	<1	15	*	*
Cation Sum		meq/L	33	6.375	12.46	7.76	1.52
Chloride	2000	mg/l	33	2.68	23	10.10	4.86
Chromium, dissolved	0.05	mg/l	33	<0.01	0.02	*	*
Chromium, Total		mg/l	3	<0.02	<0.02	*	*
Cobalt, Dissolved	1	mg/l	2	<0.02	<0.02	*	*
Cobalt, Total		mg/l	1	<0.02	<0.02	*	*
Copper, dissolved	0.5	mg/l	33	<0.01	0.02	*	*
Copper, Total		mg/l	3	0.01	0.01	0.01	0.00
Depth to Water		ft	15	39.49	141.81	108.94	26.67
Dry Well		mg/l	1	1.71	1.71	1.71	*
Field Alkalinity		mg/l	7	560	920	788.57	139.45
Field Conductivity		umhos/cm	31	389	1070	676.06	164.28
Field pH		s.u.	30	7	8.2	7.47	0.27
Fluoride		mg/l	32	0.78	2.11	1.60	0.22
Hardness (as CaCO3)		mg/l	33	31	89	45.85	13.55
Hydroxide as OH		mg/l	2	<5	<5	*	*
Iron, dissolved		mg/l	33	<0.05	0.4	*	*
Iron, total		mg/l	3	1.02	1.24	1.14	0.11
Laboratory conductivity		umhos/cm	33	580	1110	708.09	120.48
Laboratory pH		s.u.	33	7.6	8.7	8.04	0.30
Lead, dissolved	0.1	mg/l	33	<0.02	0.02	*	*
Lead, Total		mg/l	3	<0.02	0.02	*	*
Magnesium		mg/l	33	2.92	10	5.46	1.79
Manganese, dissolved	0.00005	mg/l	33	<0.02	0.57	*	*
Manganese, total		mg/l	3	0.02	0.04	0.03	0.01
Mercury, dissolved		mg/l	22	<0.001	0.001	*	*
Mercury, Total		mg/l	3	<0.001	<0.001	*	*
Molybdenum, dissolved		mg/l	33	<0.02	0.02	*	*
Molybdenum, Total		mg/l	3	<0.02	<0.02	*	*
Nickel, dissolved		mg/l	33	<0.01	0.01	*	*
Nickel, Total		mg/l	3	<0.01	0.03	*	*
Nitrate		mg/l	4	<0.03	2.84	*	*
Nitrate/Nitrite	100	mg/l	27	<0.01	2.84	*	*
Nitrite	10	mg/l	22	<0.01	<0.1	*	*
Oil & Grease Visual		s.u.	1	7.6	7.6	7.60	*
Phosphorus	10	mg/l	31	0.01	<0.4	*	*

Well: OWC-24 Date Range: 5/16/1984-8/15/2018

Parameter	Class III Standard	Units	#	Min	Max	Avg	Std Dev
Phosphorus, Orthophosphate as P		mg/l	2	<0.1	<0.1	*	*
Potassium		mg/l	33	0.6	8	4.63	1.38
Pumping Rate		gal/minute	1	6	6	6.00	*
Selenium, dissolved		mg/l	22	<0.005	0.033	*	*
Selenium, Total	0.05	mg/l	3	<0.005	<0.005	*	*
Silica as SiO2		mg/l	14	3.71	9.94	8.12	1.89
Silicon		mg/l	22	3.4	11.9	4.58	2.31
Silicon, total		mg/l	1	4.31	4.31	4.31	*
Sodium		mg/l	33	123	239	153.95	28.86
Sodium Adsorption Ratio (SAR)		Other	2	11.3	11.4	11.35	0.07
Sodium Adsorption Ratio (SAR)		Unknown	31	7.892	11.4	9.88	0.98
Sulfate	3000	mg/l	32	0.1	147	19.18	41.35
Temperature		Deg C	30	11.3	23.8	15.91	2.51
Total Anion/Cation Balance		%	33	0.02	<33.766	*	*
Total Dissolved Solids	5000	mg/l	31	344	700	430.99	95.93
Total Dissolved Solids (103)		mg/l	2	460	490	475.00	21.21
Total Dissolved Solids (calc)		mg/l	2	440	450	445.00	7.07
Water Elevation		fmsl	6	4477.28	4566.13	4513.44	33.14
Well Purging Volume		Other	2	80	154.2	117.10	52.47
Zinc, dissolved	25	mg/l	33	<0.01	0.11	*	*
Zinc, Total		mg/l	3	0.04	0.06	0.05	0.01

Well: OWS-06 Date Range: 3/22/2012-12/17/2018

Parameter	Class III Standard	Units	#	Min	Max	Avg	Std Dev
Acidity		mg/l	18	<5	<5	*	*
Acidity, Total (As CaCO3)		mg/l	8	<5	<5	*	*
Alkalinity (as CaCO3)		mg/l	26	844	1070	949.31	57.47
Alkalinity, Hydroxide		mg/l	18	<5	<5	*	*
Aluminum, dissolved	5	mg/l	26	<0.1	0.3	*	*
Ammonia		mg/l	26	0.5	3.7	2.88	0.67
Anion Sum		meq/L	26	23.95	38.3	31.95	4.38
Arsenic, dissolved	0.2	mg/l	26	<0.005	0.01	*	*
Barium, dissolved		mg/l	26	<0.5	<0.5	*	*
Bicarbonate		mg/l	26	1010	1310	1155.77	74.90
Boron, dissolved	5	mg/l	26	0.05	0.43	0.08	0.07
Cadmium, dissolved	0.05	mg/l	26	<0.002	<0.002	*	*
Calcium		mg/l	26	74	219	131.27	34.19
Carbonate		mg/l	26	<5	16	*	*
Cation Sum		meq/L	26	23.89	38.37	32.40	4.41
Chloride	2000	mg/l	26	22	29	26.12	1.68
Chromium, dissolved	0.05	mg/l	26	<0.01	<0.01	*	*
Copper, dissolved	0.5	mg/l	26	<0.01	<0.01	*	*
Depth to Water		ft	24	68.72	88.94	80.25	5.99
Field Conductivity		umhos/cm	26	1520	3433	2538.88	398.71
Field pH		s.u.	26	6.47	7.27	6.85	0.20
Fluoride		mg/l	26	0.7	1.2	0.87	0.11
Hardness (as CaCO3)		mg/l	26	377	904	641.81	152.52
Hydroxide as OH		mg/l	8	<5	<5	*	*
Iron, dissolved		mg/l	26	<0.05	2.11	*	*
Laboratory conductivity		umhos/cm	26	2010	3070	2590.77	347.38
Laboratory pH		s.u.	26	7.7	8.3	7.96	0.14
Lead, dissolved	0.1	mg/l	26	<0.02	<0.02	*	*
Magnesium		mg/l	26	46	113	76.38	17.77
Manganese, dissolved	0.0005	mg/l	26	<0.02	1.23	*	*
Mercury, dissolved		mg/l	26	<0.001	<0.001	*	*
Molybdenum, dissolved		mg/l	26	<0.02	<0.02	*	*
Nickel, dissolved		mg/l	26	<0.01	0.02	*	*
Nitrate/Nitrite	100	mg/l	26	<0.1	0.2	*	*
Nitrite	10	mg/l	26	<0.1	0.2	*	*
Phosphorus		mg/l	18	<0.1	<0.1	*	*
Phosphorus, Orthophosphate as P		mg/l	8	<0.1	<0.1	*	*
Potassium		mg/l	26	11	33	26.38	3.99
Selenium, dissolved	0.05	mg/l	26	<0.005	<0.005	*	*
Silicon		mg/l	26	3.6	10.5	6.15	1.04
Sodium		mg/l	26	350	478	430.08	34.42
Sodium Adsorption Ratio (SAR)		Other	8	6.58	7.7	7.44	0.36
Sodium Adsorption Ratio (SAR)		Unknown	18	6.2	8.9	7.54	0.74
Sulfate	3000	mg/l	26	282	770	585.54	162.66
Temperature		Deg C	26	12.7	20.8	18.01	1.57
Total Anion/Cation Balance		%	26	0.07	3.53	1.54	1.03
Total Dissolved Solids	5000	mg/l	26	1350	2190	1798.85	250.94
Total Dissolved Solids (103)		mg/l	8	1820	2150	1952.50	140.89
Total Dissolved Solids (calc)		mg/l	8	2030	2100	2070.00	25.07
Zinc, dissolved	25	mg/l	26	<0.01	0.07	*	*

Well: OWS-07 Date Range: 7/25/2016

Parameter	Class III Standard	Units	#	Min	Max	Avg	Std Dev
Acidity		mg/l	1	<5	<5	<5	*
Alkalinity (as CaCO3)		mg/l	1	601	601	601	*
Alkalinity, Hydroxide		mg/l	1	<5	<5	<5	*
Aluminum, dissolved	5	mg/l	1	0.3	0.3	0.3	*
Ammonia		mg/l	1	1.5	1.5	1.5	*
Anion Sum		meq/L	1	28.37	28.37	28.37	*
Arsenic, dissolved	0.2	mg/l	1	0.007	0.007	0.007	*
Barium, dissolved		mg/l	1	<0.5	<0.5	<0.5	*
Bicarbonate		mg/l	1	733	733	733	*
Boron, dissolved	5	mg/l	1	0.09	0.09	0.09	*
Cadmium, dissolved	0.05	mg/l	1	<0.002	<0.002	<0.002	*
Calcium		mg/l	1	92	92	92	*
Carbonate		mg/l	1	<5	<5	<5	*
Cation Sum		meq/L	1	28.56	28.56	28.56	*
Chloride	2000	mg/l	1	38	38	38	*
Chromium, dissolved	0.05	mg/l	1	<0.01	<0.01	<0.01	*
Copper, dissolved	0.5	mg/l	1	<0.01	<0.01	<0.01	*
Depth to Water		ft	1	96.13	96.13	96.13	*
Field Conductivity		umhos/cm	1	2310	2310	2310	*
Field pH		s.u.	1	7.3	7.3	7.3	*
Fluoride		mg/l	1	0.9	0.9	0.9	*
Hardness (as CaCO3)		mg/l	1	411	411	411	*
Iron, dissolved		mg/l	1	0.08	0.08	0.08	*
Laboratory conductivity		umhos/cm	1	2540	2540	2540	*
Laboratory pH		s.u.	1	8.1	8.1	8.1	*
Lead, dissolved	0.1	mg/l	1	<0.02	<0.02	<0.02	*
Magnesium		mg/l	1	44	44	44	*
Manganese, dissolved	0.0005	mg/l	1	0.21	0.21	0.21	*
Mercury, dissolved		mg/l	1	<0.001	<0.001	<0.001	*
Molybdenum, dissolved		mg/l	1	0.03	0.03	0.03	*
Nickel, dissolved		mg/l	1	<0.01	<0.01	<0.01	*
Nitrate/Nitrite	100	mg/l	1	<0.1	<0.1	<0.1	*
Nitrite	10	mg/l	1	<0.1	<0.1	<0.1	*
Phosphorus		mg/l	1	<0.1	<0.1	<0.1	*
Potassium		mg/l	1	26	26	26	*
Selenium, dissolved	0.05	mg/l	1	<0.005	<0.005	<0.005	*
Silicon		mg/l	1	6.7	6.7	6.7	*
Sodium		mg/l	1	450	450	450	*
Sodium Adsorption Ratio (SAR)		Unknown	1	9.66	9.66	9.66	*
Sulfate	3000	mg/l	1	732	732	732	*
Temperature		Deg C	1	22.6	22.6	22.6	*
Total Anion/Cation Balance		%	1	0.34	0.34	0.34	*
Total Dissolved Solids	5000	mg/l	1	1740	1740	1740	*
Zinc, dissolved	25	mg/l	1	<0.01	<0.01	<0.01	*

Well: OWS-08 Date Range: 4/12/2016-12/17/2018

Parameter	Class III Standard	Units	#	Min	Max	Avg	Std Dev
Acidity		mg/l	3	<5	<5	*	*
Acidity, Total (As CaCO3)		mg/l	7	<5	<5	*	*
Alkalinity (as CaCO3)		mg/l	10	682	905	753.10	63.11
Alkalinity, Hydroxide		mg/l	3	<5	<5	*	*
Aluminum, dissolved	5	mg/l	10	<0.1	0.8	*	*
Ammonia		mg/l	10	2	3.3	2.58	0.43
Anion Sum		meq/L	10	32.77	37.16	34.18	1.33
Arsenic, dissolved	0.2	mg/l	10	<0.005	0.007	*	*
Barium, dissolved		mg/l	10	<0.5	<0.5	*	*
Bicarbonate		mg/l	10	832	1100	918.40	75.95
Boron, dissolved	5	mg/l	10	0.05	0.07	0.06	0.01
Cadmium, dissolved	0.05	mg/l	10	<0.002	<0.002	*	*
Calcium		mg/l	10	82	133	92.40	15.57
Carbonate		mg/l	10	<5	<5	*	*
Cation Sum		meq/L	10	32.93	38.71	34.74	1.68
Chloride	2000	mg/l	10	7	11	8.60	1.17
Chromium, dissolved	0.05	mg/l	10	<0.01	<0.01	*	*
Copper, dissolved	0.5	mg/l	10	<0.01	0.01	*	*
Depth to Water		ft	10	86.42	87.9	86.86	0.40
Field Conductivity		umhos/cm	10	2650	2880	2801.50	70.48
Field pH		s.u.	10	4.2	7.13	6.59	0.86
Fluoride		mg/l	10	0.4	0.5	0.47	0.05
Hardness (as CaCO3)		mg/l	10	362	574	403.40	65.47
Hydroxide as OH		mg/l	7	<5	<5	*	*
Iron, dissolved		mg/l	10	5.48	13.4	9.78	2.46
Laboratory conductivity		umhos/cm	10	2370	3060	2814.00	207.59
Laboratory pH		s.u.	10	7.7	8.2	7.92	0.15
Lead, dissolved	0.1	mg/l	10	<0.02	<0.02	*	*
Magnesium		mg/l	10	38	59	42.10	6.57
Manganese, dissolved	0.0005	mg/l	10	0.33	1.72	0.74	0.40
Mercury, dissolved		mg/l	10	<0.001	<0.001	*	*
Molybdenum, dissolved		mg/l	10	<0.02	<0.02	*	*
Nickel, dissolved		mg/l	10	<0.01	<0.01	*	*
Nitrate/Nitrite	100	mg/l	10	<0.1	<0.1	*	*
Nitrite	10	mg/l	10	<0.1	<0.1	*	*
Phosphorus		mg/l	3	<0.1	<0.1	*	*
Phosphorus, Orthophosphate as P		mg/l	7	<0.1	<0.1	*	*
Potassium		mg/l	10	12	16	13.60	1.26
Selenium, dissolved	0.05	mg/l	10	<0.005	<0.005	*	*
Silicon		mg/l	10	5.6	8.1	6.90	0.84
Sodium		mg/l	10	580	635	601.00	17.79
Sodium Adsorption Ratio (SAR)		Other	7	13.1	14.1	13.56	0.38
Sodium Adsorption Ratio (SAR)		Unknown	3	11.1	13	12.07	0.95
Sulfate	3000	mg/l	10	860	965	905.50	32.24
Temperature		Deg C	10	11.8	21.7	15.12	2.84
Total Anion/Cation Balance		%	10	0.07	2.78	1.38	1.01
Total Dissolved Solids	5000	mg/l	10	1980	2270	2098.00	88.79
Total Dissolved Solids (103)		mg/l	7	2000	2140	2074.29	53.50
Total Dissolved Solids (calc)		mg/l	7	2060	2170	2092.86	39.46
Zinc, dissolved	25	mg/l	10	<0.01	0.02	*	*

Well: OWS-09 Date Range: 6/27/2001-8/30/2017

Parameter	Class III Standard	Units	#	Min	Max	Avg	Std Dev
Acidity		mg/l	51	<1	<5	*	*
Acidity, Total (As CaCO3)		mg/l	3	<5	<5	*	*
Alkalinity (as CaCO3)		mg/l	60	688	1080	832.52	100.22
Alkalinity, Hydroxide		mg/l	53	<1	<5	*	*
Aluminum, dissolved	5	mg/l	60	<0.1	0.6	*	*
Ammonia		mg/l	60	<0.05	5.12	*	*
Anion Sum		meq/L	60	45.64	70.33	56.80	6.06
Arsenic, dissolved	0.2	mg/l	60	<0.005	0.006	*	*
Barium, dissolved		mg/l	60	<0.5	<0.5	*	*
Bicarbonate		mg/l	60	839	1320	1015.70	122.63
Boron, dissolved	5	mg/l	60	0.07	0.26	0.15	0.04
Cadmium, dissolved	0.05	mg/l	60	<0.002	<0.002	*	*
Calcium		mg/l	60	262	428	356.10	44.43
Carbonate		mg/l	56	<1	<5	*	*
Cation Sum		meq/L	60	44.29	66.61	54.67	5.61
Chloride	2000	mg/l	60	39.2	114	58.11	11.74
Chromium, dissolved	0.05	mg/l	60	<0.01	<0.01	*	*
Copper, dissolved	0.5	mg/l	60	<0.01	0.04	*	*
Depth to Water		ft	25	59.72	76.08	68.25	5.79
Field Alkalinity		mg/l	25	1000	2460	1585.60	454.74
Field Conductivity		umhos/cm	59	2570	4690	3903.93	509.91
Field pH		s.u.	59	5.7	7.1	6.46	0.22
Fluoride		mg/l	60	0.1	0.7	0.21	0.07
Hardness (as CaCO3)		mg/l	60	1240	2060	1641.33	201.58
Hydroxide as OH		mg/l	3	<5	<5	*	*
Iron, dissolved		mg/l	60	0.48	5.94	1.63	0.66
Laboratory conductivity		umhos/cm	60	3150	5310	4123.17	395.42
Laboratory pH		s.u.	60	6.7	8.1	7.44	0.28
Lead, dissolved	0.1	mg/l	60	<0.02	<0.02	*	*
Magnesium		mg/l	60	128	240	182.55	23.05
Manganese, dissolved	0.0005	mg/l	60	0.03	0.21	0.11	0.03
Mercury, dissolved		mg/l	60	<0.001	<0.001	*	*
Molybdenum, dissolved		mg/l	60	<0.02	<0.02	*	*
Nickel, dissolved		mg/l	60	<0.01	0.03	*	*
Nitrate/Nitrite	100	mg/l	48	<0.01	0.45	*	*
Nitrite	10	mg/l	60	<0.01	1.9	*	*
Phosphorus		mg/l	57	<0.05	<0.1	*	*
Phosphorus, Orthophosphate as P		mg/l	3	<0.1	<0.1	*	*
Potassium		mg/l	60	23.1	64	49.75	9.40
Pumping Rate		gal/minute	5	3	4	3.80	0.45
Selenium, dissolved	0.05	mg/l	60	<0.005	0.015	*	*
Silicon		mg/l	60	6.05	9.9	8.27	0.61
Sodium		mg/l	60	404	557	472.90	40.20
Sodium Adsorption Ratio (SAR)		Other	3	5.42	5.51	5.45	0.05
Sodium Adsorption Ratio (SAR)		Unknown	57	4.4	6	5.07	0.32
Sulfate	3000	mg/l	60	1460	2300	1848.67	207.53
Temperature		Deg C	59	7.6	23.7	18.75	2.61
Total Anion/Cation Balance		%	60	0.02	5.02	2.19	1.52
Total Dissolved Solids	5000	mg/l	60	2770	4260	3467.00	362.45
Total Dissolved Solids (103)		mg/l	3	3720	4320	3926.67	340.78
Total Dissolved Solids (calc)		mg/l	3	3690	3910	3780.00	115.33
Zinc, dissolved	25	mg/l	60	<0.01	0.11	*	*

Well: OWS-10 Date Range: 6/19/2001-12/17/2018

Parameter	Class III Standard	Units	#	Min	Max	Avg	Std Dev
Acidity		mg/l	51	<1	<5	*	*
Acidity, Total (As CaCO3)		mg/l	6	<5	<5	*	*
Alkalinity (as CaCO3)		mg/l	63	655	1400	784.75	176.71
Alkalinity, Hydroxide		mg/l	53	<1	<5	*	*
Aluminum, dissolved	5	mg/l	63	<0.1	1.2	*	*
Ammonia		mg/l	63	<0.05	2.1	*	*
Anion Sum		meq/L	63	29.78	184.99	58.23	38.12
Arsenic, dissolved	0.2	mg/l	63	<0.005	0.008	*	*
Barium, dissolved		mg/l	63	<0.5	<0.5	*	*
Bicarbonate		mg/l	63	800	1710	957.65	215.73
Boron, dissolved	5	mg/l	63	0.07	0.74	0.19	0.11
Cadmium, dissolved	0.05	mg/l	63	<0.002	<0.002	*	*
Calcium		mg/l	63	112	551	232.41	126.68
Carbonate		mg/l	59	<1	<5	*	*
Cation Sum		meq/L	63	29.45	184.19	57.62	38.15
Chloride	2000	mg/l	63	37.3	264	92.15	48.73
Chromium, dissolved	0.05	mg/l	63	<0.01	<0.01	*	*
Copper, dissolved	0.5	mg/l	63	<0.01	0.05	*	*
Depth to Water		ft	27	63.05	93.35	78.66	11.17
Field Alkalinity		mg/l	25	860	1940	1414.40	383.56
Field Conductivity		umhos/cm	63	2190	11680	4146.63	2291.35
Field pH		s.u.	63	5.9	7.6	6.57	0.27
Fluoride		mg/l	63	0.11	1.9	0.55	0.45
Hardness (as CaCO3)		mg/l	63	594	4730	1397.30	1107.32
Hydroxide as OH		mg/l	6	<5	<5	*	*
Iron, dissolved		mg/l	63	<0.05	11.7	*	*
Laboratory conductivity		umhos/cm	63	2540	11200	4267.46	2159.78
Laboratory pH		s.u.	63	6.5	8	7.47	0.34
Lead, dissolved	0.1	mg/l	63	<0.02	<0.02	*	*
Magnesium		mg/l	63	65.9	824	198.57	194.21
Manganese, dissolved	0.0005	mg/l	63	<0.02	1.38	*	*
Mercury, dissolved		mg/l	63	<0.001	<0.001	*	*
Molybdenum, dissolved		mg/l	63	<0.02	<0.02	*	*
Nickel, dissolved		mg/l	63	<0.01	0.07	*	*
Nitrate/Nitrite	100	mg/l	51	<0.01	0.27	*	*
Nitrite	10	mg/l	63	<0.01	0.6	*	*
Phosphorus		mg/l	57	<0.05	<0.1	*	*
Phosphorus, Orthophosphate as P		mg/l	6	<0.1	<0.1	*	*
Potassium		mg/l	63	14	252	28.74	29.59
Pumping Rate		gal/minute	5	3	4	3.80	0.45
Selenium, dissolved	0.05	mg/l	63	<0.005	0.008	*	*
Silicon		mg/l	63	3.1	40.9	7.57	4.35
Sodium		mg/l	63	357	2030	664.16	371.29
Sodium Adsorption Ratio (SAR)		Other	6	8.85	12.8	11.18	1.57
Sodium Adsorption Ratio (SAR)		Unknown	57	6	9.6	7.54	0.76
Sulfate	3000	mg/l	63	676	7240	1917.13	1605.93
Temperature		Deg C	63	7.6	24.8	16.24	2.65
Total Anion/Cation Balance		%	63	0.01	4.82	1.73	1.32
Total Dissolved Solids	5000	mg/l	63	1750	12900	3693.97	2695.27
Total Dissolved Solids (103)		mg/l	6	6730	13100	11071.67	2468.69
Temperature		Deg C	6	6210	11700	9755.00	2085.68
Total Anion/Cation Balance		%	63	<0.01	0.13	*	*
Total Dissolved Solids	5000	mg/l	51	<1	<5	*	*
Total Dissolved Solids (103)		mg/l	6	<5	<5	*	*
Total Dissolved Solids (calc)		mg/l	63	655	1400	784.75	176.71
Zinc, dissolved	25	mg/l	53	<1	<5	*	*

Well: OWS-12 Date Range: 6/19/2001-12/17/2018

Parameter	Class III Standard	Units	#	Min	Max	Avg	Std Dev
Acidity		mg/l	51	<1	<5	*	*
Acidity, Total (As CaCO3)		mg/l	8	<5	<5	*	*
Alkalinity (as CaCO3)		mg/l	65	850	1120	1010.49	50.08
Alkalinity, Hydroxide		mg/l	53	<1	<5	*	*
Aluminum, dissolved	5	mg/l	65	<0.1	1.9	*	*
Ammonia		mg/l	65	<0.05	3	*	*
Anion Sum		meq/L	65	66.87	94.95	83.50	5.97
Arsenic, dissolved	0.2	mg/l	65	<0.005	0.009	*	*
Barium, dissolved		mg/l	65	<0.5	<0.5	*	*
Bicarbonate		mg/l	65	1040	1360	1232.15	60.76
Boron, dissolved	5	mg/l	65	0.34	0.86	0.57	0.13
Cadmium, dissolved	0.05	mg/l	65	<0.002	<0.002	*	*
Calcium		mg/l	65	329	696	554.72	56.46
Carbonate		mg/l	61	<1	<5	*	*
Cation Sum		meq/L	65	63.68	100.77	80.18	6.35
Chloride	2000	mg/l	65	<1	273	*	*
Chromium, dissolved	0.05	mg/l	65	<0.01	0.03	*	*
Copper, dissolved	0.5	mg/l	65	<0.01	0.05	*	*
Depth to Water		ft	29	17.24	99.17	95.26	15.02
Field Alkalinity		mg/l	23	1220	2840	2050.43	466.12
Field Conductivity		umhos/cm	65	2490	6960	5248.74	778.42
Field pH		s.u.	65	6.2	7.5	6.80	0.27
Fluoride		mg/l	65	0.8	1.72	1.26	0.20
Hardness (as CaCO3)		mg/l	65	2100	3410	2768.15	220.13
Hydroxide as OH		mg/l	8	<5	<5	*	*
Iron, dissolved		mg/l	65	0.07	7.87	1.31	1.18
Laboratory conductivity		umhos/cm	65	3680	6430	5534.77	504.37
Laboratory pH		s.u.	65	7	8.1	7.67	0.19
Lead, dissolved	0.1	mg/l	65	<0.02	<0.02	*	*
Magnesium		mg/l	65	239	406	336.42	40.77
Manganese, dissolved	0.0005	mg/l	65	0.31	1.94	1.00	0.28
Mercury, dissolved		mg/l	65	<0.001	<0.001	*	*
Molybdenum, dissolved		mg/l	65	<0.02	<0.02	*	*
Nickel, dissolved		mg/l	65	<0.01	0.1	*	*
Nitrate/Nitrite	100	mg/l	55	<0.01	1.64	*	*
Nitrite	10	mg/l	65	<0.01	0.6	*	*
Phosphorus		mg/l	57	<0.05	<0.1	*	*
Phosphorus, Orthophosphate as P		mg/l	8	<0.1	<0.1	*	*
Potassium		mg/l	65	12	29	20.58	3.69
Pumping Rate		gal/minute	5	0.5	1	0.80	0.27
Selenium, dissolved	0.05	mg/l	65	<0.005	0.033	*	*
Silicon		mg/l	65	5.7	70.4	10.21	7.64
Sodium		mg/l	65	378	827	558.42	72.59
Sodium Adsorption Ratio (SAR)		Other	8	4.03	7.85	4.67	1.29
Sodium Adsorption Ratio (SAR)		Unknown	57	3.2	5.5	4.61	0.45
Sulfate	3000	mg/l	65	2180	3380	2849.23	246.14
Temperature		Deg C	65	7	22.7	15.74	3.15
Total Anion/Cation Balance		%	65	0.02	5.77	2.46	1.65
Total Dissolved Solids	5000	mg/l	65	4290	5820	5123.69	369.77
Total Dissolved Solids (103)		mg/l	8	5280	6080	5603.75	270.55
Total Dissolved Solids (calc)		mg/l	8	3980	5130	4907.50	379.99
Zinc, dissolved	25	mg/l	65	<0.01	0.09	*	*

Well: OWS-14 Date Range: 3/22/2012-12/17/2018

Parameter	Class III Standard	Units	#	Min	Max	Avg	Std Dev
Acidity		mg/l	18	<5	<5	*	*
Acidity, Total (As CaCO3)		mg/l	8	<5	<5	*	*
Alkalinity (as CaCO3)		mg/l	26	654	956	799.08	89.09
Alkalinity, Hydroxide		mg/l	18	<5	<5	*	*
Aluminum, dissolved	5	mg/l	26	<0.1	<0.1	*	*
Ammonia		mg/l	26	0.5	1.2	0.87	0.23
Anion Sum		meq/L	26	24.92	52.97	36.12	9.08
Arsenic, dissolved	0.2	mg/l	26	<0.005	0.013	*	*
Barium, dissolved		mg/l	26	<0.5	<0.5	*	*
Bicarbonate		mg/l	26	798	1170	975.15	109.17
Boron, dissolved	5	mg/l	25	0.06	0.13	0.09	0.02
Cadmium, dissolved	0.05	mg/l	25	<0.002	<0.002	*	*
Calcium		mg/l	26	117	301	181.12	59.50
Carbonate		mg/l	26	<5	<5	*	*
Cation Sum		meq/L	26	26.58	51.56	35.61	8.09
Chloride	2000	mg/l	26	22	59	32.58	10.39
Chromium, dissolved	0.05	mg/l	25	<0.01	<0.01	*	*
Copper, dissolved	0.5	mg/l	25	<0.01	<0.01	*	*
Depth to Water		ft	24	135.41	140.46	137.64	1.52
Field Conductivity		umhos/cm	26	1860	3880	2718.42	620.21
Field pH		s.u.	26	6.5	7.16	6.83	0.16
Fluoride		mg/l	26	0.7	1.4	1.04	0.21
Hardness (as CaCO3)		mg/l	26	561	1370	860.35	262.91
Hydroxide as OH		mg/l	8	<5	<5	*	*
Iron, dissolved		mg/l	25	<0.05	8.3	*	*
Laboratory conductivity		umhos/cm	26	2070	3870	2820.00	583.20
Laboratory pH		s.u.	26	7.6	8.2	7.90	0.14
Lead, dissolved	0.1	mg/l	25	<0.02	<0.02	*	*
Magnesium		mg/l	26	66	151	99.27	27.90
Manganese, dissolved	0.0005	mg/l	25	0.13	1.29	0.45	0.34
Mercury, dissolved		mg/l	25	<0.001	<0.001	*	*
Molybdenum, dissolved		mg/l	25	<0.02	<0.02	*	*
Nickel, dissolved		mg/l	25	<0.01	<0.01	*	*
Nitrate/Nitrite	100	mg/l	26	<0.1	<0.1	*	*
Nitrite	10	mg/l	26	<0.1	<0.1	*	*
Phosphorus		mg/l	18	<0.1	<0.1	*	*
Phosphorus, Orthophosphate as P		mg/l	8	<0.1	<0.1	*	*
Potassium		mg/l	26	18	31	23.88	3.72
Selenium, dissolved	0.05	mg/l	25	<0.005	<0.005	*	*
Silicon		mg/l	25	7.2	10.1	8.85	0.56
Sodium		mg/l	26	333	535	407.96	63.25
Sodium Adsorption Ratio (SAR)		Other	8	5.94	6.32	6.14	0.13
Sodium Adsorption Ratio (SAR)		Unknown	18	5.9	6.45	6.09	0.17
Sulfate	3000	mg/l	26	534	1550	920.12	342.52
Temperature		Deg C	26	10	17.4	15.60	1.40
Total Anion/Cation Balance		%	26	0.06	4.33	1.84	1.37
Total Dissolved Solids	5000	mg/l	26	1500	3330	2123.08	551.60
Total Dissolved Solids (103)		mg/l	8	2340	3430	2863.75	406.02
Total Dissolved Solids (calc)		mg/l	8	2480	3170	2847.50	264.67
Zinc, dissolved	25	mg/l	25	<0.01	0.05	*	*

Well: OWS-15 Date Range: 3/22/2012-12/17/2018

Parameter	Class III Standard	Units	#	Min	Max	Avg	Std Dev
Acidity		mg/l	18	<5	<5	*	*
Acidity, Total (As CaCO3)		mg/l	8	<5	<5	*	*
Alkalinity (as CaCO3)		mg/l	26	1050	1410	1281.15	89.14
Alkalinity, Hydroxide		mg/l	18	<5	<5	*	*
Aluminum, dissolved	5	mg/l	26	<0.1	0.4	*	*
Ammonia		mg/l	26	4.1	9.8	5.75	1.08
Anion Sum		meq/L	26	50.44	80.25	69.86	8.12
Arsenic, dissolved	0.2	mg/l	26	<0.005	<0.005	*	*
Barium, dissolved		mg/l	26	<0.5	<0.5	*	*
Bicarbonate		mg/l	26	1280	1720	1563.08	109.32
Boron, dissolved	5	mg/l	26	0.03	0.44	0.10	0.09
Cadmium, dissolved	0.05	mg/l	26	<0.002	<0.002	*	*
Calcium		mg/l	26	299	525	429.42	62.40
Carbonate		mg/l	26	<5	<5	*	*
Cation Sum		meq/L	26	52.49	78.98	67.37	7.48
Chloride	2000	mg/l	26	24	92	47.38	11.11
Chromium, dissolved	0.05	mg/l	26	<0.01	0.03	*	*
Copper, dissolved	0.5	mg/l	26	<0.01	<0.01	*	*
Depth to Water		ft	24	181.93	184.8	183.73	0.84
Field Conductivity		umhos/cm	26	3000	5930	4918.23	622.72
Field pH		s.u.	26	6.2	7.4	6.94	0.27
Fluoride		mg/l	26	0.5	1.1	0.62	0.10
Hardness (as CaCO3)		mg/l	26	1390	2840	2025.00	321.74
Hydroxide as OH		mg/l	8	<5	<5	*	*
Iron, dissolved		mg/l	26	<0.05	9.96	*	*
Laboratory conductivity		umhos/cm	26	3500	5800	4841.92	635.31
Laboratory pH		s.u.	26	7.6	8.1	7.82	0.13
Lead, dissolved	0.1	mg/l	26	<0.02	<0.02	*	*
Magnesium		mg/l	26	155	372	231.96	44.24
Manganese, dissolved	0.0005	mg/l	26	0.43	1.35	0.78	0.23
Mercury, dissolved		mg/l	26	<0.001	<0.001	*	*
Molybdenum, dissolved		mg/l	26	<0.02	<0.02	*	*
Nickel, dissolved		mg/l	26	<0.01	0.02	*	*
Nitrate/Nitrite	100	mg/l	26	<0.1	<0.1	*	*
Nitrite	10	mg/l	26	<0.1	<0.1	*	*
Phosphorus		mg/l	18	<0.1	<0.1	*	*
Phosphorus, Orthophosphate as P		mg/l	8	<0.1	<0.1	*	*
Potassium		mg/l	26	15	60	45.35	8.83
Selenium, dissolved	0.05	mg/l	26	<0.005	0.089	*	*
Silicon		mg/l	26	6.1	8.9	7.53	0.77
Sodium		mg/l	26	491	683	582.62	48.28
Sodium Adsorption Ratio (SAR)		Other	8	4	6.21	5.50	0.68
Sodium Adsorption Ratio (SAR)		Unknown	18	4.9	6.4	5.75	0.42
Sulfate	3000	mg/l	26	1300	2480	2058.85	321.26
Temperature		Deg C	26	9.7	23.4	16.04	3.31
Total Anion/Cation Balance		%	26	0.21	6.08	2.71	1.50
Total Dissolved Solids	5000	mg/l	26	3050	4930	4098.85	469.90
Total Dissolved Solids (103)		mg/l	8	4140	5100	4535.00	331.06
Temperature		Deg C	8	4360	4700	4547.50	115.48
Total Anion/Cation Balance		%	26	<0.01	0.02	*	*
Total Dissolved Solids	5000	mg/l	18	<5	<5	*	*
Total Dissolved Solids (103)		mg/l	8	<5	<5	*	*
Total Dissolved Solids (calc)		mg/l	26	1050	1410	1281.15	89.14
Zinc, dissolved	25	mg/l	18	<5	<5	*	*

Well: OWS-18 Date Range: 4/12/2016-12/17/2018

Parameter	Class III Standard	Units	#	Min	Max	Avg	Std Dev
Acidity		mg/l	3	<5	<5	*	*
Acidity, Total (As CaCO3)		mg/l	8	<5	<5	*	*
Alkalinity (as CaCO3)		mg/l	11	846	894	860.73	16.82
Alkalinity, Hydroxide		mg/l	3	<5	<5	*	*
Aluminum, dissolved	5	mg/l	11	<0.1	0.2	*	*
Ammonia		mg/l	11	1.6	1.8	1.72	0.06
Anion Sum		meq/L	11	17.53	18.47	17.82	0.32
Arsenic, dissolved	0.2	mg/l	11	<0.005	<0.005	*	*
Barium, dissolved		mg/l	11	0.7	1	0.84	0.11
Bicarbonate		mg/l	11	1030	1090	1049.09	21.19
Boron, dissolved	5	mg/l	11	0.04	0.08	0.06	0.01
Cadmium, dissolved	0.05	mg/l	11	<0.002	<0.002	*	*
Calcium		mg/l	11	48	50	49.18	0.60
Carbonate		mg/l	11	<5	6	*	*
Cation Sum		meq/L	11	17.43	17.96	17.70	0.21
Chloride	2000	mg/l	11	19	21	19.64	0.81
Chromium, dissolved	0.05	mg/l	11	<0.01	<0.01	*	*
Copper, dissolved	0.5	mg/l	11	<0.01	<0.01	*	*
Depth to Water		ft	11	154.08	155.96	155.19	0.63
Field Conductivity		umhos/cm	11	1172	1500	1425.73	91.55
Field pH		s.u.	11	6.9	7.4	7.06	0.13
Fluoride		mg/l	11	0.9	1.1	0.99	0.05
Hardness (as CaCO3)		mg/l	11	230	244	235.09	4.13
Hydroxide as OH		mg/l	8	<5	<5	*	*
Iron, dissolved		mg/l	11	0.62	1.02	0.70	0.11
Laboratory conductivity		umhos/cm	11	1230	1540	1452.73	91.11
Laboratory pH		s.u.	11	8.1	8.3	8.16	0.07
Lead, dissolved	0.1	mg/l	11	<0.02	<0.02	*	*
Magnesium		mg/l	11	27	29	27.45	0.82
Manganese, dissolved	0.0005	mg/l	11	<0.02	0.06	*	*
Mercury, dissolved		mg/l	11	<0.001	<0.001	*	*
Molybdenum, dissolved		mg/l	11	<0.02	<0.02	*	*
Nickel, dissolved		mg/l	11	<0.01	0.04	*	*
Nitrate/Nitrite	100	mg/l	11	<0.1	0.2	*	*
Nitrite	10	mg/l	11	<0.1	0.2	*	*
Phosphorus		mg/l	3	<0.1	<0.1	*	*
Phosphorus, Orthophosphate as P		mg/l	8	<0.1	<0.1	*	*
Potassium		mg/l	11	14	27	15.73	3.80
Selenium, dissolved	0.05	mg/l	11	<0.005	<0.005	*	*
Silicon		mg/l	11	4.5	5.8	4.84	0.39
Sodium		mg/l	11	280	294	287.09	5.50
Sodium Adsorption Ratio (SAR)		Other	8	7.91	8.42	8.21	0.18
Sodium Adsorption Ratio (SAR)		Unknown	3	7.86	8.03	7.96	0.09
Sulfate	3000	mg/l	11	<1	2	*	*
Temperature		Deg C	11	14.7	16.2	15.23	0.45
Total Anion/Cation Balance		%	11	0.15	2.77	0.84	0.79
Total Dissolved Solids	5000	mg/l	11	790	950	887.27	51.79
Total Dissolved Solids (103)		mg/l	8	800	950	886.25	54.23
Total Dissolved Solids (calc)		mg/l	8	900	940	917.50	11.65
Zinc, dissolved	25	mg/l	11	<0.01	0.02	*	*

APPENDIX H

ANTELOPE MINE SPECIAL STATUS SPECIES SUMMARY TABLES
FOR FEDERAL LEASE MODIFICATION APPROVAL - WYW177903

Vertebrate Species of Special Interest Associated with the Antelope Mine Project Area

	Common Name	Scientific Name	Status Under the ESA	Protected Under the MBTA	Listed as a BLM Sensitive Species	Listed as a WYNDD SOC	WGFD SGCN			Observed in the Area
							SGCN	NNS	Tier	
Amphibian	Western Tiger Salamander	Ambystoma mavortium					Y	NSS4(Bc)	III	
Amphibian	Great Plains Toad	Anaxyrus cognatus					Y	NSSU(U)	II	
Amphibian	Northern Leopard Frog	Lithobates pipiens	NW		Y	Y	Y	NSS4(Bc)	II	
Amphibian	Plains Spadefoot	Spea bombifrons				Y	Y	NSS4(Bc)	II	
Bird	Common Redpoll	Acanthis flammea		Y						
Bird	Cooper's Hawk	Accipiter cooperii		Y						
Bird	Sharp-shinned Hawk	Accipiter striatus		Y						
Bird	Spotted Sandpiper	Actitis macularius		Y						
Bird	Western Grebe	Aechmophorus occidentalis		Y			Y	NSSU(U)	II	
Bird	White-throated Swift	Aeronautes saxatalis		Y						
Bird	Red-winged Blackbird	Agelaius phoeniceus		Y						
Bird	Grasshopper Sparrow	Ammodramus savannarum		Y			Y	NSS4(Bc)	II	
Bird	Northern Pintail	Anas acuta		Y						
Bird	Green-winged Teal	Anas crecca		Y						
Bird	Mallard	Anas platyrhynchos		Y						
Bird	Golden Eagle	Aquila chrysaetos		Y			Y	NSS4(Bc)	II	
Bird	Great Blue Heron	Ardea herodias		Y			Y	NSS4(Bc)	II	
Bird	Short-eared Owl	Asio flammeus		Y		Y	Y	NSS4(Bc)	II	
Bird	Long-eared Owl	Asio otus		Y						
Bird	Burrowing Owl	Athene cunicularia		Y	Y	Y	Y	NSSU(U)	I	
Bird	Lesser Scaup	Aythya affinis		Y						
Bird	Redhead	Aythya americana		Y						
Bird	Upland Sandpiper	Bartramia longicauda		Y			Y	NSSU(U)	II	
Bird	Cedar Waxwing	Bombycilla cedrorum		Y						
Bird	Bohemian Waxwing	Bombycilla garrulus		Y						
Bird	Canada Goose	Branta canadensis		Y						
Bird	Cackling Goose	Branta hutchinsii		Y						
Bird	Great Horned Owl	Bubo virginianus		Y						
Bird	Red-tailed Hawk	Buteo jamaicensis		Y						
Bird	Rough-legged Hawk	Buteo lagopus		Y						
Bird	Ferruginous Hawk	Buteo regalis	NW	Y	Y	Y	Y	NSS4(Cb)	II	
Bird	Swainson's Hawk	Buteo swainsoni		Y			Y	NSSU(U)	II	
Bird	Lark Bunting	Calamospiza melanocorys		Y						
Bird	Lapland Longspur	Calcarius lapponicus		Y						
Bird	Chestnut-collared Longspur	Calcarius ornatus		Y		Y	Y	NSS4(Bc)	II	
Bird	Turkey Vulture	Cathartes aura		Y						
Bird	Greater Sage-Grouse	Centrocercus urophasianus	NW		Y	Y	Y	NSS4(Bc)	II	
Bird	Mountain Plover	Charadrius montanus	NW	Y	Y	Y	Y	NSSU(U)	I	
Bird	Killdeer	Charadrius vociferus		Y						
Bird	Lark Sparrow	Chondestes grammacus		Y						
Bird	Common Nighthawk	Chordeiles minor		Y			Y	NSS4(Bc)	III	
Bird	Northern Flicker	Colaptes auratus		Y						
Bird	Western Wood-Pewee	Contopus sordidulus		Y						

	Common Name	Scientific Name	Status Under the ESA	Protected Under the MBTA	Listed as a BLM Sensitive Species	Listed as a WYNDD SOC	WGFD SGCN			Observed in the Area
							SGCN	NNS	Tier	
Bird	American Crow	Corvus brachyrhynchos		Y						
Bird	Common Raven	Corvus corax		Y						
Bird	Blue Jay	Cyanocitta cristata		Y						
Bird	Bobolink	Dolichonyx oryzivorus		Y		Y	Y	NSS4(Bc)	II	
Bird	Cordilleran Flycatcher	Empidonax occidentalis		Y						
Bird	Willow Flycatcher	Empidonax traillii		Y			Y	NSS3(Bb)	III	
Bird	Brewer's Blackbird	Euphagus cyanocephalus		Y						
Bird	Prairie Falcon	Falco mexicanus		Y						
Bird	American Kestrel	Falco sparverius		Y			Y	NSS4(Bc)	III	
Bird	American Coot	Fulica americana		Y						
Bird	Wilson's Snipe	Gallinago delicata		Y						
Bird	MacGillivray's Warbler	Geothlypis tolmiei		Y			Y	NSS4(Bc)	II	
Bird	Common Yellowthroat	Geothlypis trichas		Y			Y	NSS4(Bc)	III	
Bird	Pinyon Jay	Gymnorhinus cyanocephalus		Y						
Bird	House Finch	Haemorhous mexicanus		Y						
Bird	Bald Eagle	Haliaeetus leucocephalus	DM	Y	Y	Y	Y	NSS3(Bb)	II	
Bird	Barn Swallow	Hirundo rustica		Y						
Bird	Dark-eyed Junco	Junco hyemalis		Y		Y				
Bird	Loggerhead Shrike	Lanius ludovicianus		Y	Y	Y	Y	NSS4(Bc)	II	
Bird	California Gull	Larus californicus		Y						
Bird	Ring-billed Gull	Larus delawarensis		Y						
Bird	Belted Kingfisher	Megaceryle alcyon		Y						
Bird	Red-headed Woodpecker	Melanerpes erythrocephalus		Y			Y	NSS4(Bc)	II	
Bird	Lewis's Woodpecker	Melanerpes lewis		Y		Y	Y	NSSU(U)	II	
Bird	Song Sparrow	Melospiza melodia		Y						
Bird	Northern Mockingbird	Mimus polyglottos		Y						
Bird	Brown-headed Cowbird	Molothrus ater		Y						
Bird	Long-billed Curlew	Numenius americanus		Y	Y	Y	Y	NSS3(Bb)	II	
Bird	Sage Thrasher	Oreoscoptes montanus		Y	Y		Y	NSS4(Bc)	II	
Bird	Ruddy Duck	Oxyura jamaicensis		Y						
Bird	Osprey	Pandion haliaetus		Y						
Bird	Savannah Sparrow	Passerculus sandwichensis		Y						
Bird	Lazuli Bunting	Passerina amoena		Y						
Bird	Cliff Swallow	Petrochelidon pyrrhonota		Y						
Bird	Common Poorwill	Phalaenoptilus nuttallii		Y						
Bird	Wilson's Phalarope	Phalaropus tricolor		Y						
Bird	Black-headed Grosbeak	Pheucticus melanocephalus		Y						
Bird	Black-billed Magpie	Pica hudsonia		Y						
Bird	Green-tailed Towhee	Pipilo chlorurus		Y						
Bird	Spotted Towhee	Pipilo maculatus		Y						
Bird	Snow Bunting	Plectrophenax nivalis		Y						
Bird	White-faced Ibis	Plegadis chihi		Y	Y	Y	Y	NSS3(Bb)	II	

	Common Name	Scientific Name	Status Under the ESA	Protected Under the MBTA	Listed as a BLM Sensitive Species	Listed as a WYNDD SOC	WGFD SGCN			Observed in the Area
							SGCN	NNS	Tier	
Bird	Eared Grebe	Podiceps nigricollis		Y						
Bird	Pied-billed Grebe	Podilymbus podiceps		Y						
Bird	Black-capped Chickadee	Poecile atricapillus		Y						
Bird	Sora	Porzana carolina		Y						
Bird	Common Grackle	Quiscalus quiscula		Y						
Bird	American Avocet	Recurvirostra americana		Y						
Bird	McCown's Longspur	Rhynchophanes mccownii		Y		Y	Y	NSS4(Bc)	II	
Bird	Bank Swallow	Riparia riparia		Y						
Bird	Rock Wren	Salpinctes obsoletus		Y						
Bird	Say's Phoebe	Sayornis saya		Y						
Bird	Yellow Warbler	Setophaga petechia		Y						
Bird	Mountain Bluebird	Sialia currucoides		Y						
Bird	American Goldfinch	Spinus tristis		Y						
Bird	Brewer's Sparrow	Spizella breweri		Y	Y		Y	NSS4(Bc)	II	
Bird	Clay-colored Sparrow	Spizella pallida		Y						
Bird	Chipping Sparrow	Spizella passerina		Y						
Bird	Field Sparrow	Spizella pusilla		Y						
Bird	Northern Rough-winged Swallow	Stelgidopteryx serripennis		Y						
Bird	Western Meadowlark	Sturnella neglecta		Y						
Bird	Violet-green Swallow	Tachycineta thalassina		Y						
Bird	Brown Thrasher	Toxostoma rufum		Y						
Bird	Willet	Tringa semipalmata		Y						
Bird	House Wren	Troglodytes aedon		Y						
Bird	American Robin	Turdus migratorius		Y						
Bird	Eastern Kingbird	Tyrannus tyrannus		Y						
Bird	Western Kingbird	Tyrannus verticalis		Y						
Bird	Yellow-headed Blackbird	Xanthocephalus xanthocephalus		Y						
Bird	Mourning Dove	Zenaida macroura		Y						
Bird	American Tree Sparrow	Spizelloides arborea		Y						
Bird	Sandhill Crane	Antigone canadensis		Y						
Bird	Northern Harrier	Circus hudsonius		Y						
Bird	American Wigeon	Mareca americana		Y						
Bird	Gadwall	Mareca strepera		Y						
Bird	Northern Shoveler	Spatula clypeata		Y						
Bird	Cinnamon Teal	Spatula cyanoptera		Y						
Bird	Blue-winged Teal	Spatula discors		Y						
Bird	Northern Shrike	Lanius borealis		Y						
Bird	Baird's Sparrow	Centronyx bairdii	NW	Y	Y	Y	Y	NSS4(Bc)	II	
Mammal	Black-tailed Prairie Dog	Cynomys ludovicianus	NW		Y	Y	Y	NSS4(Cb)	II	
Mammal	Thirteen-lined Ground Squirrel	Ictidomys tridecemlineatus				Y				
Mammal	Eastern Red Bat	Lasiurus borealis					Y	NSS4(Bc)	III	
Mammal	Bobcat	Lynx rufus	NW							
Mammal	Western Small-footed Myotis	Myotis ciliolabrum					Y	NSS4(Cb)	II	
Mammal	Little Brown Myotis	Myotis lucifugus	UR				Y	NSS3(Bb)	II	

	Common Name	Scientific Name	Status Under the ESA	Protected Under the MBTA	Listed as a BLM Sensitive Species	Listed as a WYNDD SOC	WGFD SGCN			Observed in the Area
							SGCN	NNS	Tier	
Mammal	Silky Pocket Mouse	Perognathus flavus					Y	NSSU(U)	III	
Mammal	Swift Fox	Vulpes velox	NW		Y	Y	Y	NSS4(Cb)	II	
Reptile	Prairie Rattlesnake	Crotalus viridis					Y	NSS4(Bc)	III	
Reptile	Plains Hog-nosed Snake	Heterodon nasicus					Y	NSSU(U)	II	
Reptile	Plains Gartersnake	Thamnophis radix					Y	NSSU(U)	III	
Reptile	Eastern Spiny Softshell	Apalone spinifera spinifera					Y	NSS2(Ba)	II	
Reptile	Western Painted Turtle	Chrysemys picta bellii					Y	NSS4(Bc)	III	

USWS: ESA – status as a T&E species: NW-not warranted for listing, DM-delisted, UR-petition for listing under review
BCC – status as a USFWS bird of conservation concern
MBTA – protected under the Migratory Birds Treaty Act
BLM: Listed as a sensitive species by BLM
WYNDD: Determined to be a species of concern
WGFD: SGCN-species of greatest conservation concern, which is based upon the Native Species Status (NSS) classification system
Source: WYNDD 2019, NREX 2019

Species of Special Interest Summary

Amphibians	4
Birds	119
Mammals	8
Retiles	5
Total	136

118	MBTA
14	BLM Sensitive
20	WYNDD SOC
43	WGFD SGCN
43	NSS

Highest Priority[1]	- Tier I	2
Moderate Priority[2]	- Tier II	31
Lowest Priority	- Tier III	10

NSSU	10	NSSU	12	Undetermined
NSS1	0	NSS1	0	Imperiled/Extreme
NSS2	1	NSS2(Ba)	1	Vulnerable/Extreme
NSS3	5	NSS3(Bb)	5	Vulnerable/Severe
NSS4	27	NSS4(Bc)	23	Vulnerable/Moderate
		NSS4(Cb)	4	Stable/Severe

APPENDIX I

REVENUE CALCULATIONS
(Completed by WWC Engineering)

Estimated 2019 Fiscal Revenue from 2018 Coal Production in Campbell Co. (Million U.S. Dollars)

Revenue Source	Total Collected	Federal Revenue	State Revenue
Federal Mineral Royalties	404.8	202.4	202.4
Abandoned Mine Lands Fund	80.7	52.7	28.0
Severance Tax	171.6		171.6
Bonus Bid Annual Revenues	0.0	0.0	0.0
Ad Valorem Tax	146.9		146.9
Black Lung	136.5	136.5	
Sales and Use Tax	16.7		16.7
Totals	957.2	391.6	565.6
$/Ton			**$1.96**

Estimated 2019 Fiscal Revenue from 2018 Coal Production in Converse Co. (Million U.S. Dollars)

Revenue Source	Total Collected	Federal Revenue	State Revenue
Federal Mineral Royalties	7.1	3.6	3.6
Abandoned Mine Lands Fund	1.4	0.7	0.7
Severance Tax	3.5		3.5
Bonus Bid Annual Revenues	0.0	0.0	0.0
Ad Valorem Tax	3.0		3.0
Black Lung	2.4	2.4	
Sales and Use Tax	0.4		0.4
Totals	17.8	6.7	11.1
$/Ton			**$2.19**

Total Future Revenues from Antelope Mine (No Action Alternative) (Million U.S. Dollars)

Revenue Source	Total Collected	Federal Revenue	State Revenue
Federal Mineral Royalties	640.0	320.0	320.0
Abandoned Mine Lands Fund	114.7	57.3	57.3
Severance Tax	267.7		267.7
Bonus Bid Annual Revenues	0.0	0.0	0.0
Ad Valorem Tax[1]	208.67		208.7
Black Lung	17.26	17.3	
Sales and Use Tax[1]	23.7		23.7
Totals	1272.0	394.6	877.4
$/Ton			**$2.14**

Future Revenues added by the West Antelope II South Tract only (Million U.S. Dollars)

Revenue Source	Total Collected	Federal Revenue	State Revenue
Federal Mineral Royalties	22.7	11.3	11.3
Abandoned Mine Lands Fund	4.1	2.0	2.0
Severance Tax	8.6		8.6
Bonus Bid Annual Revenues	0.0	0.0	0.0
Ad Valorem Tax[1]	7.4		7.4
Black Lung	0.6	0.6	
Sales and Use Tax[1]	0.8		0.8
Totals	44.2	14.0	30.2
$/Ton			**$2.08**

Total Future Revenues from Antelope Mine (existing mine plus West Antelope II South tract) (Million U.S. Dollars)

Revenue Source	Total Collected	Federal Revenue	State Revenue
Federal Mineral Royalties	662.7	331.3	331.3
Abandoned Mine Lands Fund	118.7	59.4	59.4
Severance Tax	276.3		276.3
Bonus Bid Annual Revenues	0.0	0.0	0.0
Ad Valorem Tax[1]	216.1		216.1
Black Lung	17.9	17.9	
Sales and Use Tax[1]	24.5		24.5
Totals	1316.2	408.6	907.6
$/Ton			**$2.14**

Difference Between the Antelope Mine No Action Alternative and the Proposed Action (Million U.S. Dollars)

Revenue Source	Total Collected	Federal Revenue	State Revenue
Federal Mineral Royalties	22.7	11.3	11.3
Abandoned Mine Lands Fund	4.1	2.0	2.0
Severance Tax	8.6		8.6
Bonus Bid Annual Revenues	0.0	0.0	0.0
Ad Valorem Tax[1]	7.4		7.4
Black Lung	0.6	0.6	
Sales and Use Tax[1]	0.8		0.8
Totals	44.2	14.0	30.2

Estimated 2022 Campbell Co. Fiscal Revenue (Million U.S. Dollars)

Revenue Source	Total Collected	Federal Revenue	State Revenue
Federal Mineral Royalties	429.623	214.8	214.8
Abandoned Mine Lands Fund	76.989	38.5	38.5
Severance Tax	163.656		163.7
Bonus Bid Annual Revenues	0.000	0.0	0.0
Ad Valorem Tax	140.076		140.1
Black Lung	11.588	11.6	
Sales and Use Tax	15.900		15.9
Totals	837.832	264.9	572.9
$/Ton			**$2.08**

Estimated 2022 Converse Co. Fiscal Revenue (Million U.S. Dollars)

Revenue Source	Total Collected	Federal Revenue	State Revenue
Federal Mineral Royalties	7.544	3.8	3.8
Abandoned Mine Lands Fund	1.352	0.7	0.7
Severance Tax	3.326		3.3
Bonus Bid Annual Revenues	0.000	0.0	0.0
Ad Valorem Tax	2.830		2.8
Black Lung	0.203	0.2	
Sales and Use Tax	0.373		0.4
Totals	15.628	4.7	11.0
$/Ton			**$2.27**

[1] Calculated using Campbell County Rates

All revenues were calculated using variables presented below

Bonus Bid Payments, 2009-2018

Bonus Bids	Lease-Month	Tons	Total Bid	$/Ton	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
WYW155132	Eagle Butte West - May	255,000,000	$180,540,000.00	$0.71	$36,108,000.00	$36,108,000.00	$36,108,000.00	$36,108,000.00						
					$108,324,000.00	$72,216,000.00	$36,108,000.00	$0.00						
WYW174407	South Maysdorf - August	288,100,000	$250,800,000.00	$0.87	$50,160,000.00	$50,160,000.00	$50,160,000.00	$50,160,000.00						
					$150,480,000.00	$100,320,000.00	$50,160,000.00	$0.00						
WYW154432	North Maysdorf - August	54,657,000	$48,098,424.00	$0.88	$9,619,684.80	$9,619,684.80	$9,619,684.80	$9,619,684.80	$9,619,684.80					
					$38,478,739.20	$28,859,054.40	$19,239,369.60	$9,619,684.80	$0.00					
WYW177903	West Antelope South	56,356,000	$49,311,500.00	$0.88			$9,862,300.00	$9,862,300.00	$9,862,300.00					
							$39,449,200.00	$29,586,900.00	$0.00					
WYW163340	West Antelope North	350,263,000	$297,723,228.00	$0.85			$59,544,645.60	$59,544,645.60	$59,544,645.60	$59,544,645.60	$59,544,645.60			
							$238,178,582.40	$178,633,936.80	$119,089,291.20	$59,544,645.60	$0.00			
WYW161248	Belle Ayr North	221,734,800	$210,648,060.00	$0.95			$42,129,612.00	$42,129,612.00	$42,129,612.00	$42,129,612.00	$42,129,612.00			
							$168,518,448.00	$126,388,836.00	$84,259,224.00	$42,129,612.00	$0.00			
WYW172657	Caballo West	130,196,000	$143,417,403.80	$1.10			$28,683,480.76	$28,683,480.76	$28,683,480.76	$28,683,480.76	$28,683,480.76			
							$114,733,923.04	$86,050,442.28	$57,366,961.52	$28,683,480.76	$0.00			
WYW174596	South Hilight	222,676,000	$300,001,011.66	$1.35				$60,000,202.33	$60,000,202.33	$60,000,202.33	$60,000,202.33	$60,000,202.33		
								$240,000,809.33	$180,000,607.00	$120,000,404.66	$60,000,202.33	$0.00		
WYW176095	South Porcupine LBA	401,830,508	$446,031,864.00	$1.11				$89,206,372.80	$89,206,372.80	$89,206,372.80	$89,206,372.80	$89,206,372.80		
								$356,825,491.20	$267,619,118.40	$178,412,745.60	$89,206,372.80	$0.00		
WYW173408	North Porcupine LBA	721,154,828	$793,270,311.00	$1.10				$158,654,062.20	$158,654,062.20	$158,654,062.20	$158,654,062.20	$158,654,062.20		
								$634,616,248.80	$475,962,186.60	$317,308,124.40	$158,654,062.20	$0.00		
Average				**$0.98**	**$95,887,684.80**	**$95,887,684.80**	**$236,107,723.16**	**$543,968,360.49**	**$457,700,360.49**	**$438,218,375.69**	**$438,218,375.69**	**$307,860,637.33**	**$0.00**	**$0.00**

Source: BLM 2019a and 2019b. Bids are paid off in four equal annual payments, after the initial 1/5 amount payment attached to the bid.

Revenue Variables

Coal Surface #	Units of Taxable Valuation	Taxable Valuation	Taxable Valuation Per Unit	Average Tax Levy (Mills)	Estimated Ad Valorem Tax Levied	Average Tax Per Unit	Sev. Tax Rate %	Estimated Severance Tax Collectible	Average Sev. Tax Per Unit
2016 Wyoming	295,805,879	$2,879,630,622	9.73	62.327	$179,478,738	0.6067	0.07	201,574,144	$0.6814
2016 Campbell Co.	270,867,980	$2,458,928,638	9.08	59.468	$146,227,568	0.5398	0.07	172,125,005	$0.6355
2016 Converse Co.	16,316,153	$158,189,068	9.70	58.540	$9,260,388	0.5676	0.07	11,073,235	$0.6787
2017 Wyoming	314,755,317	$2,995,345,054	9.52	62.462	$187,095,243	0.5944	0.07	209,674,154	$0.6661
2017 Campbell Co.	292,994,954	$2,592,159,599	8.85	59.610	$154,518,634	0.5274	0.07	181,451,172	$0.6193
2017 Converse Co.	12,446,197	$115,908,856	9.31	58.411	$6,770,352	0.5440	0.07	8,113,620	$0.6519
2018 Wyoming	301,912,354	$2,773,957,693	9.19	62.683	$173,879,990	0.5759	0.07	194,177,039	$0.6432
2018 Campbell Co.	288,349,463	$2,451,805,435	8.50	59.914	$146,897,471	0.5094	0.07	171,626,380	$0.5952
2018 Converse Co.	5,063,248	$49,822,198	9.84	59.572	$2,968,008	0.5862	0.07	3,487,554	$0.6888

Source: WDOR 2017, 2018a, and 2019

Revenue Calculations Variables

Coal Production (tons)				
		Campbell	Converse	Wyoming
	2018 Tons Produced[1]	288,349,463	5,063,248	304,122,976
	2022 Tons Produced (Estimated)	280,430,000[2]	4,828,119[2]	290,000,000[3]
	West Antelope II South Tract	(tons mineable)		(tons recoverable)
	No Action Alternative	437,200,000		409,600,000
	Added by Proposed Action	15,800,000		14,500,000
	Average 2018 Sales Price ($/ton)			
	2018 Price[4]	$11.23	$11.23	$12.68
	2018 Price without BLT[5]	$10.76	$10.76	$12.13
Federal Royalties				
	WY share of FR = 0.5 x FR			
	Federal Royalties[6]	$404,770,558.69	$7,107,534.38	
	Wyoming Share	$202,385,279.34	$3,553,767.19	
Abandoned Mine Lands Funds[7]				
	AML Total	$80,737,849.64	$1,417,709.44	
	WY Share[8]	$28,000,000.00	$708,854.72	
Severance Taxes[9]				
	ST Rate/Ton	$0.5952	0.6888	
	2018 Severance Taxes	$171,626,380.45	$3,487,553.86	
Lease Bonus Bids (2018 Payments)				
	2018+	$0.00	$0.00	
	Total 2018+ Bonus Bid Payments	$0.00	$0.00	
	WY share	$0.00	$0.00	
Ad Valorem Taxes[9]				
	AVT Rate/ton	$0.51	$0.59	
	AVT (Total)	$146,897,470.83	$2,968,007.98	
Black Lung				
	2018 BLT Rate/Ton[10]	$0.473	$0.473	
	2018 BLT Collected[11]	$136,474,364.61	2,396,410.06	
	Future BLT Rate/Ton[12]	$0.25	$0.25	
	Future BLT Collected[13]	$68,739,745.82	$1,207,029.75	
2018 Campbell and Converse Co. Employment (mining)[14]				
	Buckskin	178		
	Belle Ayr	263		
	Eagle Butte	313		
	Cordero Rojo	320		
	Antelope	575		
	Caballo	174		
	NARM	1,274		
	Rawhide	112		
	Black Thunder	1,176		
	Coal Creek	145		
	Dry Fork	80		
	Wyodak	66		
	Total	4,676		
Federal Income Tax				
	Average Earnings (Mining)[15]	$71,475		
	Head of Household income info:			
	10% on first $13,600			
	12% on next (up to $51,800)			
	22% on next (up to $82,500)			
	Rate[16]	14.4%		
	Tax/employee	$10,272.50		
	Fed Tax	$48,034,210.00		
Fiscal Year 2018 Sales and Use Tax[17]				
	Coal Mining	$16,673,917.00	$391,045.00	
	$/ton	$0.06	$0.08	

[1] WDOR 2018a, surface and underground
[2] Calculated – Tons produced = [County tons produced (2018)/Wyoming tons produced (2018)] x Estimated Wyoming tons produced (2022)
[3] CREG 2018
[4] EIA 2018, Campbell County priced used since price for Converse County withheld
[5] Black lung tax removed since it is included in the sale price

[6] Calculated - Tons produced x 2018 sales price per ton x 12.5%
[7] Calculated - AML = $0.28 per ton produced - through 2021, WY share = 0.5 x AML (Max 28,000,000/yr as of September 2013), Price from CREG 2018
[8] Calculated - Wyoming's portion of 2018 + AML Funds (Max out at $75,000,000)
[9] WDOR 2019, recalculated using county numbers only
[10] Calculated - Maximum per ton rate is $0.55
[11] IRS 2019
[12] Post January 2019 BLT Rate (maximum per ton rate is $0.25)
[13] Calculated – Post January 2019 BLT Rate x 2022 Estimated Production
[14] WDWS 2018
[15] WDOE 2018
[16] Calculated using 2018 Head of Household tax rates
[17] WDOR 2018b

REFERENCES

Bureau of Land Management (BLM), 2019a, Wyoming Coal Data – Coal Lease Modifications and Coal Lease Applications. Available on the internet as of January 2020: https://www.blm.gov/programs/energy-and-minerals/wyoming/coal

Bureau of Land Management (BLM), 2019b, Wyoming Coal Data – Coal Lease Modifications and Coal Lease Applications. Available on the internet as of January 2020: https://www.blm.gov/programs/energy-and-minerals/wyoming/coal

Internal Revenue Service (IRS), 2019, Coal Excise Tax Audit Technique Guide (ATG). Available on the internet as of December 2019: https://www.irs.gov/pub/irs-mssp/coal.pdf

U.S. Energy Information Administration (EIA), 2018, Average price by Rank: Powder River Basin. Available on the internet as of December 2019: https://www.eia.gov/coal/data.php.

Wyoming Department of Administration & Information, Consensus Revenue Estimating Group (CREG), 2018, Wyoming State Government Revenue Forecast Fiscal Year 2019 – Fiscal Year 2024. Available on the internet as of December 2019: http://eadiv.state.wy.us/creg/GreenCREG_Oct18.pdf

Wyoming Department of Employment (WDOE), 2018, Wage Records in Wyoming: Employment and Earnings by Age and Gender within Mining, Including Oil and Gas, 2000-2018. Available on the internet as of December 2019: https://doe.state.wy.us/lmi/earnings_tables/2019/Industry/21.pdf

Wyoming Department of Revenue (WDOR), 2017, 2017 Annual Report. Available on the internet as of December 2019: https://sites.google.com/a/wyo.gov/wy-dor/dor-annual-reports

Wyoming Department of Revenue (WDOR), 2018a, 2018 Annual Report. Available on the internet as of December 2019: https://sites.google.com/a/wyo.gov/wy-dor/dor-annual-reports

Wyoming Department of Revenue (WDOR), 2018b, Total Distribution by Minor Business Class by County, Reporting Date Range: 07/2017 – 06/2018. Available on the internet as of December 2019: https://sites.google.com/a/wyo.gov/wy-dor/tax-distribution-reports/minor-industry-code-by-month-year-summary

Wyoming Department of Revenue (WDOR), 2019, 2019 Annual Report. Available on the internet as of December 2019: https://sites.google.com/a/wyo.gov/wy-dor/dor-annual-reports

Wyoming Department of Workforce Services (WDWS), 2018, Annual Report of the State Inspector of Mines of Wyoming. Available on the internet as of November 2019: http://www.wyomingworkforce.org/businesses/mines/info/.

APPENDIX J

UNAVOIDABLE ADVERSE EFFECTS
OF THE PROPOSED ACTION

Unavoidable Adverse Effects of the Proposed Action

Resource	**Unavoidable Adverse Effect**
Topography and Physiography	Topographic effects of mining are unavoidable because mining activities such as blasting, excavating, loading and hauling of overburden and coal are required to recover coal in an economical manner.
Geology, Mineral Resources and Paleontology	Geology, mineral resources, and buried paleontological resources may be permanently impacted by mining activities. Such impacts are unavoidable as the resources cannot be avoided during mining.
Air Quality/GHGs	Emissions and associated impacts are unavoidable, but are not expected to degrade air quality in the area. Mined coal is primarily used for combustion; therefore, any associated GHG emissions are unavoidable if the Proposed Action is implemented.
Water Resources	Impacts to water resources resulting from coal extraction are unavoidable. However, these impacts would be mitigated through replacement of groundwater or surface water supplies for domestic, agricultural, industrial, or any other legitimate use if such a supply is diminished, interrupted, or contaminated to the extent of precluding use of the water as a result of mining.
Soils	Soil in disturbance areas would exhibit more homogenous textures and may have coarser fragments near the surface following mining. Some soil loss may occur as a result of erosion, prior to stabilization. Microbial and chemical impacts due to accelerated erosion and mixing of soil zones may occur as a result of disturbance.
Vegetation	Vegetation would be eliminated beginning with the initial disturbance and continuing until reclamation is complete. Noxious weeds may be introduced as a result of mining activity, potentially affecting vegetation communities and requiring implementation of control measures in the long term.
Wildlife	Wildlife would be temporarily affected by mine activities, which would alter habitat conditions, particularly in the vicinity of surface disturbance. These impacts would be short term and habitats would be reclaimed following mining.
Visual Resources	Mining activity and associated disturbances and facilities would unavoidably alter the landscape during the mining term, affecting the aesthetic qualities. Some features would be visible from public access points, including State Highway 59.
Noise	Noise would result from mining activities similar to the existing condition.
Transportation Facilities	State Highway 59 would continue to experience similar mine related traffic.
Hazardous and Solid Waste	Coal mining and associated coal processing would yield coal waste.