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Denbury Green Pipeline-MT, LLC; Denbury Onshore, LLC

Cedar Creek Anticline CO_2 Pipeline and EOR Development Projects

Location: Powder River, Carter, and Fallon Counties, Montana (MT)

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Abbreviations

ACHP	Advisory Council on Historic Preservation
APD	Application for Permit to Drill
APE	Area of Potential Effects
ARMP	Approved Resource Management Plan
ARTSD	Air Resources Technical Support Document
AQRVs	Air Quality-Related Values
BBLs	Barrels
BLM	Bureau of Land Management
CCA	Cedar Creek Anticline
CFR	Code of Federal Regulations
CO_2	Carbon Dioxide
CO_2e	Carbon Dioxide Equivalent
EA	Environmental Assessment
EOR	Enhanced Oil Recovery
GHGs	Greenhouse Gases
GWP	Global Warming Potential
HAPs	Hazardous Air Pollutants
HQT	Habitat Quantification Tool
MAAQS	Montana Ambient Air Quality Standards
MCFO	Miles City Field Office
MDEQ	Montana Department of Environmental Quality
NAAQS	National Ambient Air Quality Standards
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NRHP	National Register of Historic Places
NSPS	New Source Performance Standards
PA	Programmatic Agreement
PFYC	Potential Fossil Yield Classification
PGM	Photochemical Grid Modeling
POD	Plan of Development
RMP	Resource Management Plan
ROD	Record of Decision
ROW	Right-of-way

SHPO	State Historic Preservation Office
TUP	Temporary Use Permit
U.S. EPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
VOC	Volatile Organic Compound

Chapter 1. Purpose and Need for Action

Proposed Action and Background

On December 16, 2015, Denbury Green Pipeline - Montana LLC submitted an SF-299 Application for Transportation and Utility Systems and Facilities on Federal Lands (SF-299) to the Bureau of Land Management (BLM) Miles City Field Office (MCFO). The SF-299 requested a right-of-way (ROW) for 30 years (renewable) and temporary use permit (TUP) for 3 years to install, operate, maintain, and terminate a 20-inch carbon dioxide (CO_2) pipeline (project). The pipeline is approximately 110 miles, of which 87 miles are on private lands, 17 miles are on BLM lands, and 6 miles are on Montana State lands crossing Powder River, Carter, and Fallon Counties (Figure 1-1). Denbury Green Pipeline - Montana LLC is proposing the project to allow Denbury Onshore LLC (from here on collectively referred to as Denbury) to pursue an Enhanced Oil Recovery (EOR), or tertiary oil recovery, project to increase the recovery of oil resources within three existing federal units (Coral Creek, East Lookout Butte, and Pennel) within the Cedar Creek Anticline (CCA) in Fallon County.

On December 18, 2015, Denbury submitted two Plans of Development (PODs) to initiate review of the SF-299 application.

- The first POD outlines the construction procedures, environmental requirements, site-specific project plans, and applicant-committed resource protection measures that would be implemented by Denbury during the construction of the pipeline. The project area for the 110-mile long CCA CO_2 Pipeline and associated facilities and infrastructure areas encompasses approximately 1,741 acres in Powder River, Carter, and Fallon Counties, Montana. The CCA CO_2 Pipeline POD summary (Appendix A) describes the pipeline that would transport CO_2 from the Bell Creek Field, an existing federal oil field undergoing EOR, in Powder River County, Montana, to the CCA located in Fallon County, Montana. Denbury has located the proposed ROW parallel to previously disturbed areas or along utility or road corridors where it is possible to minimize disturbance and avoid sensitive surface resources. Denbury proposed to initiate pipeline construction activities in 2019. The full CCA CO_2 Pipeline POD (Denbury 2018a), including complete details of all related resource plans and protection measures, is available on the project's BLM ePlanning website (https://eplanning.blm.gov).
- The second POD describes Denbury's future CCA EOR Unit Development project to develop and upgrade three existing federal units to increase oil production in the CCA. The CCA is a geologic structure that stretches approximately 115 miles southeast from Glendive, Montana, to Buffalo, South Dakota, and has produced oil since the early 1950s. Denbury has operated wells in the CCA since 2010 and proposes to extend production by 30 years using EOR. The CCA EOR Unit Development project area includes three units encompassing 44,489 acres and consisting of the Coral Creek Unit, the East Lookout Butte Unit, and the Pennel Unit. These units would be developed in a multiple phased approach over 8 years, with one phase developed every 2 years beginning in 2019 and ending in 2026. The CCA EOR Development Units are within an active oil and gas field. Existing disturbance on these units, due to prior permitted well pad development activities, totals approximately 182 acres; in addition, there are approximately 155 miles of existing roads. Denbury proposes utilizing 408 EOR wells (353 existing wells and 55 new wells). In addition, pipelines, test sites, EOR facilities, roads, and utility lines are also planned. New disturbance would total approximately 1,555 acres in the three units, of which 1,307 acres would be associated with temporary disturbances and 248 acres with permanent disturbances. The EOR Unit Development POD summary (Appendix A) describes existing and new proposed project components to be used or constructed for the development of the three units and describes the different phases of operations of CCA EOR Unit Development. The complete CCA EOR Unit Development POD (Denbury 2018b), including full detail of all related resource plans and protection measures, is available on the project's BLM ePlanning website.

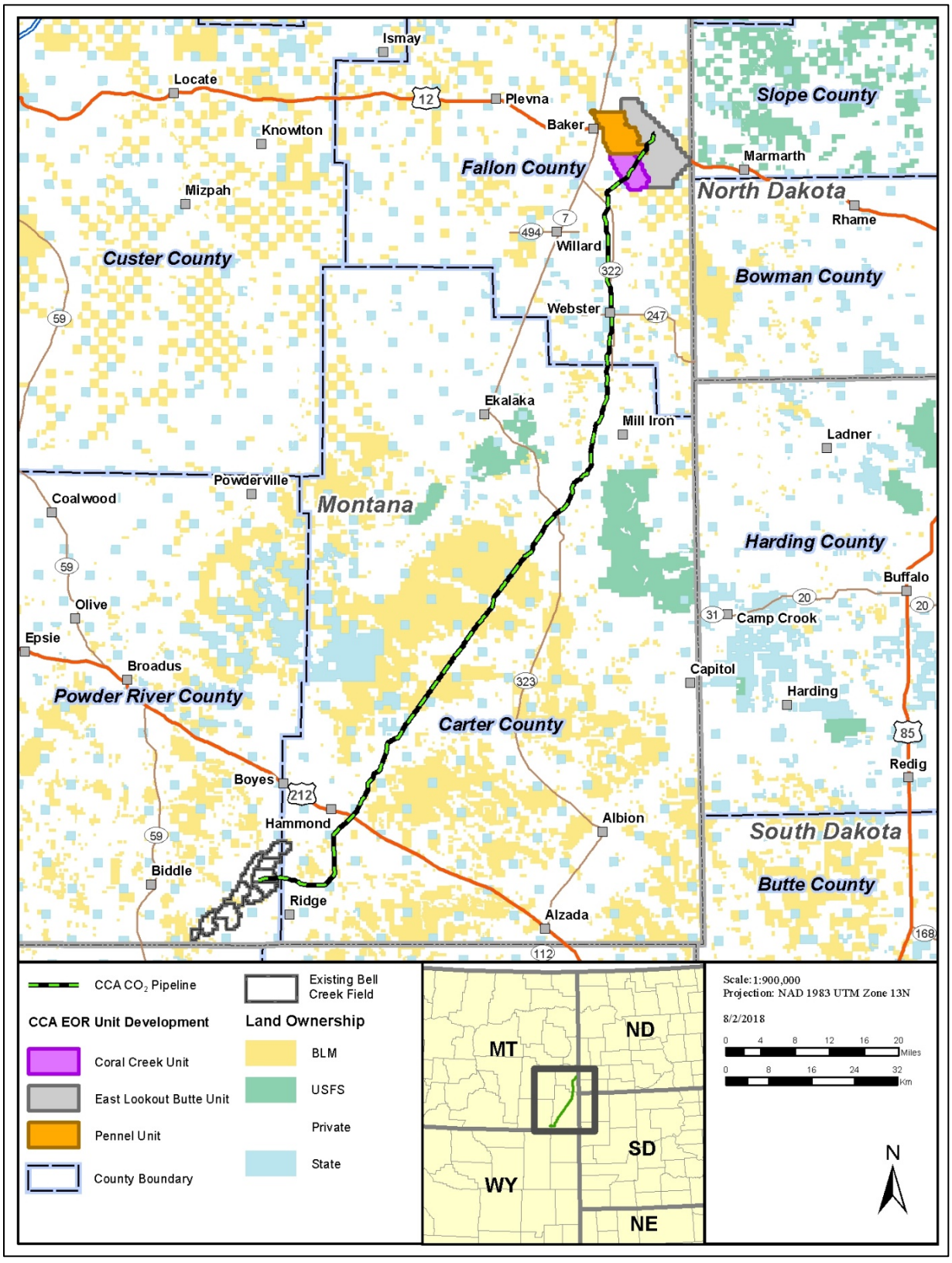

Figure 1-1. Cedar Creek Anticline Carbon Dioxide Pipeline and Cedar Creek Anticline Enhanced Oil Recovery Unit Development project locations.

The CCA CO_2 Pipeline project is analyzed in this Environmental Assessment (EA) as the proposed action. Due to the connected nature of the CCA CO_2 Pipeline and CCA EOR Unit Development, they are both analyzed within this EA. However, the CCA EOR Unit Development is not included as part of the proposed action. The CCA EOR Unit Development project is considered a connected action. Hereafter, the projects are referred to by their respective project names or jointly as the projects.

Purpose and Need

The purpose and need for the BLM is to respond to the SF-299 application submitted by Denbury to install, operate, maintain, and terminate a 110-mile, 20-inch-diameter CO_2 pipeline across federal land from the Bell Creek Field to the three proposed federal units (Coral Creek, East Lookout Butte, and Pennel) located within the CCA, which would allow for EOR development of three federal units.

Decision to be Made

The BLM would determine whether to approve the SF-299 application for the proposed action and, if so, with what stipulations to the ROW grant and TUP.

At this time, no decisions will be made for actions directly associated with the CCA EOR Unit Development in the three federal units (Coral Creek, East Lookout Butte, and Pennel). Any future decisions on the EOR development would be made upon submission and review of Applications for Permit to Drill (APDs) and other applications in accordance with Title 43 Code of Federal Regulations (CFR) 3160, the Federal Land Policy and Management Act of 1976, and the National Environmental Policy Act of 1970 (NEPA).

Conformance with Land Use Plan

This proposed action and CCA EOR Unit Development are in accordance with the decisions contained in the 2015 Rocky Mountain Region Record of Decision (ROD) and Miles City Approved Resource Management Plan (ARMP). The ARMP states on page 3-8 for Goal LR 4, “Strive to increase and diversify the nation’s sources of both traditional and alternative energy resources, improve the energy transportation network, and ensure sound environmental management.” The proposed action is in conformance with ROW decisions in the ARMP.

The BLM has formally adopted and implemented the state’s approach to analyzing disturbance as outlined in Attachments D (Stipulations for Uses and Activities) and H (Definitions) of the Governor’s Executive Order 12-2015. This proposed action is in compliance with BLM greater sage-grouse (*Centrocercus urophasianus*) management as noted in the 2015 Rocky Mountain Region ROD and Miles City ARMP.

The EOR Unit Development is a connected action within this analysis and is in conformance with the ARMP. The ARMP states 1) “Provide opportunities for mineral use in an environmentally responsible manner” (page 3-12, Goal MIN-1), and 2) “Oil and gas leasing is open and surface occupancy and use is allowed with lease terms on approximately 987,000 acres” (page 3-13, MD MIN 12). Lease stipulations have been applied where natural resource protection is warranted. The EOR Unit Development is in full compliance with all applicable laws, regulations and BLM Onshore Oil and Gas Orders (43 CFR 3100). This action has been reviewed for conformance with this plan and its terms and conditions as required by 43 CFR 1610.5.

Relationship to Statutes, Regulations, and Other National Environmental Policy Act Documents

The CCA CO_2 Pipeline project crosses federal, state, and private land and is subject to federal, state, and local permit requirements. This proposed action would comply with all applicable federal, state, and local laws, plans, and permits required for this type of activity. See Table 1-3 in the CCA CO_2 Pipeline POD summary (Appendix A) for a list of the federal, state, and local permits and/or approvals required prior to construction of the proposed action. The ROW and TUP would be issued pursuant to 43 CFR 2880 and Section 28 of the Mineral Leasing Act of 1920, as amended (30 U.S.C. 185) for the construction, operation, maintenance, and termination of the proposed action. The ROW and TUP would be subject to the terms and conditions in 43 CFR 2880, the terms and conditions and stipulations specified, and mitigations set forth in the application and POD. Denbury requested a ROW term for a period of 30 years (renewable) and a 3-year term for the TUP.

Although considered in this EA, any future decisions on the CCA EOR Unit Development would be made upon submission and review of APDs and other applications in the units described. Analysis of APDs and other applications would be in accordance with FLPMA and NEPA.

Public Involvement, Consultation, and Coordination

On September 13, 2017, the proposed action was posted on the BLM ePlanning website with NEPA number DOI-BLM-MT-C020-2017-0081-EA. A 30-day public scoping period was initiated on October 5, 2017, with the posting of the proposed action and associated maps to the BLM ePlanning website as listed above. Letters seeking comments on the proposed action were sent on October 4, 2017. A Facebook post on October 17, 2017, and a newspaper article in the *Billings Gazette* on October 4, 2017, were published requesting comments. On October 25, 2017, a public meeting was held in Ekalaka, Montana. On March 12, 2018, a scoping report was posted on the BLM ePlanning website. Issues identified through the scoping process that warrant detailed analysis in this EA are listed below.

State Historic Preservation Office Consultation

The proposed action is considered a federal undertaking, as defined in Section 106 of the National Historic Preservation Act (NHPA) and its implementing regulations found in 36 CFR 800. The BLM's Cultural Resource Program in Montana operates under a National Programmatic Agreement with an implementing protocol with the Montana State Historic Preservation Office (SHPO). The BLM has consulted with the Montana SHPO under provision Section VIII.8D of its state protocol. Due to access being restricted to complete inventories on approximately 144.99 acres on BLM, state, and private surface, the BLM drafted a Programmatic Agreement (PA) (Appendix B). The PA was provided to the consulting tribes, Advisory Council on Historic Preservation (ACHP), SHPO, and listed signatories for review. On May 7, 2018, the SHPO concurred with the BLM's Determination of No Effect on inventoried historic properties within the Area of Potential Effects (APE) for the proposed action.

Advisory Council on Historic Preservation

The ACHP is afforded an opportunity to comment if there would be adverse effects on historic properties resulting from a project. The ACHP was invited to participate in Section 106 consultation for the proposed action and declined on June 18, 2018, although it may enter the process at any time.

Tribal Consultation

The BLM consults with Native Americans under various statutes, regulations, and executive orders, including the American Indian Religious Freedom Act, the NHPA, the Native American Graves Protection and Repatriation Act, NEPA, and Executive Order 13175 - Consultation and Coordination with Indian Tribal Governments. On September 5, 2017, the BLM sent letters to 17 consulting tribes for the 30-day scoping period, informing them of the projects and inviting them to an inter-tribal consultation meeting November 1–2, 2017, in Billings, Montana, to discuss the proposed projects, Tribal concerns, and future site visits. Letters were sent to the tribal president/chairperson, Tribal Historic Preservation Officer and other cultural contacts for the Cheyenne River Sioux Tribe; Crow Tribe of Montana; Crow Creek Sioux Tribe; Eastern Shoshone Tribe; Fort Belknap Indian Community; Fort Peck Tribes; Lower Brule Sioux Tribe; Mandan, Hidatsa, and Arikara Nation; Northern Arapaho Nation; Northern Cheyenne Tribe; Oglala Sioux Tribe; Rocky Boy Chippewa Cree; Rosebud Sioux Tribe of Indians; Standing Rock Sioux Tribe; Turtle Mountain Band of Chippewa; Yankton Sioux Tribe; Spirit Lake Sioux Tribe; and Sisseton Wahpeton Oyate. Thirteen tribes attended the meeting. At the meeting, the BLM provided the tribes with cultural resource reports, maps, and a presentation on the projects. On December 13, 2017, the BLM and tribal representatives from the Northern Cheyenne and Crow Tribes conducted site visits on private and BLM lands. The BLM sent a second letter to the tribes informing them about the 15-day public comment period for this EA and soliciting comments.

U.S. Fish and Wildlife Service Consultation

Under the provisions of Section 7(a)(2) of the Endangered Species Act of 1973, a federal agency that carries out, permits, licenses, funds, or otherwise authorizes an activity must consult with the U.S. Fish and Wildlife Service (USFWS), as appropriate, to ensure that the proposed action is not likely to jeopardize the continued existence of any species listed under the Endangered Species Act of 1973 or result in the destruction or adverse modification of designated critical habitat. During preparation of the environmental analysis, the BLM informally consulted with the USFWS regarding the effects of the proposed action on the northern long-eared bat. On June 18, 2018, the BLM completed the Northern Long-Eared Bat 4(d) Rule Streamlined Consultation Form for review and concurrence by the USFWS. On July 3, 2018, the USFWS concurred with the BLM's effect determination in accordance with the USFWS's programmatic biological opinion for the final 4(d) rule dated January 5, 2016. No additional listed, proposed, or candidate species or designated critical habitat were identified in the project areas.

Montana Department of Natural Resources and Conservation

Denbury and the BLM have coordinated with the State of Montana in accordance with the Governor's Executive Order 12-2015 regarding a greater sage-grouse conservation strategy for the proposed action.

Resource Issues Identified for Analysis

Site-specific resource concerns were identified by the BLM and the public through the preliminary review process conducted during the scoping period. The BLM focuses its analysis on issues that are truly significant to the action in question. Issues have a cause-effect relationship with the proposed action and CCA EOR Unit Development, are within the scope of analysis, and are amenable to scientific analysis.

Issue 1. Air Resources

a) What are the potential impacts to air resources from the estimated magnitude of criteria pollutants, hazardous air pollutants (HAPs), and greenhouse gases (GHGs) from the CCA CO_2 Pipeline project construction and reclamation activities?

b) What are the potential impacts to air resources from the estimated magnitude of criteria pollutants, HAPs, and GHGs from future construction, reclamation, and development activities of new and existing infrastructure within the three federal units proposed for EOR?

c) Potential impacts to climate change would depend on the affected resources for these projects. The issues of climate change on affected resources would be disclosed in analyses as necessary.

Issue 2. Cultural Resources

a) What are the potential impacts to cultural resources that have undetermined, unknown, or are listed on or eligible for listing on the National Register of Historic Places (NRHP) from the CCA CO_2 Pipeline construction activities?

b) Does the information from new and existing cultural survey reports adequately address cultural resources related to the CCA CO_2 Pipeline?

Issue 3. Socioeconomics

a) What are the potential impacts to local social and economic conditions that may include changes in output, employment, earnings and tax revenues; impacts on non-market values; displacement of economic activities; and economic analysis for the CCA CO_2 Pipeline and EOR project areas?

b) What are the potential impacts to the types of social issues that may need to be addressed?

Issue 4. Wildlife

a) What are the potential impacts to greater sage-grouse habitat within the CCA CO_2 Pipeline ROW and within the EOR and confirmed active greater sage-grouse leks (see Resource Issue 4 in Chapter 3) in and within 3.1 miles of the CO_2 pipeline and EOR project areas from construction and reclamation activities?

b) What are the potential impacts to raptor nests active in the past 7 years in and within 0.5 mile of the CO_2 pipeline and within EOR project areas from construction and reclamation activities?

Issue 5. Paleontological Resources

a) What are the potential impacts to paleontological resources identified in the survey reports and potentially unidentified sites from construction and reclamation activities within the CCA CO_2 pipeline and EOR project areas?

Resource Issues Eliminated from Further Analysis

During the scoping process, the following resources were determined to not be present within or adjacent to the proposed action or CCA EOR Unit Development project areas: Areas of Critical Environmental Concern, 100-year floodplains, mineral materials, locatable minerals, lands with wilderness characteristics, Native American religious concerns, special status species animals not included below, special-status species plants, bighorn sheep, Visual Resource Management Class I areas, source water protection areas, Wild and Scenic Rivers, hazardous materials areas, Wilderness Study Areas, and environmental justice populations.

In addition, the BLM determined that the following resources were present within the area of the proposed action and CCA EOR Unit Development but not affected to a degree that detailed analysis is required at this time: aquatics and fisheries; crucial big game winter range; northern long-eared bat; migratory birds; black-tailed prairie dog colonies; bald eagles, colonial nesting birds, sharp-tailed grouse, prime farmland; sensitive soils; rock outcrops; solid minerals; fluid minerals, erionite; invasive, noxious, and non-native species; livestock grazing-associated infrastructure; noise and vibration; recreation; vegetation; visual resources management; lands and realty, surface water resources; livestock grazing; and wetland and riparian areas. Details on the listed resources can be found in the internal scoping report upon request.

No additional issues were identified through the scoping process or public comments submitted that would require analysis in the EA.

Chapter 2. Proposed Action and Alternatives

Introduction

Alternatives were developed based on national and state BLM direction and policy, existing conditions, and resource issues. Resource issues were discussed in Chapter 1. Other factors that influenced alternative development are discussed in Chapter 3.

Alternatives Considered but Eliminated

Multiple factors such as natural resources and associated habitats, existing disturbances, and topography influenced the proposed route location. The proposed CCA CO_2 Pipeline route is located parallel to previously disturbed areas or along utility or road corridors where possible to minimize disturbance and avoid sensitive surface resources. The BLM considered alternate routes north and south of the proposed CCA CO_2 Pipeline route; however, alternate routes would locate the proposed action in unfragmented greater sage-grouse habitat with higher lek densities, across multiple areas of designated crucial big game winter range habitat, and in areas without existing disturbances.

Alternative A (No Action)

Under the no action alternative, the BLM would reject the CCA CO_2 Pipeline project as proposed, would not approve the SF-299 application, and would not issue a ROW grant. Without a ROW grant and TUP across federal lands, the proposed action could not be constructed due to the federal landownership patterns in the region. Without the CCA CO_2 Pipeline ROW grant, the CCA EOR Unit Development project would not proceed. Oil and gas development within the Coral Creek, East Lookout Butte, and Pennel units would be expected to continue.

Alternative B (Proposed Action)

Denbury submitted an SF-299 application for a ROW to install, operate, maintain, and terminate a 110-mile-long, 20-inch diameter steel CO_2 pipeline that would originate at the existing terminus of the Greencore Pipeline at the Bell Creek EOR field in Powder River County, Montana (see Figure 1-1). Construction of the CCA CO_2 Pipeline would take place from June 15 to December 15. The CCA CO_2 Pipeline route extends north and east through Carter County, Montana, and terminates at the CCA field in Fallon County, Montana. Approximately 97 miles would parallel previously disturbed areas or be located along utility/road corridors (including co-location along portions of the existing Bison and ONEOK Pipelines). The pipeline crosses privately owned land, as well as surface land administered by the State of Montana and the BLM. The corridor consists of a 50-foot-wide permanent ROW and a 50-foot-wide temporary construction workspace. The permanent ROW would include the CO_2 Pipeline and long-term access roads The TUP would include the, additional temporary workspace and temporary access roads. The project area for the 110-mile-long CCA CO_2 Pipeline and associated facilities and infrastructure areas encompasses approximately 1,741 acres in Powder River, Carter, and Fallon Counties, Montana.

Design features and applicant-committed resource protection measures for all phases of operation are proposed for the pipeline and the associated features. A summary of all of the phases of operation of the CO_2 pipeline and associated design features is located in Appendix A of this EA. The full CCA CO_2 Pipeline POD (Denbury 2018a), including complete details of all related resource plans and protection measures, is available on the project's BLM ePlanning website.

Connected Action to Alternative B – Cedar Creek Anticline Enhanced Oil Recovery Unit Development

As discussed in Chapter 1, any future decisions on EOR development would be made upon submission and review of APDs and other applications in the units described. The review and analysis of such applications for EOR development would be compliant with NEPA. Design features and applicant-committed resource protection measures for all phases of EOR operation are proposed for existing and new infrastructure.

The CCA EOR Unit Development project area includes three units encompassing 44,489 acres and consisting of the Coral Creek Unit, the East Lookout Butte Unit, and the Pennel Unit. These units would be developed in a multiple phased approach over 8 years, with one phase developed every 2 years beginning in 2019 and ending in 2026. The CCA EOR Development Units are within an active oil and gas field. Existing disturbance on these units, due to prior permitted well pad development activities, totals approximately 182 acres; in addition, there are approximately 155 miles of existing roads. Denbury proposes utilizing 408 EOR wells (353 existing wells and 55 new wells). In addition, pipelines, test sites, EOR facilities, roads, and utility lines are also planned. New disturbance would total approximately 1,555 acres in the three units of which 1,307 acres would be associated with temporary disturbances and 248 acres with permanent disturbances.

The EOR Unit Development POD summary (Appendix A) describes existing and new proposed project components to be used or constructed for the development of the three units and describes the different phases of operations of CCA EOR Unit Development. The complete CCA EOR Unit Development POD (Denbury 2018b), including full detail of all related resource plans and protection measures, is available on the project's BLM ePlanning website.

Chapter 3. Affected Environment and Environmental Consequences

General Setting

The environmental settings of the projects are described below. There are numerous similarities between the projects. A summary is provided below, and additional general setting and detailed resource information is provided in the CCA CO_2 Pipeline and CCA EOR Unit Development PODs (Denbury 2018a and Denbury 2018b) on the project's BLM ePlanning website.

Cedar Creek Anticline Carbon Dioxide Pipeline

The proposed action project area is in the Northwestern Great Plains U.S. Environmental Protection Agency (U.S. EPA) Level III ecoregion. The general climate is 10–20 inches of precipitation per year, with more than half occurring during the growing season of 110–160 days. The average temperature is 37–48 degrees Fahrenheit. The semiarid rolling plains are dominated by native grasslands, with an abundance of grassland (59%) and shrubland (21%). Soil types are primarily clayey-silty, dense clay saline uplands, claypans, and subirrigated saline lowlands. Historical land uses are mainly grazing, followed by agriculture, developed at about 8.4% of the landscape. Geology is characterized as shale, siltstone, and sandstone, with occasional buttes and badlands.

Cedar Creek Anticline Enhanced Oil Recovery Unit Development

The connected action project area would have characteristics similar to the pipeline's, but with a number of differences. The semiarid rolling plains are dominated by native grasslands, with an abundance of grassland (56%) and shrubland (27%). Historical land uses are mainly grazing, followed by agriculture, developed at about 7.7% of the landscape. The CCA geologic structure stretches approximately 115 miles southeast from Glendive, Montana, to Buffalo, South Dakota. The primary source rocks are the organic shales in the Cambrian Winnipeg Formation, lower Ordovician Red River Formation, and lower Lodgepole Formation (Davis 2013). The primary producing carbonate reservoirs include the Ordovician Red River and Stony Mountain Formations, the Silurian Interlake Formation, and the Mississippian Mission Canyon Formation. All the producing reservoirs, except the Mission Canyon, are intercrystalline and interparticle dolomites and were deposited in supratidal, intertidal, and subtidal environments. The Mission Canyon reservoirs are mostly limestone.

Existing oil and gas development activities currently occur on fee, state, and federal leases in Powder River, Carter, and Fallon Counties, and they would be expected to continue within the Coral Creek Unit, the East Lookout Butte Unit, and the Pennel Unit. Activities on federal and state leases require extensive environmental regulatory conformance. Project proponents would be required to meet all surface owner requirements and would continue to develop a variety of protection and mitigative measures for resource protection.

Analysis Areas

The direct, indirect, and cumulative analysis area of the projects for most resources analyzed in this EA comprises the three counties crossed by the proposed action (Powder River, Carter, and Fallon Counties) and includes the connected action in Fallon County (see Figure 1-1). An exception to this is for air resources and climate change, where the direct, indirect, and cumulative analysis area is the MCFO Resource Management Plan (RMP) area.

The timeline for anticipated effects from the proposed action and connected action projects would be 50 years. Air analysis uses additional 20-year and 100-year timelines for emissions analysis.

Reasonably Foreseeable Future Actions

Reasonably foreseeable future actions in the cumulative analysis area that have the potential to affect resources similar to those considered for analysis under the proposed action and connected action include current and proposed oil and gas development on fee, state, and federal leases (including the anticipated development of five APDs proposed on three well pads in the CCA and two APDs on separate well pads in Bell Creek) and construction and operation of a portion of the proposed Keystone XL Pipeline located in Fallon County. Other ongoing activities in the cumulative analysis area include livestock grazing and agriculture.

Proposed Oil and Gas Development Activities

Five wells are proposed by Denbury in Fallon County to be drilled on three pads within the CCA. These wells are separate actions proposed by Denbury and are not part of the connected action.

The well APDs proposed by Denbury within the Bell Creek Field in Powder River County would be located near the terminus of the proposed action.

Keystone XL Pipeline

The U.S. Department of State approved the ROD and National Interest Determination for the TransCanada Keystone Pipeline, L.P. Application for Presidential Permit for the Keystone XL Pipeline on March 23, 2017 (U.S. Department of State 2017). The Keystone XL Pipeline would transport crude oil from existing facilities in Hardisty, Alberta, Canada, as well as crude oil from an on-ramp at Baker, Montana, to Steele City, Nebraska, for onward delivery to refineries in the Gulf Coast area, subject to commercial demand. Approximately 3 miles of this pipeline would be within the cumulative analysis area in Fallon County, Montana.

Resource Issue 1 (Air Resources)

Affected Environment

The air resources section addresses regional ambient air quality; air quality-related values (AQRVs), which include visibility and atmospheric deposition; and climate change from the proposed action and connected actions. Specific impacts associated with the build-out and operation of the proposed and connected actions will be identified as appropriate throughout this EA and generally encompass all construction and operationally related activities associated with the proposed and connected actions.

When discussing the effects of the proposed and connected actions, it must be noted that the affected environment varies in size depending on which of the specified impacts are being evaluated. The MCFO RMP area is considered the air resources analysis area. With respect to impacts to ambient air quality and near-field visibility impacts, the areas near construction and subsequent operation of the proposed and connected actions would experience the highest pollutant concentration increases. Therefore, the affected environment in terms of the assessment of ambient air quality and near-field visibility impacts would be near (< 50 kilometers) the proposed and connected actions. Impacts to regional haze and the deposition of pollutants are evaluated at the nearest Class I area, which is Theodore Roosevelt National Park in western North Dakota, approximately 50 miles northeast from the proposed and connected actions. Climate impacts have the potential to be regional and global in scale as the GHG emissions are long lasting and impacts are, by nature, cumulative. Thus, the relative contribution of the proposed action to regional and global impacts to climate associated with GHG emissions is assessed herein.

Ambient Air Quality

Emissions of criteria air pollutants may impact human health and welfare by contributing to the deterioration of ambient air quality. The specific extent that a source of emissions may impact air quality is affected by the regional weather patterns, nearby terrain, and background concentrations, but generally, air quality emissions tend to disperse from their initial source. Thus, the highest concentrations of these pollutants are likely to occur near their respective emission sources and the impacts of these emissions on human health would be realized to the greatest degree within the areas immediately surrounding an air pollutant source. Both the Montana Department of Environmental Quality (MDEQ) and the U.S. EPA have established ambient air quality standards—called Montana Ambient Air Quality Standards (MAAQS) and National Ambient Air Quality Standards (NAAQS), respectively for the pollutants listed below, which are known as criteria air pollutants:

- Carbon Monoxide (CO). CO is a colorless, odorless gas primarily produced by incomplete combustion in stationary and mobile sources.
- Nitrogen Dioxide (NO_2). NO_2 is a compound primarily produced by the combustion of fossil fuels in stationary and mobile sources. Some oxides of nitrogen (NO_x) convert into NO_2 after being emitted and are thus regulated as precursor pollutants.
- Ozone. Ozone is rarely directly emitted into the atmosphere from sources. Rather, ozone is formed by chemical reactions between NO_x and volatile organic compounds (VOCs) in the presence of sunlight. NO_x and VOCs are both regulated as precursor pollutants.
- Respirable particulate matter with a diameter of less than 10 microns (PM_{10}) and fine particulate matter with a diameter of less than 2.5 microns ($PM_{2.5}$). PM_{10} and $PM_{2.5}$ are emitted from a variety of sources, including agricultural operations, industrial processes, combustion, construction and demolition activities, road dust, windblown dust, and wildfires.
- Sulfur Dioxide (SO_2). SO_2 is a sulfur compound emitted by power plants, industrial facilities, combustion in mobile sources, and natural sources such as volcanoes.

The MDEQ has installed and maintained air quality monitoring stations throughout the state, including counties located near the proposed project areas. Based on current monitoring data, no criteria pollutants currently exceed either the NAAQS or MAAQS. Additionally, 2017 Air Quality Index reports in nearby counties (provided in Appendix C) indicate that air quality in the region is classified as “good” in regard to the U.S. EPA’s Air Quality Index, which means that current air quality is considered satisfactory and pollution causes little or no risk.

The stationary and mobile sources existing in the proposed action area also emit HAPs, which are compounds regulated by the Clean Air Act known or suspected to cause cancer or other serious health problems, including chronic respiratory disease, reproductive disorders, or birth defects. The original list of 189 pollutants was included in in Section 112 of the Clean Air Act (U.S. EPA 2013). The U.S. EPA has periodically modified the list through rulemaking, and there are now 187 pollutants designated as HAPs. Typically, HAPs associated with urban or industrial development include formaldehyde, benzene, toluene, ethylbenzene, xylenes, and n-hexane. Emissions of these pollutants within the analysis area are mostly associated with tailpipe emissions from mobile sources, stationary combustion sources, and emissions from oil and gas production and exploration. Concentrations of HAPs within the MCFO planning area were predicted to be well below acute and chronic health-based thresholds based on the near-field modelling analysis conducted for the MCFO RMP (BLM 2014).

Regulatory Setting

The MDEQ administers various air quality permitting programs[1] applicable to stationary sources that ensure compliance with the NAAQS and establish control requirements for HAP emissions through the implementation of enforceable regulatory requirements. Additionally, implementation of best management practices (BMPs) are required to limit fugitive emissions of fine particulate matter (BLM 2015a). The BMPs to manage fugitive dust include:

- designing roads and well pads to reduce the amount of fugitive dust generated by traffic or other activities;
- application of water, dust suppression chemicals, or gravel on unpaved surfaces during construction or drilling projects and in high-traffic production operations; and
- implementing vehicle speed limitations in and around oil and gas project plans of development.

Federal requirements to protect ambient air quality include New Source Performance Standards (NSPS) promulgated under 40 CFR Part 60, which are designed to control criteria air pollutant emissions and. National Emission Standards for Hazardous Air Pollutants promulgated under 40 CFR Part 61 and 63, which are designed to control HAP emissions. Part 63 requirements are known as Maximum Achievable Control Technology Standards. A federal operating permit program also applies to all major stationary sources as specified in 40 CFR Part 70 of the Clean Air Act. The U.S. EPA has delegated authority to administer the federal operating permit program to the MDEQ.

Air Quality-Related Values

The AQRVs include visibility and atmospheric deposition; changes to these values may result from air pollutant emissions that potentially impact visibility by contributing to regional haze, sulfur, nitrogen, acid deposition, or lake acidification. Visibility impairment and deposition of pollutants into the environment may result from cumulative air pollutant emissions from both stationary and area sources distributed over a wide geographic area. Thus, the area that may be affected is larger in scale geographically than the affected environment in terms of ambient air quality effects. The primary pollutants associated with the formation of regional haze in many areas are $PM_{2.5}$ and $PM_{10,}$ since this particulate matter scatters light in the atmosphere. A primary goal of the Clean Air Act related to Class I Federal Areas is to remedy the existing impairment and prevent the future impairment of visibility caused by human-made pollution. Deposition of sulfur and nitrogen compounds originating from emission sources may be removed from the atmosphere and eventually deposited within these Class I areas. The effects of deposition of these pollutants have demonstrable impacts on terrestrial and aquatic ecosystems and have been shown to cause the leaching of nutrients from soils and the acidification of surface waters (U.S. EPA 2017). The closest Class I area is the Theodore Roosevelt National Park in western North Dakota, approximately 50 miles to the northeast of the proposed action. The Fort Peck and Medicine Lake Class I areas are located 150 miles northwest and 150 miles north of the proposed action, respectively. The Air Resources and Climate Appendix of the MCFO Final Environmental Impact Statement (BLM 2015b) includes figures[2] demonstrating previous trends in the deposition and visibility within the Miles City ARMP area and at nearby Class I and II areas.

[1] The MDEQ State Implementation Plan approved New Source permitting programs, which include Prevention of Significant Deterioration, Nonattainment, and minor source programs.

[2] Refer to Figures 24 through 27 in the Air Resources and Climate Appendix I.

Regulatory Setting

The Federal Regional Haze Program allows states to design and implement plans to reduce air pollutants, which are then reviewed by the EPA. The State of Montana, in partnership with Federal Land Managers, has developed a State Implementation Plan (SIP) which meets the goal of the Regional Haze Program to prevent future and remedy existing visibility impairment in Class I areas due to anthropogenic air pollution. Elements of the SIP include maintaining ambient air quality monitoring stations, requiring control of criteria air pollutants through applicable air permitting programs, establishing BMPs to control fugitive dust within the MCFO RMP area, and reviewing the visibility plan. These regulatory efforts limit the pollutants that contribute to visibility impairment and deposition impacts.

Climate Change

Changes to climate from increases in atmospheric GHG concentrations may persist for decades or even centuries. Buildup of GHGs in the atmosphere from anthropogenic sources has been occurring since at least the start of the industrial revolution. Since the 1950s, many of the observed changes to Earth's climate are unprecedented and beyond the predicted climatic shifts that would otherwise be expected without anthropogenic contributions to GHG emissions (United Nations Intergovernmental Panel on Climate Change [IPCC] 2013). Anthropogenic sources of GHG emissions can be attributed mostly to fossil fuel production, exploration, and combustion, land use change, industrial activities, and agricultural practices (IPCC 2013). These activities have substantially increased atmospheric concentrations of GHG compounds compared to background levels. The mechanism by which increased GHG concentrations cause changes to climate is that each GHG molecule absorbs infrared energy from earth's surface which are then re-radiated by the molecule in all directions, including back down to Earth's surface. Thus, with increased concentrations of GHGs caused by anthropogenic emissions, more of the energy that would otherwise have escaped back into space are absorbed and re-radiated to earth's surface leading to warming and climatic shifts (IPCC 2013). The most common GHGs and their typical emission sources are as follows:

- Carbon dioxide. CO_2 is the most prevalent GHG and is produced by the combustion of fossil fuels, the combustion of biomass, and chemical reactions.
- Methane (CH_4). CH_4 is emitted from combustion, production of fossil fuels, livestock, agriculture, and municipal solid waste landfills.
- Nitrous oxide (N_2O). N_2O is emitted from combustion, agricultural activities, and industrial processes.

Each GHG has a Global Warming Potential (GWP) that accounts for the intensity of each GHG's heat trapping effect and its longevity in the atmosphere. The GWP values allow for a comparison of the impacts of emissions and reductions of different gases. According to the IPCC, GWPs typically have an uncertainty of ±35 percent. The GWPs have been developed for several GHGs over different time horizons including the 20-year, 100-year, and 500-year horizons. The choice of emission metric and time horizon depends on type of application and policy context; hence, no single metric is optimal for all policy goals. The 100-year GWP was adopted by the United Nations Framework Convention on Climate Change and its Kyoto Protocol and is now used widely as the default metric. In addition, the EPA uses the 100-year time horizon in its *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990–2016* (U.S. EPA 2018) and GHG Reporting Rule requirements under 40 CFR Part 98 Subpart A. Further, the U.S. EPA uses the GWPs and time horizon consistent with the Fifth Assessment Report, Climate Change Synthesis Report (IPCC 2014) in its science communications. In this EA, the BLM uses GWPs and time horizon consistent with EPA in its GHG emission calculations associated with the proposed action. The BLM has also included a comparison of GHG emissions using the 20-year time horizon for illustrative purposes.

The discussion below regarding potential impacts to the affected environment is within a context of a more general discussion of potential impacts of GHG emissions to global, regional, and local climate since climate change affects nearly all resources within all geographic scales. Pollution-emitting sources within the proposed action area impact global climate by contributing to an increase in the concentration of GHGs in the atmosphere. No models currently exist that can estimate specific local, regional, or global biophysical-related climate impacts based on potential GHG emissions from any one specific project. Therefore, the assessment of impacts must be considered cumulatively and in relation to all contributors to GHG emissions on a global and regional scale to understand the intensity of the impacts resulting from emission sources within the MCFO RMP area.

On a global scale, the anticipated climate change impacts caused by anthropogenic GHG emissions include an increase in global temperatures; a rise in sea levels; the melting of permafrost, glaciers, and ice caps; a change in weather patterns; ocean acidification; species extinction; and desertification. Global average surface temperatures from 1880 to 2012 have increased by approximately 1.5°F (IPCC 2013). However, the observed magnitude of warming is greater at higher latitudes in the northern hemisphere which has led to decreasing sea ice extent, melting of permafrost and glaciers in the northern hemisphere. Decreases in the extent of these highly reflective ice surfaces has in turn, reduced the amount of incoming short-wave radiation that is re-reflected back into space. Instead, this radiation is absorbed by the ocean or land surface and causes further warming (CIT 2018). Additionally, melting permafrost releases trapped methane reservoirs which further increases climate impacts due to methane being a particularly potent GHG (IPCC 2013).

The ocean absorbs more than 90 percent of the increased atmospheric heat associated with anthropogenic warming. Higher ocean temperatures, in addition to contributing to the decreasing extent of sea ice, also leads to thermal expansion of water in the oceans, which causes sea levels to rise. Sea levels have also risen due to melting glaciers and other land-based ice. Additionally, increased carbonic acid concentrations due to the increased CO_2 concentrations in the atmosphere causes ocean acidification that may put shelled animals at risk by interfering with calcium carbonate shell formation (IPCC 2013). Due to changes to the global climate, resultant changes in regional weather patterns are likely to cause widespread and long-lasting impacts to agriculture as well as plant and animal species (IPCC 2013). Almost all regions of earth will experience some impacts from changes to their local climates. However, the impacts discussed for the purposes of this EA will focus on the northern Great Plains region since this is the location of the proposed and connected actions.

Climate change would impact the MCFO RMP area, which is located within the northern part of the Great Plains region of the United States. The MCFO RMP area would likely be affected by changes in temperature and precipitation. In the northern Great Plains region as a whole, the number of days with temperatures over 100°F is projected to double by 2050. Winter and spring precipitation and the number of days with heavy downpours and snowfall are expected to increase (U.S. Global Change Research Program 2014). Additional state level findings are described in the 2017 Montana Climate Assessment (Whitlock 2017). Major findings of this report include:

- Annual average temperatures, including daily minimums, maximums, and averages, have risen across the state between 1950 and 2015. The increases range between 2.0 and 3.0°F.
- Average winter precipitation decreased by 0.9 inch, which can largely be attributed to natural variability and an increase in El Niño events, especially in the western and central parts of the state. A significant increase in spring precipitation (1.3–2.0 inches) also occurred during this period for the eastern part of the state.
- Montana is projected to continue to warm in all geographic locations, seasons, and under all emission scenarios throughout the 21st century. By mid-century, Montana's temperatures are projected to increase by approximately 4.5–6.0°F.

North Dakota has also experienced increased average annual temperatures. Between 1901 and 2016, the average annual temperature for the state of North Dakota has increased from 40.1°F to 44.4°F. Average precipitation has increased slightly, but the regional precipitation varies by region of the state (NOAA 2018).

These temperature and precipitation variations within the larger northern Great Plains region and states where the proposed action and connected actions are located have had and will continue to have impacts on the local area surrounding the proposed and connected actions. Very heavy precipitation events can increase flooding, nutrient runoff, and soil erosion, which impact local water and agricultural soil quality (USGCRP 2014). Increased winter temperatures can also lead to survival of pests and invasive weeds, which may impact local agriculture, terrestrial and aquatic ecosystems, and increase the pollen season for common allergens such as ragweed (USGCRP 2014). Increasing temperatures and number of days with temperatures over 100°F, as well as changing precipitation patterns, are likely to stress the local plant and animal populations (USGCRP 2014).

Regulatory Setting

National actions to reduce GHG emissions include Clean Air Act permitting for large stationary sources under the Prevention of Significant Deterioration program, as well as programs for specific industrial sectors such as NSPS and the Clean Power Plan. Under U.S. EPA NSPS Subpart OOOOa, common oil and gas emission sources are required to comply with applicable measures to reduce methane emissions. Additionally, the U.S. EPA requires the reporting of GHG emissions from specified emission sources or industry segments emitting more than 25,000 metric tons per year of carbon dioxide equivalent (CO_2e).

Environmental Impacts - Alternative A (No Action)

A no action decision for the construction of the pipeline would remove any potential direct or indirect impacts from the construction of the pipeline. Foregoing construction would avoid emission sources from construction equipment, dust, fugitive emissions, or transports. Under no action, there would be no direct or indirect impacts to air resources due to connected action construction or operation and, because the CCA would not be developed via EOR, no indirect emissions resulting from EOR fuels being burned would occur. Therefore, under no action, the emission sources currently existing within the MCFO area would continue to operate and the area would be expected to remain in compliance with all NAAQS and MAAQS standards. The HAP concentrations would continue to be below the relevant acute and chronic health and risk-based thresholds, and the current air quality would continue to be considered satisfactory with pollution causing little or no risk.

A no action decision would also eliminate the GHG emissions associated with the proposed and connected actions, which would not contribute to climate change.

Cumulative Impacts

Air Quality and Air Quality-Related Values

Under the no action alternative, the proposed and connected actions would not impact air resources and would not contribute to cumulative effects. Cumulative impacts to air quality and AQRVs related to a no action decision would be derived solely from current and projected industrial activities within the region. These are evaluated and addressed with respect to criteria air pollutant and HAP impacts and AQRV-related impacts in the Air Resource Technical Support Document (ARTSD) (BLM 2014) which was conducted to support the development of the ARMP. The ARTSD quantifies potential future concentrations of criteria air pollutants and HAPs due to reasonably foreseeable oil and gas development. Emission inventories were used to estimate pollutant emissions from typical oil and gas construction and

operating scenarios, then AERMOD software was used to conduct near-field modelling to determine the likely pollutant concentrations. This assessment was completed to determine potential impacts to air quality near oil and gas construction. Projected pollutant concentrations were compared with the NAAQS and MAAQS for criteria air pollutants (except ozone, which cannot be modelled via AERMOD) and against acute and chronic health and risk-based thresholds for HAPs. Results of near field modelling are available in the ARTSD and showed that there were no projected near-field exceedances of NAAQS or MAAQS standards modelled, nor any projected near-field exceedances of acute or chronic health-based thresholds for any HAP.

Additional modelling for near-field criteria air pollutant concentrations was conducted as part of the Photochemical Grid Modeling (PGM)[3] Study conducted on behalf of the BLM Montana/Dakotas State Office (Ramboll Environ and Kleinfelder 2016), which discloses potential air quality and AQRV impacts due to oil and gas activities within the BLM's MCFO RMP area. Like the results presented in the ARTSD, the near-field modelling conducted as part of the PGM (which did include modelled ozone concentrations) did not predict any exceedances of NAAQS or MAAQS.

Far-field modeling to assess AQRV impacts from cumulative oil and gas development was conducted as part of photochemical grid modelling as well. It is projected that, due to reasonably foreseeable oil and gas development through 2032 in the BLM RMP area, an exceedance of > 1.0 deciview[4] change will occur at the Class I areas of Fort Peck and Medicine Lake. Additionally, at Medicine Lake, Theodore Roosevelt National Park, and Fort Peck Class I areas, the Deposition Analysis Threshold is projected to be exceeded for nitrogen, and at the Theodore Roosevelt National Park, the Deposition Analysis Threshold for sulfur is projected to be exceeded due to predicted potential future oil and gas development authorized by the BLM.

Climate Change

Cumulative emissions of GHGs related to a no action decision would be derived from current and reasonably foreseeable activities within the proposed action project area and larger MCFO RMP area only since a no action decision would eliminate all direct and indirect GHG emissions from the proposed and connected actions. Emissions from direct, indirect, and downstream sources of GHGs resulting from current and reasonably foreseeable activities within the MCFO planning area are quantified in Appendix D. The magnitude of current and reasonably foreseeable CO_2e emissions within the MCFO RMP area can be used as an indicator of the potential intensity of climate change cumulative impacts from sources within the MCFO RMP area through a quantitative comparison against national and global CO_2e emissions. The potential climate change impacts discussed in the Affected Environment section would be a result of large-scale changes in atmospheric GHG concentrations. Total CO_2e emissions from the MCFO RMP area, including all reasonably foreseeable direct and indirect sources of GHG emissions from plan development, were calculated in Appendix D, and were 98.52 million metric tons of per year based on 100-year GWPs or 99.05 million metric tons per year based on 20-year GWPs. Notably, the MCFO RMP area GHG emissions would be approximately 1% of U.S. and 0.2% of global GHG emissions, which is an indication of the relative intensity of MCFO RMP area impacts to climate change.

[3] PGM was conducted to assess potential air quality and AQRV impacts due to oil and gas activity on the BLM's Montana/Dakotas State Office-administered mineral estate in Montana, South Dakota, and North Dakota. This was deemed necessary as the CALPUFF (a puff air dispersion model) modeling included in the ARTSD report was limited at the time that the ARMP was published.

[4] A deciview is a unit of measurement to quantify human perception of visibility. It is derived from the natural logarithm of atmospheric light extinction coefficient. One (1) deciview is roughly the smallest change in visibility (haze) that is barely perceptible (40 CFR 301).

Environmental Impacts - Alternative B (Proposed Action)

The proposed action would include the construction of the EOR pipeline and associated staging areas, additional temporary workspaces, permanent and temporary access roads, and additional facilities allowing for pipeline maintenance activities such as mainline valves, pigging facilities and pipeline markers. To facilitate construction of the pipeline, pipe will be shipped via rail from the manufacturer in Houston, Texas (Denbury 2018a). The connected actions include reworking, converting, or upgrading existing wells for production or injection; drilling re-entry or new wells; construction of test sites; construction of EOR facilities; and construction of additional access roads, flowlines, and electrical distribution lines. The connected action would also include the subsequent operation of the well pads, test sites, and EOR facilities.

Criteria air pollutant, HAP, and GHG emissions would result from five primary categories of activities: 1) on-road and rail transport of personnel, materials, and equipment; 2) surface disturbance related to construction; 3) use of nonroad mobile and portable equipment for construction and well drilling; 4) operating and maintaining field assets; and 5) indirectly, processing and the ultimate combustion of recovered crude oil (life cycle emissions). The air pollutant emissions resulting from construction of the proposed and connected actions would occur intermittently over a large area and over a period of several years. Construction activities relating to the proposed and connected actions stationary source buildout would vary within and among four 2-year project phases, from 2019 through 2026. Construction emissions associated with the proposed action would occur from June through November of 2019 and involve the construction of the largest length of linear facilities (the proposed action) and have the largest disturbance area. The construction emissions for the proposed action are shown in Appendix C. Since construction would be occurring for such a short duration within each geographic area, it is assumed that direct air quality impacts would be less than construction activities resulting from construction of the connected actions and, thus, it is more conservative to assess construction-related impacts based on construction activities for the connected action.

Therefore, construction impacts to air quality and AQRVs are conservatively based on Phase A Activities that would occur from 2025 to 2026, disturb the greatest surface area, and include construction of a majority of the confined (or nonlinear) facilities and the greatest length of linear facilities associated with construction of the connected action. Annual direct construction-related emissions for the other connected action construction phases would be less. Construction-related emissions are presented in Appendix C for reference. Using the highest level of construction emissions during an annual period is appropriate for evaluating impacts with respect to ambient air quality and AQRVs since these effects are generally short-lived. Construction impacts to climate change due to GHG emissions will be discussed in the cumulative section.

The life-span and production of the existing field through CO_2 injection would be made possible through construction of the proposed action. Operation of the stationary sources constructed as part of the connected actions would be long-lived. Direct emissions would occur due to operation of stationary source equipment at EOR facilities and from fugitive emissions at the new well pads and test sites. Indirect emissions would result from the processing and combustion of additional fossil fuels recovered over the life of the field due to the EOR project. Should the project be approved, it is assumed that oil and gas development projected by BLM in the ARMP would include development to handle the processing of the additional EOR field production and, thus, these impacts are assessed as part of cumulative impacts for air quality and AQRVs. The impacts from fossil fuel combustion (end use) are considered when assessing GHG impacts since GHG emissions are not generally regulated directly at stationary sources. Exhibits 1–13 of the Air Resources Report (Appendix C) present estimated rates of air pollutant emissions that would result from field construction, operations, and crude oil use.

Air Quality and Air Quality-Related Values

The highest annual emissions due to construction-related activities throughout project buildout were used as a metric to evaluate impacts to ambient air quality. A summary of Phase A construction emissions of criteria air pollutant and HAP emissions is included in Table 1-1 and Table 1-2. It should be noted that these emissions represent the construction of multiple stationary connected action sources that would be dispersed over the connected action area.

Table 1-1. Criteria Air Pollutant Construction Emissions

Compound*	Source	Emission Rate (tpy)±
NO_x	On- and off-road equipment exhaust	17
CO	On- and off-road equipment exhaust	67
VOCs	On- and off-road equipment exhaust	8
SO_2	On- and off-road equipment exhaust	0.03
PM_{10}	Road Dust, Construction Disturbance, Wind Erosion, and On- and off-road equipment exhaust	6
$PM_{2.5}$	Road Dust, Construction Disturbance, Wind Erosion, and On- and off-road equipment exhaust	2

* NO_x = oxides of nitrogen, CO = carbon monoxide, VOC = volatile organic compound, SO_2 = sulfur dioxide, PM_{10} = particulate matter with a diameter less than 10 microns, $PM_{2.5}$ = particulate matter with a diameter less than 2.5 microns.

± maximum annual tons per year

Table 1-2. Hazardous Air Pollutants Construction Emissions

Compound	Source	Emission Rate (lb/yr)*
Benzene	On- and off-road equipment exhaust	102
Ethylbenzene	On- and off-road equipment exhaust	22
Formaldehyde	On- and off-road equipment exhaust	940
n-Hexane	On- and off-road equipment exhaust	14
Toluene	On- and off-road equipment exhaust	121
Xylenes	On- and off-road equipment exhaust	109

* maximum annual pounds per year

Criteria air pollutant and HAP emissions associated with operating the proposed CCA EOR Unit Development stationary recycle facilities, well pads, and test sites would largely be attributable to stationary point source emissions that are regulated at the state and federal levels. A summary of the maximum anticipated criteria air pollutant and HAP emissions from the operation of the connected actions is shown below in Tables 1-3 and 1 -4. It should be noted that these emissions represent the

operation of multiple stationary connected action sources which would be dispersed over the connected action area.

Table 1-3. Criteria Air Pollutant Operational Emissions

Compound*	**Source**	**Emission Rate (tpy)±**
NO_x	On-road traffic exhaust, enhanced oil recovery (EOR) facilities	53
CO	On-road traffic exhaust, EOR facilities	11
VOC	On-road traffic exhaust, EOR facilities, well pads and test sites	6
SO_2	On-road traffic exhaust, EOR facilities	1
PM_{10}	Road Dust, On-road traffic exhaust, EOR facilities	57
$PM_{2.5}$	Road Dust, On-road traffic exhaust, EOR facilities	287

* NO_x = oxides of nitrogen, CO = carbon monoxide, VOC = volatile organic compound, SO_2 = sulfur dioxide, PM_{10} = particulate matter with a diameter less than 10 microns, $PM_{2.5}$ = particulate matter with a diameter less than 2.5 microns.
± maximum annual tons per year

Table 1-4. Hazardous Air Pollutants Operational Emissions

Compound	**Source**	**Emission Rate (lb/yr)***
Benzene	On-road traffic exhaust, new well pad and test site equipment leaks	9
Ethylbenzene	On-road traffic exhaust, new well pad and test site equipment leaks	12
Formaldehyde	On-road traffic exhaust, new well pad and test site equipment leaks	28
n-Hexane	On-road traffic exhaust, new well pad and test site equipment leaks	1,045
Toluene	On-road traffic exhaust, new well pad and test site equipment leaks	26
Xylenes	On-road traffic exhaust, new well pad and test site equipment leaks	809
Hazardous Air Pollutants (not speciated) ±	Four (4) enhanced oil recovery injection facilities (permitted maximum potential total HAP emissions).	45,600

* maximum annual pounds per year
± Enhanced oil recovery facility emissions are presented as total combined facility HAP emissions.

A comprehensive discussion of air emission sources associated with the proposed and connected is provided in Section 5 of Appendix C. The project's proponents would be required to obtain an air quality permit from the MDEQ before commencing construction on each of four planned recycle facilities. The MDEQ would ensure that appropriate emissions controls would be used and that acceptable air quality impacts would result as a condition of issuing each permit. Additionally, affected stationary source equipment (such as wells, tanks, compressors, and equipment leaks) would be subject to the emission control, monitoring, and reporting requirements of NSPS [40 CFR Part 60, Subpart OOOOa].

Additionally, the proposed and connected action construction and operations would include implementation of the following measures to control emissions

- implementing dust abatement practices during construction and operation of the projects,
- using a closed-loop drilling technique to avoid venting during well completions, and
- using U.S. EPA Tier IV-certified drill rigs and electric motors to drive compression equipment associated with connected action facilities, and

The air analysis completed for the MCFO RMP included an ARTSD for Emission Inventories, Near-Field Modeling, and Visibility Screening (BLM 2014). Near-field modeling results within the ARTSD were used to evaluate impacts to air quality and to AQRVs that could potentially result from activities located at and near a generic well pad. The analysis was intentionally designed to model conservatively high impacts from operations representing a combination of sources at both oil and gas well pad sites. Construction and drilling activities at well pads for the connected action would be similar in type and scope to those included in the ARTSD. However, notable differences exist between connected action development and the generic well pad scenarios modelled in the ARTSD and the emission reduction measures discussed above would be implemented for the connected actions. Therefore, maximum construction and operational related emissions from the connected action would likely be less than the "generic well pad" scenario construction and operational-related emissions used in the ARTSD to assess near field impacts as further discussed below.

The generic well pad scenario includes a construction phase, which is based on the largest well pad type with the greatest possible disturbance areas. For the connected actions associated with this project, some of the well pads being developed already exist, which would not necessitate land clearing and reduce near-field fugitive dust emission impacts. Additionally, the modelled scenario assumptions include that drill or completion rigs have the greatest anticipated horsepower, drilling times, and emissions needed to complete drilling and completion activities. It is also assumed the wells would be fracked and that flaring would be required during completion. In contrast, Tier 4 engines during drilling or completion activities necessary for the connected action would be used and, further, some of the proposed EOR injection wells already exist, which would, therefore, not require drilling. An additional difference from the modeled generic well pad scenario is that the proposed wells that require drilling will not be injected with liquid at high pressure (fracked) and no venting or flaring would be required during their completion. Finally, unlike the typical wellhead scenarios modeled, during operation of the proposed facilities no flares, dehydrators, or boilers would be needed, and necessary compression equipment would be electric-powered, thereby eliminating the need for fossil fuel-powered compressor engines. Thus, it is safe to assume that the proposed and connected action impacts would be less than the modeled impacts in the ARTSD and PGM, which are discussed below.

The ARTSD and PGM include assessment of near field impacts to ambient air quality and visibility. Modeled worst-case criteria air pollutant concentrations resulting from evaluated scenarios were compared with the current NAAQS and MAAQS. In all cases, modeled impacts provided in the ARTSD and PGM were below the NAAQS and MAAQS. Modeled worst-case HAP concentrations were compared with relevant acute and chronic health-based thresholds. The resultant HAP concentrations presented in the ARTSD were below acute and chronic thresholds (BLM 2014). The ARTSD also evaluated aesthetic effects potentially resulting from field development activities near the Class I or sensitive Class II boundaries. Using the VISCREEN modeling program, near-field direct impacts of emissions from a theoretical drill rig were modeled to determine the degree to which an exhaust plume would be visible near a Class I or sensitive Class II area. Results of the VISCREEN modelling are listed in the ARTSD, Section 5.1, Table 22, and were well below Federal Land Manager guideline thresholds (BLM 2014). Additionally, the closest Class I area to the project areas is 50 miles, which is well outside the range used in the VISCREEN model (1 kilometer). As previously discussed, fugitive dust mitigation measures would be implemented during construction activities, and the operation of the connected actions

will require less equipment than the "typical well pad scenario." Therefore, it is safe to assume that since the visibility impacts from a point source modelled in the ARTSD would be acceptable, the proposed action and connected action's impacts to visibility would be minimal due to implementation of emission reduction measures and the relative distances involved. Thus, impacts to visibility associated with the proposed and connected actions would not alone be expected to cause significant impacts to visibility near a Class I area. A discussion of the far-field project impacts with respect to regional haze and other AQRVs is presented in the ARTSD and the PGM analysis and is discussed in more detail below in terms of cumulative impacts.

Climate Change

The GHG emissions potentially resulting from construction of the proposed and connected actions along with subsequent operation of the connected action stationary sources are presented in Appendix C and summarized below in the cumulative impacts discussion. The GHG emissions would also result indirectly from the processing and combustion of recovered crude oil (life cycle emissions). The quantified GHG emissions would be an indicator of the intensity of the proposed action's contribution to climate impacts. Impacts from the proposed and connected actions will be discussed in more detail within the context of cumulative impacts.

Emission Reduction Measures

Throughout the buildout of the proposed action and connected actions, various emission reduction measures will be implemented. The emission reduction measures implemented during construction of the proposed action and connected actions will include the mitigation of fugitive dust according to best management practices. These measures include applying water and/or non-toxic chemical dust suppressants, using wind fences, berms, or covering materials such as gravel or textiles, imposing speed limitations along all access roads during construction and maintenance activities. Construction equipment will also be maintained in good working order to minimize trace gas emissions (Denbury 2018a). Drilling activities associated with the connected action will not involve venting or flaring since a closed-loop drilling technique will be utilized. U.S. EPA Tier 4-certified drilling rigs would be used, and compression associated with operation of the stationary EOR facilities would be electric driven. Finally, Denbury will implement best available control technologies throughout project operations and comply with all federal and state emission-reduction requirements.

Cumulative Impacts

Air Quality and Air Quality-Related Values

Cumulative impacts to air quality and AQRVs would be derived from emissions associated with the proposed and connected actions, along with current and projected industrial activities within the region. These are evaluated and addressed with respect to criteria air pollutant and AQRV-related impacts in the ARTSD and as part of the PGM study (Ramboll Environ and Kleinfelder 2016)) that supplements and expands on the modeling results presented in the ARTSD and discloses potential air quality and AQRV impacts due to oil and gas activities within the BLM's jurisdiction. Based on the AERMOD (air dispersion model) results presented in the ARTSD and the CAMx (photochemical modeling system) results presented in the PGM study, no exceedances to NAAQS or MAAQS standards would occur in the future based on projected development in the area. As discussed previously, the nature and scope of the proposed and connected actions is similar to the scenarios evaluated in both the ARTSD and PGM; thus, no substantial cumulative impacts to ambient air quality would be expected to occur if the proposed and connected action projects were approved.

Cumulative impacts to regional haze and far-field visibility resulting from projected development within the MCFO RMP area are addressed in the ARTSD report, which presents CALPUFF modeling results. These results demonstrated acceptable impacts at Class I and sensitive Class II areas in the MCFO RMP area. However, the PGM study found that, based on cumulative impacts of reasonably foreseeable oil and gas development in the proposed and connected action area over the next 20 years, impacts to visibility and atmospheric deposition of nitrogen and sulfur were predicted. In response, the BLM has implemented an interagency study at Medicine Lake National Wildlife Refuge in northeastern Montana to monitor pollutants of concern to compare results against the predicted impacts from the PGM study. The PGM results do indicate potential cumulative impacts to AQRVs at Class I and II locations would likely result from 2032 levels of oil and gas development (as previously discussed in the context of a no action decision). However, the proposed projects would likely have negligible impacts since the closest Class I area is over 50 miles from the location of the proposed projects and the BLM and project proponents are implementing mitigation strategies to reduce emissions to be lower than those assumed in the PGM scenarios.

Climate Change

Appendix C quantifies the GHG emissions that would result from the proposed and connected actions and includes emissions calculated based on construction, operation, and indirect GHG emissions resulting from fossil fuel combustion of the recovered oil throughout the entire project lifespan. Appendix D shows existing and reasonably foreseeable direct and indirect sources of GHG emissions in the MCFO planning area as well as downstream emissions from the combustion of fossil fuel resources extracted from the MCFO planning area. The GHG emission levels serve as an indicator of the potential intensity of climate effects. For reference, Table 1-5 summarizes the annual GHG emissions from the proposed and connected actions, the state of Montana[5], the RMP Area, the United States, and globally in million metric tons CO_2e per year based on 100-year GWPs.

Table 1-5. Greenhouse Gas Emission Comparisons

Scale	**Emission Rate Carbon Dioxide Equivalent (million metric tons/year)**
Proposed and Connected Actions	5.0
Montana	21.1
RMP Area	98.5
United States	6,511
Global	54,000

[5] The GHG emissions shown for Montana are based on greenhouse gas emissions from large industrial facilities from the U.S. EPA's website, which includes emissions only for facilities subject to the mandatory greenhouse gas reporting requirements of 40 CFR Part 98.

The GHG emissions presented above are quantified as CO_2e emissions. Calculations of CO_2e emission rates combine CO_2, CH_4, and N_2O emissions into a single value considering the respective climate change effects from each pollutant. The emissions from both the proposed and connected actions, as well as reasonably foreseeable potential development projects in the MCFO RMP area, are quantified in their respective appendices (C and D) based on both the 20- and 100-year GWP values to determine CO_2e, but they are shown above only based on 100-year GWP for easy comparison with the emissions resulting across other geographic scales. The 100-year timescale is used widely as a default metric, but the 20-year horizon is also included for illustrative purposes because the 20-year GWP is slightly higher for methane compared with the 100-year value. This is because methane has only a 12-year residence time in the atmosphere and thus is a more potent GHG on shorter timescales (IPCC 2013). The calculated difference in CO_2e emissions based on the 20- and 100-year GWPs were minimal for the proposed and connected actions as well as for the RMP area. The relative intensity of proposed and connected action and MCFO RMP area impacts can be assumed to be proportional to their relative magnitudes of GHG emissions since climate change impacts result from the atmospheric buildup of GHGs, which are eventually distributed throughout the atmosphere (IPCC 2013). The GHG emissions from the proposed action and the MCFO RMP area would both contribute to climate change impacts on local, regional, and global scales as discussed in the Affected Environment section.

The proposed and connected action's GHG emission increases represent approximately 5% of the emissions expected to result from all MCFO resource development contributions. As previously mentioned, the MCFO RMP area emissions are 1% and 0.2% of U.S. and global GHG emissions, respectively.

Results are also presented below in Table 1-6 based in terms of GHG equivalency metrics. The EPA's GHG equivalency calculator reports passenger vehicles at 4.67 metric tons CO_2e/yr and homes at 9.26 metric tons CO_2e/yr (U.S. EPA 2018c). Comparison of the impacts resulting from maximum annual GHG emissions (including direct emissions, indirect emissions, and resource life cycle emissions) from the proposed and connected actions and the MCFO RMP area in these terms is useful to gain additional perspective and understand the magnitude of the metric ton results presented in Table 1-5 above in everyday terms.

Table 1-6. Greenhouse Gas Emission Comparisons in terms of Greenhouse Gas Equivalency

Scale	Number of Additional Cars/Year	Number of Additional Houses/Year
Proposed and Connected Actions	1,076,611	542,956
RPM Area	21,092,077	10,637,149

Efforts to combat global climate change impacts, including mandatory reporting requirements for specific source types and industries and NSPS rules to control methane emissions (40 CFR Part 60 Subpart OOOOa), would be implemented by sources of GHG emissions within the MCFO planning area, including the proposed and connected actions.

Resource Issue 2 (Cultural Resources)

Affected Environment

The analysis area (herein referred to as the APE, or Area of Potential Effects [see SHPO consultation section in Chapter 1]), consists of the proposed action project area and cultural resource survey boundaries, as well as all related previous adequate surveys, existing surface disturbance, and previous cultural resource site information. The APE means the geographic area or areas within which an undertaking may directly or indirectly cause alterations in the character or use of historic properties, if any such properties exist. The APE is influenced by the scale and nature of an undertaking and may be different for different kinds of effects caused by the undertaking. These areas were identified to facilitate analysis of impacts and effects to cultural resources specific to the undertaking. The APE is 7,735 acres. Class III inventories conducted by SWCA Environmental Consultants (SWCA) covered 3,674.3 of those acres (Burnett et al. 2015; Kennedy et al. 2017) and 6.44 acres were covered by the BLM Class III inventory (Truesdale 2018). Previous adequate surveys and existing disturbance areas account for 3,393 acres. Although the cumulative cultural resource effects area for the connected action is considered in this analysis, the related cultural resource affected environment and direct and indirect impacts are not addressed in this EA or the PA (Appendix B). The effects associated with development of the connected action would be addressed as surveys and impact analysis are completed during the APD and approval process.

There are 145.99 acres of BLM, state, and private lands in the APE that require additional cultural resource investigations. There are 70 total cultural resources sites that are either newly recorded/revisited or identified within the APE. Of those, 48 sites are indicated as not eligible for listing on the NRHP and 16 sites within the APE will not be impacted by the proposed action. The remaining six sites are addressed as follows

- 24FA0832, the Chicago, Milwaukee and St. Paul Railway is considered eligible for the NRHP;
- 24FA0888, U.S. Highway 12, is unevaluated for its eligibility;
- 24CT0803, a prehistoric lithic scatter, has unresolved eligibility;
- 24FA0407, a prehistoric material concentration, is undetermined for the NRHP; and
- 24CT0887 and 24CT889 are prehistoric material concentrations recommended by the BLM as not eligible for NRHP nomination.

Environmental Impacts - Alternative A (No Action)

Under the no action alternative, the proposed action would not proceed. Therefore, there would be no effects to historic properties.

Cumulative Impacts

Under the no action alternative, the proposed and connected actions would not be constructed; therefore, no cumulative impacts would occur. Existing land uses, including current and proposed oil and gas development, would continue as well as the current and anticipated implementation of resource protections.

Environmental Impacts - Alternative B (Proposed Action)

The proposed action would impact 50 cultural sites. None of these sites are eligible for listing on the NRHP. There would be no adverse effect to historic properties through development of the proposed action. None of the four sites that are or may have potential to be eligible for the NRHP (24FA0382, the Chicago, Milwaukee and St. Paul Railway; 24FA0888, U.S. Highway 12; or 24FA0803 and 24FA0407,

each a lithic scatter) would be adversely affected by the proposed action. Specific design measures, engineering standards, and construction methodology are in place relative to 24FA0888 and 24FA0382, which address impacts to the properties resulting in no adverse effect (Denbury 2018a).

Mitigation

The PA (Appendix B) addresses how inventories would be conducted on the 145.99 acres of BLM, state, and private lands to meet the BLM's requirements. The PA also addresses the additional identification of cultural properties that includes recordation and evaluation of one historic site and provides additional detailed context information for 24FA0888, where the site is crossed by the pipeline (36 CFR 800.4). The Denbury CO_2 Pipeline Treatment, Monitoring, and Unanticipated Discoveries Plan in the POD provides for unanticipated discoveries and the requirement of additional site-specific monitoring and information addressing the BLM's responsibilities under the NHPA specifically related to the implementing regulations found in 36 CFR 800. On May 7, 2018, the SHPO concurred with the BLM's recommendations and Determination of No Effect to historic properties within the APE for the proposed action, including the proposed PA and treatment and monitoring plan.

No additional mitigation measures are identified for the proposed action. Site-specific cultural resource mitigation measures for the connected action would be determined on a case-by-case basis upon review of individual applications and applied as conditions of approval.

Cumulative Impacts

The authorization of the proposed action would contribute to 50 sites being impacted, disturbed, or destroyed, none of which are eligible for the NRHP or would contribute to cumulative adverse effects to historic properties. The authorization of the proposed action would allow for the development of the connected action in the three units. The three units encompass 44,489 acres with 150 known recorded cultural sites within their boundaries. The connected action units have a site density of one site per 296.95 acres. The reasonable foreseeable development model indicates that 162.38 total acres comprised of 114.95 acres from roads, pipelines, power lines, etc. and 47.43 acres from other surface disturbance would be the disturbance from new well drills. Approximately 25% of the mineral estate in the three unit boundaries is federal minerals, with 14 of the foreseeable wells potentially having federal involvement. The 162.38 acres of disturbance-related federal undertakings by the connected action may have the potential to effect one site (Appendix A and https://eplanning.blm.gov). The MCFO RMP area has a site density of one site per 96.6 acres, which indicates that one to two sites, which may or may not be eligible for the NRHP, may be impacted with the area of the connected action. Each of these undertakings would be handled on a case-by-case basis using the Montana State Protocol for implementing the BLM's National Programmatic Agreement for meeting it responsibilities under the NHPA.

Cumulative impacts to cultural resources would be the greatest in Fallon County, Montana, as the proposed action, connected action, five APDs in the CCA, and Keystone XL Pipeline would contribute to further development of this county. However, impacts from a portion of the proposed action, connected action, and the five APDs in the CCA would occur in the same area or close to it.

Resource Issue 3 (Socioeconomic Resources)

Affected Environment

The affected environment includes portions of Powder River, Carter, and Fallon Counties, Montana. The majority (approximately 78 miles) of the 110-mile CCA CO_2 Pipeline project would traverse Carter County. The smallest portion (less than three miles of the pipeline) would be in Powder River County. Approximately 30 miles of the pipeline would be in Fallon County. Carter County is described as

picturesque and is known for ranching and farming. It covers an area of 3,341 square miles and had a population estimate of 1,222 people in 2017; the population per square mile in 2010 was 0.3. Fallon County covers an area of approximately 1,621 square miles and had a population estimate of 3,009 in 2017. The population per square mile in 2010 was 1.8. Powder River County covers 3,297 square miles and had a 2017 population estimate of 1,752. The 2010 population per square mile was 0.5 (U.S. Census Bureau 2018).

Fallon County is known for its oil and gas reserves and has experienced decades of oil and gas development. Montana Board of Oil and Gas Conservation data indicate that in 2016, 3,573,891 barrels (BBLs) of crude oil and 6,765,524 thousand cubic feet of natural gas were produced in Fallon County (MBOGC 2018a). Carter County produced 15,184 BBLs of crude oil and no natural gas in 2016 (MBOGC 2018b). Powder River County produced 1,359,788 BBLs of crude oil and no natural gas in 2016 (MBOGC 2018c).

Bureau of Labor Statistics data (2018) indicate that in 2016 there were 250 mining, including oil and gas extraction, jobs in Fallon County in 20 establishments, which paid $23,300,000 in total wages. Average annual pay for these jobs was $93,078. No mining jobs were disclosable in Bureau of Labor Statistics data for Carter or Powder River Counties in 2016 (Bureau of Labor Statistics 2018).

Past research on social impacts associated with energy development shows that social well-being often decreased during a boom but then tended to increase once the boom was over. A comparative and longitudinal study conducted in Delta, Vernal, and Tremonton, Utah, and Evanston, Wyoming, addressed issues of social well-being in boomtowns (Brown et al. 1989; Brown et al. 2005; Greider et al. 1991; Hunter et al. 2002; Smith et al. 2001). With the exception of Tremonton, each of these communities experienced a boom during the late 1970s and early 1980s. Delta's boom resulted after the construction of a power plant while the booms in Evanston and Vernal were primarily related to oil and gas development. At least four surveys were conducted in these communities from 1975 to 1995. Several indicators of social well-being were examined, including perceived social integration, relationships with neighbors, trust of community residents, and community satisfaction. Delta and Evanston showed similar patterns associated with these indicators. During the peak boom years, residents experienced diminished perceived social integration, relationships with neighbors, trust of residents, and community satisfaction. Interestingly, Brown and others (2005) pointed out that the greatest declines in community satisfaction in Delta occurred just before the largest population increase of the 20-year study period, indicating that changes in population cannot alone account for shifts in community satisfaction and social integration. Nonetheless, by 1995, the levels of these indicators had returned to or exceeded pre-boom levels.

Another 2011 study highlights several of the changes that have been seen across the Bakken oil counties and the impacts to quality of life (Bohnenkamp et al. 2011). For example, the study highlights that the familiarity of residents with other residents and the safety often felt in small rural communities shifted, with safety concerns resulting from the in-migration of new people and not knowing these people. The study also highlights concerns over housing prices and increasing values and the changing of the population. While there is an in-migration of people for oil field jobs, there has also been an out-migration of long-time residents due to not being able to afford the rising housing costs (Bohnenkamp et al. 2011).

The proximity of oil and gas wells and related facilities can influence nearby residential property sales, especially those on split estate land; landowners who do not own the mineral rights to their land may be subject to federal mineral development on their land. Usually, these landowners enter into a surface use agreement and receive compensation (i.e., income) for the use of their land. Estimates of how individual properties are affected by nearby oil and gas development vary from case to case depending on specific location and the exact character and features of a property.

Several studies published in the past several years have attempted to estimate how property values are impacted by nearby oil or gas exploration, drilling, and production. See Krupnick and Echarte (2017) for a summary of recent studies. In general, these studies find that, at the time of sale, the presence of oil and gas wells near the property reduces the property value relative to what it would have sold for without a nearby well. Unfortunately, the explicit and implicit assumptions used in these estimates (such as the maximum distance for a "nearby well") vary a great deal from study to study, as does the size of the price impacts, which range from 0 to negative 37%.

Current research also doesn't provide much guidance on how long these price impacts persist. In a study in Weld County, Colorado, Bennett and Loomis (2015) estimate a 1% decrease in urban house prices for every well being drilled within 0.5 mile "during the time the buyer is deciding upon buying the house," but "(o)nce the well moves out of active drilling and into becoming a producing well, all our models show there is no statistically significant negative effect on house prices" (p. 1181, 1184).

Environmental Impacts - Alternative A (No Action)

Under the no action alternative, the proposed action would not proceed. The current local economic conditions would likely continue under current trends. No long-term employment, sales taxes, property taxes, or mineral royalties would be generated by the proposed action or connected action. Oil production in Carter, Fallon, and Powder River Counties and gas production in Fallon County would be expected to continue.

The rural setting, including ranching and agriculture, likely would continue at current levels. Social impacts associated with ongoing oil and gas production still would occur. This ongoing oil and gas exploration, drilling, or production would potentially inconvenience people through increased traffic and traffic delays, noise, and visual impacts. These impacts would be particularly noticeable in rural areas where oil and gas development has not occurred previously. The level of inconvenience would depend on the activity affected, traffic patterns within the area, noise levels, the length of time and season in which these activities occurred, and other factors.

Cumulative Impacts

Under Alternative A, the projects would not be constructed; therefore, these actions would not contribute to cumulative impacts in the future. The cumulative impacts would be similar to those described above under the no action alternative.

Environmental Impacts - Alternative B (Proposed Action)

Construction and operations associated with the proposed action and connected action would result in direct impacts by increasing employment and tax revenue, as discussed in the following paragraphs. Sales taxes would be collected on indirect spending for construction materials and on induced spending from workers buying items. The construction of the proposed action is projected to have a direct economic impact of $100 million over a 6-month period, from June to December (Denbury 2018c). The secondary economic impacts of the CCA CO_2 Pipeline project are estimated to be $17.5 million, for a total economic impact of $117.5 million over the 6-month construction period. The total economic activity would support a projected 490 direct and secondary jobs and generate an estimated $32.4 million in direct and secondary labor income. The average earnings per job over the life of the project are estimated to be $66,173 (IMPLAN 2018).

The development of the 408 wells anticipated as part of the connected action would be projected to have an average direct economic impact of $26.7 million per year from the development of an average of 51 wells per year over the 8-year development period. The secondary economic impacts of the well

development project are estimated to be $5.3 million annually, for a total economic impact of $32.0 million annually over the life of the project. The total economic activity would support a projected 207 direct and secondary jobs and generate an estimated $13.4 million in direct and secondary labor income. The average earnings per job over the life of the project are estimated to be $64,526 (IMPLAN 2018).

The connected action would be projected to produce an average of 5.4 million barrels of oil annually over the life of the project (Denbury 2018c). At $60 per barrel, the direct economic impact from this production would be $324.0 million annually over the life of the project. Adding in the additional direct economic impact from the operation of the CCA CO_2 Pipeline brings the total direct economic impact to $324.3 million. The secondary economic impacts from the operation of the pipeline and connected action are estimated to be $8.1 million, for a total economic impact of $332.4 million. The total economic activity would support a projected 54.6 direct and secondary jobs and provide an estimated $3.8 million in direct and secondary labor income. The average earnings per job are estimated to be $70,198 (IMPLAN 2018). Annual tax revenues are projected to be $726,000 from the pipeline, $22.3 million from severance and ad valorem taxes, $421,200 in federal mineral royalties to the federal government, and $388,800 in federal mineral royalties to the state government (Denbury 2018c).

The total direct economic impact from the development of the connected action (not including pipeline construction) over the 8-year development timeframe is projected to be $213.3 million. The total secondary economic impacts for well development are estimated to be $42.4 million, for a total economic impact of $255.9 million. The total economic activity would support a projected 1,658 job-years (207 jobs, 8 years) of direct and secondary employment and generate an estimated $107.0 million in direct and secondary labor earnings (IMPLAN 2018). The total production (at 5.4 million barrels annual average) would be projected to be 270 million barrels of oil over the 50-year life of the project (Denbury 2018d). The total direct economic impact from the production and operation of the proposed action is projected to be $16.2 billion. The total secondary economic impacts from operation of the connected action are estimated to be $404.1 million, for a total economic impact of $16.6 billion. The total economic impact from the operation of the unit would support a projected 2,730 job-years of direct and secondary employment and provide an estimated $191.6 million in direct and secondary labor earnings. Total tax revenues are projected to be $36.3 million from the pipeline, $1.1 billion from severance and ad valorem taxes, $21.1 million in federal mineral royalties to the federal government, and $19.4 million in federal mineral royalties to the state government.

Although oil and gas development already occurs in the three counties, additional development could put stress on community services and impact people living near or using the area in the vicinity of the development. As discussed under the no action alternative, oil and gas exploration, drilling, or production would potentially inconvenience these people through increased traffic and traffic delays, noise, and visual impacts. These impacts would be particularly noticeable in rural areas where oil and gas development has not occurred previously. The level of inconvenience would depend on the activity affected, traffic patterns within the area, noise levels, the length of time and season in which these activities occurred, and other factors. Another concern with additional development and production is the creation of new access roads which could potentially allow increased public access and exposure of private property to vandalism.

Mitigation

No additional mitigation measures are identified for the proposed action. More site-specific socioeconomic mitigation measures for the connected action would be determined on a case-by-case basis upon review of individual applications and applied as conditions of approval.

Cumulative Impacts

Because the majority of the proposed action construction would occur over a period of 6 months in Carter County, the county is predominantly rural with ongoing ranching and agriculture, and no additional federal actions are proposed in this area, the cumulative socioeconomic impacts of the proposed action would be similar to the impacts described above under Alternative B. The cumulative socioeconomic impact of the proposed and connected actions, in addition to the proposed and ongoing oil and gas development, would be an increase of approximately 55 jobs for the 50-year life of the project over the 250 mining (including oil and gas) jobs reported for Fallon County in 2016. Assuming (for purposes of demonstration) that at least 200 of those mining jobs reflect oil and gas jobs, that would be an approximately 27 percent increase in oil and gas jobs in Fallon County. The development of the proposed and connected actions, in addition to ongoing oil production in Fallon County, would mean an increase of approximately 1.5 times the stated annual production of 3.6 million barrels of oil that was produced in Fallon County in 2016. The cumulative average annual production, if the 2016 production in Fallon County was to continue through the CCA CO_2 Pipeline and EOR Unit Development projects, would be 9 million barrels per year.

Resource Issue 4 (Wildlife Resources)

Affected Environment

The analysis areas for greater sage-grouse and raptors vary, but both extend beyond the project areas because these species are mobile and impacts from the proposed and connected actions can extend beyond the limits of the project areas. For this undertaking, the analysis area for greater sage-grouse is a 3.1-mile buffer on the project areas; for raptors it is a 0.5-mile buffer on the project areas.

The predominant wildlife habitat types occurring within the project areas include grassland (58% of the project areas), sagebrush shrubland (24%), and agricultural lands (7%) (LANDFIRE 2015). Within the CCA CO_2 Pipeline project area, grassland habitats account for 916 acres, shrublands for 325 acres, and agricultural lands for 110 acres. Within the CCA EOR Development Unit project area, grassland account for 828 acres, shrubland for 396 acres, and agricultural lands for 106 acres. Limited areas of riparian and wetland vegetation scattered throughout the project areas also provide wildlife habitat. Topographic relief varies from flat to rolling with occasional sections of steep terrain. Cliffs are present in some parts of the project areas, particularly along the southern extent of the CCA CO_2 Pipeline.

The grassland vegetation cover type is composed primarily of mixed-grass prairie with small percentages of shrubs and forbs. Grass species in the project areas include cool and warm season grasses such as western wheatgrass (*Pascopyrum smithii*), bluebunch wheatgrass (*Pseudoroegneria spicata*), green needlegrass (*Nassella viridula*), Sandberg's bluegrass (*Poa secunda*), prairie Junegrass (*Koeleria macrantha*), and blue grama (*Bouteloua gracilis*) (SWCA 2015). Forbs include prairie clovers (*Dalea* spp.), American vetch (*Vicia americana*), winterfat (*Krascheninnikovia lanata*), and scurfpeas (*Psoralidium* spp.). Shrubs, including Wyoming big sagebrush (*Artemisia tridentata* ssp. *wyomingensis*), silver sagebrush (*Artemisia cana*), and saltbushes (*Atriplex* spp.), are present in small numbers.

The shrubland vegetation cover type is primarily composed of Wyoming big sagebrush shrubland communities. Common shrub species in this habitat type may also include rubber rabbitbrush (*Ericameria nauseosa*), yellow rabbitbrush (*Chrysothamnus viscidiflorus*), and saltbushes. Common native graminoid species can include Indian ricegrass (*Achnatherum hymenoides*), blue grama, thickspike wheatgrass (*Elymus lanceolatus*), needle and thread grass (*Hesperostipa comata*), basin wildrye (*Leymus cinereus*), western wheatgrass, and Sandberg's bluegrass (LANDFIRE 2015; NatureServe 2009).

Agricultural lands in the project areas are predominantly hay fields consisting of alfalfa (*Medicago sativa*) or a mixture of cultivated grass species (e.g., crested wheatgrass [*Agropyron cristatum*], intermediate wheatgrass [*Thinopyrum intermedium*], and tall wheatgrass [*Thinopyrum ponticum*]) and alfalfa. Hay fields are harvested one or multiple times per year. Other common crops grown in the area include barley (*Hordeum vulgare*), spring wheat (*Triticum aestivum*), sugar beets (*Beta vulgaris*), safflower (*Carthamus tinctorius*), and canola (*Brassica* sp.) (LANDFIRE 2015).

Greater Sage-Grouse (*Centrocercus urophasianus*)

Greater sage-grouse is a sagebrush-obligate species that requires continuous sagebrush-dominated habitats. Greater sage-grouse also forage in riparian, wet meadow, and hay fields during the spring and summer nesting and brood-rearing seasons and are dependent on mature sagebrush stands for forage and shelter in winter (Connelly et al. 2004). Occupied habitat in Montana includes the sagebrush steppe of western North America, and greater sage-grouse distribution closely follows that of sagebrush, primarily big sagebrush (Montana Sage Grouse Work Group 2005). In addition to mature sagebrush, greater sage-grouse require an understory of grasses and forbs. In eastern Montana, where close interspersion of wintering, nesting, breeding, and brood-rearing habitats exist, greater sage-grouse are essentially nonmigratory (BLM 2015a).

To assess greater sage-grouse habitat within the analysis area, a GIS-based habitat quantification tool (HQT) was used, which consists of a three-level assessment (Johnson 1980). Similar multilevel approaches have also been used to evaluate greater sage-grouse habitat use and quality in Montana (Doherty 2008; Montana Sage Grouse Work Group 2005). The HQT quantified differences in habitat quality consistent with greater sage-grouse habitat use on the landscape. Baseline habitat services, the value of the greater sage-grouse habitat prior to project initiation, were mapped for the project area. The lowest possible habitat service score is 0, and the highest possible habitat service score is 100. The project has been sited in areas of existing disturbance to avoid higher quality greater sage-grouse habitat (see Figures 5 and 6 in Appendix K of the CCA CO_2 Pipeline POD [Denbury 2018a]). The majority of the baseline functional acres in the project HQT assessment area, based on a 500-foot buffer of all project disturbance within core or general habitat, have a low HQT value, indicating that the area consists primarily of marginal to unsuitable sage-grouse habitat.

Approximately 209.9 acres of General Habitat Management Area, 519.9 acres of Priority Habitat Management Area, and 101.2 acres of Restoration Habitat Management Area are present within the CCA CO_2 Pipeline analysis area. Approximately 1,109.4 acres of General Habitat Management Area and 630.1 acres of Restoration Habitat Management Area are present within the CCA EOR Unit Development analysis area. See Appendix K, CCA CO_2 Pipeline Project Greater Sage-grouse Mitigation Planning Approach (August 2018) for definitions of the various habitat management areas for greater sage-grouse.

Greater sage-grouse population declines are primarily due to habitat loss, habitat fragmentation, and reduced habitat quality resulting from energy development, urban expansion, conversion of habitats to agriculture, and alteration of habitats by invasive species that reduce habitat quality by reducing herbaceous forage and/or increasing the frequency and intensity of ground fires (USFWS 2013). Other threats include limited distribution, predation, and fences (Connelly et al. 2004).

Leks are open areas where strutting male grouse congregate on or near the lek location to compete for mating opportunities. Greater sage-grouse leks are typically in the same location every year, with some leks persisting for over 85 years. Leks often occur in complexes, with one or more primary leks occurring near other lek locations that support fewer males (Connelly et al 2011). Some shifting of lek locations has been observed, potentially caused by persistent disturbance and/or alteration of vegetative cover (Connelly et al. 2011; Holloran 2005; Walker et al. 2007). It is surmised that the most important factor affecting a lek location is the proximity to and configuration and abundance of nesting habitat (Connelly

et al. 2011; Connelly et al. 2000). Lek habitat is not considered limited to greater sage-grouse populations (Connelly et al. 2011) but is rather indicative of the location of high-quality nesting habitat and may change if the quality of that particular nesting habitat declines. It is thought that the most important factors for increasing greater sage-grouse populations are nest success, chick survival, and female survival (Taylor et al. 2012). Therefore, maintaining high-quality nesting and brood-rearing habitats is the more essential component of maintaining or increasing populations. Based on Montana Fish, Wildlife and Parks lek definitions, a total of 47 lek locations are within the analysis area, of which 31 are confirmed active, nine are confirmed inactive, six are unconfirmed, and one is confirmed extirpated. For the purpose of the impact analysis, only confirmed active leks were used, as these are locations where greater sage-grouse are known to occur. Fifteen confirmed active leks are within the CCA CO_2 Pipeline analysis area and 11 confirmed active leks are within the CCA EOR Development Unit analysis area. An additional five confirmed active leks are within both analysis areas.

Raptors

Raptor species that could occur within the analysis area are those primarily associated with open grasslands, but a variety of habitats are used for nesting, foraging, and roosting. Nesting and roosting sites occur in the few areas of trees scattered throughout the riparian areas and on the elevated terrain more common in the analysis area. Foraging areas are abundant in the grassland and shrubland habitats within the analysis area. Raptor species that could occur in the analysis area include American kestrel (*Falco sparverius*), bald eagle (*Haliaeetus leucocephalus*), burrowing owl (*Athene cunicularia*), golden eagle (*Aquila chrysaetos*), great horned owl (*Bubo virginianus*), ferruginous hawk (*Buteo regalis*), merlin (*Falco columbarius*), northern harrier (*Circus cyaneus*), peregrine falcon (*Falco peregrinus*), prairie falcon (*Falco mexicanus*), Swainson's hawk (*Buteo swainsoni*), red-tailed hawk (*Buteo jamaicensis*), rough-legged hawk (*Buteo lagopus*), and short-eared owl (*Asio flammeus*) (Montana Natural Heritage Program and Montana Fish, Wildlife and Parks 2018; SWCA 2015). The BLM-listed sensitive raptor species with potential to occur in the analysis area are bald eagle, burrowing owl, golden eagle, ferruginous hawk, and peregrine falcon. Raptor species documented within the analysis area include burrowing owl, golden eagle, great horned owl, ferruginous hawk, northern harrier, prairie falcon, red-tailed hawk, short-eared owl, and Swainson's hawk (SWCA 2015, 2016, 2017).

Raptor nest surveys were conducted in the analysis area in 2016, 2017, and 2018 (SWCA 2016, 2017, 2018). A historical nesting records review indicated that 17 nesting locations were present in the analysis area, but nesting information for these locations was more than 10 years old. Nine of the 17 nest records were not located or marked as "nest gone" during the multiyear survey effort and, therefore, are not included in this analysis. Species documented nesting in the analysis area include great horned owl, golden eagle, ferruginous hawk, red-tailed hawk, and an unknown raptor species. Two raptor nests (unknown raptor species – UNRAA06S56E1301 and golden eagle-R9BFA001) within the 0.5-mile analysis area were documented as active status in 2018.

Environmental Impacts - Alternative A (No Action)

Under Alternative A, the BLM would not approve the SF-299 application and would not issue a ROW grant and TUP. Without the proposed action to service the connected action, Denbury would be unable to develop the connected action as proposed. Therefore, no construction or reclamation activities would be conducted for the proposed and connected actions and no impacts to greater sage-grouse habitat, leks, or raptor nests would occur.

Cumulative Impacts

Under Alternative A, the proposed and connected actions would not be constructed; therefore, no cumulative impacts would occur. Existing land uses, including current and proposed oil and gas development, are expected to continue, as is the current and anticipated implementation of resource protections.

Environmental Impacts - Alternative B (Proposed Action)

Under Alternative B, the BLM would approve the SF-299 application and would issue a ROW grant and TUP. With construction and operation of the proposed action, Denbury would be able to develop the connected action as proposed. Therefore, construction and reclamation activities would be conducted for the proposed and connected actions. Impacts to greater sage-grouse habitat, leks, and raptor nests are analyzed below.

Applicant-committed resource protections, as outlined in the associated CCA CO_2 Pipeline POD (Denbury 2018a) and CCA EOR Unit Development POD (Denbury 2018b), would greatly minimize local and regional impacts to greater sage-grouse habitat, leks, and raptors by maintaining the functionality of lekking/nesting habitats and lek/nest sites. The applicant-committed resource protection measures for the proposed and connected action include

- timing construction and reclamation activities to occur at the end of the raptor breeding season and outside the grouse lekking and brood-rearing times;
- co-locating activities to prior or current disturbances, conducting reclamation activities concurrent with construction activities, using seed mix suited for the ecological site description and including Wyoming big sagebrush;
- monitoring reclamation activities and vegetation;
- managing noxious weeds; and
- providing compensatory mitigation as required by the State of Montana Sage Grouse Habitat Conservation Program (https://sagegrouse.mt.gov/).

Additional applicant-committed resource protection measures specifically for the proposed action include: not placing pipeline markers within 0.6 mile of an active lek, placing aerial markers every 3 miles instead of every mile within greater sage-grouse habitat, and conventional boring of perennial streams.

Greater Sage-Grouse (*Centrocercus urophasianus*)

Impacts from the proposed action to greater sage-grouse lek areas are not anticipated. Impacts to nesting, wintering, and brood-rearing habitats through construction activities and habitat loss would be mitigated through the committed protection measures listed above. Large portions of the proposed action would occur in existing ROWs, thus minimizing habitat fragmentation, as outlined in Table 4-1. However, where the proposed action would be constructed in new areas, temporary habitat fragmentation and degradation would occur. Reclamation activities, including habitat restoration and the elimination of anthropogenic disturbance activities the following year, would occur at the completion of construction and would minimize habitat impacts within the CCA CO_2 Pipeline ROW. Habitat conversion would occur in shrubland areas, as reclamation would reclaim these areas to the grassland habitat type.

Table 4-1. Project Disturbance Summary

Project Disturbance	PHMA*	GHMA*	RHMA*	Nonhabitat
CO_2 Pipeline Disturbance – Collocated (acres)	514.97	116.30	57.11	560.70
CO_2 Pipeline Disturbance – Non-collocated (acres)	4.93	93.61	44.09	21.11
EOR Existing Disturbance (acres)	0.00	105.14	77.07	0.00
EOR New Temporary Disturbance (acres)	0.00	822.24	485.85	0.00
EOR New Permanent Disturbance (acres)	0.00	182.07	67.18	0.00

* PHMA = Priority Habitat Management Area, GHMA = General Habitat Management Area, RHMA = Restoration Habitat Management Area

Denbury has committed to compensatory mitigation as required by the State of Montana Sage Grouse Habitat Conservation Program. The mitigation measures would meet state requirements to offset impacts to greater sage-grouse habitat using a perpetual conservation easement and removing infrastructure from a nearby existing gas field to regain habitat quality. The Ringling Ranch conservation easement would provide 4,443 acres of high-quality greater sage-grouse habitat in perpetuity while the Hammond Field project will restore and protect a 15,856-acre former gas field located in RHMA and Core Area. These two projects would maintain and restore functional habitat at a landscape scale for the greater sage-grouse Yellowstone Watershed population.

Raptors

Within the proposed action, in the event of a late-nesting raptors, increased human activity, traffic, noise, and a change in the visual environment could have localized impacts on raptor behavior, including avoidance or changes in habitat use and possible abandonment of eggs and/or young. In addition, if construction and reclamation activities of the proposed action occur while the golden eagle nest (R4AFA001) is active during nesting time period, this could also result in nest abandonment.

Impacts from the Connected Action

For the connected action, 30% would be constructed in existing disturbance areas, so impacts to raptor and greater sage-grouse habitats from construction activities in these areas are not anticipated. Additionally, installation of some new pipelines for existing wells would occur within existing disturbance corridors. However, in the remaining areas where new wells and associated infrastructure would be constructed, conversion of habitat would occur, resulting in habitat degradation and loss. The increase in well density and disturbance has also shown negative impacts on lek attendance (Green et al. 2017). Increased human activity, traffic, noise, light pollution, and change in the visual environment during construction activities would have localized impacts, including avoidance of areas or shifts in the lekking and nesting behaviors of greater sage-grouse and raptors. Change in the visual landscape could also cause some raptors to avoid areas within and in the vicinity of the CCA EOR Unit Development, but most species that are known to nest in this area are generally tolerant of these types of activities and would still nest in the area. Reclamation activities would provide benefits by restoring disturbed areas more quickly to the native grassland habitat type and would minimize the introduction and colonization of invasive vegetative species. Restored habitats would provide foraging areas for greater sage-grouse and nesting raptors in the short term, and over the long term, habitat function would be restored, providing for a variety of uses by greater sage-grouse and raptors.

Mitigation

Denbury has committed to compensatory mitigation as required by the State of Montana Sage Grouse Habitat Conservation Program. The mitigation measures would meet state requirements to offset impacts to greater sage-grouse habitat using a perpetual conservation easement and removing infrastructure from a nearby existing gas field to regain habitat quality.

To mitigate impacts to golden eagle nest R4AF001, CCA CO_2 Pipeline construction and reclamation activities would not occur within 0.5-mile of the active nest between March 1 and July 31 if golden eagle nest R4AFA001 is active and within line-of-sight of the CCA CO_2 Pipeline activities. Timing end date may be adjusted with BLM approval if nest activity/occupancy, monitored by a BLM-approved biologist, indicate completion of nesting activities or failure has occurred. If the active nest is not in line-of-sight or topographic features reduce or eliminate potential impacts to the active nest, the construction and reclamation activities could occur with BLM approval.

More site-specific mitigation measures for the EOR Unit Development would be determined on a case-by-case basis upon review of individual applications and applied as conditions of approval. Mitigation measures would be implemented to avoid and minimize impacts from construction and reclamation activities to greater sage-grouse habitats, leks, and raptor nests. These could include burying proposed overhead power lines to new wells, monitoring wildlife, and/or controlling surface use and timing limitation conditions of approval.

Cumulative Impacts

Under Alternative B, the BLM would approve the SF-299 application and would issue a ROW grant and TUP. Cumulative impacts to greater sage-grouse habitat, leks, and raptor nests would occur because of the oil development and pipeline projects in the region. Construction and reclamation activities are similar for all projects; therefore, the impacts to greater sage-grouse habitats, leks, and raptor nests would be similar. Cumulative impacts to greater sage-grouse habitats, leks, and raptor nests would be the greatest in Fallon County, Montana, as the proposed and connected actions, the five APDs in the CCA, and the Keystone XL Pipeline would contribute to the further development of this county. However, impacts from a portion of the proposed and connected actions and the five APDs in the CCA are expected to occur in the same area or very near the same area. Additionally, mitigation and reclamation activities associated with the CCA CO_2 Pipeline and Keystone XL Pipeline would maintain and restore habitats and offset impacts in these areas once construction was complete.

Resource Issue 5 (Paleontological Resources)

Affected Environment

The Potential Fossil Yield Classification (PFYC) is a ranking of geologic units according to their potential to contain vertebrate fossils or noteworthy occurrences of invertebrate or plant fossils. These rankings are used in land use planning and for identifying areas that may warrant special management and/or special designations. The BLM has assigned a PFYC ranking (Classes 1–5) to each geologic unit (formation, member, or other distinguishable unit) based on the taxonomic diversity and abundance of previously recorded scientifically significant paleontological resources associated with the unit and the potential for future discoveries, with a higher class number indicating higher potential (BLM 2016a).

The BLM's data (2015c) and published geologic mapping (Vuke, Wilde, Colton, and Stickney 2001; Vuke, Heffern, Bergantino, and Colton 2001; Vuke, Wilde, Colton, and Bergantino 2001; Vuke, Wilde, Bergantino, and Colton 2001) indicate that the analysis area overlies one PFYC 2 geologic unit (Holocene alluvium), two PFYC 3 geologic units (Quaternary alluvium from an alluvial terrace deposit, Colgate

Member of the Fox Hills Formation), two PFYC 4 geologic units (Fort Union Formation and the Pierre Shale), and three PFYC 5 geologic units (Hell Creek Formation, Timber Lake and Trail City Members of the Fox Hills Formation). Table 5-1 summarizes the geologic units in the analysis area that have a moderate (PFYC 3) to very high (PFYC 5) potential to contain important paleontological resources.

Table 5-1. Geologic Units in the Analysis Area with Moderate-to-High Potential to Contain Important Paleontological Resources

Geologic Unit	**Age**	**Typical Paleontological Resources**	**Potential Fossil Yield Classification***
Alluvium of alluvial terrace deposit	Quaternary	Holocene-age deposits contain the unfossilized remains of modern taxa and are too young to contain fossils; Pleistocene-age deposits may contain mineralized or partially mineralized bones, invertebrates, and plants.	3
Fort Union Formation; Ludlow and Ekalaka Members	Tertiary	Plants (leaves and wood); invertebrates (mollusks and arthropods); locally abundant vertebrates (fish, amphibians, reptiles, birds, mammals)	4
Hell Creek Formation	Late Cretaceous	Abundant, diverse, and well-preserved terrestrial vertebrates (fish, amphibians, mammals, and reptiles, including dinosaurs), invertebrates (mollusks), and terrestrial plants	5
Fox Hills Formation; Colgate, Timber Lake, and Trail City Members	Late Cretaceous	Marine invertebrates and vertebrates (fish, sharks) are common; terrestrial plants and vertebrates (reptiles, dinosaurs, mammals) are less common.	3 (Fox Hills Formation, Trail City Member), 5 (Fox Hills Formation, Timber Lake and Trail City Members, undivided)
Pierre Shale, including the informal Groat Sandstone Bed	Late Cretaceous	Plants (wood); trace fossils (burrows, borings, fecal pellets, gastroliths), abundant invertebrates (mollusks, gastropods, bivalves), locally abundant vertebrates (fish, turtles, mosasaurs, plesiosaurs, and more rare dinosaurs, pterosaurs, and birds)	4 (Pierre Shale), 3 (Pierre Shale, Groat Sandstone Bed)

Source: BLM 2015c.

Paleontological resource surveys were conducted in 2015 and 2016 for the projects. The CCA CO_2 Pipeline survey area consisted of a 300-foot-wide corridor along the pipeline and a 100-foot-wide corridor

along unimproved access roads. Block surveys of the CCA EOR Unit Development were conducted where land access was permitted. A search of existing data prior to the field surveys concluded that no previously recorded fossil localities were known in the CCA EOR Unit Development survey area and 53 were known within the CCA CO_2 Pipeline survey area prior to project-specific surveys (Knauss et al. 2016a, 2016b).

Following BLM guidelines, pedestrian field surveys concentrated on bedrock exposures of geologic units with moderate-to-high potential to contain paleontological resources (PFYC 3 and PFYC 5). The objective of the field surveys was to examine the analysis area for the presence of surface fossils and potentially fossiliferous outcrops of bedrock. The CCA CO_2 Pipeline survey area contains 1,453 acres of PFYC 5 geologic units, 2,937 acres of PFYC 4 geologic units, and 96 acres of PFYC 3 geologic units. The CCA EOR Unit Development survey area contains 11,306 acres of PFYC 5 geologic units, 23,939 acres of PFYC 4 geologic units, and 8,933 acres of PFYC 3 geologic units.

All land, regardless of surface ownership (BLM, private, or state), was surveyed during the field surveys, except for a small portion of private land where access was denied. The pedestrian survey area totals 4,138 acres for the CCA CO_2 Pipeline and 33,243 acres for the CCA EOR Unit Development. The surveys concentrated on exposures of geologic units with potential to contain scientifically significant fossils. An additional 464 acres within the CCA CO_2 Pipeline survey area and 11,248 acres within the CCA EOR Unit Development survey area were cleared using geologic map data (PFYC 2), aerial imagery, and visual checks while in the area. Only one of the previously recorded localities was revisited during the CCA CO_2 Pipeline survey. Fossil fragments were noted near a few of the other localities that were partially disturbed during construction of the Bison Pipeline project (Murphey et al. 2012).

During the CCA CO_2 Pipeline field surveys, 30 new fossil localities were documented, and fossils from these localities comprise molds and casts of marine invertebrates, including ammonites, baculites, gastropods, brachiopods, and clams; molds (or molts) of crabs; coral; vertebrate teeth, bones, osteoderms, and scales of fish, turtles, crocodilians, champsosaurs, dinosaurs, mosasaurs, and other marine reptiles; fossil plants; and worm burrows. Ten of the localities occurs on BLM-administered land; two are on Montana state land; and the remainder (18) are on privately owned land. Of these 30 new localities, nine were determined to meet the BLM's significance criteria. The other 21 localities are limited to small concentrations of incomplete and mostly unidentified fossils, which are common in these geologic units, as indicated by the results of the previously recorded locality search. In addition, isolated, weathered, fragmented, and/or very common fossils consisting primarily of invertebrate shells were documented at 33 other locations within the survey area. These resources were not fully recorded because of their lack of morphological information, ex-situ position, or isolated occurrence.

Of the 269 fossil localities documented during the field survey for the CCA EOR Unit Development, 66 were determined by SWCA's paleontological principal investigator to meet the BLM's significance criteria. Of the 66 important localities, 13 are on BLM-administered land, one is on Montana state land, and 52 are on privately owned land. The other 203 localities are limited to small concentrations of incomplete and mostly unidentified fossils, which are locally common in these geologic units. In addition, isolated, weathered, fragmented, and/or very common fossils consisting primarily of invertebrate shells were documented at 799 other locations within the survey area. These resources were not fully recorded because of their lack of morphological information, ex-situ position, or isolated occurrence.

Environmental Impacts - Alternative A (No Action)

Under the no action alternative, the projects as proposed would not be constructed or developed. Therefore, no effects to paleontological resources would be anticipated.

Cumulative Impacts

There are no anticipated impacts to add to other known projects included in the reasonably foreseeable future actions, and effects to paleontological resources would remain at existing levels. Existing effects to paleontological resources in the analysis area are associated with previous disturbance from existing pipelines, well pads, roads and from ranching and farming, and natural erosion. Additionally, human activity along existing roads may cause indirect effects through the unpermitted collection of surface fossils.

Environmental Impacts - Alternative B (Proposed Action)

In coordination with BLM resource specialists, the number of paleontological localities recorded during preconstruction field surveys and the acres of geologic units with potential to contain scientifically important fossils within the area of direct disturbance were identified as resource indicators for the paleontological issues identified. Acres of geologic units provide a quantitative value for unknown paleontological resources that are buried but could be physically disturbed by the proposed action and/or the connected action.

Applicant-committed resource protections, as outlined in the associated PODs, would avoid or minimize impacts to paleontological resources to the extent practicable. Additionally, all newly documented localities would be monitored by a BLM-approved paleontologist during ground-disturbing activities.

Of the 18 previously recorded localities within or crossing the proposed action analysis area, 16 localities contained no significant fossils, and all but possibly three of these areas had been at least partially disturbed (e.g., graded) during construction of the Bison Pipeline in 2010. Only one of the two previously recorded important localities, which has not been mitigated, is within the proposed action analysis area. Of the 30 newly recorded fossil localities found during the CCA CO_2 Pipeline field survey, 14 are within the disturbance area. Five of these 14 fossil localities were determined to meet the BLM's significance criteria. As noted above, 66 important localities were recorded in the connected action analysis area during the field surveys; however, potential impacts from the connected action to these paleontological localities cannot be determined now; instead, they would be evaluated on a case-by-case basis as infrastructure is proposed.

In addition to the known paleontological resources in these areas, there is the potential for important paleontological resources to be present in the subsurface. Ground disturbance and increased human activity during construction may affect known and unknown paleontological resources. Up to 444 surface acres of PFYC 5, 976 surface acres of PYFC Class 4, and 29 surface acres of PFYC 3 would be directly disturbed by construction of the proposed action. Impacts to acres of geologic units are not known for the connected action at this time; however, an analysis would be conducted on a case-by-case basis for proposed infrastructure within the connected action area.

In addition to direct impact from ground disturbance, direct short-term effects to paleontological resources may include increased erosion of sediment prior to final reclamation, which may expose previously unknown paleontological resources. Paleontological resources that are exposed from erosion may be completely eroded away prior to authorized collection.

Increased human activity could indirectly affect paleontological resources for the life of the proposed and connected actions through increasing unauthorized surface collection of paleontological resources or ground disturbance. This could occur at the known paleontological localities in the analysis area or at newly exposed localities.

Mitigation

No additional mitigation measures are identified for the proposed action. More site-specific paleontological resource mitigation measures for the connected action would be determined on a case-by-case basis upon review of individual applications and applied as conditions of approval.

Cumulative Impacts

Any land-disturbing activity can cause surface and subsurface physical disturbance that could result in the destruction or discovery/recovery of paleontological resources. Cumulative effects from such disturbance would depend on the amount, placement, and type of surface disturbance. If previously unrecorded paleontological resources are identified during project activities in the cumulative analysis area, such activities may contribute cumulatively to an increase in the knowledge of paleontological data in the area, and new specimens may be collected. However, projects can also contribute cumulatively to widespread disturbance activities that cover a large portion of the landscape when viewed as a whole. Such disturbances could lead to an increase in the potential for destruction or damage to fossil resources in the cumulative analysis area and could irreversibly damage the paleontological information base and preclude future analysis of destroyed fossils.

Based on the analysis outlined above, the proposed and connected actions could add cumulatively to effects on paleontological resources from past and present actions and reasonably foreseeable future actions. However, these effects from the proposed and connected actions would be avoided, minimized, and/or mitigated under existing provisions in the PODs and other applicable guidance (e.g., Handbook H-8270-1 [BLM 1998], IM 2009 011 [BLM 2008], IM MT-2016-042 [BLM 2016b]).

List of Preparers

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Appendices

APPENDIX A

Summary of Plans of Development for Cedar Creek Anticline Carbon Dioxide Equivalent Pipeline and Enhanced Oil Recovery Unit Development Projects

Plan of Development

Cedar Creek Anticline CO_2 Pipeline Project

Prepared for

Denbury Green Pipeline – Montana, LLC
5320 Legacy Drive
Plano, Texas 75024

Prepared by

SWCA Environmental Consultants
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Fort Collins, Colorado 80525

April 2018

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1.0 PROJECT DESCRIPTION

1.1 PROJECT OVERVIEW

Denbury Green Pipeline - Montana, LLC (Denbury) proposes to construct a 110-mile-long, 20-inch-diameter carbon dioxide (CO_2) pipeline and ancillary facilities that will originate from the existing terminus of the Greencore pipeline at the Bell Creek Enhanced Oil Recovery (EOR) Development in Powder River County, Montana, extending north and east through Carter County, Montana, and terminate at the Cedar Creek Anticline (CCA) EOR Development in Fallon County, Montana (the Project). The proposed Project will transmit liquid (dense phase) CO_2 from the Bell Creek EOR Development to the CCA EOR Development, where it will be used in EOR techniques to stimulate oil production. Figure 1-1 provides a general location of the proposed Project.

The CO_2 pipeline will total 110.28 miles in length. The pipeline route will generally consist of a 100-foot-wide construction area. The 100-foot-wide construction area will consist of a 50-foot-wide permanent right-of-way (ROW) and a 50-foot-wide temporary use permit (TUP). Table 1-1 and Table 1-2 list the approximate land ownerships for the Project.

Table 1-1. Approximate Land Ownership Miles for ROW and Access Roads

Land Status	Private	Bureau of Land Management	Montana State Lands	Total
Pipe length (approx. miles)	86.95	17.09	6.24	110.28
Permanent access roads (approx. miles)	6.14	3.84	0.00	9.98
Temporary access roads (approx. miles)	68.98	19.28	6.34	94.60
Total (approx. miles)	**162.07**	**40.21**	**12.58**	**214.86**

Table 1-2. Approximate Land Ownership Acres for ROW and Access Roads

Land Status	Private	Bureau of Land Management	Montana State Lands	Total
Permanent pipeline ROW (approx. acres)	526.96	103.61	37.80	668.37
Temporary pipeline workspace (approx. acres)	526.85	103.97	37.85	668.67
Additional temporary workspace (approx. acres)	78.78	11.18	1.52	91.48
Permanent access roads (approx. acres)	18.70	11.61	0.00	30.31
Temporary access roads (approx. acres)	208.53	55.42	17.80	281.75
Total (approx. acres)	**1,359.82**	**285.79**	**94.97**	**1,740.58**

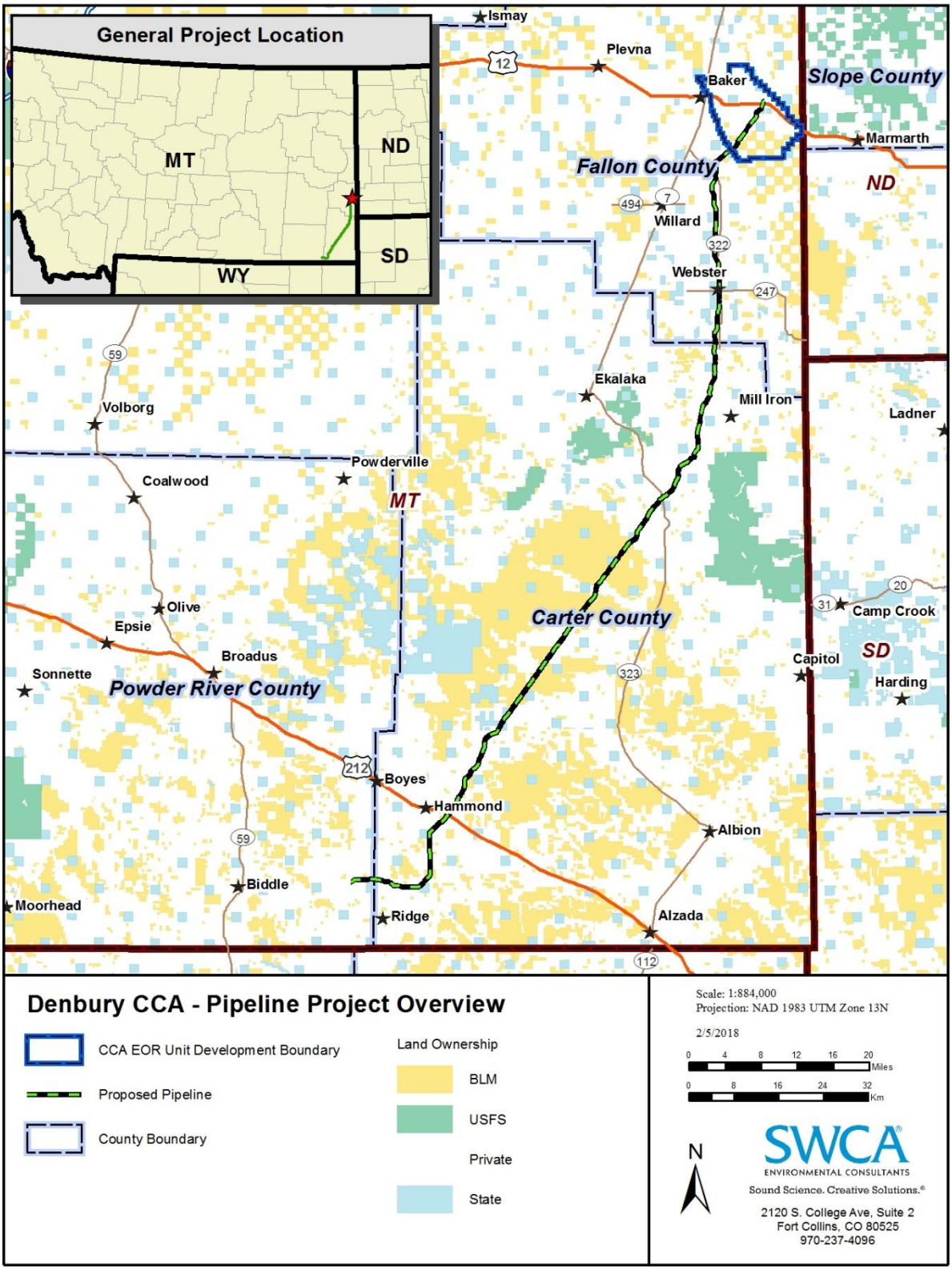


Figure 1-1. Project location map.

1.2 PERMITS AND APPROVALS REQUIRED

The proposed Project crosses federal, state, and private land and is subject to federal, state, and local permit requirements. Denbury will obtain all federal, state, and local permits and approvals necessary prior to construction of the proposed Project. The list of permits and/or approvals that are required prior to construction is included in Table 1-3.

Circumstances may require Denbury to modify what is proposed in this POD. Denbury will document any such variances through a formal change management process and will coordinate with the appropriate agencies for permitting purposes, to ensure proper reviews and requirements are met.

Table 1-3. Permits and Approvals Required

Issuing Agency/Program/ Permit Name	Permits/Approvals/ Authorizing Actions	Application Project Component
FEDERAL PERMITS, APPROVALS, AND AUTHORIZING ACTIONS		
Bureau of Land Management (BLM)		
National Environmental Policy Act/Environmental Assessment	Environmental assessment development, review, and approval; issuance of Record of Decision.	All Project components on BLM-managed land and connected actions
Cultural Resource Clearances	Cultural resource permit.	Antiquities Act of 1906 Archaeological Resources Protection Act of 1979 National Historic Preservation Act, Section 106 (36 Code of Federal Regulations 800)
Cultural Resource Protection and Consultation	Coordination and consultation with Montana State Historic Preservation Office.	All surface disturbance
Endangered Species Act	Informal or formal consultation with U.S. Fish and Wildlife Service for threatened and endangered species.	All Project components
Right-of-Way Grant, Temporary Use Permits	ROW grant consists of: permanent pipeline and roads; Temporary Use Permit consists of: temporary workspace, additional temporary workspace, temporary roads.	Permanent access roads and pipeline, temporary workspace, additional temporary workspace, and temporary roads that are located on BLM-managed land
Notice to Proceed	Following issuance of a ROW grant and approval of the Project's Plan of Development, the Authorized Officer will issue a Notice to Proceed with the project development and mitigation activities for BLM lands.	Project component on BLM-managed land

Issuing Agency/Program/ Permit Name	Permits/Approvals/ Authorizing Actions	Application Project Component
U.S. Department of Transportation		
Pipeline and Hazardous Materials Safety Administration (PHMSA)	Type F notification 60 days prior to commencing construction	Pipeline construction and safety
U.S. Army Corps of Engineers		
Permit for Dredged or Fill Material (404 Permit)	Placement of fill or dredged material in waters of the U.S. (WUS) or adjacent wetlands.	All surface-disturbing activities affecting WUS or wetlands
U.S. Environmental Protection Agency		
Clean Water Act	Spill Prevention, Control, and Countermeasure Plans.	Transfer and storage of fuels and oils
STATE PERMITS, APPROVALS, AND AUTHORIZING ACTIONS		
Montana Department of Environmental Quality		
Section 401 Water Quality Certification for Stream Crossings	State approvals for 404 Permits for stream crossings.	All surface-disturbing activities affecting WUS
Short-Term Water Quality Standard for Turbidity – 318 Authorization	Construction activities that will cause short-term or temporary violations of state water quality standard for turbidity.	Stream crossings, near-stream activities that will discharge stormwater to stream
Montana Natural Streambed and Land Preservation Act – 310 Permit	Construction activities that alter the bed or banks of a perennially flowing stream.	Perennial stream crossings
Individual Montana Pollutant Discharge Elimination System Discharge Permit	Discharges of hydrostatic test water.	Pipeline testing
General Permit for Construction Dewatering	Discharges for construction dewatering.	Construction sites
Montana Department of Transportation		
Transport Permits	Permit for oversize, over length, and overweight loads.	Transportation of equipment and materials on state highways
Montana Board of Land Commissioners		
Authorization of Activities on State Land	Approval of oil and gas leases, ROWs, Temporary Use Permits, and developments on state land.	Facilities on state land
Montana State Engineer		
Water Agreement for Temporary Use of Water	Temporary water use for hydrostatic testing, and dust abatement.	Pipeline and facility construction
LOCAL PERMITS, APPROVALS, AND AUTHORIZING ACTIONS		
Powder River, Carter, and Fallon Counties		
Road Use Authorization	Overweight and over length loads on county roads.	Transportation of equipment and materials on county roads
Conditional Use and Special Use Permits, Zoning	New structures.	Associated facilities
County Road Departments	Crossing permits.	Project access roads

Issuing Agency/Program/ Permit Name	Permits/Approvals/ Authorizing Actions	Application Project Component
PRIVATE LANDOWNERS AND COMPANIES		
Private Landowners	Land easements/agreements.	All land-disturbing activities
Burlington Northern Santa Fe	Crossing permits.	Railroad crossings

1.3 CO_2 PIPELINE LOCATION IN RELATION TO EXISTING DISTURBANCE

Denbury has located the proposed ROW parallel to previously disturbed areas or along utility or road corridors where possible to minimize disturbance and avoid sensitive surface resources. Approximately 96.0 miles (87%) are parallel to existing pipeline ROWs; 1.2 miles (1%) are parallel to road ROWs; and approximately 13.1 miles (12% percent) will not be parallel to any existing linear features. Table 1-4 summarizes locations along the ROW that are parallel to existing ROWs and Figure 1-2 provides a typical ROW construction profile for parallel utilities.

Table 1-4. Locations along ROW Parallel to Existing ROWs

Location	Milepost		Length (miles)	Land Ownership
	Begin	Exit		
No parallel existing features	0.00	0.70	0.70	Private
Parallel with pipeline/transmission ROW	0.70	1.59	0.89	Private
Parallel with pipeline/transmission ROW	1.59	1.84	0.25	BLM
Parallel with pipeline/transmission ROW	1.84	4.90	3.06	Private
No parallel existing features	4.90	5.50	0.60	Private
Parallel with pipeline/transmission ROW	5.50	8.16	2.66	Private
Parallel with pipeline/transmission ROW	8.16	8.58	0.42	State
Parallel with pipeline/transmission ROW	8.58	9.24	0.66	Private
Parallel with pipeline/transmission ROW	9.24	9.64	0.40	BLM
Parallel with pipeline/transmission ROW	9.64	9.89	0.25	Private
Parallel with pipeline/transmission ROW	9.89	10.89	1.00	BLM
Parallel with pipeline/transmission ROW	10.89	17.94	7.05	Private
Parallel with pipeline/transmission ROW	17.94	18.95	1.01	State
Parallel with pipeline/transmission ROW	18.95	22.22	3.27	Private
Parallel with pipeline/transmission ROW	22.22	22.56	0.34	BLM
Parallel with pipeline/transmission ROW	22.56	26.15	3.59	Private
Parallel with pipeline/transmission ROW	26.15	26.41	0.26	BLM
Parallel with pipeline/transmission ROW	26.41	29.12	2.71	Private
Parallel with pipeline/transmission ROW	29.12	30.88	1.76	State
Parallel with pipeline/transmission ROW	30.88	31.83	0.95	Private
Parallel with pipeline/transmission ROW	31.83	35.52	3.69	BLM
Parallel with pipeline/transmission ROW	35.52	35.70	0.18	Private
Parallel with pipeline/transmission ROW	35.70	37.00	1.30	BLM
Parallel with pipeline/transmission ROW	37.00	37.07	0.07	Private
Parallel with pipeline/transmission ROW	37.07	37.93	0.86	BLM
Parallel with pipeline/transmission ROW	37.93	39.16	1.23	Private
Parallel with pipeline/transmission ROW	39.16	39.64	0.48	BLM
Parallel with pipeline/transmission ROW	39.64	40.50	0.86	Private

Location	Milepost		Length (miles)	Land Ownership
	Begin	Exit		
No parallel existing features	40.50	40.70	0.20	Private
Parallel with pipeline/transmission ROW	40.70	41.60	0.90	Private
No parallel existing features	41.60	41.90	0.30	Private
Parallel with pipeline/transmission ROW	41.90	44.02	2.12	Private
Parallel with pipeline/transmission ROW	44.02	47.33	3.31	BLM
Parallel with pipeline/transmission ROW	47.33	47.39	0.06	Private
Parallel with pipeline/transmission ROW	47.39	47.66	0.27	BLM
Parallel with pipeline/transmission ROW	47.66	49.34	1.68	Private
Parallel with pipeline/transmission ROW	49.34	51.52	2.18	BLM
Parallel with pipeline/transmission ROW	51.52	52.35	0.83	State
Parallel with pipeline/transmission ROW	52.35	54.97	2.62	BLM
Parallel with pipeline/transmission ROW	54.97	56.23	1.26	State
Parallel with pipeline/transmission ROW	56.23	75.10	18.87	Private
No parallel existing features	75.10	75.30	0.20	Private
Parallel with pipeline/transmission ROW	75.30	86.50	11.20	Private
Parallel with pipeline/transmission ROW	86.50	87.00	0.50	State
Parallel with pipeline/transmission ROW	87.00	98.40	11.40	Private
No parallel existing features	98.40	99.90	1.50	Private
Parallel with road ROW	99.90	100.20	0.30	Private
No parallel existing features	100.20	100.40	0.20	Private
Parallel with road ROW	100.40	100.50	0.10	Private
No parallel existing features	100.50	101.00	0.50	Private
Parallel with road ROW	101.00	101.30	0.30	Private
No parallel existing features	101.30	103.19	1.89	Private
No parallel existing features	103.19	103.49	0.30	State
No parallel existing features	103.49	104.73	1.24	Private
No parallel existing features	104.73	104.87	0.14	BLM
No parallel existing features	104.87	108.00	3.13	Private
Parallel with road ROW	108.00	108.50	0.50	Private
No parallel existing features	108.50	109.19	0.69	Private
No parallel existing features	109.19	109.35	0.16	State
No parallel existing features	109.35	110.28	0.93	Private

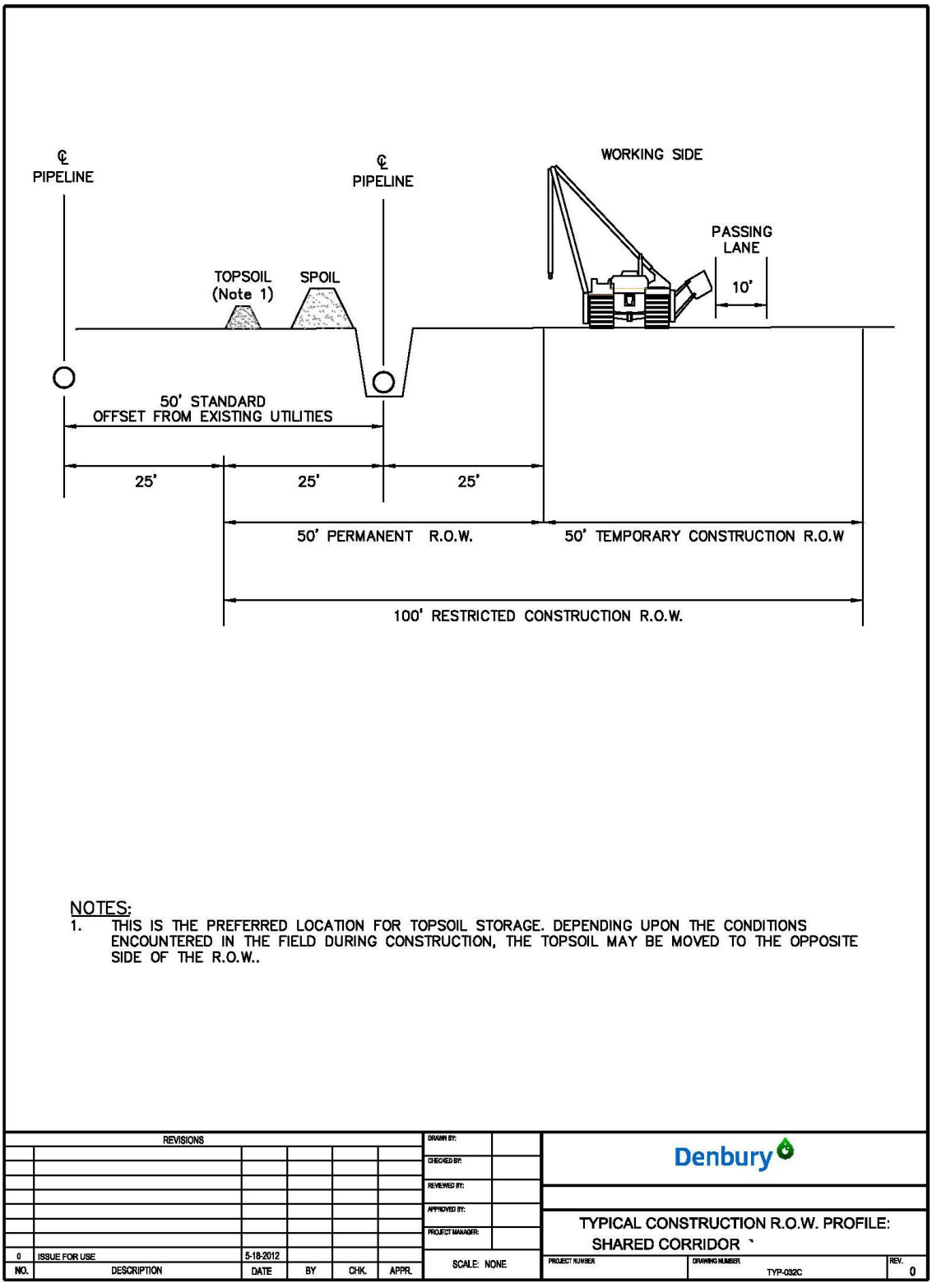


Figure 1-2. Typical construction ROW profile for shared corridor.

1.4 ADDITIONAL FEATURES ASSOCIATED WITH THE RIGHT-OF-WAY

In addition to the 50-foot-wide permanent ROW and 50-foot-wide temporary ROW, additional features will be required for the installation, production, and maintenance of the CO_2 pipeline. These additional features include pipeline transportation and storage; staging areas; additional temporary workspace (ATWS); permanent and temporary access roads; mainline valves and pigging facilities; and permanent pipeline markers.

1.4.1 Pipe Transportation and Storage

An existing pipe storage yard located in Gascoyne, North Dakota (approximately 60 miles east of the pipeline) will be used to store the pipe. Pipe will be delivered to the yard via rail from the manufacturer in Houston, Texas, unloaded, and then transported to staging areas in Baker and Bell Creek, Montana, by truck. It is estimated that 20 trucks will be needed for pipe transport per day, per spread, over a 30- to 40-day stringing period. Table 1-5 outlines the distances, methods, and timeframes of transportation of the pipe throughout the Project.

1.4.2 Additional Temporary Workspace

ATWS is needed at locations in areas where the terrain or other features require more room to work outside of the nominal 100-foot-wide pipeline ROW/TUP. Justification for ATWS includes spoil storage area for side slopes/terrain, creek crossings, road crossings, foreign pipeline crossings, and railroad crossings. ATWS will be stripped of vegetation and topsoil to create level and safe construction conditions; ATWS used to store topsoil will not be stripped of existing topsoil and vegetation. A complete list of proposed ATWS locations, sorted by milepost and including land ownership and justification per ATWS, is provided in Appendix A.

1.4.3 Staging Areas and Truck Turn Arounds

Staging areas (total of seven) are ATWS that will be used specifically for temporary storage of equipment, vehicles, and pipe sections at strategic locations along the ROW. They will be located on previously disturbed areas to the maximum extent practical. Staging areas are proposed immediately adjacent to the ROW and/or at locations that are easily accessible to access roads. Truck turn arounds (total of 14) are ATWS that have been identified where stringing trucks will need additional workspace for turning around. A complete list of proposed staging area locations and truck turn arounds, sorted by milepost and including land ownership, is provided in Appendix A.

Table 1-5. Pipeline Transportation Summary

Trip Segment		Trip Length (miles)	Transportation Method	Pipe Segments per Vehicle*	Total Vehicle Trips†	Total Vehicle Miles	Timeframe
From	To						
Houston, TX	Gascoyne, ND, Rail Yard	1,410	Rail	39	202	1,410	March 2019
Gascoyne, ND, Rail Yard	Baker, MT, Staging Area	65	Truck	9	430	27,964	March–July 2019
Gascoyne, ND, Rail Yard	Bell Creek, MT, Staging Area	185	Truck	9	430	79,591	March–July 2019
Baker, MT, Staging Area	Pipeline ROW (northern half)	55‡	Truck	9	430	23,662	Jul–Nov 2019
Bell Creek, MT, Staging Area	Pipeline ROW (southern half)	55‡	Truck	9	430	23,662	May–Nov 2019

* Average pipe length per segment is 75 feet
† Total number of rail/truck trips (number of rail cars/trucks times the number of trips taken)
‡ Distance from Staging Areas to ROW is an average of all deliveries along the entire ROW segment

1.4.4 Permanent and Temporary Access Roads

The Project will require temporary and permanent access roads that connect to existing state or county roads for the construction, operation, and maintenance of the pipeline. Some of these access roads are already improved roads and will only require maintenance actions (e.g., blading, re-graveling, etc.) while other access roads are primitive two-tracks that will require modification (e.g., blading, culvert placement, gravel, etc.). A two-track road consists of two tracks where tires have been previously driven over the landscape, with vegetation growing in the middle and along the edges of the tire tracks. It is common practice to blade and/or add gravel to two-track roads in order to use them affectively for construction equipment.

All temporary and permanent access roads will be improved to no more than 25 feet wide. Survey stakes will be used to delineate the edges of the 25-foot-wide boundary for access roads that require improvements. The temporary and permanent access roads that need to be improved on Bureau of Land Management (BLM)-administered lands will be covered in a visually compatible material that is similar to the color of native soil and rock. Temporary access roads that require improvements/widening will be returned to pre-construction conditions, including original contour, on BLM-administered lands and done according to landowner requirements for the other lands. Proposed access roads that cross intermittent or perennial streams will be designed to cross at right angles to minimize impacts to the riparian habitat.

Maps that illustrate the locations of access roads are provided in Appendix B. A comprehensive list of all proposed access roads is provided in Appendix C including any environmental concerns associated with each road (e.g., wetlands or waterbodies crossed by the road).

1.4.5 Mainline Valves and Pipeline Inspection Gauge Facilities

Proposed mainline valves and pipeline inspection gauge facilities (e.g., scraper traps, block valves, and takeoff valves) will be installed according to applicable requirements of Title 49 Code of Federal Regulations (CFR) Part 195, Transportation of Hazardous Liquids. A pipeline inspection gauge is commonly referred to as a "pig" and is used for inspecting or cleaning the pipeline. A launcher will be located at each delivery point and a receiver at each receipt point to allow for pigging operations. The locations and dimensions of the pig launcher and receiver facilities are listed in Table 1-6. Route maps that show the location of all the pig launchers and receivers are included in Appendix B.

Seven permanent mainline valves (MLVs) will be installed at approximately 20-mile intervals along the pipeline and will be electric or solar powered. Table 1-6 lists the locations for each MLV and launcher/receiver site by milepost, dimension, acreage, power (solar or electric distribution line), and land ownership. One MLV will be located on BLM-administered land (MLV 4) and will be painted in accordance with the BLM Standard Environmental Color Chart (BLM 2008) to blend with the surrounding landscape. Permanent, fenced enclosures will be constructed for valve sites, and they will be located within the limits of the permanent ROW. Valve sites will be graveled and consist of a 6-foot-high chain link fence with 1-foot-high barbed wire on top. Overhead electric power lines already exist immediately adjacent to MLVs 1, 4, 5, and 7; therefore, the power will be extended to Denbury's proposed facility sites. The overview maps in Appendix B depict the location of the MLVs, and photographs of typical mainline valves and launcher/receiver sites are provided in Appendix D.

Table 1-6. Locations and Dimensions of Mainline Valves and Launcher/Receiver Sites

Milepost	Facility Type	Dimensions (feet)	Acreage	Power	Landowner
0.00	Launcher, MLV 1	150 × 150	0.52	Electric distribution line from Bell Creek Plant	Denbury Onshore, LLC
17.48	MLV 2	50 × 50	0.06	Solar power	Private
35.66	MLV 3	50 × 50	0.06	Solar power	Private
54.20	Launcher/Receiver, MLV 4	50 × 150	0.17	Electric distribution line from adjacent Bison MLV	BLM
74.09	MLV 5	50 × 50	0.06	Electric distribution line from adjacent ONEOK Pump Station	Private
91.35	MLV 6	50 × 50	0.06	Solar power	Private
110.28	Receiver, MLV 7	150 × 150	0.52	Electric distribution line from ELOB Plant	Denbury Onshore, LLC

1.4.6 Permanent Pipeline Markers

The pipeline centerline will be identified by 3-foot-tall pipeline markers placed at each public road crossing, railroad crossing, and line-of-sight; the markers will be inter-visible in accordance with 49 CFR 195.410. Six-foot-tall aerial markers will be placed at 1-mile intervals along the ROW and will be larger so that milepost numbers can be seen from the air. Variances for placement of both types of markers will be allowed in waterbodies or where restricted by special habitats or other resource considerations. No pipeline markers will be placed within 0.6 mile of active sage-grouse leks, and aerial markers at each milepost will be restricted to every 3 miles in greater sage-grouse priority habitat management areas (rather than every mile) from mileposts 18.95 to 59.92. Locations where pipeline maker variances will be required are outlined in Table 1-7, and typical drawings for these markers are provided as Figures 1-3 and 1-4.

Table 1-7. Variances to Locations of Aerial Milepost Markers

Milepost	Resource Concern	Mitigation
18.95–59.92	Greater sage-grouse priority habitat management area	Aerial markers every 3 miles
70.00	Potential mountain plover habitat (MP1ACT001)	No aerial marker

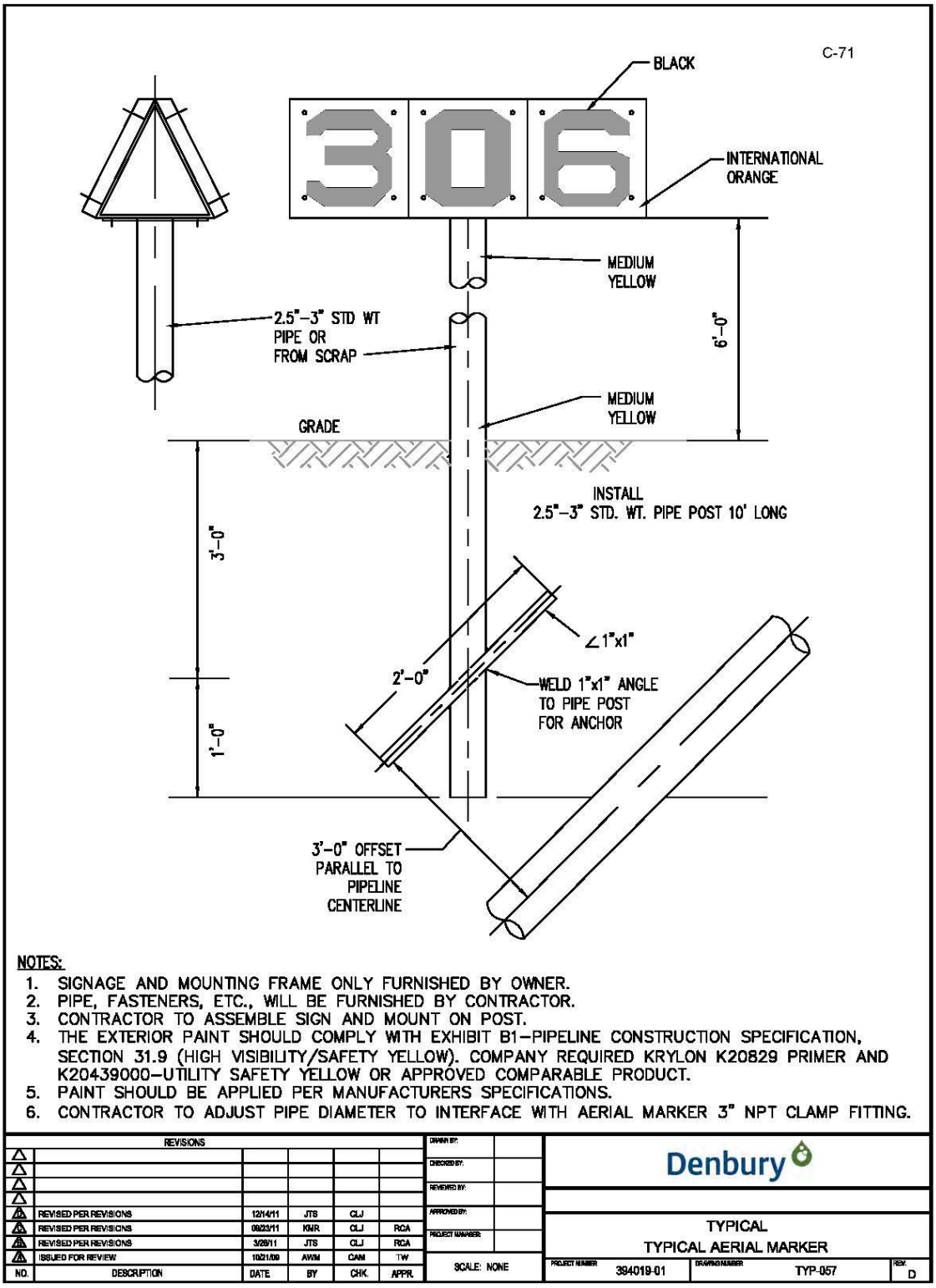


Figure 1-3. Typical aerial marker.

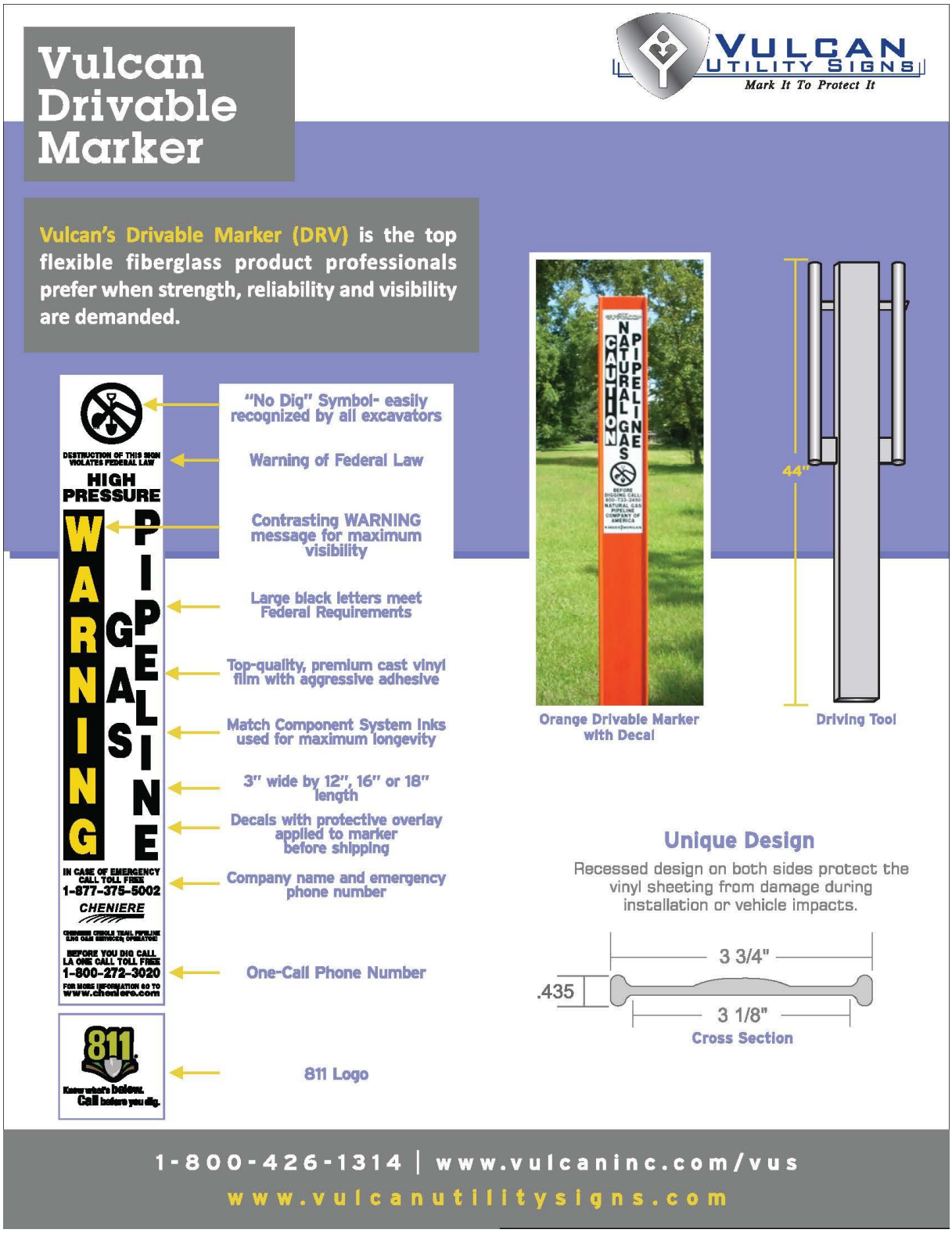


Figure 1-4. Typical drivable marker.

2.0 CONSTRUCTION SEQUENCE, SCHEDULE, AND EQUIPMENT

Pipeline construction is generally sequenced as a moving assembly line as shown in Figure 2-1. This Project will be constructed in a similar manner with the exception of some pre-construction activities that are identified below that will occur prior to clearing of the ROW.

Construction of the Project will not begin until the BLM issues a Decision Record, grants the ROW and TUP, and issues a Notice to Proceed. All applicable federal, state, and local permits and approvals, including private landowner agreements, will also be needed prior to commencement of construction.

The Project will be constructed via two spreads split at MP 54.05 with two separate contractors, as outlined in Table 2-1. Each spread will start at the southern end (mileposts 0.00 and 54.05) and continue in a northerly direction.

Denbury's contractor(s) will begin pre-construction activities described in Section 2.2 on May 25, 2019, three weeks prior to mainline construction activities described in Section 2.3.

Denbury's contractor(s) will begin mainline construction activities described in Section 2.3 on June 15, 2019 for each spread. Mainline construction and reclamation activities for each spread will be completed by December 15, 2019.

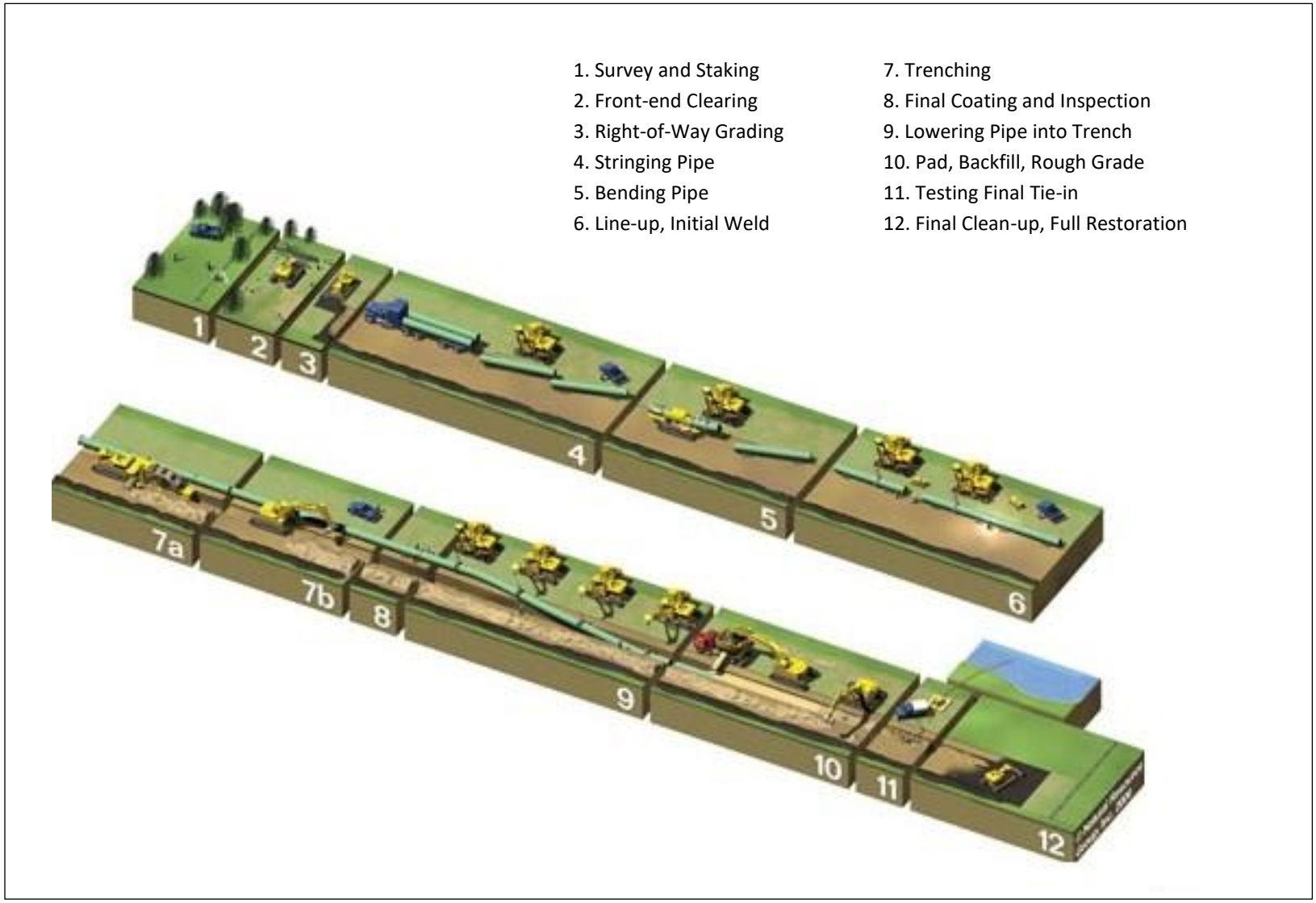


Figure 2-1. Typical pipeline construction sequence.

Table 2-1. Project Personnel Requirements

Construction Crew	Feb 2019	Mar 2019	Apr 2019	May 2019	June 2019	July 2019	Aug 2019	Sept 2019	Oct 2019	Nov 2019	Dec 2019	Total
Pre-construction Survey	0	0	0	8	8	0	0	8	8	0	0	32
Pre-construction Geotechnical	0	0	0	6	6	0	0	6	6	0	0	24
Logistics/Pipe Receiving	23	23	23	23	0	0	0	0	0	0	0	92
Mainline Construction – Spread 1	0	0	0	0	100	200	400	400	400	300	0	1,800
Mainline Construction – Spread 2	0	0	0	0	100	200	400	400	400	300	0	1,800
Non-Destructive Testing – Spread 1	0	0	0	0	3	16	16	16	16	10	0	77
Non-Destructive Testing – Spread 2	0	0	0	0	3	16	16	16	16	10	0	77
Civil Survey – Spread 1	0	0	0	0	16	16	16	16	16	12	0	92
Civil Survey – Spread 2	0	0	0	0	16	16	16	16	16	12	0	92
Environmental Inspection – Spread 1	0	0	0	0	6	6	6	6	6	6	4	40
Environmental Inspection – Spread 2	0	0	0	0	6	6	6	6	6	6	4	40
Construction Inspection – Spread 1	0	0	0	0	8	12	20	20	20	12	6	98
Construction Inspection – Spread 2	0	0	0	0	8	12	20	20	20	12	6	98
Post-construction Electrical – Spread 1	0	0	0	0	0	0	0	0	0	6	6	12
Post-construction Electrical – Spread 2	0	0	0	0	0	0	0	0	0	6	6	12
Total	**23**	**23**	**23**	**37**	**280**	**500**	**916**	**930**	**930**	**692**	**32**	**4,386**

2.1 CONSTRUCTION EQUIPMENT

Standard pipeline construction techniques will be implemented along the pipeline route and typically involve the following sequential operations: clearing and grading, ditching, stringing and bending, welding, joint coating, lowering and backfilling, hydrostatic testing, and cleanup and restoration.

Typical equipment for pipeline construction includes pickup trucks, loaders, various sized dozers, shovels and backhoes, side booms, generators, and bending machines. Equipment typically used for ROW reclamation includes dozers, blades, and track hoes. An estimate of the type and number of each piece of equipment required for construction is included in Table 2-2.

Table 2-2. Construction Equipment Requirements

Equipment	Number	Use/Purpose
4x4 pick-up truck	6	Pre-construction survey
4x4 UTV	4	Pre-construction survey
4x4 pick-up truck	4	Pre-construction geotechnical
2-ton truck mounted core drilling unit	2	Pre-construction geotechnical
330 track excavator (with vacuum units)	2	Logistics/pipe receiving contractor
Stringing truck	12	Logistics/pipe receiving contractor
Pick-up truck	6	Logistics/pipe receiving contractor
Mechanic truck (with welding equipment)	1	Logistics/pipe receiving contractor
D7 bulldozer	24	Mainline construction contractor
Motorgrader	4	Mainline construction contractor
330 track excavator	24	Mainline construction contractor
Sideboom tractor	20	Mainline construction contractor
D6 crawler tractor (with welding equipment, air compressor and generator)	4	Mainline construction contractor
Generator-powered coating rig	2	Mainline construction contractor
Air compressor powered sandblast coating rig	2	Mainline construction contractor
Stringing truck	24	Mainline construction contractor
Lowboy	TBD*	Mainline construction contractor
Haul truck	TBD*	Mainline construction contractor
Water truck	6	Mainline construction contractor
Mechanics rig (with welding equipment, generator and air compressor)	6	Mainline construction contractor
Welding rig (with welding machine)	40	Mainline construction contractor
Crew truck	TBD*	Mainline construction contractor
Pick-up truck	100	Mainline construction contractor
Telescoping fork lift	4	Mainline construction contractor
Crew truck (with trailer)	TBD*	Non-destructive testing contractor
X-ray truck	8	Non-destructive testing contractor
Pick-up truck	12	Civil survey contractor
Pick-up truck	12	Environmental inspection
Pick-up truck	40	Construction inspection
Mini-excavators	4	Post-construction electrical contractor
Pick-up truck	6	Post-construction electrical contractor

*TBD = to be determined

2.2 PRE-CONSTRUCTION ACTIVITIES

2.2.1 Amendment of Alignment Sheets

Once all required environmental permits have been acquired and conditions of approval, avoidance areas, and seasonal restrictions have been determined, these items will be incorporated into the Issued for Construction (IFC) alignment sheets. Compliance with permit conditions will be aided by distributing the IFC alignment sheets prior to construction and discussing the contents with Environmental Inspectors, construction managers, and Denbury representatives.

2.2.2 Survey Monuments

All survey monuments found within the ROW/TUP will be protected. Survey monuments include, but are not limited to, General Land Office and BLM Cadastral Survey Corners, reference corners, witness points, U.S. Coastal and Geodetic benchmarks and triangulation stations, military control monuments, and recognizable civil (both public and private) survey monuments. If any survey monuments found within the ROW or TUP are disturbed or obliterated during the course of Project development, the contractor will immediately report it to Denbury; Denbury will report the incident in writing to the BLM Authorized Officer (AO) and the respective installing authority, if known.

2.2.3 Surveying and Staking

Civil engineering surveys will be conducted to identify the centerline of the pipeline and the boundaries of both sides of the approved working limits before construction. Survey and staking crews will access the ROW via approved, existing access roads using pickup trucks and UTVs. Denbury's construction inspectors will be responsible for verifying that the limits of authorized construction work areas are staked prior to construction. Flagged and/or painted lath will be set at 200-foot intervals (maximum), or as required to maintain line of sight, along the proposed centerline. The edges of the work limits will be marked with flagged or painted lath at 200-foot intervals (maximum), or as required to maintain a line of sight. All TUP areas will be marked in a similar fashion and all four corners of each temporary use area will be flagged or marked with painted laths. This staking will clearly demark the boundary of the area that can be used or accessed by construction personnel. Equipment will not be parked or driven beyond these stakes. The edges of work limits will also be marked along access roads that require improvements (maximum 25-foot disturbance). This staking effort will commence three weeks prior to any ground-disturbing activities, as coordinated with the BLM AO and/or private landowners.

2.2.4 ROW Signage and Fence Modification

Signage will be installed by the Environmental Inspectors along the ROW and roads to indicate wetland boundaries, refueling setbacks, waterbody boundaries, approved/unapproved construction access roads, or any other sensitive areas or features deemed appropriate by Denbury or BLM.

Fences crossing the ROW will be braced, cut, and temporarily fitted with gates to permit construction traffic passage. Typical fence installation drawings are included in Section 2.8.6 of the Reclamation, Mitigation, and Monitoring Plan (Appendix E). Signage installation and

fencing efforts will commence three weeks prior to any ground-disturbing activities, as coordinated with the BLM AO and/or private landowners. Signage and fencing crews will access the ROW via approved, existing access roads using pickup trucks and UTVs.

2.3 CONSTRUCTION PROCESS

The following construction process sections are presented in the order that they will occur on the ground, and they generally follow the sequence diagram in Figure 2-1. However, depending on the type of contractor that is selected for the Project (union versus non-union), certain activities may precede others (e.g., trenching and stringing sections).

Best management practices (BMPs) will be installed to limit sediment transport and erosion. The Reclamation, Mitigation, and Monitoring Plan (Appendix E) should be referred to throughout the proposed Project to ensure proper sediment- and erosion-control, mitigation, and reporting procedures are followed.

2.3.1 Clearing

Once the ROW/TUP has been clearly staked, equipment will be brought in to clear the existing vegetation. All vegetation, including trees, will be removed from the entire ROW/TUP. The only areas where vegetation will not be removed are wetland and waterbody areas. Stumps will be left in place except over the trench line or removed as necessary to create a safe and level workspace. The Environmental Inspector will coordinate with the appropriate agency or landowner to locate areas for stump disposal when necessary. Trees will be felled only within the approved ROW boundaries. Clearing and all subsequent earth-moving activities will commence as outlined in Figure 2-1 and Section 2.0.

As discussed in the Resource Report for Aquatics, Vegetation, and Wildlife (Appendix F), specific wooded or forested areas within the proposed disturbance will be cleared prior to construction to avoid disturbance to species-specific habitat.

2.3.2 Topsoil Stripping

The objective of topsoil handling is to maintain topsoil capability by conserving topsoil for future replacement and reclamation and to minimize the degradation of topsoil from compaction, rutting, loss of organic matter, or soil mixing so that successful reclamation of the ROW/TUP can occur. Topsoil will be stripped and stockpiled in a windrow along the edges of the ROW/TUP and any other work areas. Topsoil stripping will occur along the entire ROW/TUP prior to grading operations. Available topsoil depths vary across the proposed Project but will be stockpiled separately from subsoil and will not be used to pad the trench or construct trench breakers. Topsoil will be used as the final layer of soil during reclamation.

In order to avoid mixing of topsoil and subsoil, rutting greater than 4 inches deep will not be allowed in areas where topsoil is intact. The 4-inch rutting rule will not be enforced in areas that have already been stripped of topsoil (i.e., where equipment is working on subsoil). This rule includes access roads; if the topsoil has not been stripped, ruts cannot exceed 4 inches.

In wetlands, only the topsoil on the trench line will be removed and segregated before digging and removing the subsoil (double-ditching method). The Environmental Inspector will

determine the depth of available topsoil per site conditions. Dry ephemeral drainages (arroyos and swales) crossed by the ROW/TUP will not be blocked with topsoil piles. Topsoil will be placed on the banks of drainages so natural flows are not impeded and topsoil is not washed away.

2.3.3 Front End Grading

In locations where side sloping terrain exists, grading will occur to create a flat, level work area for construction equipment. The grading crew will install timber mats in wetlands and over flowing waterbodies, or where soil conditions cannot support construction equipment. These areas will be restored to the existing natural contours after the trench is backfilled (during the rough grade phase of construction).

2.3.4 Restaking Centerline of the Trench

Following clearing, topsoil stripping, and grading of the ROW/TUP, civil engineering survey crews will re-stake the centerline of the pipeline trench. Flagged and/or painted lath will be set at 200-foot intervals (maximum), or as required to maintain line of sight.

2.3.5 Trenching

If a union contractor is selected for construction, it is standard practice for them to excavate the trench prior to stringing (see Section 2.3.6). If a non-union contractor is hired, they typically string pipe prior to trenching.

Trenches will be excavated using a wheel trencher or backhoe; the method selected will be based on soils, rock, terrain, and/or other related factors. Special excavation equipment or techniques may be used if large quantities of solid rock are encountered.

Trenches will be excavated to a depth sufficient to provide the minimum 4 feet of cover required by federal, state, and local municipalities as well as landowner requirements. The minimum cover depth (and therefore the total depth of the trench) will vary depending on soil type and existing conditions/land use; the different depth of cover requirements are listed in Table 2-2. Trenches will be excavated to approximately 3 to 4 feet wide at the bottom with the sides sloped according to Occupational Safety and Health Administration specifications (up to approximately 8 feet wide).

Table 2-3. Minimum Depth of Pipeline Cover Requirements

Crossing Type	No Rock (minimum inches)	Rock Trench (minimum inches)
Standard trench	48	48
Agricultural land*	60	60
Water crossings	60	60
Drainage or ephemeral waterways	60	60
Road crossings	60	60
Drainage ditch at public road crossing	48	48
Wetlands	60	60

* Note: Double-ditching required for agricultural areas.

2.3.6 Stringing

If a union contractor is selected for construction, it is standard practice for them to excavate the trench prior to stringing. If a non-union contractor is hired, they typically string pipe prior to trenching (see Section 2.3.5).

The contractor will string the pipe along the ROW/TUP as shown in Figure 2-1. Line pipe will be transported as indicated in Table 1-5. Stringing trucks will collect and deliver the pipe to the ROW from staging areas and/or the pipeyard. Each individual joint of pipe will be unloaded with a side-boom or trackhoe and placed (strung) parallel to the trench in a continuous line. Pipe for road, waterbody, and/or wetland crossings will be stockpiled at temporary use areas near the crossings. Stringing operations will be coordinated with trenching and installation activities in order to properly manage the construction time on a particular tract of land. Gaps will be left at access points across the trench to allow for ROW crossing, as discussed in the Reclamation, Mitigation, and Monitoring Plan (Appendix E).

2.3.7 Bending

After joints of pipe are strung along the trench, but before the joints are welded or pressed together, individual joints of pipe will be bent to accommodate horizontal and vertical changes in direction. Field bends will be made using a hydraulically operated bending machine. The bending machine uses a series of clamps and hydraulic pressure to make a smooth, controlled bend in the pipe. All bending is performed in strict accordance with federal standards to ensure integrity of the bend. Pipe will be bent at the mill when necessary for sharp bends. All pipe will be pre-coated at the mill with a fusion-bonded epoxy external coating (or other coating technique) to provide corrosion protection.

2.3.8 Welding

After pipe joints are bent, the joints will be lined up end-to-end into one continuous length and clamped into positions. Each welder will be required to pass an approved qualification test to work on the pipeline. The qualification tests will be conducted using Project-specific weld procedures that are developed in accordance with federally adopted welding standards. The pipeline joints will be welded together in conformance with 49 CFR Part 195 Subpart D (Construction).

2.3.9 Weld Inspection

Welds will be visually inspected by an American Welding Society-certified inspector who is part of the construction management staff. Nondestructive radiographic inspection methods will be conducted to ensure structural integrity and compliance with the applicable U.S. Department of Transportation (USDOT) regulations. The percentage of welds radiographically inspected will be in accordance with 49 CFR Chapter 1 (Part 195.234 Welds: Nondestructive Testing). Any defect will be repaired or cut out as required under the specified regulations and standards. Documents that verify the integrity of the pipeline will be kept on file by Denbury for inspection by the Office of Pipeline Safety, USDOT.

2.3.10 Coating of Field Welds

To prevent corrosion, the pipeline will be externally coated with fusion bonded epoxy coating prior to delivery. After welding, field joints will be coated with a tape wrap, brush grade urethane epoxy, or field-applied fusion bond epoxy.

2.3.11 Cathodic Protection

Cathodic protection test sites will be installed at accessible locations, at intervals of 2 miles or less, to measure the pipe to soil potential for the establishment and maintenance of an effective cathodic protection system.

2.3.12 Inspection and Repair of Coating

Before the pipe is lowered into the trench, the pipeline coating will be visually inspected and tested with an electronic detector, and any faults or scratches will be repaired.

2.3.13 Padding and Lowering In the Trench

Specialized padding machines may be used to sift the excavated subsoils to provide rock-free pipeline padding and bedding. In rocky areas, sandbags may be used to pad the bottom of the trench instead of, or in combination with, using soil fines for padding. Rock shields also may be used to protect the pipe from rocks. No topsoil will be used to pad the pipe.

Before a pipe section is lowered into the trench, inspection will be conducted to ensure the trench bottom is free of rocks and other debris that could damage the external pipe coating. A series of side-boom tractors will simultaneously lift welded sections of the pipe and carefully lower the sections into the trench. Non-metallic slings will protect the pipe and its coating as it is raised and moved into position A second inspection will be done to verify that the pipe is properly fitted and installed in the trench and that minimum cover is provided.

2.3.14 Backfilling and Rough Grade

Backfilling will begin after a section of pipe has been successfully placed in the trench. Trench breakers will be installed, as needed. Prior to backfilling the trench, the equipment operator will check the trench for wildlife and/or livestock; any wildlife or livestock found in the trench will be removed before backfilling begins. The backfilling process will use a bulldozer, rotary auger backfiller, padding machine, or other suitable equipment. Backfill material will be subsoil previously excavated from the trench, except in rocky areas where imported select fill material may be needed (sand pits for barrow material may need to be identified and used).

Backfill will be graded and compacted by tamping or walking with a wheeled or tracked vehicle to ensure ground stability. Compaction will be done to the extent that there are no voids in the trench. In irrigated agricultural areas, the backfill will be replaced at the same compaction density as the adjacent undisturbed soil. Backfilling at road crossing will be in accordance with the crossing permit. Any excavated materials or materials unfit for backfill will be used elsewhere or properly disposed in conformance with applicable laws or regulations.

2.3.15 Hydrostatic Testing

The entire length of the pipeline will be hydrostatically tested in compliance with USDOT regulations (49 CFR Part 195.300) before being placed into service. Test water will be obtained from a permitted source and/or as negotiated with water rights owners or commercial wells and will be required to meet water quality standards prior to use. A detailed description of hydrostatic pressure testing procedures is included in the Hydrostatic Test Plan (Appendix G). A summary of water sources for hydrostatic testing for the proposed Project is provided in Section 3.4.

2.3.16 Final Cleanup and Reclamation

The final step in the construction process is restoring the ROW/TUP as closely as possible to its original condition. All construction debris and miscellaneous items will be removed from the construction site and disposed properly by the contractor. No trash will be buried. Fences and roads will be replaced/rebuilt as negotiated with the landowner.

Disturbed portions of the construction workspace (including the ROW, TUP, travel lane) will be returned to pre-construction grades and contours as close as possible as described in the Reclamation, Mitigation, and Monitoring Plan (Appendix E). Requirements related to seeding, mulching, slope and trench breaker installation, relieving compaction, restoration of stream banks and slopes, etc. are also included in the Reclamation, Mitigation, and Monitoring Plan (Appendix E).

2.4 BLASTING

Based on a preliminary analysis of geologic conditions, blasting will not be necessary for construction of the Project.

3.0 ADDITIONAL DESIGN FEATURES

3.1 ROAD AND RAILROAD CROSSINGS

All road and railroad crossings will be designed in accordance with American Society of Mechanical Engineers standard B31.4 and American Petroleum Institute standard RP 1102. Depending on local regulations, traffic, construction availability, and costs, road crossings will be bored or achieved through open cut techniques. Table 3-1 lists all roads and railroads crossed by the Project.

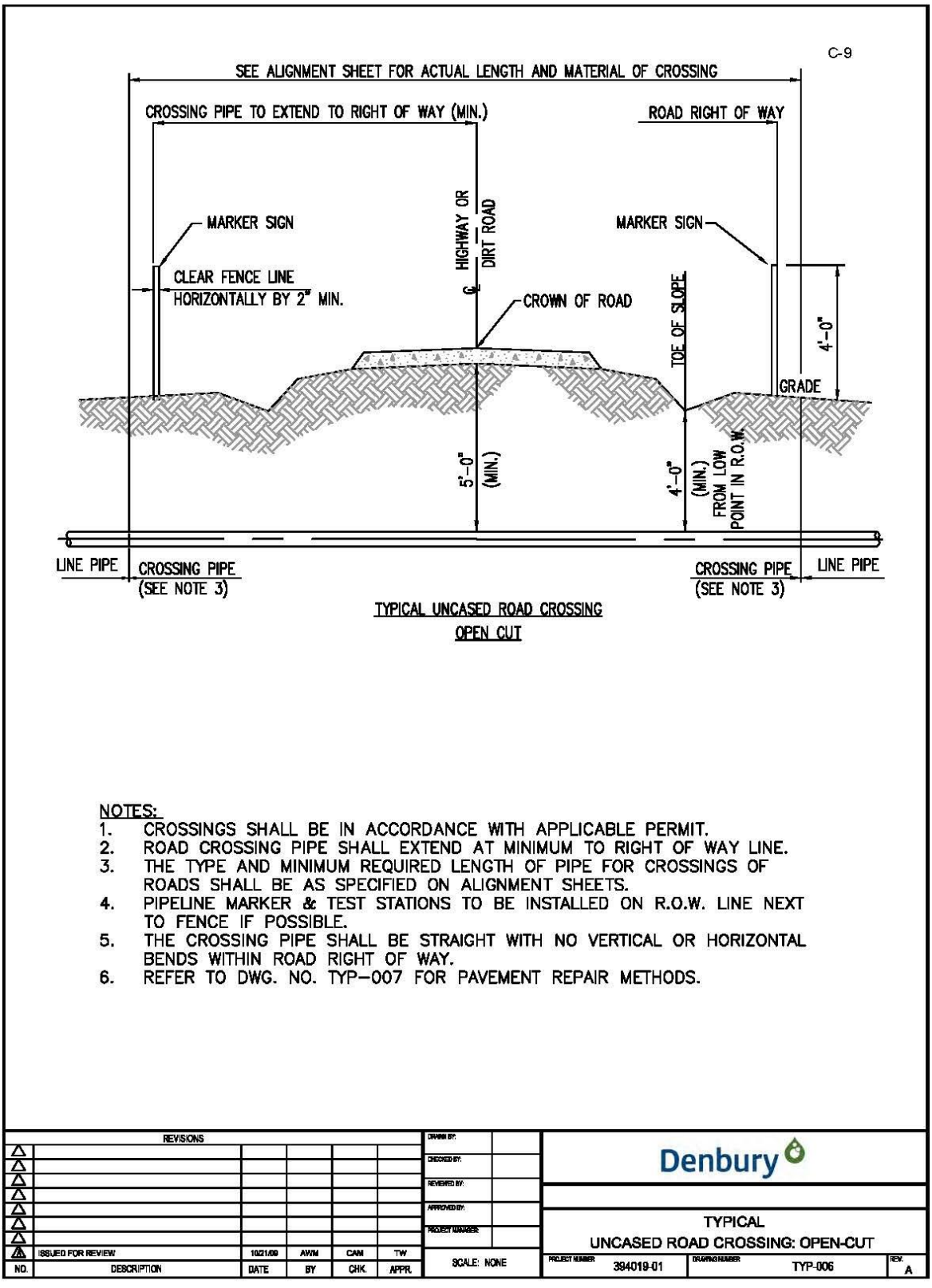
Table 3-1. Road and Railroad Crossings

Milepost	Road/Rail Name	Road Surface	Ownership	Proposed Crossing Method
0.16	Unnamed two-track	Dirt	Private	Open cut
0.34	Unnamed two-track	Dirt	Private	Open cut
0.70	Unnamed two-track	Dirt	Private	Open cut
1.40	Unnamed two-track	Dirt	Private	Open cut
1.49	Unnamed two-track	Dirt	Private	Open cut
3.37	Ridge Road	Gravel	Private	Conventional bore
5.31	Dinstel's Road	Gravel	Private	Conventional bore
5.50	Dinstel's Road	Gravel	Private	Conventional bore
17.44	US Highway 212	Paved	Private	Conventional bore
18.86	Unnamed two-track	Dirt	State	Open cut
20.54	Unnamed two-track	Dirt	Private	Open cut
23.47	Unnamed two-track	Dirt	Private	Open cut
25.04	Unnamed two-track	Dirt	Private	Open cut
25.72	Unnamed two-track	Dirt	Private	Open cut
25.77	Unnamed two-track	Dirt	Private	Open cut
26.02	Unnamed two-track	Dirt	Private	Open cut
27.22	Hammond Road/Boxelder Road	Gravel	Private	Conventional bore
35.65	Hopkin's Road	Gravel	Private	Conventional bore
44.49	Ridge Road	Gravel	BLM	Conventional bore
46.02	Unnamed two-track	Dirt	BLM	Open cut
48.29	Unnamed two-track	Dirt	Private	Open cut
50.01	Unnamed two-track	Dirt	BLM	Open cut
54.11	Lone Tree Road	Gravel	BLM	Conventional bore
55.14	Unnamed two-track	Dirt	State	Open cut
56.20	Unnamed two-track	Dirt	State	Open cut
56.35	Unnamed two-track	Dirt	Private	Open cut
57.15	Unnamed two-track	Dirt	Private	Open cut
57.62	Unnamed two-track	Dirt	Private	Open cut
57.65	Unnamed two-track	Dirt	Private	Open cut
58.10	Unnamed two-track	Dirt	Private	Open cut
60.85	Unnamed private road	Dirt	Private	Open cut
61.01	State Highway 323	Paved	Private	Conventional bore
61.43	Unnamed two-track	Dirt	Private	Open cut
62.00	Unnamed two-track	Dirt	Private	Open cut
62.55	Unnamed two-track	Dirt	Private	Open cut
63.24	McCabe Road	Gravel	Private	Conventional bore
65.50	Unnamed private road	Dirt	Private	Open cut
69.75	Unnamed private road	Dirt	Private	Open cut
69.86	Prairiedale Road	Gravel	Private	Conventional bore
74.25	Mill Iron Camp Crook Road	Gravel	Private	Conventional bore
77.25	Unnamed two-track	Dirt	Private	Open cut
82.25	Unnamed private road	Dirt	Private	Open cut
85.02	County Road 322	Gravel	Private	Conventional bore

Milepost	Road/Rail Name	Road Surface	Ownership	Proposed Crossing Method
86.48	State Highway 322/Webster Road	Gravel	Private	Conventional bore
86.51	State Highway 247	Gravel	State	Conventional bore
89.08	State Highway 322	Gravel	Private	Conventional bore
94.22	Bergstrom Hill Road	Gravel	Private	Conventional bore
97.46	Wiley Butte Trail	Gravel	Private	Conventional bore
99.67	State Highway 322/101 Road	Paved	Private	Conventional bore
101.30	Airport Road	Gravel	Private	Conventional bore
103.56	Brackett Butte Road	Gravel	Private	Conventional bore
104.13	Unnamed private road	Dirt	Private	Open cut
104.62	Unnamed private road	Dirt	Private	Open cut
104.66	Coral Creek Road	Gravel	Private	Conventional bore
104.75	Unnamed road	Dirt	BLM	Open cut
105.15	Unnamed private road	Dirt	Private	Open cut
105.29	Unnamed oil field road	Dirt	Private	Open cut
106.82	Unnamed private road	Dirt	Private	Open cut
106.88	Railroad	N/A	Private	Conventional bore
107.55	Unnamed private road	Dirt	Private	Open cut
108.03	Unnamed private road	Dirt	Private	Open cut
108.55	Dance Hall Road	Gravel	Private	Conventional bore
109.88	US Highway 12	Paved	Private	Conventional bore

Crossings of two-track roads and gravel roads will use open cut techniques; paved county roads and state highways will be crossed via conventional bore (Figures 3-1 and 3-2, respectively). Denbury will work with the specific landowner and local agencies to coordinate detours and emergency access. Traffic control is included in Section 4.6 (Recreation) of this POD, which includes information regarding road closures, signage, etc.

The pipeline will be buried at a minimum depth of 4 feet below the bottom of existing road ditches and 5 feet below the base of the road itself. Barrow ditches on county roads will be provided a means for mechanical protection. Set-on concrete pipe weights will be used to cover the pipeline in these ditches. Road crossings will not be cased. The Frac-Out Contingency Plan (Appendix H) addresses concerns related to the potential for drilling fluid release during boring operations.



NOTES:
1. CROSSINGS SHALL BE IN ACCORDANCE WITH APPLICABLE PERMIT.
2. ROAD CROSSING PIPE SHALL EXTEND AT MINIMUM TO RIGHT OF WAY LINE.
3. THE TYPE AND MINIMUM REQUIRED LENGTH OF PIPE FOR CROSSINGS OF ROADS SHALL BE AS SPECIFIED ON ALIGNMENT SHEETS.
4. PIPELINE MARKER & TEST STATIONS TO BE INSTALLED ON R.O.W. LINE NEXT TO FENCE IF POSSIBLE.
5. THE CROSSING PIPE SHALL BE STRAIGHT WITH NO VERTICAL OR HORIZONTAL BENDS WITHIN ROAD RIGHT OF WAY.
6. REFER TO DWG. NO. TYP–007 FOR PAVEMENT REPAIR METHODS.

REVISIONS					
NO.	DESCRIPTION	DATE	BY	CHK.	APPR.
1	ISSUED FOR REVIEW	10/21/09	AWM	CAM	TW

DRAWN BY: | CHECKED BY: | REVIEWED BY: | APPROVED BY: | PROJECT MANAGER:

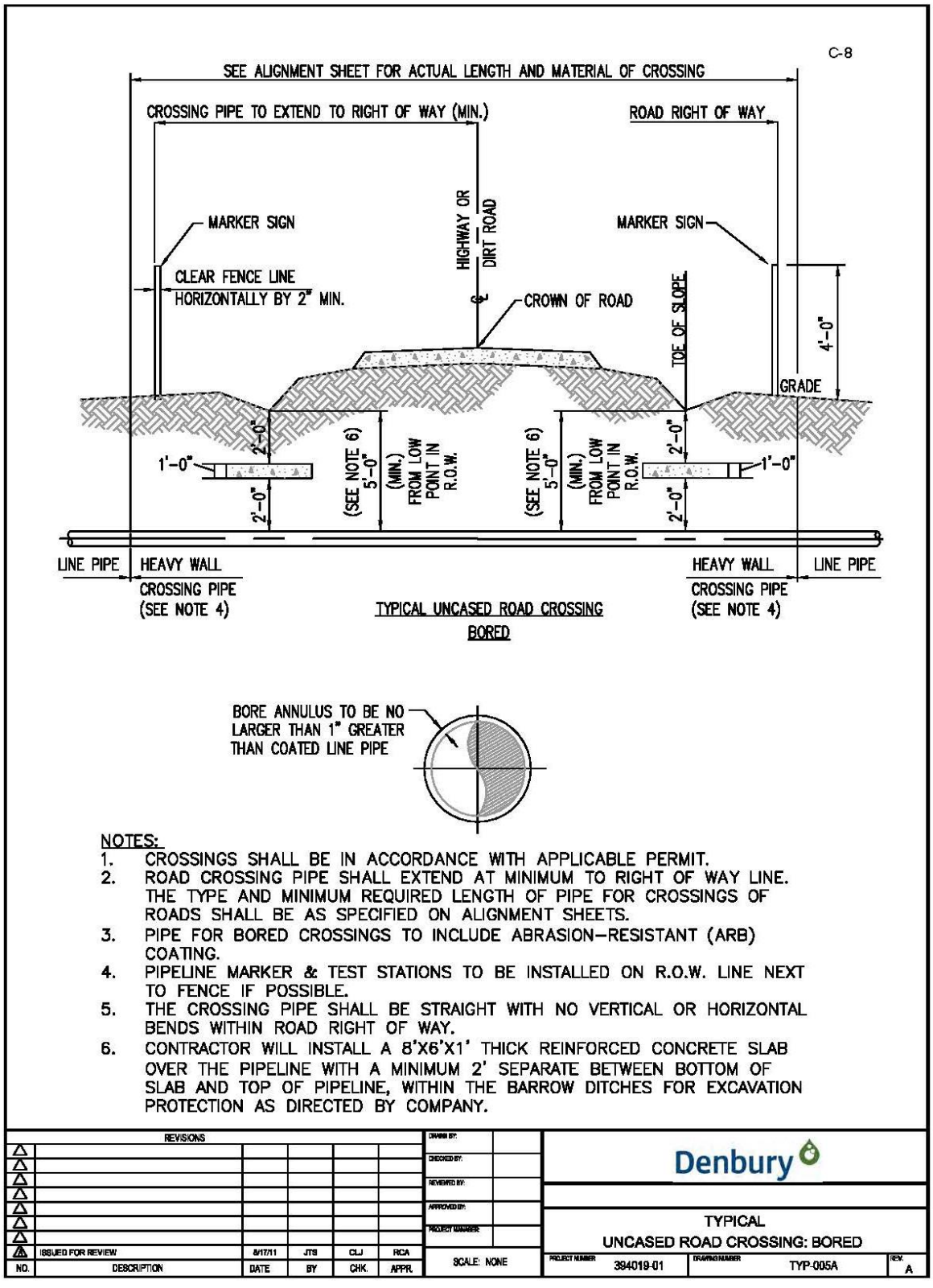
SCALE: NONE

Denbury

TYPICAL
UNCASED ROAD CROSSING: OPEN-CUT

PROJECT NUMBER 394019-01 | DRAWING NUMBER TYP-006 | REV. A

Figure 3-1. Typical open-cut road crossing.



NOTES:

1. CROSSINGS SHALL BE IN ACCORDANCE WITH APPLICABLE PERMIT.
2. ROAD CROSSING PIPE SHALL EXTEND AT MINIMUM TO RIGHT OF WAY LINE. THE TYPE AND MINIMUM REQUIRED LENGTH OF PIPE FOR CROSSINGS OF ROADS SHALL BE AS SPECIFIED ON ALIGNMENT SHEETS.
3. PIPE FOR BORED CROSSINGS TO INCLUDE ABRASION–RESISTANT (ARB) COATING.
4. PIPELINE MARKER & TEST STATIONS TO BE INSTALLED ON R.O.W. LINE NEXT TO FENCE IF POSSIBLE.
5. THE CROSSING PIPE SHALL BE STRAIGHT WITH NO VERTICAL OR HORIZONTAL BENDS WITHIN ROAD RIGHT OF WAY.
6. CONTRACTOR WILL INSTALL A 8'X6'X1' THICK REINFORCED CONCRETE SLAB OVER THE PIPELINE WITH A MINIMUM 2' SEPARATE BETWEEN BOTTOM OF SLAB AND TOP OF PIPELINE, WITHIN THE BARROW DITCHES FOR EXCAVATION PROTECTION AS DIRECTED BY COMPANY.

REVISIONS					
NO.	DESCRIPTION	DATE	BY	CHK.	APPR.
1	ISSUED FOR REVIEW	8/17/11	JTS	CLJ	RCA

DRAWN BY: | CHECKED BY: | REVIEWED BY: | APPROVED BY: | PROJECT NUMBER: | SCALE: NONE

Denbury

TYPICAL UNCASED ROAD CROSSING: BORED

PROJECT NUMBER 394019-01 | DRAWING NUMBER TYP-005A | REV. A

Figure 3-2. Typical bored road crossing.

3.2 WETLANDS

A full description of wetlands that have been delineated within the Project area, including crossing techniques, typical construction drawings, erosion- and sediment-control measures, and other mitigative measures, is provided in Section 3.0 of the Reclamation, Mitigation, and Monitoring Plan (Appendix E).

3.3 WATERBODY CROSSINGS

A waterbody includes any natural or artificial stream, river, canal, or drainage with perceptible flow at the time of crossing, as well as other permanent waterbodies such as ponds or lakes. A full description of the waterbodies that have been delineated within the Project area, including crossing techniques, bridge/mat installation, typical construction drawings, erosion- and sediment-control measures, bank stabilization, and other mitigative measures, is provided in Section 4.0 of the Reclamation, Mitigation, and Monitoring Plan (Appendix E).

3.3.1 Horizontal Directional Drill

Denbury is not currently proposing to use the horizontal directional drill technique for waterbody crossings within this Project.

3.4 FUGITIVE DUST CONTROL

Construction activities and the use of unpaved roads can result in varying degrees of fugitive dust emissions. BMPs that will be used to control fugitive dust during construction, when necessary or during periods of dry conditions, include the following.

- Water and/or non-toxic chemical dust suppressant, alone or in combination with mulches, will be applied to areas of disturbance to minimize fugitive dust emissions. Note: Chemical dust suppressant will not be used on BLM-managed lands.
- Use of wind fences, berms, or covering material such as gravel or textiles in areas of disturbance will minimize fugitive dust emissions.
- Unpaved roads in the construction area that pass within 0.25 mile of inhabited dwellings will be watered or treated with non-toxic chemical dust suppressant.

Water for fugitive dust control purposes will be obtained prior to construction, through permits or purchase contracts with owners of valid existing water rights as necessary. The dust abatement contractor will be responsible for obtaining any necessary permits. Table 3-2 provides a summary of water sources for dust abatement and hydrostatic testing for the proposed Project.

Federal, state, and local air quality standards will be met during construction. Site revegetation will be conducted in accordance with Denbury's reclamation procedures, which will also reduce dust emissions.

Table 3-2. Water Sources for Dust Abatement and Hydrostatic Testing

Water Source ID#	Landowner Name	Nearest Milepost	Volume for Dust Abatement (gallons)	Volume for Hydrotest (gallons)	Distance from Centerline (miles)	Ownership	Water Source Type	Comments
WS_001	Williams, Lacy H.	0.00	2,000,000	N/A	0.45	Private	Reservoir	None
WS_002	Hasapis, Jennie F. et al.	0.58	Secondary source (if needed)	N/A	0.46	Private	Well	Bell Creek water source
WS_003	Trucano, Randy	15.12	Secondary source (if needed)	N/A	5.43	Private	Well	Boyes community hall water well (GWIC ID 195290)
WS_004	Talcott, Ronald D.	18.90	500,000	N/A	1.43	Private	Reservoir	None
WS_005	Gardner, Douglas A.	21.51	1,000,000	N/A	0.52	Private	Reservoir	None
WS_006	Gardner, Douglas A.	21.57	1,000,000	4,217,086	0.83	Private	Reservoir	None
WS_008	Brownfield Ranch Inc.	26.71	2,000,000	N/A	0.01	Private	Stream	Boxelder Creek; hydro/dust
WS_009	Testamentary Trust Richard Owen	35.93	Secondary source (if needed)	N/A	3.27	Private	Reservoir	Richard Owen Reservoir
WS_010	Western Star Inc.	41.84	1,000,000	N/A	0.01	Private	Stream	Corral Creek; dust abatement water
WS_011	Rosencranz, Helen M.	48.31	1,000,000	N/A	0.01	Private	Stream	Cabin Creek; dust abatement water
WS_013	Hammel Ranch Inc.	55.47	1,000,000	N/A	2.62	Private	Stream	Boxelder Creek; dust abatement water
WS_014	Wolff Ranch Inc.	56.81	1,000,000	N/A	0.01	Private	Stream	Buffalo Creek; dust abatement water
WS_015	Wolff Ranch Inc.	58.79	1,000,000	N/A	1.82	Private	Stream	New near WS_013 on AR-20C

Water Source ID#	Landowner Name	Nearest Milepost	Volume for Dust Abatement (gallons)	Volume for Hydrotest (gallons)	Distance from Centerline (miles)	Ownership	Water Source Type	Comments
WS_016	O'Connor Ranch Lands LLC	59.02	Secondary source (if needed)	N/A	2.15	Private	Stream	Boxelder Creek; dust abatement water
WS_017	Loehding Ranch Inc.	62.77	2,000,000	N/A	1.09	Private	Stream	Boxelder Creek; dust abatement water
WS_018	Marks, Kathleen L.	64.49	Secondary source (if needed)	N/A	3.90	Private	Well	Unused well owned by Jim Hendricks (GWIC ID 95031)
WS_019	Walker, Travis J.	66.70	Secondary source (if needed)	N/A	0.06	Private	Reservoir	Possible dust abatement water
WS_020	Walker, Travis J.	67.12	2,000,000	4,413,012	0.27	Private	Stream	Boxelder Creek; dust/hydro water
WS_021	Jardee, Leroy	69.62	2,000,000	N/A	2.72	Private	Stream	Boxelder Creek; dust water
WS_022	U Hanging 7 Ranch Inc.	91.44	2,000,000	N/A	0.01	Private	Stream	Little Beaver Creek
WS_023	State	103.58	2,000,000	N/A	0.21	State	Reservoir	Possible dust abatement water
Project Total			**21,500,000**	**8,630,098**				

Portions of Carter and Fallon Counties are known to contain geologic formations containing erionite, a carcinogen on the Toxic Substance Control Act (TSCA) list. Denbury will verify that fill and surfacing material source locations are properly permitted and have been tested for erionite. Denbury will complete testing, if not already completed and properly documented, to ensure that all fill and surfacing materials used during construction are free of erionite. All material used for the project would be privately owned surface and minerals or permitted by the appropriate entity. Between MP 47 and 87, areas known to, or suspected of, containing erionite, additional controls will be implemented, including the following.

- Keep windows and doors to equipment closed while operating and driving down dirt roads.
- Maintain equipment air filters regularly as recommended by the equipment manufacturer.
- Ensure an effective hazard communication program to educate employees on the health effects and hazards of crystalline silica and the potential health effects of erionite.
- Wet the soil or aggregate before disturbing to reduce dust generation.
- Wash protective clothing and other equipment regularly to remove dust, dirt, and other contaminants.

3.5 HEALTH AND SAFETY

The pipeline will be designed in accordance with the USDOT Pipeline Safety Regulations, 49 CFR Part 195. The pipe will be steel line pipe conforming to API 5L and made from Grade X-70, high-strength steel. Special design consideration will be given to road crossings, river crossings, and any areas with potential for class location change that would require heavier wall pipe; in these locations, a Grade X 65 steel is anticipated to be used. The pipeline will initially have a uniform design maximum allowable operating pressure of 2,200 pounds per square inch gauge (psig) throughout. Table 3-3 outlines the pipeline specifications for each type of pipe to be used during construction.

Table 3-3. Pipeline Specifications

Specification	Grade X 70 Pipe*	Grade X 65 Pipe†
Miles Used for Construction	107.0	3.3
Material Strength (psi)	70,000	65,000
Outside Diameter (inches)	20	20
Wall Thickness (inches)	0.441	0.580
Design Factor	0.72	0.60
Pressure (psig)	2,222	2,262
Weight (lbs. per foot)	92.2	119.4

* Grade X 70 pipe is anticipated for general construction areas.
† Grade X 65 pipe is anticipated for special construction areas including road crossings, river crossings, and any areas with potential for class change that require heavier wall pipe.

As part of the construction mobilization activities, Denbury will provide contractor prevention, response, and safety training to improve awareness of safety requirements, pollution control laws and procedures, and proper operation and maintenance of equipment. Pre-construction safety coordination meetings will be held at each spread or Project work location. The safety meeting will address specific Denbury or contractor concerns and expectations; discuss safety initiatives; and review the safety compliance program, incident reporting, and established protocols for determining, correcting, and documenting safety non-compliance incidents. A detailed discussion of the health and safety measures to be followed is included in the Emergency Response Plan (Appendix I).

3.6 WASTE DISPOSAL

Denbury Construction Inspectors will ensure that the contractor implements the following waste disposal measures.

- No littering will be allowed on the ROW/TUP. Construction and operations sites will be maintained in a sanitary condition at all times and waste materials at these sites will be disposed promptly at an appropriate waste disposal site. Waste is defined as all discarded matter including, but not limited to, human waste, discarded food, trash, garbage, refuse, oil drums, petroleum products, blasting boxes, and equipment.
- The contractor will dispose excess or unsuitable materials at commercial disposal sites, commercial recycling centers, and disposal sites approved by Denbury and the State of Montana.
- The contractor will comply with all hazardous waste disposal requirements.
- Human wastes, temporarily located within self-contained facilities (portable toilets), will be removed from the ROW/TUP and disposed in accordance with applicable laws and regulations; these facilities will not be placed within 100 feet of a drainage, wetland, or waterbody.

3.7 LIVESTOCK GRAZING AND ASSOCIATED STRUCTURES

Grazing allotments and associated permit infrastructure (fences, gates, cattle guards, water pipelines, etc.) are present within the proposed Project on private, state, and BLM-administered lands. The acres of BLM grazing allotments disturbed by construction of the pipeline are listed in Table 3-4.

Denbury will implement BMPs to maintain current permit operations for grazing permittees during construction and to re-establish permit operations and disturbed infrastructure following construction. Fences crossing the ROW/TUP will be braced, cut, and temporarily fitted with gates to permit construction traffic passage. During construction, the opening will be controlled to prevent the escape of livestock. If necessary, gates would be installed with chained locks to allow access to the ROW/TUP after construction, as negotiated with landowners. Locked gates will not restrict public access to areas with legal public access. Care will be taken to not obstruct or damage existing gates or cattle guards. All livestock facilities (gates, cattle guards, corrals, fences, water sources, etc.) damaged or made inoperable will be repaired to BLM and private landowner satisfaction (per BLM specifications on public land).

Table 3-4. Acres of Grazing Allotments Disturbed by Pipeline Construction

Allotment Name	Land Ownership Acres				Total Acres
	BIA*	BLM	Private	State	
A. Pinnow	0.00	2.29	26.86	3.88	33.03
Allotment A and B	0.00	14.72	26.25	6.57	47.54
Ash Draw	0.00	0.00	38.81	0.00	38.81
Baldick	0.00	0.00	5.14	0.00	5.14
Belltower	0.00	24.85	8.29	0.00	33.14
Blackford	0.00	24.24	38.70	0.00	62.94
Brost	0.00	25.73	21.53	7.94	55.21
Brownfield	0.00	0.00	50.56	0.00	50.56
Cline	0.00	0.00	22.80	0.00	22.80
Cook Unit	0.00	0.00	11.09	0.00	11.09
Craft	0.00	0.00	0.51	0.00	0.51
Curry	0.00	0.00	37.13	0.00	37.13
Dinstel	0.00	0.74	43.63	0.00	44.36
Flasted Creek	0.00	0.00	41.21	0.00	41.21
Greasy Hill	0.00	0.00	19.68	0.00	19.68
Gussie Richards	0.00	0.00	0.19	0.00	0.19
Harrington	0.00	0.00	60.33	2.29	62.61
Hopkins	0.00	39.36	9.00	0.00	48.36
Horsetrack Draw	0.00	2.04	0.00	0.00	2.04
Jardee	0.00	0.00	88.11	0.01	88.12
Kingsley Allotment	0.00	0.00	0.04	0.00	0.04
Kirschten	0.00	2.82	21.81	0.00	24.63
Lang	0.00	0.00	16.02	0.00	16.02
Major	0.00	5.51	22.18	0.00	27.69
McCarty Creek	1.73	50.41	8.76	0.00	60.91
McKee & Home	0.00	0.00	16.42	0.00	16.42
Migratti	0.00	0.00	8.17	0.00	8.17
Murphy	0.00	0.00	1.57	2.49	4.06
Muskrat Amp	0.00	9.28	0.00	0.00	9.28
Phillippi	0.00	3.22	25.77	0.00	29.00
Pinnow Unit	0.00	0.00	0.03	0.00	0.03
Riesland	0.00	3.58	49.03	0.00	52.61
Sandons Corral Creek	0.00	0.00	15.35	0.00	15.35
Schweigert	0.00	0.00	16.04	0.00	16.04
Singer	0.00	0.84	0.43	0.00	1.27
Soda Creek	0.00	4.36	22.18	0.00	26.54
Spring Creek	0.00	0.00	0.56	0.00	0.56
Talcott	0.00	0.00	18.94	12.89	31.83
Tauck L & L	0.00	30.40	0.89	0.00	31.28
Taylor Hills	0.00	34.07	11.49	10.37	55.94
Warford Unit	0.00	0.00	1.44	0.00	1.44
Williams Unit	0.00	0.00	6.49	13.38	19.87
Wolff	0.00	9.76	52.20	18.36	80.32
Zupanik	0.00	0.00	22.56	0.00	22.56
Total Acres	**1.73**	**288.22**	**878.19**	**78.18**	**1,256.32**

* BIA = Bureau of Indian Affairs

4.0 AREAS OF SPECIAL CONDITIONS

The pipeline has been routed and will be installed to avoid impacts to special environmental resources and sensitive cultural resource locations, as much as possible. Special environmental resources could include wetlands, waterbodies, sensitive wildlife habitats, and wildlife migration corridors. In cases where routing cannot avoid all impacts to areas of special environmental conditions and cultural resource locations, the construction ROW/TUP will be reduced to minimize impacts. Additionally, timing restrictions and construction stipulations have been established to help protect these resources in the Resource Report for Aquatics, Vegetation, and Wildlife (Appendix F).

4.1 FEDERALLY LISTED, PROPOSED THREATENED OR ENDANGERED, AND CANDIDATE SPECIES

The U.S. Fish and Wildlife Service (USFWS) identifies two listed endangered species (pallid sturgeon and whooping crane) and two listed threatened species (northern long-eared bat and piping plover) with potential to occur in Carter, Fallon, and/or Powder River Counties, Montana. The BLM Miles City Field Office may require a biological assessment for this Project. Additional information on these species can be found in Section 5.1 of the Resource Report for Aquatics, Vegetation, and Wildlife (Appendix F of this POD).

4.2 SPECIAL STATUS SPECIES

BLM sensitive wildlife and rare plant species that could potentially occur within the proposed Project area are listed in Section 5.2 of the Resource Report for Aquatics, Vegetation, and Wildlife (Appendix F). The proposed Project area was evaluated for the potential occurrence of special status species based on range, known distribution, and the presence of suitable habitat in the proposed Project area.

Field surveys were conducted for black-tailed prairie dog colonies, greater sage-grouse leks, sharp-tailed grouse leks, mountain plover habitat, raptor nests, potential wading bird rookery habitat, potential eagle winter roost habitat, and rare plants as discussed in the Resource Report for Aquatics, Vegetation, and Wildlife (Appendix F).

Migratory bird presence in the Project area is discussed in the Resource Report for Aquatics, Vegetation, and Wildlife (Appendix F). Additional discussion on migratory bird presence and conservation measures for mitigation of Project impacts to migratory birds is provided in the Migratory Bird Conservation Plan (Appendix J).

Greater sage-grouse lek surveys and presence in the Project area are discussed in the Resource Report for Aquatics, Vegetation, and Wildlife (Appendix F). The approach that will be used by Denbury to produce a science-based mitigation plan that will compensate for effects to greater sage-grouse habitat is described in the Greater Sage-grouse Mitigation Planning Approach (Appendix K).

As discussed in the Resource Report for Aquatics, Vegetation, and Wildlife (Appendix F), certain specific wooded or forested areas within the proposed disturbance will be cleared prior

to construction between September 30 and June 1 to avoid disturbance to northern long-eared bat summer maternity habitat.

4.3 AQUATIC RESOURCES

Wetlands, waterbodies, and other aquatic features are described in Appendices E and F of this POD. Section 404 permits from the U.S. Army Corps of Engineers will be required before these resources are disturbed.

4.4 GENERAL WILDLIFE

The BLM, Montana Fish, Wildlife & Parks, and USFWS cooperatively manage wildlife resources over the Project area with the goal of avoiding or minimizing impacts from Project development. In addition, these agencies also work with other state and federal agencies, Denbury, and landowners to implement protective measures within the Project area.

Denbury acquired wildlife baseline information for the Project area in 2015, 2016, and 2017 (Appendix F). That information will be used to facilitate the BLM's ability to identify concerns, provide guidance for the design of Project plans that encourage conservation, monitor the effectiveness of decisions, and make recommendations to adjust management to address specific situations. Specific biological resources that have been identified as potentially occurring within the Project area are discussed in the Resource Report for Aquatics, Vegetation, and Wildlife in Appendix F of this POD.

Protection and conservation measures will be implemented for the proposed Project as outlined in Appendix F and Appendix K. Additional measures may be included in the Conditions of Approval, BMPs, and recommendations from consultation with the BLM, USFWS, and Montana Fish, Wildlife & Parks.

4.5 RECREATION AREAS

Areas of public recreation and outfitter use exist along the pipeline route and could be temporarily impacted by construction of the Project. BLM lands with legal public access that could be used for dispersed recreation (e.g., hunting, birding, fishing, hiking, etc.) are located within the proposed Project area. Hunting is the predominant recreational use most affected on BLM land. Construction and reclamation work during hunting season will temporarily exclude hunters and outfitters from comparatively small areas on BLM land. Denbury will contact the BLM via regular status update reports throughout construction, which will enable the BLM to notify the public of anticipated road closures or delays to regular traffic patterns to these areas.

4.5.1 Traffic Control Plan

Safety of the public is the primary concern associated with active construction within or near recreation or other public use areas. Signage will be used along public roads, Project access roads, and the construction ROW to indicate where the public and/or construction contractor are allowed access. Construction warning signs will also be used along public roads to warn the public when they are approaching a construction work area (Figure 4-1).

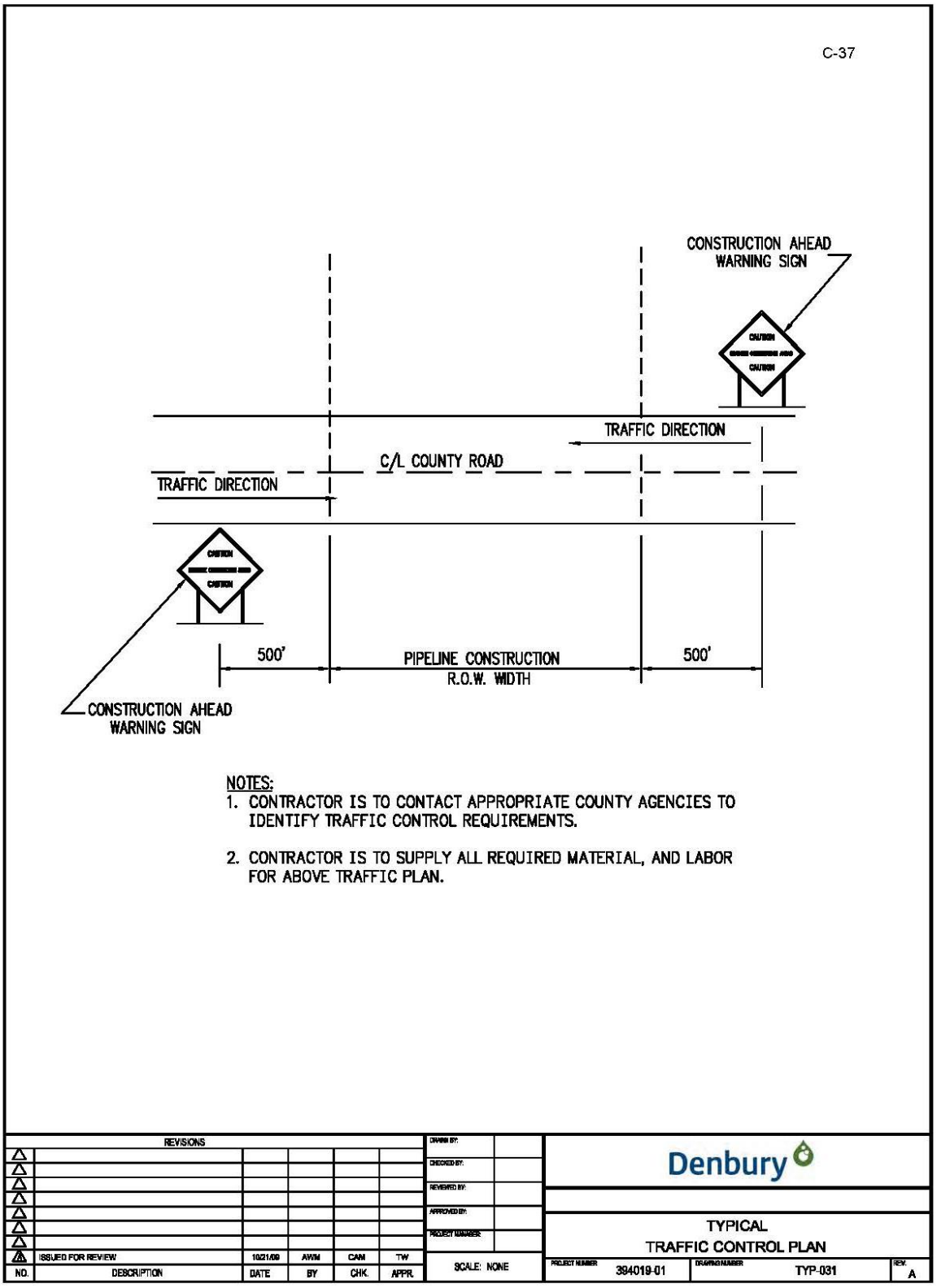


Figure 4-1. Typical traffic-control plan.

Public access to open excavations will be limited by either installation of BLM-approved locked gates at public access points, installation of barbed wire fences or temporary gates (Section 2.8.6 of Appendix E), or use of other approved means of limiting public access. Flag persons will be used to control traffic (as needed) for ingress and egress from the ROW/TUP.

Designated hard-surfaced roads used during Project construction activities will be maintained in an operable condition to allow access for the public and/or landowners during construction. However, construction activities may in some cases require temporary lane or road closure. Partial closure or closure and detouring of existing roads will be performed only following authorization by the appropriate agency (counties, Montana Department of Transportation, etc.). An alternate route will be provided to residents, contractors, and the emergency response organizations for their approval prior to any road closures. Proper signage will be provided and signage locations will be approved prior to any change in traffic flow. Notification of road closure with detour routes and reopening of roads will be communicated to the appropriate agencies, emergency response personnel, operators, and contractors working onsite prior to closures. Proper signage such as detour and road closure signs will be placed before the roads are taken out of service.

One BLM-designated sport-fish reservoir, Frigid Reservoir, is adjacent to the proposed access road AR-16. Denbury will allow public access to facilitate continued use by the public during construction via use of clear signage and/or traffic-control devices including a flag person.

4.5.2 Visual Resource Management

Visual Resource Management (VRM) classes along with the corresponding VRM objectives, have been established for BLM lands within the project area. These VRM objectives provide standards for evaluating and analyzing proposed projects as well as identifying mitigating measures that serve to minimize visual impacts.

The VRM class established for this Project area falls within a Class IV, the objectives of which are described as follows.

Class IV Objectives. The objective of this class is to provide for management activities which require major modification of the existing character of the landscape. The level of change to the characteristic landscape can be high. These management activities may dominate the view and be the major focus of viewer attention. However, every attempt should be made to minimize the impact of these activities through careful location, minimal disturbance, and repeating the basic elements.

4.6 SPECIAL OR SENSITIVE SOIL LOCATIONS

A variety of unique or special soils exist within the Project area. Sensitive areas include landscape features, soil attributes, and vegetation community characteristics that may limit the success of reclamation. Denbury will implement reclamation techniques that ensure subsurface integrity and re-establish slope and surface stability while maintaining the biological, chemical, and physical integrity of the soil resource. A more detailed discussion of the specific techniques used during and after construction are included in the Reclamation, Mitigation, and Monitoring

Plan (Appendix E). The locations of sensitive soils crossed by the proposed Project are summarized in Table 4-1.

No areas of Prime Farmland are located within the proposed Project area.

Table 4-1. Locations of Sensitive Soils Crossed by Pipeline

Milepost		Length (miles)	Land Ownership
Begin	**Exit**		
4.00	4.14	0.14	Private
6.52	6.76	0.24	Private
8.73	9.00	0.27	Private
9.13	9.24	0.11	Private
9.24	9.64	0.41	BLM
9.64	9.89	0.25	Private
9.89	10.89	1.00	BLM
10.89	11.29	0.40	Private
19.15	19.54	0.40	Private
21.15	21.27	0.12	Private
21.74	21.83	0.09	Private
22.12	22.13	0.01	Private
22.26	22.36	0.10	BLM
25.93	25.98	0.06	Private
28.66	28.80	0.14	Private
35.81	35.89	0.09	Private
35.81	35.89	0.09	BLM
35.96	36.28	0.33	Private
35.96	36.28	0.33	BLM
43.96	44.02	0.06	Private
44.02	44.14	0.12	BLM
44.33	45.07	0.74	BLM
46.06	46.28	0.22	BLM
68.79	68.86	0.08	Private
69.93	70.11	0.17	Private
78.27	78.37	0.10	Private
79.40	80.13	0.73	Private
84.33	84.43	0.10	Private
84.57	84.79	0.22	Private
99.33	99.35	0.02	Private
100.78	100.79	0.02	Private
100.83	100.83	0.00	Private
101.44	101.48	0.04	Private
109.44	109.74	0.29	Private

4.7 ENVIRONMENTAL INSPECTIONS

Denbury will be responsible for providing environmental inspection for the proposed Project during construction. An Environmental Compliance Plan (ECP) will be prepared that includes this POD as well as Conditions of Approval, permit stipulations, and other approvals from various agencies that are applicable to environmental compliance. The ECP will describe roles, responsibilities, and reporting procedures for the Environmental Inspectors to use during the construction and post-construction phases of the Project. Inspection personnel will have the qualifications and experience necessary to conduct environmental inspections, as well as stormwater inspections and compliance reporting for pipelines. Environmental Inspectors will be responsible for conducting water quality sampling at discharge locations per the Hydrostatic Test Plan (see Appendix G).

4.8 NOXIOUS WEED MANAGEMENT

Denbury will be responsible for noxious weed control within the limits of the ROW/TUP and other disturbance areas. Noxious weeds will be monitored and mitigated in accordance with the Noxious Weed Management Plan (Appendix L).

4.9 AREAS OF CULTURAL SIGNIFICANCE

SWCA Environmental Consultants has completed Class III inventories on the proposed pipeline route. Cultural resource monitoring and trench inspection activities are detailed in the monitoring and treatment plan (Appendix M) to be approved by BLM and State Historic Preservation Office (SHPO) prior to construction.

5.0 EMERGENCY PROCEDURES

The Emergency Response Plan is included in Appendix I, and includes a Safety Response Plan and Fire Prevention and Suppression Plan. The Emergency Response Plan will be reviewed by all contractors and updated as needed to meet changing conditions and applicability with federal regulations. The Emergency Response Plan will also outline the reliability, safety standards, CO_2 pipeline accident data, and damage control program requirements.

6.0 FIRE PREVENTION AND SUPPRESSION

Contractors will comply with Denbury's Fire Prevention and Suppression Plan, which is included in Emergency Response Plan (Appendix I). This plan details fire control procedures including responsibilities and coordination, notification procedures, emergency fire patrols, fire prevention methods, and fire prevention requirements for construction equipment.

7.0 SPILL PREVENTION AND CONTAINMENT

Spill prevention and containment applies to the use and management of hazardous materials on the construction ROW and all ancillary areas during construction. This includes the refueling or servicing of all equipment with diesel fuel, gasoline, lubricating oils, grease, and hydraulic

and other fluids during normal upland applications and special applications on federal lands that are within 500 feet of perennial streams or wetlands.

Denbury or its contractors will prepare a Project-specific Spill Prevention Containment and Countermeasure (SPCC) Plan prior to construction. The contractor will provide additional information to complete the SPCC Plan for each construction spread (if applicable), and will provide site-specific data that meet the requirements of 40 CFR Part 112 for every location used for staging fuel or oil storage tanks and for every location used for bulk fuel or oil transfer. Each SPCC Plan will be prepared prior to introducing the subject fuel, oil, or hazardous material to the subject location.

7.1 SPILL PREVENTION

7.1.1 Staging Areas

Staging areas (including contractor yards and pipe stockpile sites) will be used as described in Section 1.4.3. Bulk fuel and storage tanks used during construction will be placed only at contractor yards. Hazardous materials at staging areas will be stored in compliance with federal and state laws. The following spill prevention measures will be implemented by the contractor to reduce the potential of a spill to impact federal lands.

- Contractor fuel trucks will be loaded at existing bulk fuel dealerships or from bulk tanks set up for that purpose at the staging area. In the former case, the bulk dealer is responsible for preventing and controlling spills.
- The Environmental Inspector will inspect the tank site for compliance with the 500-foot setback requirement and approve the tank site prior to installing bulk fuel or storage tanks on the construction yard.
- Fuels and lubricants will be stored only at designated staging areas. Storage of fuel and lubricants in the staging area will be at least 500 feet away from the water's edge. Refueling and lubrication of equipment will be restricted to upland areas at least 500 feet away from perennial streams and wetlands.
- Contractors will be required to perform all routine equipment maintenance at the staging area and recover and dispose of wastes in an appropriate manner.
- Fixed fuel dispensing locations will be provided with secondary containment to capture fuel from leaks, drips, and overfills.
- Temporary liners, berms, or dikes (secondary containment) will be constructed around the aboveground bulk tanks, providing 110% containment volume of the largest storage tank or trailer within the containment structure, so that containment structures may consist of temporary earthen berms with a chemical resistant liner, or a portable containment system constructed of steel, PVC, or other suitable material. The secondary containment structure will be capable of containing 110% of the volume of material stored in these areas.

Denbury may allow modification of the above specifications as necessary to accommodate specific situations or procedures. Any modifications must comply with all applicable regulations and permits.

7.1.2 Construction Right-of-Way

The contractor will ensure that all equipment is free of leaks prior to use on the Project and prior to entering or working in or near waterbodies or wetlands. Throughout construction, the contractor will conduct regular maintenance and inspections of the equipment to reduce the potential for spills or leaks.

Rubber-tired vehicles will refuel at the construction staging areas or commercial gas stations. Tracked machinery (backhoes, bulldozers) may be refueled and lubricated on the construction ROW. Equipment maintenance may be conducted in staging areas when practical. When impractical, repairs to equipment can be made on the construction ROW/TUP when approved by Denbury's representative.

Each fuel truck that transports and dispenses fuel to construction equipment or Project vehicles along the construction ROW/TUP or within equipment staging and material areas will carry an oil spill response kit and spill response equipment onboard at all times. In the event that response materials are depleted through use or their condition is deteriorated through age, the materials will be replenished prior to placing the fueling vehicle back into service.

The following preventive measures apply to refueling and lubricating activities on the construction ROW.

- Construction activities will be conducted to allow for prompt and effective cleanup of spills of fuel and other hazardous materials. Each construction crew, including cleanup crews, will have on hand sufficient tools and material to stop leaks and supplies of absorbent and barrier materials to allow rapid containment and recovery of spilled materials. Crew members must know and follow the procedure for reporting spills.
- Refueling and lubricating of construction equipment will be restricted to upland areas at least 500 feet away from waterbodies, perennial streams, and wetlands located on federal lands. Where this is not possible (e.g., trench dewatering pumps), the equipment will be approved in advance by the BLM Authorized Officer and fueled by designated personnel with special training in refueling, spill containment, and cleanup. The Environmental Inspector will ensure that signs are installed identifying restricted areas Spent oils, lubricants, filters, etc. will be collected and disposed of at an approved location in accordance with state and federal regulations.
- Equipment will not be washed within 500 feet of waterbodies, streams, or wetlands.
- Stationary equipment will be placed within a secondary containment if it will be operated or require refueling within 500 feet of a wetland or waterbody boundary.

Denbury may allow modification of the above specifications as necessary to accommodate specific situations or procedures. Any modifications on federal lands must comply with all applicable regulations and permits and be approved by BLM Authorized Officer.

If a spill occurs on navigable waters of the United States, Denbury will notify the National Response Center at 1-800-424-8802. For spills that occur on federal lands, which includes surface waters or into sensitive areas, the BLM Authorized Officer also will be notified.

7.2 SPILL CONTAINMENT AND COUNTERMEASURES

In the event of a spill of hazardous material, contractor personnel will complete the following steps.

- Notify the appointed Denbury representative.
- Identify the product hazards related to the spilled material and implement appropriate safety procedures, based on the nature of the hazard.
- Control danger to the public and personnel at the site.
- Implement spill contingency plans and mobilize appropriate resources and manpower.
- Isolate or shutdown the source of the spill.
- Block culverts to limit spill travel.
- Initiate containment procedures to limit the spill to as small an area as possible to prevent damage to property or areas of environment concern (e.g., watercourses).
- Commence recovery of the spill and cleanup operations.

When notified of a spill, the Denbury representative will immediately ensure the following procedures are completed.

- Action is taken to control danger to the public and personnel at the site.
- Spill contingency plans are implemented and necessary equipment and manpower are mobilized.
- Measures are taken to isolate or shutdown the source of the spill.
- All resources necessary to contain, recover, and clean up the spill are available.
- Any resources requested by the contractor from Denbury are provided.
- The appropriate agencies are notified. For spills that occur on federal lands, which includes surface waters or into sensitive areas, the BLM Authorized Officer will also be notified and involved in the incident.

For a land spill, berms will be constructed with available equipment to physically contain the spill. Personnel entry and travel on contaminated soils will be minimized. Sorbent materials will be applied or, if necessary, heavily contaminated soils will be removed to an approved facility. Contaminated sorbent materials and vegetation will also be disposed of at an approved facility.

For a spill threatening a waterbody, berms or trenches will be constructed to contain the spill prior to entry into the waterbody. Deployment of booms, skimmers, and sorbent materials will be necessary if the spill reaches the water. The spilled product will be recovered and the contaminated area will be cleaned up in consultation with spill response specialists and appropriate government agencies.

8.0 OPERATION AND MAINTENANCE ACTIVITIES

Denbury will be responsible for monitoring pipeline operations after construction is completed. This will include environmental inspections, and equipment and facility inspections. Inspection personnel will have the qualifications necessary to conduct stormwater inspections and reporting for pipelines.

Denbury's main Supervisory Control and Data Acquisition (SCADA) control center will continuously monitor pipeline pressure and flow conditions. A SCADA system is a control system, manned at all times, that monitors the entire system for pressures, flows, receipts, deliveries, and operating conditions of the pipeline. The control system will be programmed to alarm any time there is a deviation in pressure or flow indicating abnormal condition in the pipeline system.

The proposed CO_2 pipeline will be operated and maintained in accordance with industry standard procedures to ensure safe operation and to maintain the integrity of the pipeline system. Denbury's operating and maintenance procedures are developed in accordance with the safety standards outlined in 49 CFR Part 195 and other applicable regulations. These procedures will continue to be implemented during the operation and maintenance of the pipeline facilities.

8.1 SURVEILLANCE

Communication and detection systems for the proposed Project will be developed. The frequency of pipeline ground inspections will be in compliance with USDOT Office of Pipeline Safety requirements. The ROW will be periodically inspected by aerial patrol.

Operations and maintenance stipulations to protect cultural resource sites during operation and maintenance of the pipeline will be specified in the Section 106 of the National Historic Preservation Act. Ground-disturbing operations and maintenance activities within or near known significant cultural or paleontological resources will not occur without prior coordination with BLM, and may require monitoring by qualified archaeologists or paleontologists.

8.2 RIGHT-OF-WAY ACCESS

Surface travel along the ROW/TUP will be limited to periodic valve inspections, leak surveys, erosion control (stormwater inspections), and any pipeline repairs that may be needed. In addition, it also will be necessary to access the ROW/TUP for the corrosion control inspections and noxious weed surveys; this will be conducted with a field service truck or all-terrain vehicle. Denbury will use the identified access roads (as negotiated via signed agreements with each individual landowner) to gain access to the ROW/TUP following construction.

8.3 PIPELINE AND SITE MAINTENANCE AND REPAIR

Specialists and technicians will be on-call to service the pipeline. Surface traffic will be limited to workers performing pipeline and valve maintenance, periodic monitoring and inspection, and emergency repairs to the pipeline or associated equipment.

Repairs from minor corrosion and slight external mechanical damage to pipe and coating material can be made without interruption or with a minimum interruption of service. These types of repairs are usually made under a reduced pipeline pressure and require a minimum amount of excavation and heavy equipment. Other minor repairs may include BMP maintenance, pipeline marker replacement, and debris removal.

Some settling of the backfilled trench will occur, particularly after the first winter following construction. Subsidence and potholes will be filled if necessary and the surface restored to normal grade and reseeded. Subsidence discovered in subsequent years will be filled, surface restored to normal grade, and reseeded (per BLM's approved seed mixture on public land).

9.0 TERMINATION AND ABANDONMENT OF RIGHT-OF-WAY AND FACILITIES

Prior to termination of the BLM ROW Grant and TUP, or any portion thereof, Denbury will contact the BLM AO to arrange for a pre-termination meeting and joint inspection of the ROW/TUP. This meeting and inspection will take place a minimum of 30 days prior to termination. The meeting and inspection will be held so that an agreement on an acceptable termination and reclamation plan is reached. This plan will include, but not be limited to, abandonment and/or removal of facilities, drainage structure and/or surface material, recontouring, replacement of topsoil, seeding, and monitoring (including the monitoring of noxious weeds). The Authorized Officer must approve the plan in writing. Denbury will relinquish all, or those specified portions, of the ROW/TUP in accordance with the termination plan.

10.0 UNANTICIPATED DISCOVERY PLAN

Denbury prepared a separate monitoring and treatment plan for cultural resources (Appendix M) and paleontological resources (Appendix N) that details the procedures to be followed by Environmental Inspectors, construction personnel, and cultural and paleontological resource monitors in the event of cultural or paleontological resource discoveries during construction. The cultural resource plan has been submitted to the BLM as the lead federal agency for SHPO and other consulting party review and concurrence. Procedures outlined in the plan will be reviewed during construction contractor training.

11.0 GLOSSARY

AO	Authorized Officer
ATWS	additional temporary workspace
BLM	Bureau of Land Management
BMP	best management practice
CCA	Cedar Creek Anticline
CFR	Code of Federal Regulations
CO_2	carbon dioxide
Denbury	Denbury Green Pipeline – Montana, LLC
MLV	mainline valve
ROW	right-of-way
SHPO	State Historic Preservation Office
SPCC	Spill Prevention Containment and Countermeasure
TUP	Temporary Use Permit
USDOT	U.S. Department of Transportation
USFWS	U.S. Fish and Wildlife Service

12.0 REFERENCES

Bureau of Land Management (BLM). 2008. Standard Environmental Color Chart. Washington, D.C. Available at: http://www.blm.gov/bmp. Accessed December 12, 2017.

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Plan of Development

Cedar Creek Anticline Enhanced Oil Recovery Unit Development Project

Prepared for

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April 2018

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Appendix

1.0 PROJECT DESCRIPTION

1.1 PROJECT OVERVIEW

Denbury Onshore, LLC (Denbury) proposes an Enhanced Oil Recovery (EOR) Unit Development within three existing units of the Cedar Creek Anticline (CCA) in Fallon County, Montana (Figure 1-1 and 1-2), which is described in this Plan of Development (POD). The three units combined consist of approximately 44,490 acres and include the Pennel Unit (12,046 acres), the East Lookout Butte (ELOB) Unit (24,625 acres), and the Coral Creek Unit (7,819 acres). The units will be developed using a multiple-phased approach. The three units include lands administered by the Bureau of Land Management (BLM) and State of Montana, and privately-owned land (Table 1-1). The subsurface mineral ownership is summarized in Table 1-2. Applications for Permit to Drill (APDs) for new grass roots, replacement wells, and re-entry wells will be submitted to the BLM for review and approval prior to disturbance and when a right-of-way (ROW) is granted.

Denbury has submitted a separate POD to the BLM proposing a 110-mile-long carbon dioxide (CO_2) pipeline to transport CO_2 from the existing Bell Creek Oilfield in Powder River County, Montana, to the CCA EOR unit development in Fallon County, Montana (Figure 1-1). The proposed EOR unit development and 110-mile-long pipeline are being analyzed as a connected action in the same National Environmental Policy Act document.

Table 1-1. Surface Land Ownership

CCA Unit	Land Ownership Acres (Percent)			Total Acres
	BLM	Private	State	
Coral Creek	2,082.0 (27%)	5,455.8 (70%)	281.3 (3%)	7,819.1
ELOB	3,521.8 (14%)	19,340.8 (79%)	1,762.3 (7%)	24,624.9
Pennel	0.0 (0%)	11,397.5 (95%)	648.4 (5%)	12,045.9
Total	**5,603.8 (13%)**	**36,194.1 (81%)**	**2,692.0 (6%)**	**44,489.9**

Table 1-2. BLM Subsurface Mineral Ownership

CCA Unit	BLM Mineral Ownership Acres (Percent)			Total Acres
	All Minerals	Oil and Gas Only	None/Undetermined	
Coral Creek	2,082.0 (27%)	441.4 (5%)	5,295.7 (68%)	7,819.1
ELOB	3,521.8 (14%)	250.2 (1%)	20,853.0 (85%)	24,624.9
Pennel	0.0 (0%)	240.7 (2%)	11,805.1 (98%)	12,045.9
Total	**5,603.8 (13%)**	**932.3 (2%)**	**37,953.8 (85%)**	**44,489.9**

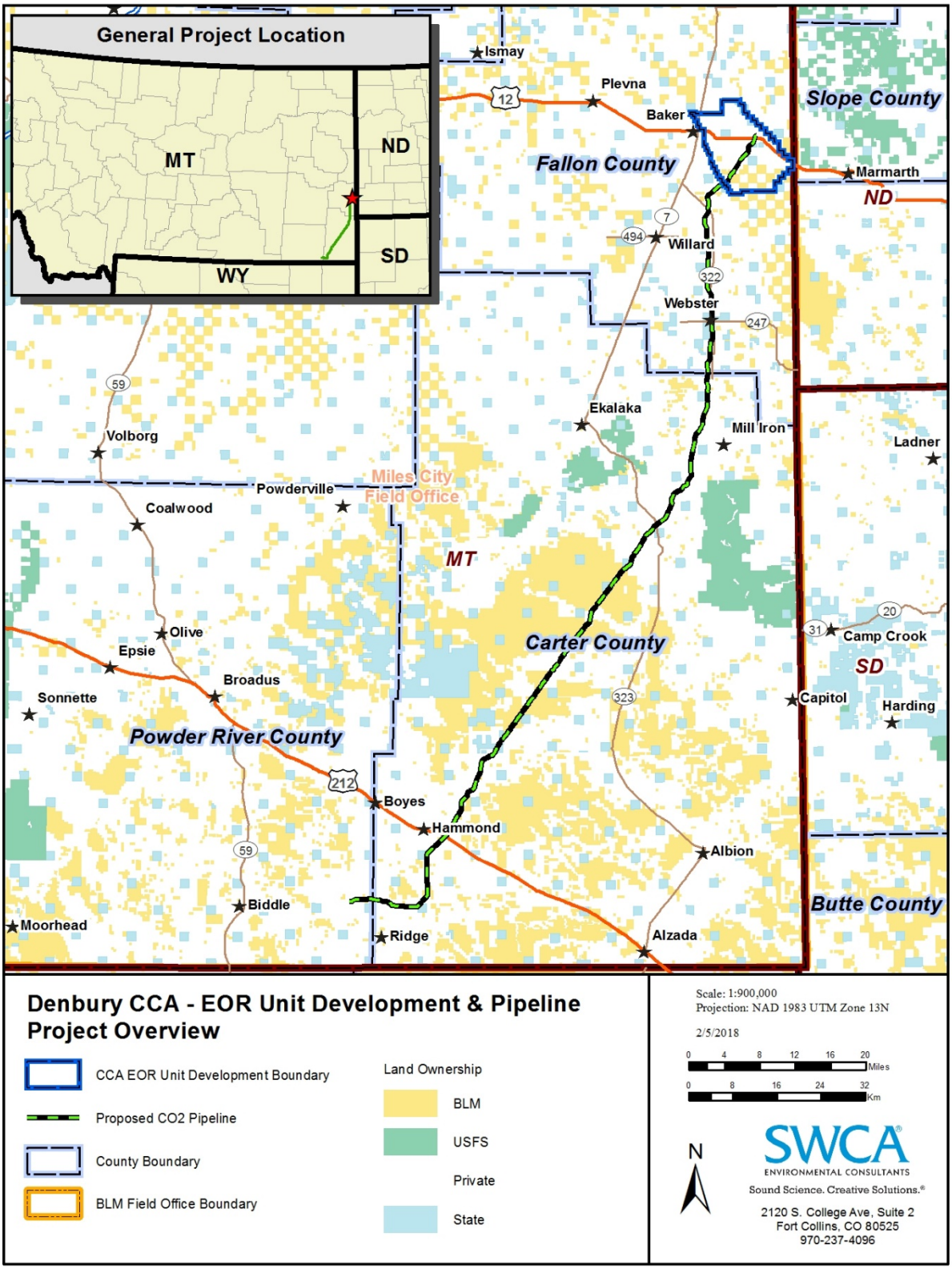


Figure 1-1. Project location map.

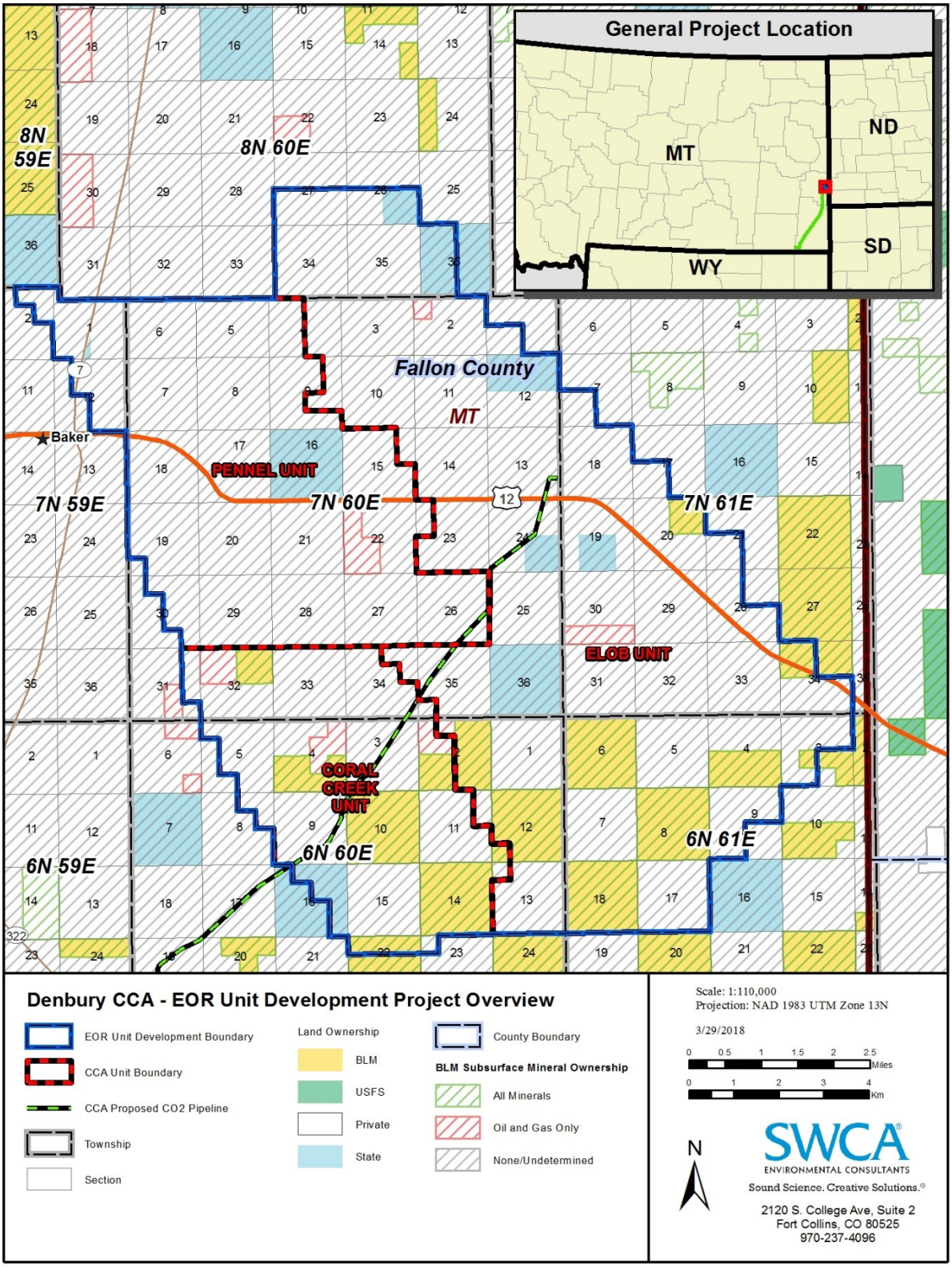


Figure 1-2. EOR Unit Development Project overview.

1.2 PERMITS AND APPROVALS REQUIRED PRIOR TO CONSTRUCTION

The Project is located on federal, state, and private lands in Fallon County, Montana, and is subject to federal, state, and local permit requirements. Denbury will obtain all federal, state, and local permits prior to construction of the proposed Project. Table 1-3 lists the federal, state, and local permits and/or approvals required for Project development. Denbury will adhere to the Conditions of Approval for both the APDs and Sundry Notice on public land, as specified by the BLM Miles City Office and outlined in Denbury's Applicant-Committed Measures (Appendix A).

Table 1-3. List of Permits, Approvals, and Reviews

Issuing Agency/ Program/Permit Name	Permits/Approvals/Authorizing Actions	Application Project Component
FEDERAL PERMITS, APPROVALS, AND AUTHORIZING ACTIONS		
U.S. Department of the Interior, Bureau of Land Management (BLM)		
Onshore Oil and Gas Orders and Current Codes of Federal Regulations	Permitting of federal operations (drilling, completion, abandonment), drilling operations, site security, measurement of oil, produced water disposal.	Wells, associated facilities, roads
Right-of-Way (ROW) Grant, Temporary Use Permits	ROW grant consists of access roads, pipelines, power lines; temporary use permit consists of additional workspace.	Permanent access roads, power lines, and pipelines, and additional temporary workspaces that are located on BLM-managed land
National Environmental Policy Act	National Environmental Policy Act review and approval, issuance of Decision Record.	All Project components that occur over BLM minerals or on BLM surface ownership and connected actions
Cultural Resource Clearances	Cultural resource permit.	Antiquities Act of 1906 Archaeological Resources Protection Act of 1979 National Historic Preservation Act, Section 106 (36 Code of Federal Regulations 800)
Endangered Species Act	Informal or formal consultation with U.S. Fish and Wildlife Service for threatened and endangered species.	All Project components
Cultural Resource Protection and Consultation	Consultation with Montana State Historic Preservation Office.	All surface disturbance
U.S. Army Corps of Engineers		
Permit for Dredged or Fill Material (404 Permit)	Placement of fill or dredged material in waters of the U.S. or adjacent wetlands.	All surface-disturbing activities affecting waters of the U.S. or wetlands

Issuing Agency/ Program/Permit Name	Permits/Approvals/Authorizing Actions	Application Project Component
U.S. Environmental Protection Agency		
Clean Water Act	Spill Prevention, Control, and Countermeasure Plans.	Transfer and storage of fuels and oils
STATE PERMITS, APPROVALS, AND AUTHORIZING ACTIONS		
Montana Department of Environmental Quality		
Montana Air Quality Standards	Permits for emissions from new or modified sources; prevention of significant deterioration (if applicable); control of hazardous air pollutants, hydrogen sulfide, and volatile organic compounds.	All stationary fuel-burning sources, tanks, separators, dehydrators, and compressors
Section 401 Water Quality Certification for Stream Crossings	State approvals for 404 Permits for stream crossings.	Access roads, pipelines
Short Term Water Quality Standard for Turbidity – 318 Authorization	Construction activities that will cause short-term or temporary violations of state water quality standard for turbidity.	Stream crossings, near-stream activities that will discharge stormwater to stream
Individual Montana Pollutant Discharge Elimination System Discharge Permit	Discharges of hydrostatic test water.	Pipeline testing
General Permit for Construction Dewatering	Discharges for construction dewatering.	Construction sites
General Permit for Produced Water	Discharges of produced water.	Produced water
General Permit for Storm Water Discharges Associated with Construction Activity	Storm water discharges.	All construction disturbance
Montana Department of Transportation		
Transport Permits	Permit for oversize, over-length, and overweight loads.	Transportation of equipment and materials on state highways
Montana Department of Natural Resources and Conservation, Oil and Gas Conservation Division		
Oil and Gas Rules and Regulations	Drilling operations, safety regulations, pit permits, product measurement, and authorization of flaring for fee and state wells.	Wells and related facilities
Underground Injection Control Permit/Approval	Class II injection/disposal wells.	Underground injection/disposal wells
Montana Board of Land Commissioners		
Authorization of Activities on State Land	Approval of oil and gas leases, ROWs, temporary use permits, and developments on state land.	Facilities on state lands
Montana Department of Natural Resources and Conservation		
Montana Natural Streambed and Land Preservation Act – 310 Permit	Activity that physically alters or modifies the bed or banks of a perennial stream.	Perennial stream crossings

Issuing Agency/ Program/Permit Name	Permits/Approvals/Authorizing Actions	Application Project Component
Floodplain Development Permit	New development within designated Special Flood Hazard Areas.	Floodplains
Land Use License of Easement on Navigable Waters	Project below low-water mark of navigable water.	Stream crossings
Water Right Permit and Change Authorization	Temporary water use for hydrostatic testing.	Pipeline testing
Montana State Engineer		
Water Agreement for Temporary Use of Water	Temporary water use for hydrostatic testing, and dust abatement.	Pipeline and facility construction
LOCAL PERMITS, APPROVALS, AND AUTHORIZING ACTIONS		
Fallon County		
Road Use Authorization	Overweight and over-length loads on county roads.	Transportation of equipment and materials on county roads
Conditional Use and Special Use Permits, Zoning	New structures.	Associated facilities
County Road Access	Construction of new roads that connect to county roads.	Project access roads
PRIVATE LANDOWNERS AND COMPANIES		
Private Landowners	Land easements/agreements.	All land-disturbing activities
Burlington Northern Santa Fe (BNSF)	Crossing permits.	Railroad crossings

2.0 HISTORY OF THE CEDAR CREEK ANTICLINE GEOLOGIC STRUCTURE

The CCA geologic structure stretches approximately 115 miles southeast from Glendive, Montana, to Buffalo, South Dakota (Figure 2-1). The CCA is a collection of structural traps, inter-connected by various faulting styles, including some subsets of fracture pattern overprinting. The primary producing carbonate reservoirs include the Ordovician Red River, the Silurian Stony Mountain and Interlake Formations, and the Mississippian Mission Canyon Formation. The primary source rocks are the organic shales in the Cambrian Winnepeg Formation, Ordovican Lower Red River Formation, and lower Lodgepole Formation (Davis 2013). All of the producing reservoirs, except the Mission Canyon, are intercrystalline and interpartical dolomites, and were deposited in supratidal, intertidal, and subtidal environments. The Mission Canyon reservoirs are mostly limestone.

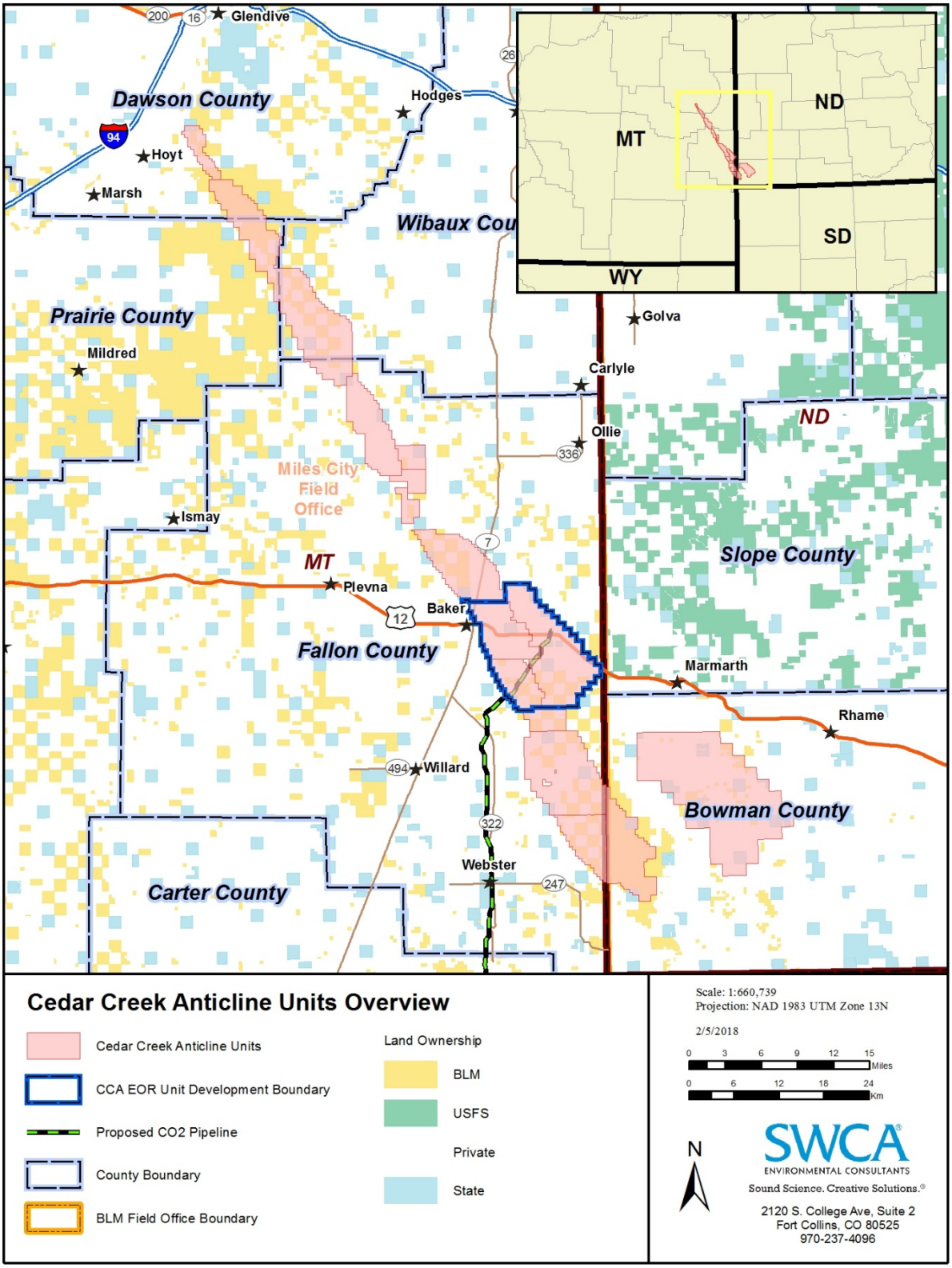


Figure 2-1. Cedar Creek Anticline units overview.

Oil was discovered in the CCA in 1951. Thirteen oil and gas units on the anticline have produced over a half billion barrels of oil from about 2,700 wells. Within the CCA, Shell Oil was the major explorer and developer for oil in these units from 1950 to 1998 and commenced water flooding and infill drilling from 1959 to 1984. Shell Oil sold their interests to Encore in 1999, whose focus was infill drilling for new oil. Denbury Resources Inc. bought Encore's interest in 2010, and current activities are centered on optimizing water flood patterns in preparation to commence CO_2 floods (Davis 2013).

3.0 DESCRIPTION OF EOR PROCESS

EOR, or tertiary oil recovery, uses processes to increase the recovery of oil resources. EOR involves the application of heat, chemicals, or gases to a petroleum reservoir to provide energy or alter reservoir fluid properties to recover additional reserves. Injection of CO_2 for EOR can increase recovery of oil by 4% to 15% over primary and secondary methods, and in some cases, more than 20% of original oil in place (U.S. Department of Energy 2013). A commonly used method of EOR using CO_2 is the water-alternating-gas method which involves alternating injection of gas and water into the reservoir using injection wells. A slug (a pre-determined volume) of CO_2 is injected into the oil zone to maintain a solvent bank between the CO_2 and the oil, and then a slug of water is introduced behind the CO_2. The water pushes the CO_2 slug and oil bank to production wells, where the fluids and CO_2 are recovered. The water-alternating-gas method is proposed for the EOR process within the Coral Creek, ELOB, and Pennel units.

CO_2 will be transported from the Greencore Pipeline termination point in the Bell Creek Oil Field Development to the proposed three units within the CCA. Denbury proposes to use 353 existing wells and 55 new wells within the Pennel Unit, ELOB Unit, and Coral Creek Unit, and equip them to become either producing oil wells or injection wells (water and CO_2). As part of the process, tubing, downhole equipment, wellheads, water injection lines and flowlines will be refurbished or replaced to make compatible with the new service conditions. New CO_2 injection lines will be installed, connecting the CO_2 supply to the wellbores.

Fluids will be processed at central processing and compression facilities, called EOR facilities, located within the EOR unit development boundary. No processing will occur at the well site. At the processing facilities, the produced oil, water, and CO_2 will be separated, and then water will be injected back into the reservoir or into both existing and new disposal wells. The oil will be processed and routed to oil storage tanks located at the EOR facility sites for eventual sale using existing oil sales pipelines. The CO_2 will be recycled and compressed for re-injection into the oil reservoir. Figure 3-1 provides an overview of the basic EOR process.

There will be injector and producer wells in the units that will be developed in patterns during the EOR process (e.g., one CO_2 injector to five producers). Oil production is expected to last for 30 years for all wells being developed.

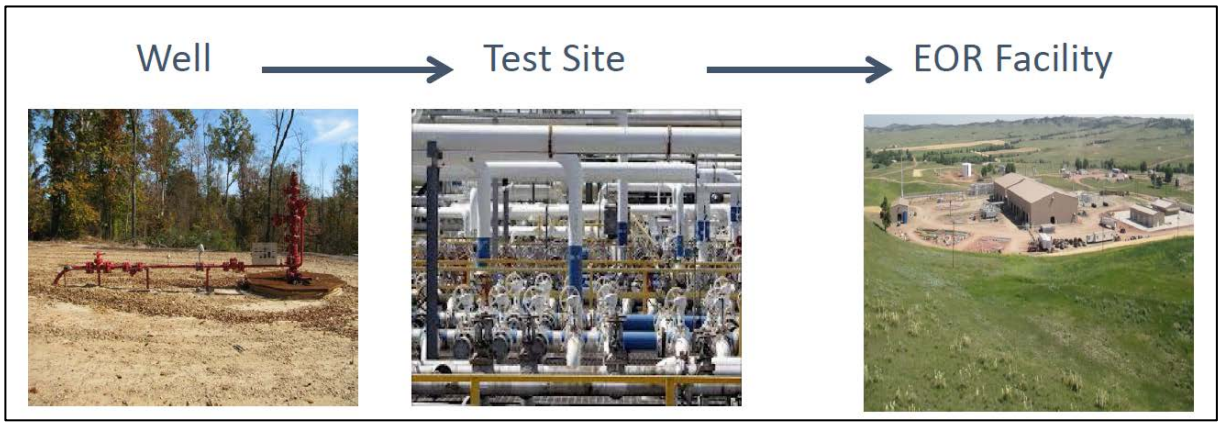


Figure 3-1. Basic EOR process.

4.0 PROJECT COMPONENTS

The following sections describe the various components proposed for EOR unit development and include a detailed description of the existing and new infrastructure to be used during EOR development. The Project is located in an active oil and gas field; therefore, existing infrastructure will be used to the greatest extent possible.

Project development will occur in a four-phased approach, with one phase developed every 2 years beginning with Phase D in 2019–2020, Phase C in 2021–2022, Phase B in 2023–2024, and Phase A in 2025–2026. The four phases are illustrated in Figure 4-1 and described in detail in Tables 4-1 through 4-4.

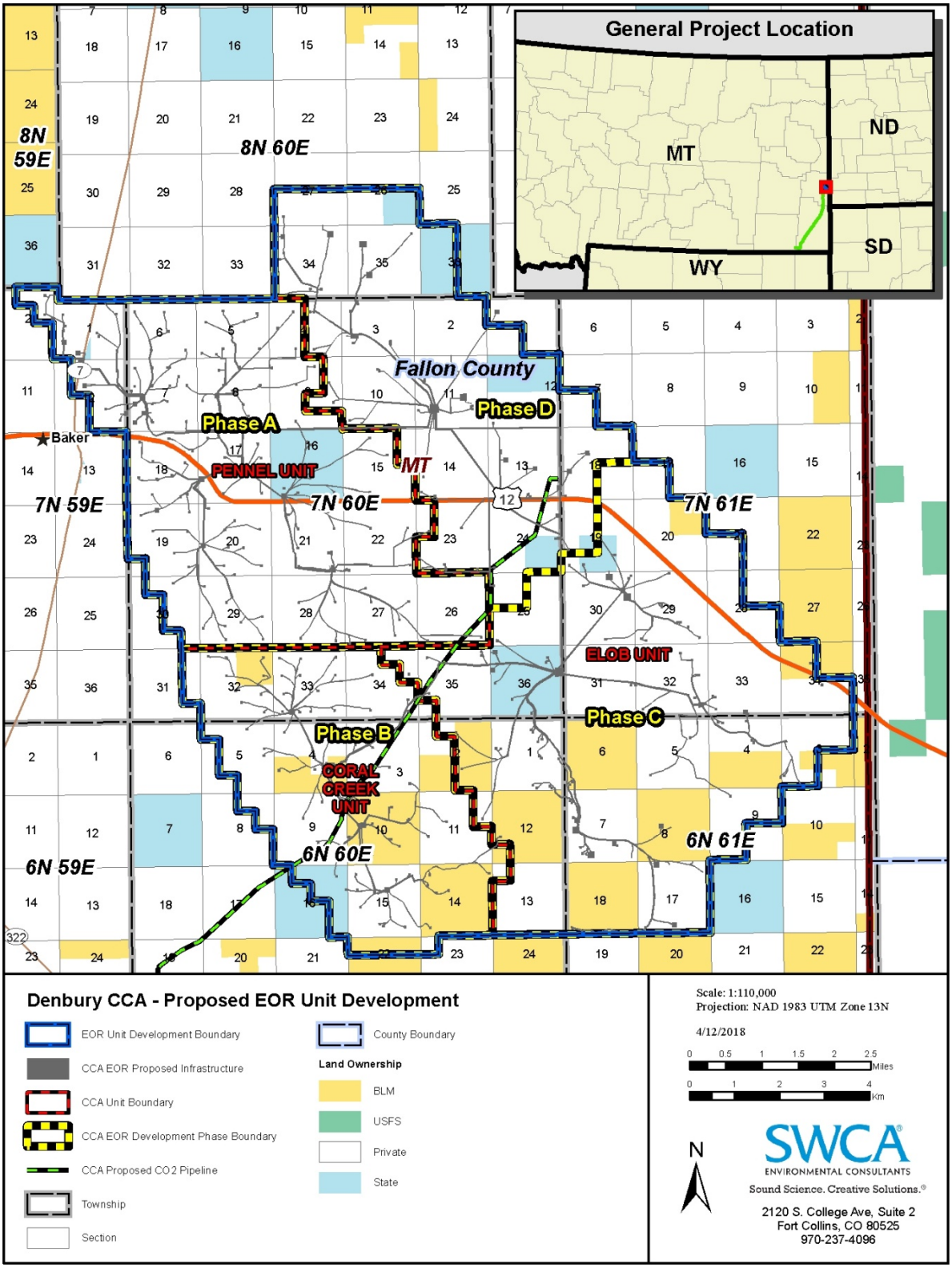


Figure 4-1. EOR Unit Development Project overview.

Table 4-1. Phase A Summary of Existing and Proposed Disturbance

Infrastructure Type	Land Ownership			Total
	BLM	Private	State	
Existing Infrastructure				
Well pads (acres)	0.00	63.74	6.33	70.07
Total Existing Disturbance (acres)	**0.00**	**63.74**	**6.33**	**70.07**
Proposed New Infrastructure				
New access roads (acres)	0.00	3.60	0.77	4.37
EOR facilities (acres)	0.00	8.26	0.00	8.26
Flowlines (50-foot ROW)* (acres)	0.00	201.95	29.43	231.38
Flowlines (100-foot ROW)* (acres)	0.00	203.17	4.40	207.57
Flowlines (140-foot ROW)* (acres)	0.00	0.00	0.00	0.00
Well pads (acres) (new and re-entry)	0.00	39.75	2.06	41.81
Test sites (acres)	0.00	14.05	2.81	16.86
New electrical distribution lines (acres)	0.00	4.99	0.67	5.66
Total Proposed New Disturbance (acres)	**0.00**	**475.77**	**40.14**	**515.91**

* Flowlines include injection, production, disposal, and bulk pipelines carrying CO_2, oil, gas, and/or water. ROW width is determined by the number of lines within a given corridor: 1–3 flowlines = ROW width of 50 feet, 4–16 flowlines = ROW width of 100 feet, 17+ flowlines = ROW width of 140 feet, bulk lines = ROW width of 100 feet.

Table 4-2. Phase B Summary of Existing and Proposed Disturbance

Infrastructure Type	Land Ownership			Total
	BLM	Private	State	
Existing Infrastructure				
Well pads (acres)	7.23	26.84	4.13	38.20
Total Existing Disturbance (acres)	**7.23**	**26.84**	**4.13**	**38.20**
Proposed New Infrastructure				
New access roads (acres)	0.00	0.34	0.00	0.34
EOR facilities (acres)	5.93	2.32	0.00	8.26
Flowlines (50-foot ROW)* (acres)	27.28	87.48	10.77	125.53
Flowlines (100-foot ROW)* (acres)	30.36	65.73	0.38	96.46
Flowlines (140-foot ROW)* (acres)	0.00	0.00	0.00	0.00
Well pads (acres) (new and re-entry)	0.00	0.00	0.00	0.00
Test sites (acres)	2.81	8.30	0.00	11.11
New electrical distribution lines (acres)	0.00	0.05	0.00	0.05
Total Proposed New Disturbance (acres)	**66.38**	**164.22**	**11.15**	**241.75**

* Flowlines include injection, production, discharge, disposal, and bulk pipelines carrying CO_2, oil, gas, and/or water. ROW width is determined by the number of lines within a given corridor: 1–3 flowlines = ROW width of 50 feet, 4–16 flowlines = ROW width of 100 feet, 17+ flowlines = ROW width of 140 feet, bulk lines = ROW width of 100 feet.

Table 4-3. Phase C Summary of Existing and Proposed Disturbance

Infrastructure Type	Land Ownership			Total
	BLM	Private	State	
Existing Infrastructure				
Well pads (acres)	4.62	37.08	4.65	46.35
Total Existing Disturbance (acres)	**4.62**	**36.05**	**4.65**	**45.32**
Proposed New Infrastructure				
New access roads (acres)	0.09	2.16	0.17	2.42
EOR facilities (acres)	0.00	0.23	8.03	8.26
Flowlines (50-foot ROW)* (acres)	16.82	111.57	12.92	141.31
Flowlines (100-foot ROW)* (acres)	25.61	163.38	39.97	228.96
Flowlines (140-foot ROW)* (acres)	0.00	2.58	0.00	2.58
Well pads (acres) (new and re-entry)	3.45	38.29	4.12	45.86
Test sites (acres)	0.00	8.43	1.52	9.95
New electrical distribution lines (acres)	2.62	7.21	0.17	10.00
Total Proposed New Disturbance (acres)	**48.59**	**333.85**	**66.9**	**449.34**

* Flowlines include injection, production, discharge, disposal, and bulk pipelines carrying CO_2, oil, gas, and/or water. ROW width is determined by the number of lines within a given corridor: 1–3 flowlines = ROW width of 50 feet, 4–16 flowlines = ROW width of 100 feet, 17+ flowlines = ROW width of 140 feet, bulk lines = ROW width of 100 feet.

Table 4-4. Phase D Summary of Existing and Proposed Disturbance

Infrastructure Type	Land Ownership			Total
	BLM	Private	State	
Existing Infrastructure				
Well pads (acres)	0.00	26.32	1.03	27.35
Total Existing Disturbance (acres)	**0.00**	**26.32**	**1.03**	**27.35**
Proposed New Infrastructure				
New access roads (acres)	0.00	4.80	0.00	4.80
EOR facilities (acres)	0.00	8.26	0.00	8.26
Flowlines (50-foot ROW)* (acres)	0.00	79.03	0.40	79.44
Flowlines (100-foot ROW)* (acres)	0.00	187.78	5.84	193.62
Flowlines (140-foot ROW)* (acres)	0.00	0.00	0.00	0.00
Well pads (acres) (new and re-entry)	0.00	42.11	0.00	42.11
Test sites (acres)	0.00	6.66	0.00	6.66
New electrical distribution lines (acres)	0.00	13.21	0.00	13.21
Total Proposed New Disturbance (acres)	**0.00**	**341.85**	**6.24**	**348.10**

* Flowlines include injection, production, discharge, disposal, and bulk pipelines carrying CO_2, oil, gas, and/or water. ROW width is determined by the number of lines within a given corridor: 1–3 flowlines = ROW width of 50 feet, 4–16 flowlines = ROW width of 100 feet, 17+ flowlines = ROW width of 140 feet, bulk lines = ROW width of 100 feet.

4.1 WELLS

4.1.1 Existing Wells

Existing operating, shut-in, or temporarily abandoned wells will be re-worked, converted, or upgraded for production or injection. No new surface disturbance is expected outside of existing well pads. Some wells will be dual purpose, starting as production wells and, as production tapers off, they will be converted to injection wells. All existing wells are illustrated in Figures 4-2 through 4-5 and detailed information about each well is included in Appendix B.

4.1.2 Re-Entry Wells

Well bores that have been abandoned and contain cement plugs will be re-entered and reactivated by drilling out existing cement plugs and testing/remediating casing to ensure wellbore integrity. The well bores will be cleared of debris and existing tubing. Well bore integrity will be evaluated by wireline logs and pressure tests as necessary to ensure groundwater and other zones are adequately protected. Re-entry pads will be constructed, and each pad will range from 1.2 to 1.6 acres depending on site-specific conditions. All re-entry wells are illustrated in Figures 4-2 through 4-5 and detailed information about each well is included in Appendix B.

4.1.3 New Wells

There will be two types of new wells: replacement wells and “grass roots” wells. If re-entry and re-activation of old wells is deemed infeasible, then new replacement wells will be drilled to obtain expected recovery. These replacement wells will require new well bores but will be drilled adjacent to plugged wells. The number of replacement wells that will be required is unknown until the re-entry wells are drilled. Grass roots wells will be drilled at new locations absent of pre-existing wells. Currently, 55 grass roots wells are proposed to be drilled on 45 new well pads during the EOR unit development process. One or two wells will be drilled per pad. All new wells are illustrated in Figures 4-2 through 4-5 and detailed information about each well is included in Appendix B.

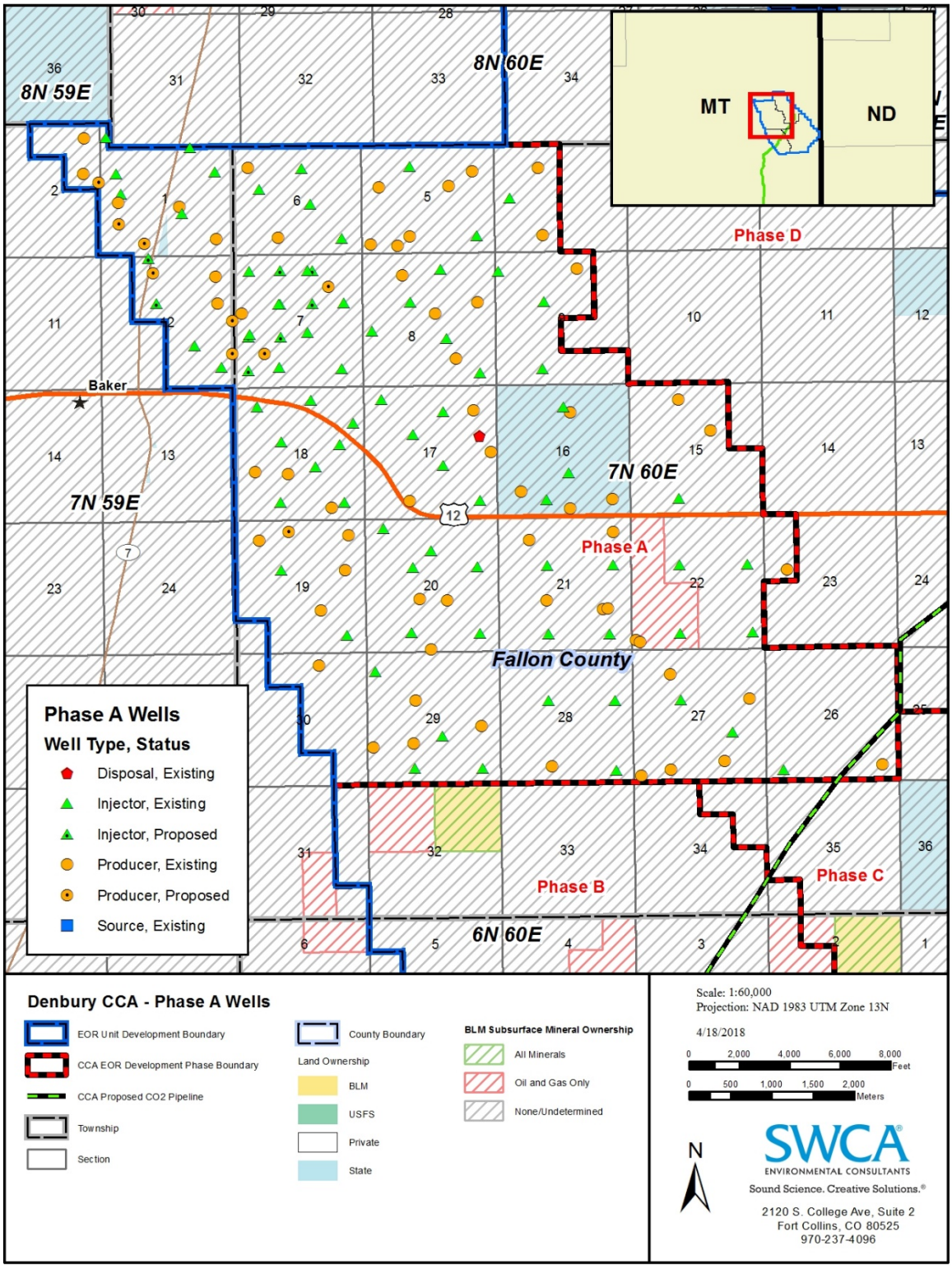


Figure 4-2. EOR Unit Development Phase A wells.

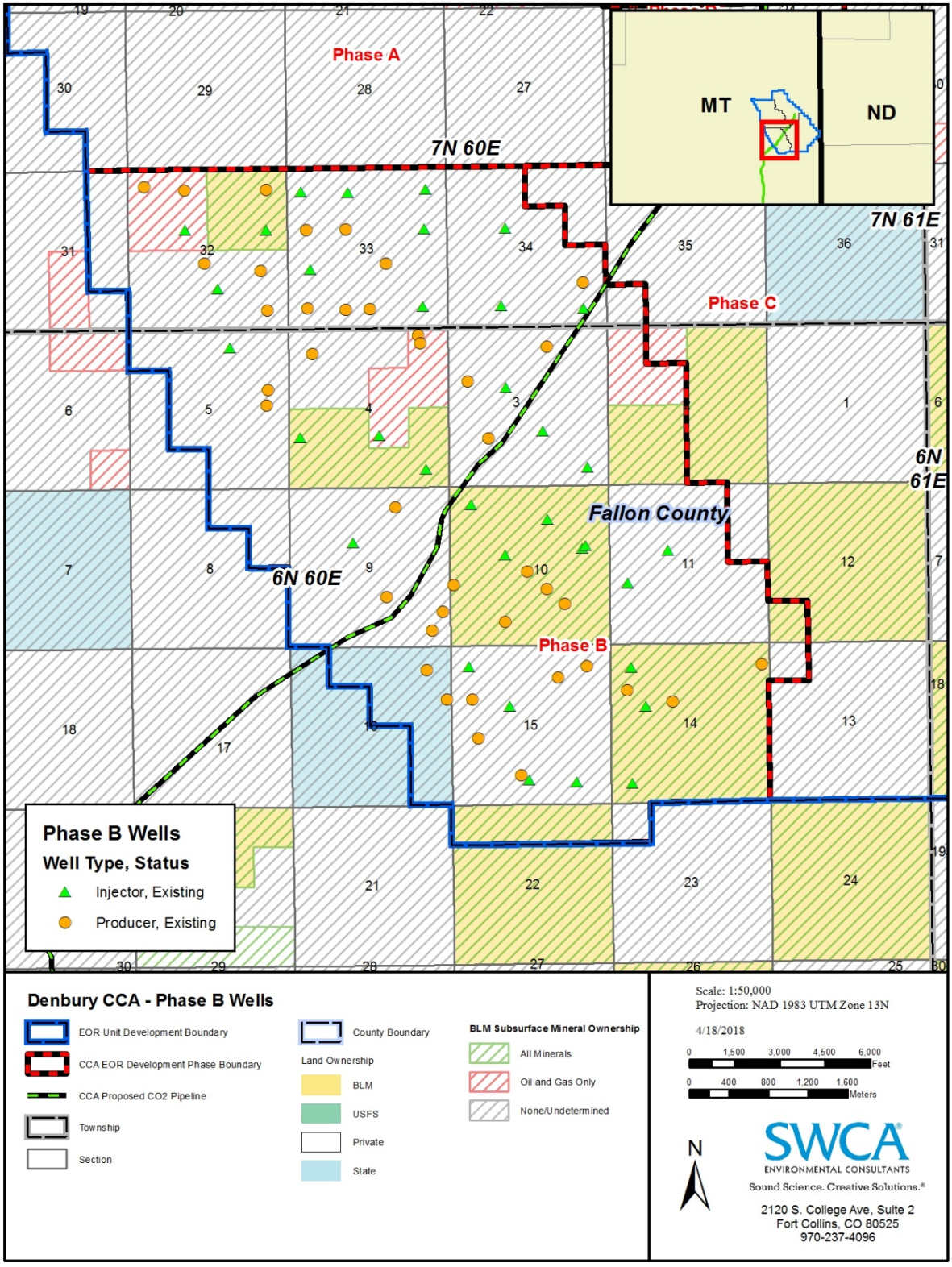


Figure 4-3. EOR Unit Development Phase B wells.

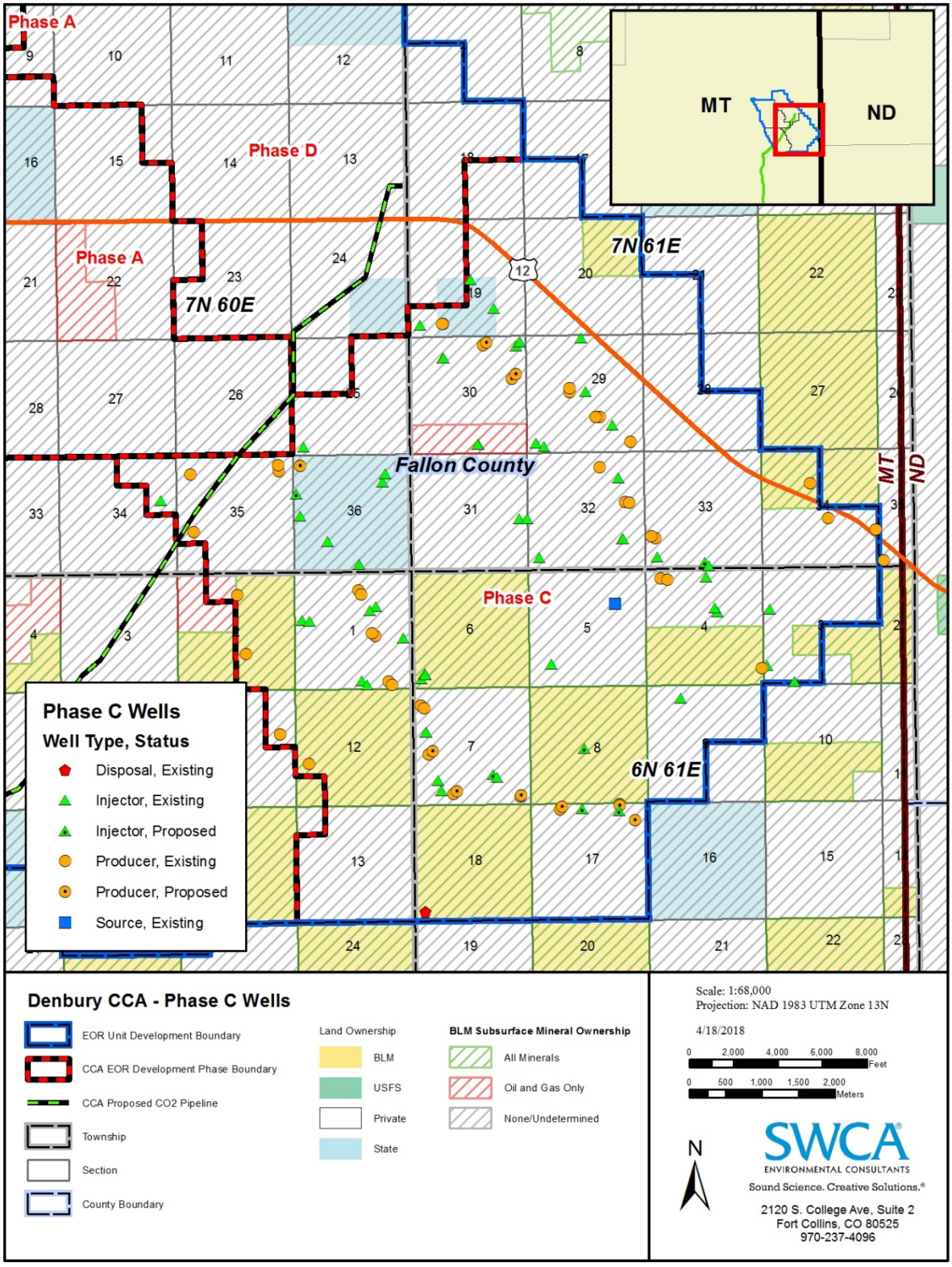


Figure 4-4. EOR Unit Development Phase C wells.

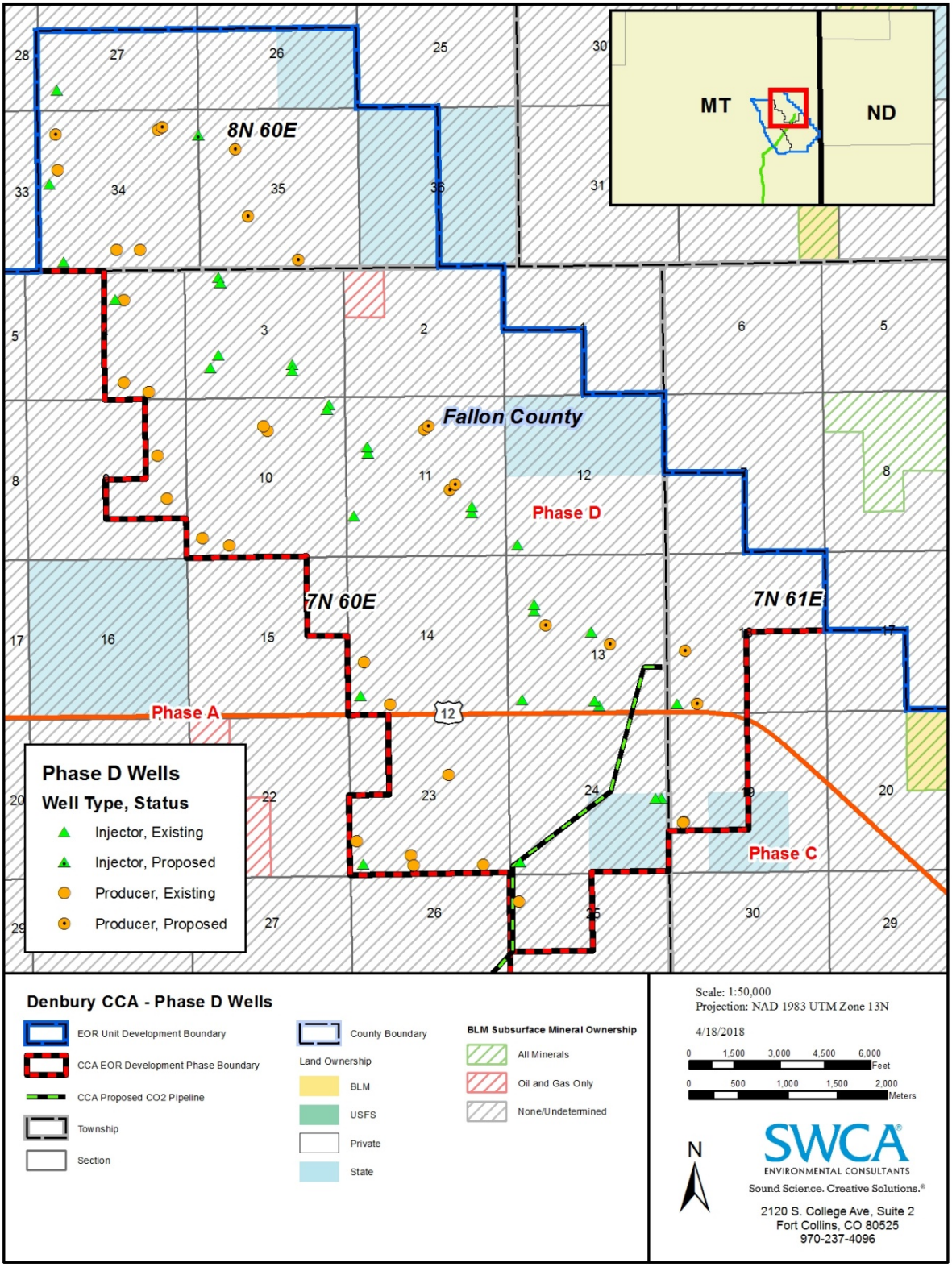


Figure 4-5. EOR Unit Development Phase D wells.

Grass roots and replacement wells will require construction of new pads that will range in size from approximately 2.06 acres up to 5.50 acres for pads with two wells (Figures 4-6 and 4-7). Replacement and new grass roots wells will be drilled to approximately 9,400 feet, which is approximately the same depth as the existing wells. All new replacement and grass roots wells will have additional horizontal laterals that range between 3,000 to 8,000 feet to maintain proper pattern alignment. The total measured well depths will range from approximately 12,400 to 17,400 feet. Surface casing will be set below the lowest underground source of drinking water and cemented to the surface as required by regulation to protect groundwater resources and to a depth adequate to isolate the Judith River and Eagle formations. Production casing will be sized to accommodate the well completion program and typically will consist of a 5.5-inch-diameter casing. The production casing will be cemented to achieve competent cement according to agency-specified distance above the top of the production/injection zone. A cement bond log will be run to confirm sufficiency of cement. If the bond log or conditions encountered during the cementing process or required pressure testing indicate less than adequate bond in the opinion of the BLM and Montana Board of Oil and Gas, then remedial cementing will be conducted in accordance with agency direction and approval. Cement must be appropriate for subsurface conditions that will be encountered and in consideration of the corrosive properties of CO_2. No hydraulic fracturing will be done for the proposed wells. Onshore Oil and Gas Order No. 2 will be complied with for all federal wells.

All wells will be drilled using a closed-loop system with no reserve pit. All drilling fluids will be recycled, and all drill cuttings will be hauled off-site to a licensed disposal site.

After the casing is cemented, the drilling rig will be released from the location, and a smaller completion rig will be moved on location to finish construction of the well. Both newly drilled grass roots wells and re-entry wells will be completed by installing 2.375- or 2.875-inch tubing with appropriate artificial lift. Typical well bore diagrams for vertical and horizontal drilling are included in Appendix C.

Reserve pits will be closed by decanting fluids and allowing the remaining solids to dry. Fluids pumped from reserve pits will be disposed either by injection into a disposal well or at a licensed off-site oilfield waste facility. The residual solids will be allowed to dry; then the pit will be backfilled, re-contoured, and reclaimed as described in the Reclamation, Mitigation, and Monitoring Plan (Appendix D). The pit will not be cut or trenched, and the backfilled pit will be covered with a minimum 3 feet of soil.

Following drilling activities, each well location will be prepared for production operations by reducing the well pad size where possible and adding gravel. Well flow data will be recorded on instrumentation located on each well pad. Surface equipment at the well locations will be painted to match surrounding areas as directed by the surface managing agency. Denbury is not proposing any flaring or venting as part of the Project.

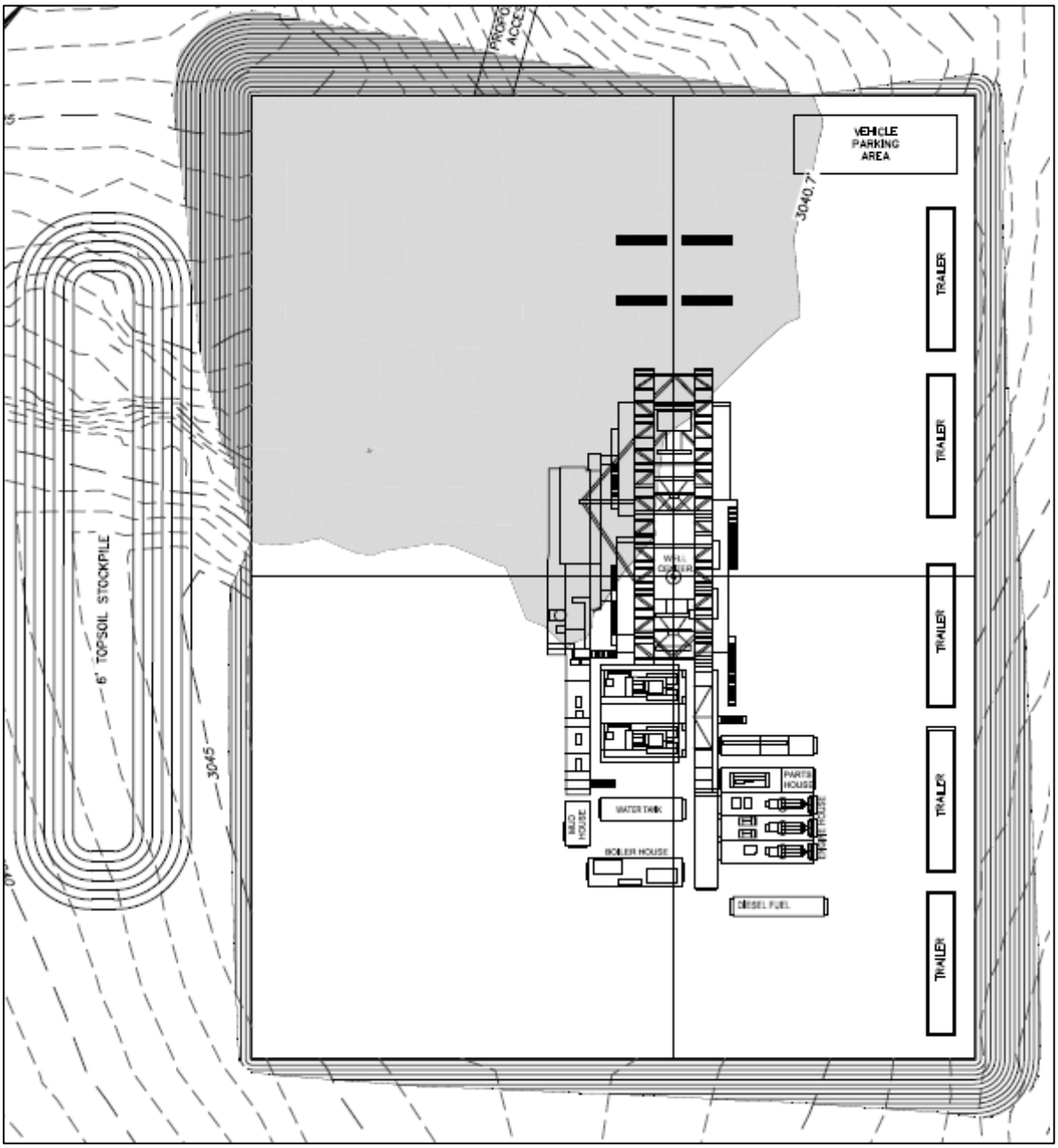


Figure 4-6. Typical drilling layout for new grass roots, replacement, and/or re-entry single well pad during construction.

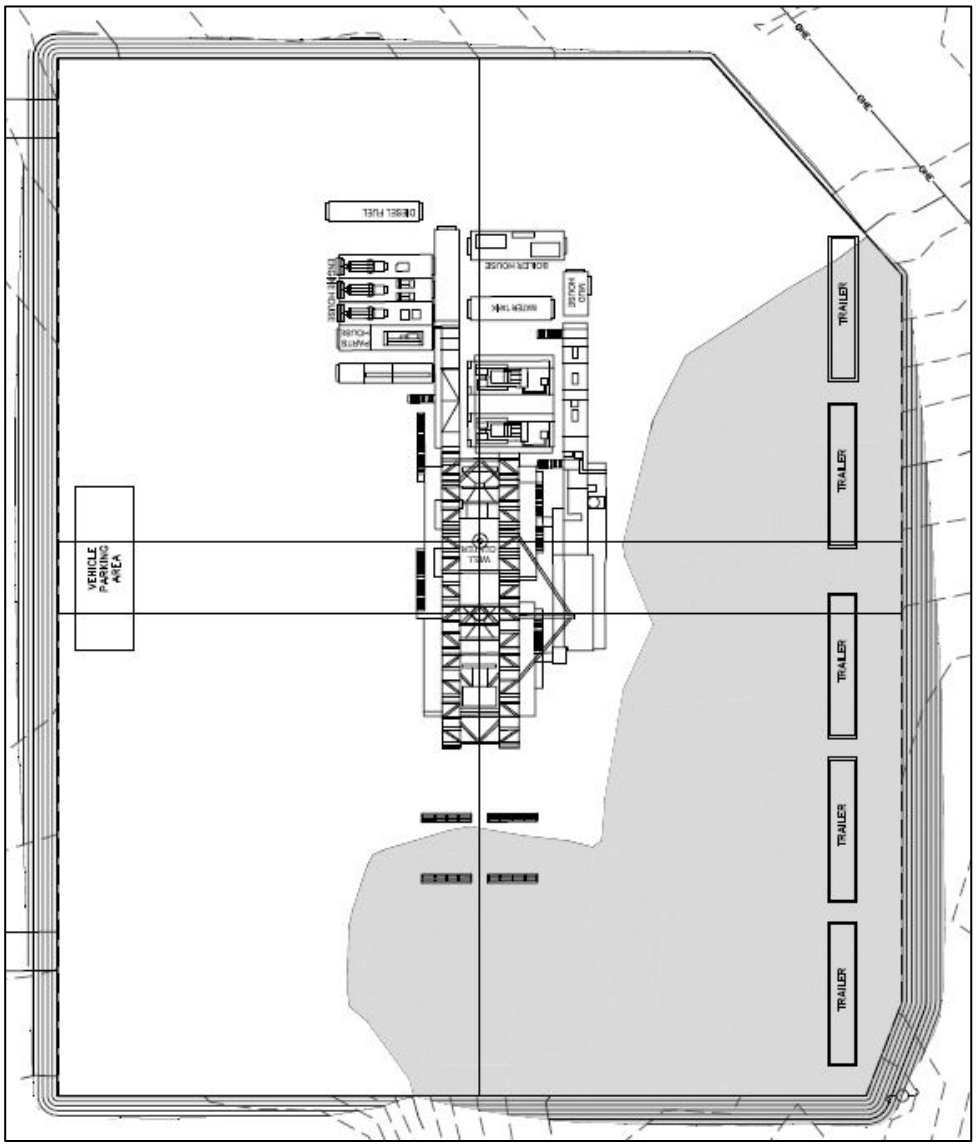


Figure 4-7. Typical drilling layout for new grass root, replacement, and/or re-entry double well pad during construction.

4.2 ACCESS ROADS

Vehicles will access the existing well sites and facilities using existing roads. Approximately 155.66 miles of existing roads will be used to access existing well pads and facilities. In addition, approximately 33 new access roads totaling 3.52 miles in length are proposed to be constructed for accessing 45 new well pads. A 25-foot-wide corridor will be established for roads that require new disturbance. If additional infrastructure (power lines, flowlines, etc.) needs to be installed parallel to the access road corridor, additional workspace and disturbance will be requested outside this 25-foot-wide corridor. Survey stakes will be used to delineate the edges of the disturbance boundary for access roads that require improvements.

The road corridors will be maintained while in use, and gravel to match the surrounding landscape will be added as needed to allow access to the well pads year-round. Denbury and/or its contractors will coordinate the source of gravel with BLM/state agencies prior to purchase to ensure there are no concerns related to erionite. All material used for the Project will be from privately owned surface and minerals and/or permitted by the appropriate entity. Access roads will receive dust abatement as described in the Section 6.4 of this document. The procedures that Denbury will implement to reclaim, mitigate, and maintain roads is included in the Reclamation, Mitigation, and Monitoring Plan (Appendix D).

The locations of the existing and new access roads to be used are summarized in Table 4-5 and illustrated in Figure 4-8.

Table 4-5. Summary of Proposed Access Roads

Infrastructure Type	Land Ownership (miles)			Total (miles)
	BLM	Private	State	
Phase A				
Existing Road length	0.00	55.34	4.67	60.01
Proposed Road length	0.00	1.14	0.25	1.39
Phase A Total Miles	**0.00**	**56.48**	**4.92**	**61.40**
Phase B				
Existing Road length	7.57	20.75	2.10	30.42
Proposed Road length	0.00	0.11	0.00	0.11
Phase B Total Miles	**7.57**	**20.86**	**2.10**	**30.53**
Phase C				
Existing Road length	4.66	30.36	3.57	38.59
Proposed Road length	0.00	0.38	0.05	0.44
Phase C Total Miles	**4.66**	**30.74**	**3.62**	**39.03**
Phase D				
Existing Road length	0.00	25.36	1.29	26.64
Proposed Road length	0.00	1.59	0.00	1.59
Phase D Total Miles	**0.00**	**26.95**	**1.29**	**28.23**
Existing Road Total (miles)	**12.23**	**131.81**	**11.63**	**155.66**
Proposed Road Total (miles)	**0.00**	**3.22**	**0.30**	**3.52**
Roads Grand Total (miles)	**12.23**	**135.03**	**11.93**	**159.18**

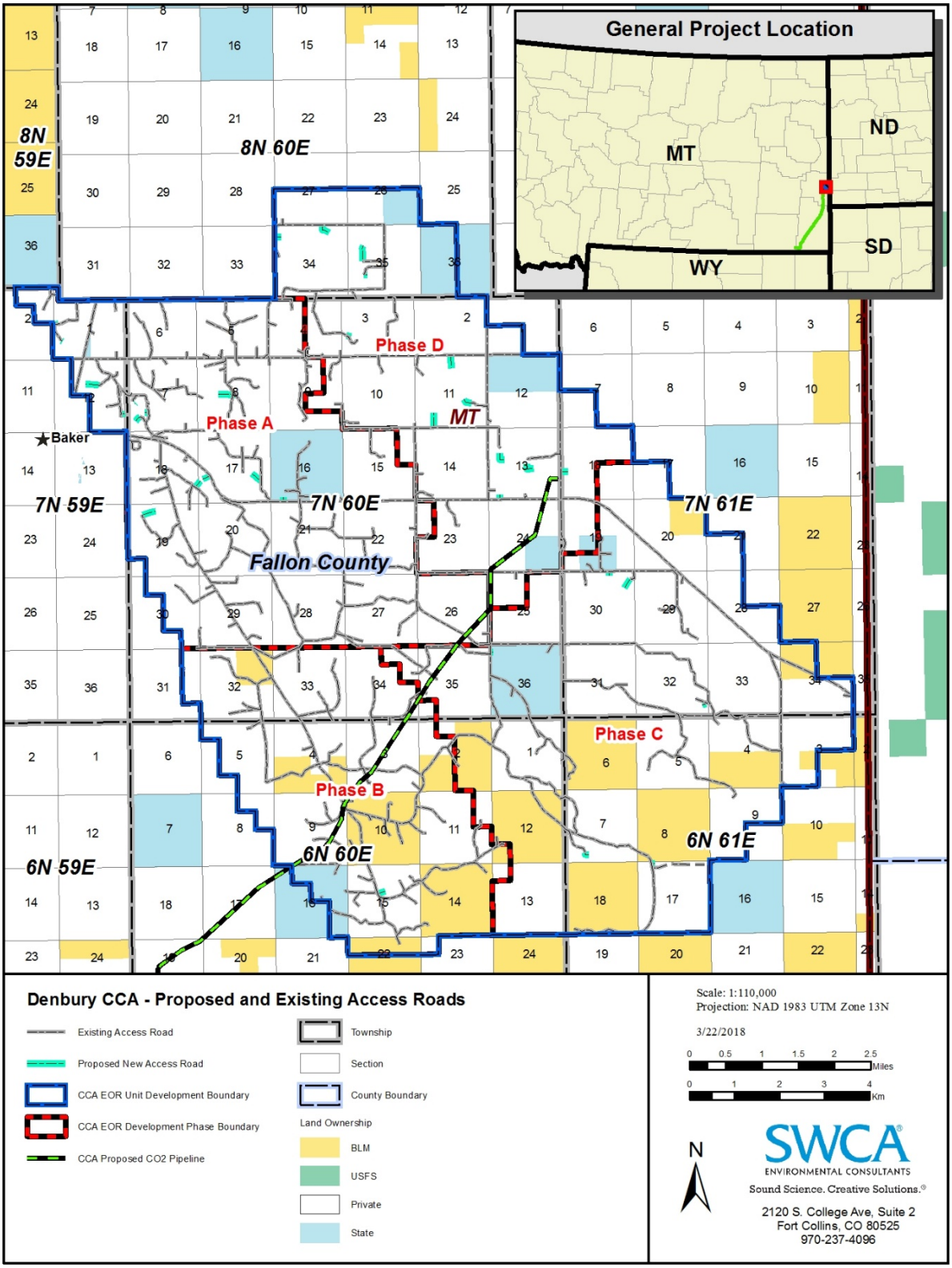


Figure 4-8. Proposed and existing access roads.

4.3 FLOWLINES (PIPELINES)

A summary of the disturbance acres, or ROW, for pipelines is provided in Table 4-6 and illustrated in Figure 4-9. If necessary, a BLM-regulated ROW permit will be required on federal lands. The widths of ROW will be determined by the type and number of lines, as described below.

- ROW width for 1 to 3 flowlines will be 50 feet.
- ROW width for 4 to 16 flowlines will be 100 feet.
- ROW width for 17 or more flowlines will be 140 feet.
- ROW width for bulk lines will be 100 feet.

Table 4-6. Summary of Proposed Flowline Disturbance*

Infrastructure Type	Land Ownership			Total
	BLM	Private	State	
Phase A				
Flowline 50-foot ROW acres	0.00	201.95	29.43	231.38
Flowline 100-foot ROW acres	0.00	203.17	4.40	207.57
Flowline 140-foot ROW acres	0.00	0.00	0.00	0.00
Phase A Total Acres	**0.00**	**405.12**	**33.83**	**438.95**
Flowline 50-foot length (miles)	0.00	38.21	5.30	43.51
Flowline 100-foot length (miles)	0.00	17.87	0.37	18.24
Flowline 140-foot length (miles)	0.00	0.00	0.00	0.00
Phase A Total Length (miles)	**0.00**	**56.08**	**5.67**	**61.75**
Phase B				
Flowline 50-foot ROW acres	27.28	87.48	10.77	125.53
Flowline 100-foot ROW acres	30.36	65.73	0.38	96.46
Flowline 140-foot ROW acres	0.00	0.00	0.00	0.00
Phase B Total Acres	**57.63**	**153.21**	**11.15**	**221.99**
Flowline 50-foot length (miles)	4.91	16.46	1.94	23.31
Flowline 100-foot length (miles)	2.85	6.02	0.02	8.90
Flowline 140-foot length (miles)	0.00	0.00	0.00	0.00
Phase B Total Length (miles)	**7.76**	**22.48**	**1.96**	**32.21**
Phase C				
Flowline 50-foot ROW acres	16.82	111.57	12.92	141.31
Flowline 100-foot ROW acres	25.61	163.38	39.97	228.96
Flowline 140-foot ROW acres	0.00	2.58	0.00	2.58
Phase C Total Acres	**42.43**	**277.53**	**52.89**	**372.84**
Flowline 50-foot length (miles)	3.47	16.46	2.54	27.49
Flowline 100-foot length (miles)	1.97	15.35	4.32	21.65
Flowline 140-foot length (miles)	0.00	0.23	0.00	0.23
Phase C Total Length (miles)	**5.45**	**37.06**	**6.86**	**49.37**

Infrastructure Type	Land Ownership			Total
	BLM	Private	State	
Phase D				
Flowline 50-foot ROW acres	0.00	80.24	0.40	80.64
Flowline 100-foot ROW acres	0.00	187.78	5.84	193.62
Flowline 140-foot ROW acres	0.00	0.00	0.00	0.00
Phase D Total Acres	**0.00**	**268.02**	**6.24**	**274.26**
Flowline 50-foot length (miles)	0.00	15.63	0.16	15.79
Flowline 100-foot length (miles)	0.00	16.17	0.49	16.66
Flowline 140-foot length (miles)	0.00	0.00	0.00	0.00
Phase D Total Length (miles)	**0.00**	**31.80**	**0.65**	**32.45**
Flowline ROW Acres Total	**100.06**	**1,103.88**	**104.11**	**1,308.05**
Flowline Length Total (miles)	**13.21**	**147.42**	**15.15**	**175.78**

* Flowlines include injection, production, discharge, disposal, and bulk pipelines carrying CO_2, oil, gas, and/or water. ROW width is determined by the number of lines within a given corridor: 1–3 flowlines = ROW width of 50 feet, 4–16 flowlines = ROW width of 100 feet, 17+ flowlines = ROW width of 140 feet, bulk lines = ROW width of 100 feet.

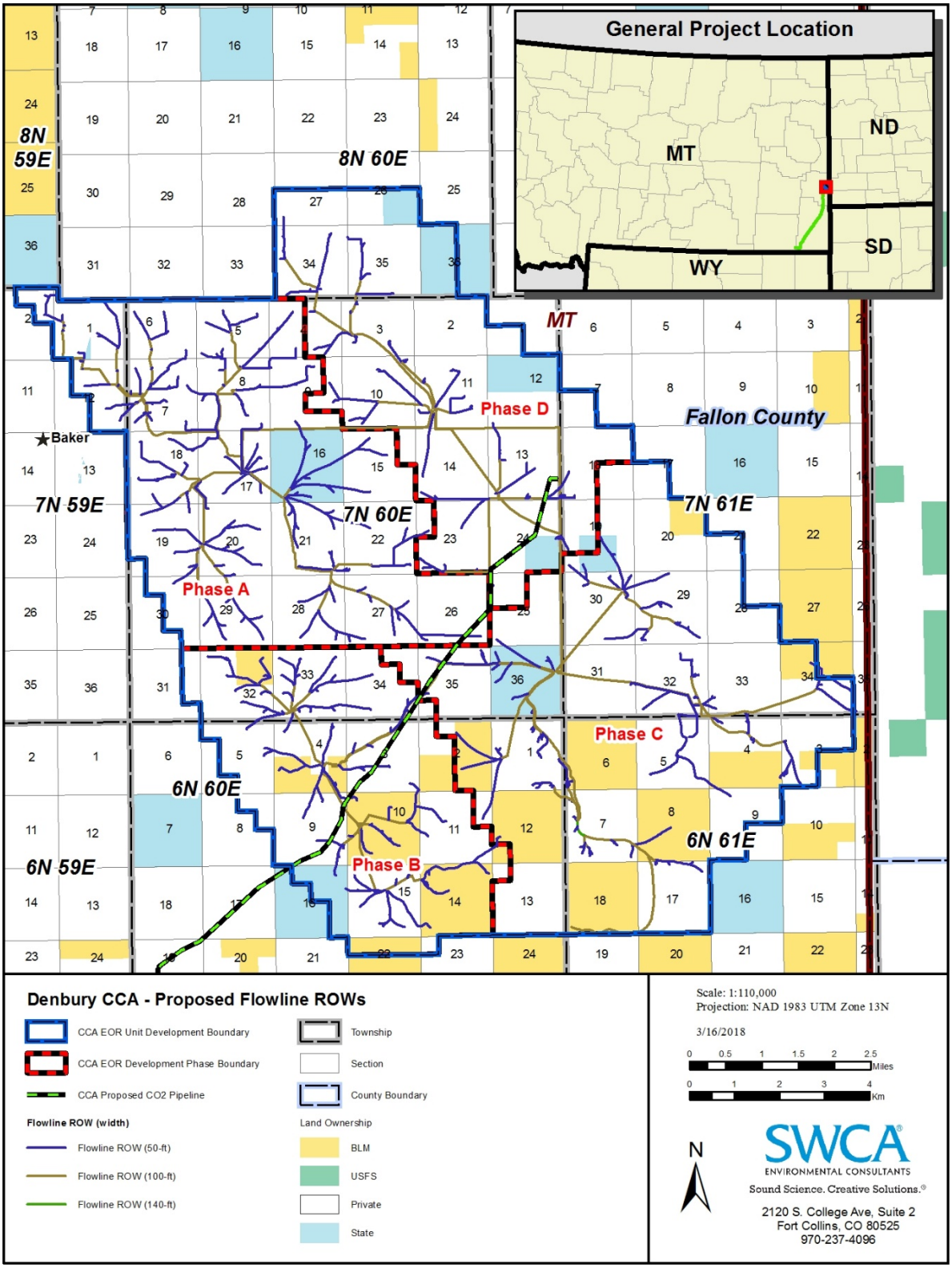


Figure 4-9. Proposed flowline ROWs.

4.4 ELECTRICAL DISTRIBUTION LINES

Electrical distribution lines, all owned and operated by Denbury, will be needed for new grass roots wells in the EOR unit development. However, existing lines will be used to the greatest extent practical, and new lines will not be required for existing facilities or re-drilled (replacement) wells. The lengths of existing and proposed electrical distribution and transmission lines within the EOR Unit development area are presented in Tables 4-7 and 4-8 and illustrated in Figure 4-10.

Overhead electrical distribution lines will be used to bring electrical power to new drills. The lines will be located along existing or proposed access roads or on ROWs across open land. Electrical junction boxes will be installed where needed and will be painted to blend with the surrounding environment, as directed by the approving agency. Buried electrical lines will tie into the overhead power lines at a service tap or drop to serve the well sites.

An approximately 25-foot-wide corridor of disturbance will be required for new overhead power lines. These corridors will be disturbed during construction activities, and reclamation standards are included in the Reclamation, Mitigation, and Monitoring Plan (Appendix D). All new overhead lines will be constructed using guidelines established by the Avian Power Line Interaction Committee to mitigate impacts to wildlife, particularly raptors.

Table 4-7. Existing Electrical Distribution and Transmission Lines within the EOR Unit Development

Infrastructure Type	Land Ownership			Total
	BLM	Private	State	
Phase A				
Distribution line length	0.00	64.54	5.81	70.36
Transmission line length	0.00	5.70	0.00	5.70
Phase A Total Miles	**0.00**	**70.24**	**5.81**	**76.07**
Phase B				
Distribution line length	8.00	24.09	3.34	35.43
Transmission line length	0.00	0.00	0.00	0.00
Phase B Total Miles	**8.00**	**24.09**	**3.34**	**35.43**
Phase C				
Distribution line length	2.93	32.32	4.10	39.35
Transmission line length	1.11	6.20	0.00	7.31
Phase C Total Miles	**4.04**	**38.52**	**4.10**	**46.66**
Phase D				
Distribution line length	0.00	20.60	0.83	21.43
Transmission line length	0.00	5.26	0.00	5.26
Phase D Total Miles	**0.00**	**25.86**	**0.83**	**26.69**
Existing Distribution Line Total	**10.93**	**141.55**	**14.08**	**166.56**
Existing Transmission Line Total	**1.11**	**17.17**	**0.00**	**18.28**
Existing Line Grand Total	**12.04**	**158.72**	**14.08**	**184.84**

Table 4-8. Proposed New Electrical Distribution Lines within the EOR Unit Development

Infrastructure Type	Land Ownership			Total
	BLM	Private	State	
Proposed Distribution Line Length (miles)				
Phase A	0.00	1.65	0.22	1.87
Phase B	0.00	0.02	0.00	0.02
Phase C	0.87	2.38	0.05	3.30
Phase D	0.00	4.37	0.00	4.37
Proposed Distribution Line Total Length	**0.87**	**8.41**	**0.28**	**9.56**
Proposed Distribution Line ROW Disturbance Area (acres)				
Phase A	0.00	4.99	0.67	5.66
Phase B	0.00	0.05	0.00	0.05
Phase C	2.62	7.21	0.17	10.00
Phase D	0.00	13.21	0.00	13.21
Proposed Distribution Line ROW Total Disturbance Area	**2.62**	**25.46**	**0.84**	**28.93**

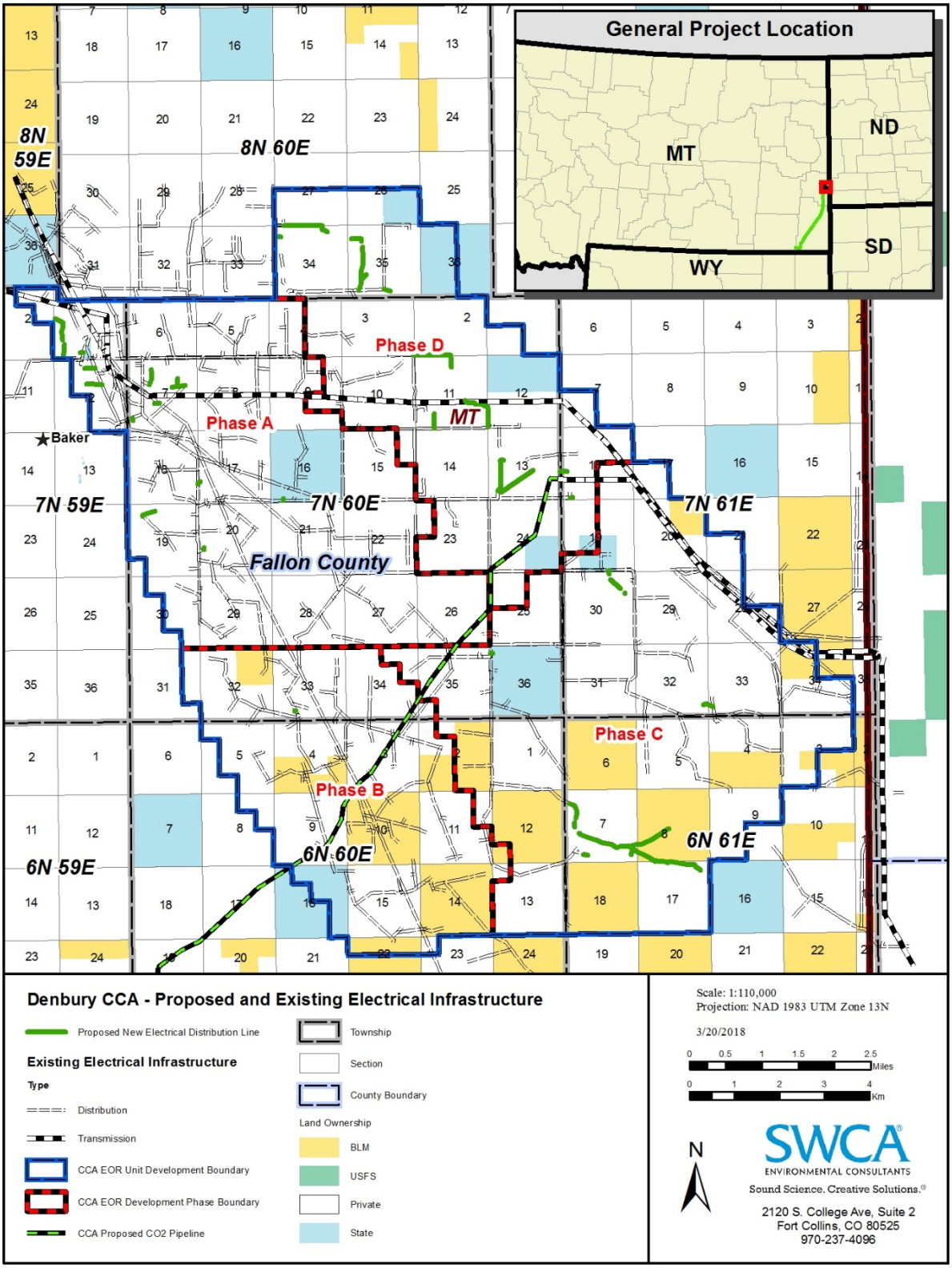


Figure 4-10. Proposed and existing electrical infrastructure.

4.5 TEST SITES

The test sites will contain a manifold system and test production equipment. A typical test site layout is presented in Figure 4-11. Currently, 17 test sites are proposed to be constructed during the EOR unit development process. Producing wells will generally require artificial lift to produce at economic rates and produced fluids will be routed to test sites for measurements and then transported to the EOR facilities for final processing. Table 4-9 outlines the land requirements for each test site and the location of each test site is illustrated in Figure 4-12.

Table 4-9. Proposed Test Sites and Proposed New Disturbance

Test Site	Land Ownership Acres				Township, Range, Section	Development Phase	Unit
	BLM	Private	State	Total			
TS-A1	0.00	2.81	0.00	2.81	T7N, R60E, S07	Phase A	Pennel
TS-A2	0.00	2.81	0.00	2.81	T7N, R60E, S08	Phase A	Pennel
TS-A3	0.00	2.81	0.00	2.81	T7N, R60E, S17	Phase A	Pennel
TS-A4	0.00	0.00	2.81	2.81	T7N, R60E, S16	Phase A	Pennel
TS-A5	0.00	2.81	0.00	2.81	T7N, R60E, S20	Phase A	Pennel
TS-A6	0.00	2.81	0.00	2.81	T7N, R60E, S21	Phase A	Pennel
TS-B1	0.00	2.81	0.00	2.81	T7N, R60E, S33	Phase B	Coral Creek
TS-B2	0.00	2.81	0.00	2.81	T6N, R60E, S04	Phase B	Coral Creek
TS-B3	2.81	0.00	0.00	2.81	T6N, R60E, S10	Phase B	Coral Creek
TS-B4	0.00	2.81	0.00	2.81	T6N, R60E, S15	Phase B	Coral Creek
TS-C1	0.00	2.81	0.00	2.81	T7N, R61E, S30	Phase C	ELOB
TS-C2	0.00	0.00	2.81	2.81	T7N, R60E, S36	Phase C	ELOB
TS-C3	0.00	2.81	0.00	2.81	T7N, R61E, S32	Phase C	ELOB
TS-C4	0.00	2.81	0.00	2.81	T6N, R61E, S07	Phase C	ELOB
TS-D1	0.00	2.81	0.00	2.81	T7N, R60E, S03	Phase D	ELOB
TS-D2	0.00	2.81	0.00	2.81	T7N, R60E, S11	Phase D	ELOB
TS-D3	0.00	2.81	0.00	2.81	T7N, R60E, S13	Phase D	ELOB
Total	**2.81**	**39.34**	**5.62**	**47.77**			

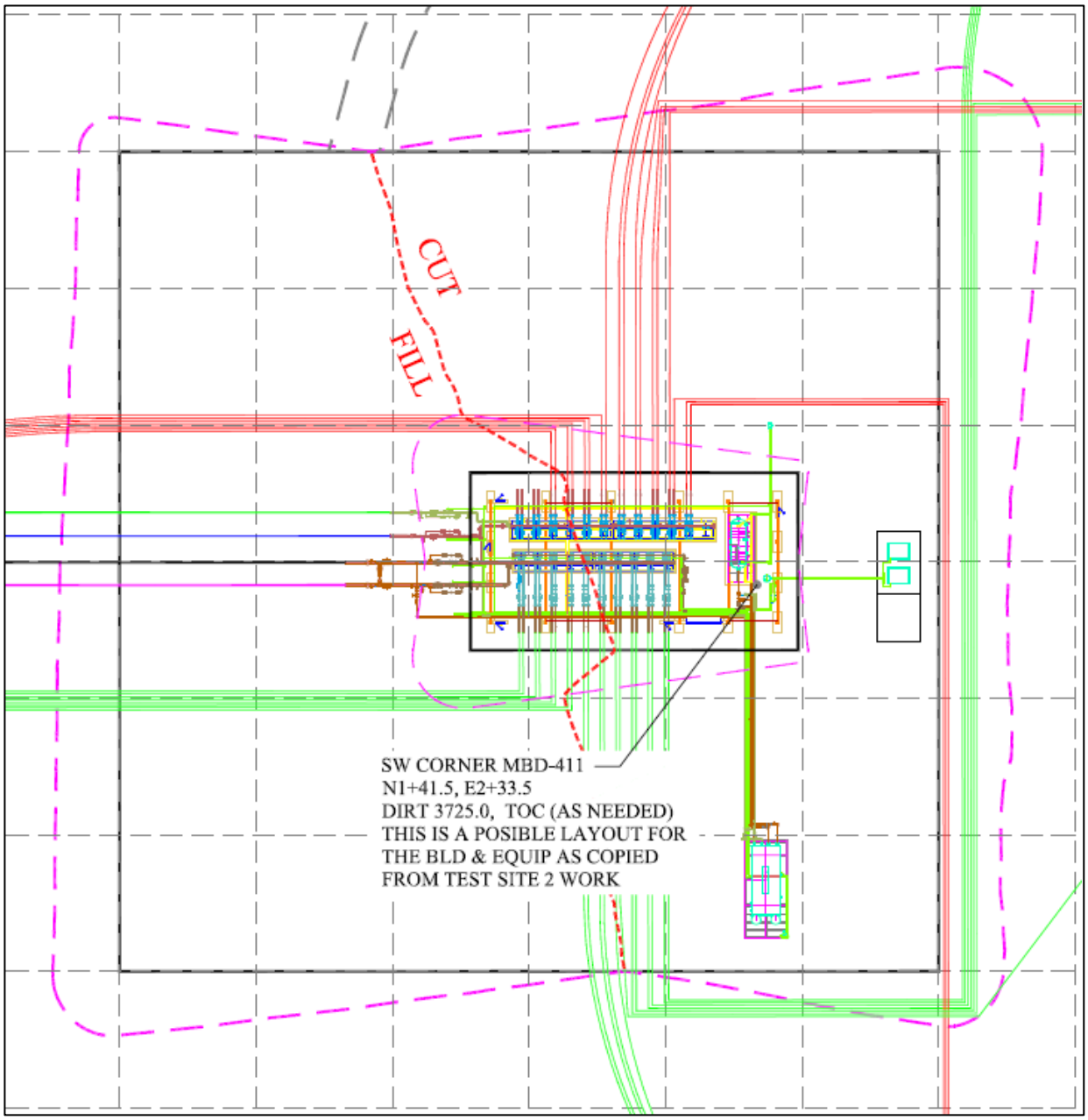


Figure 4-11. Typical site plan for test sites.

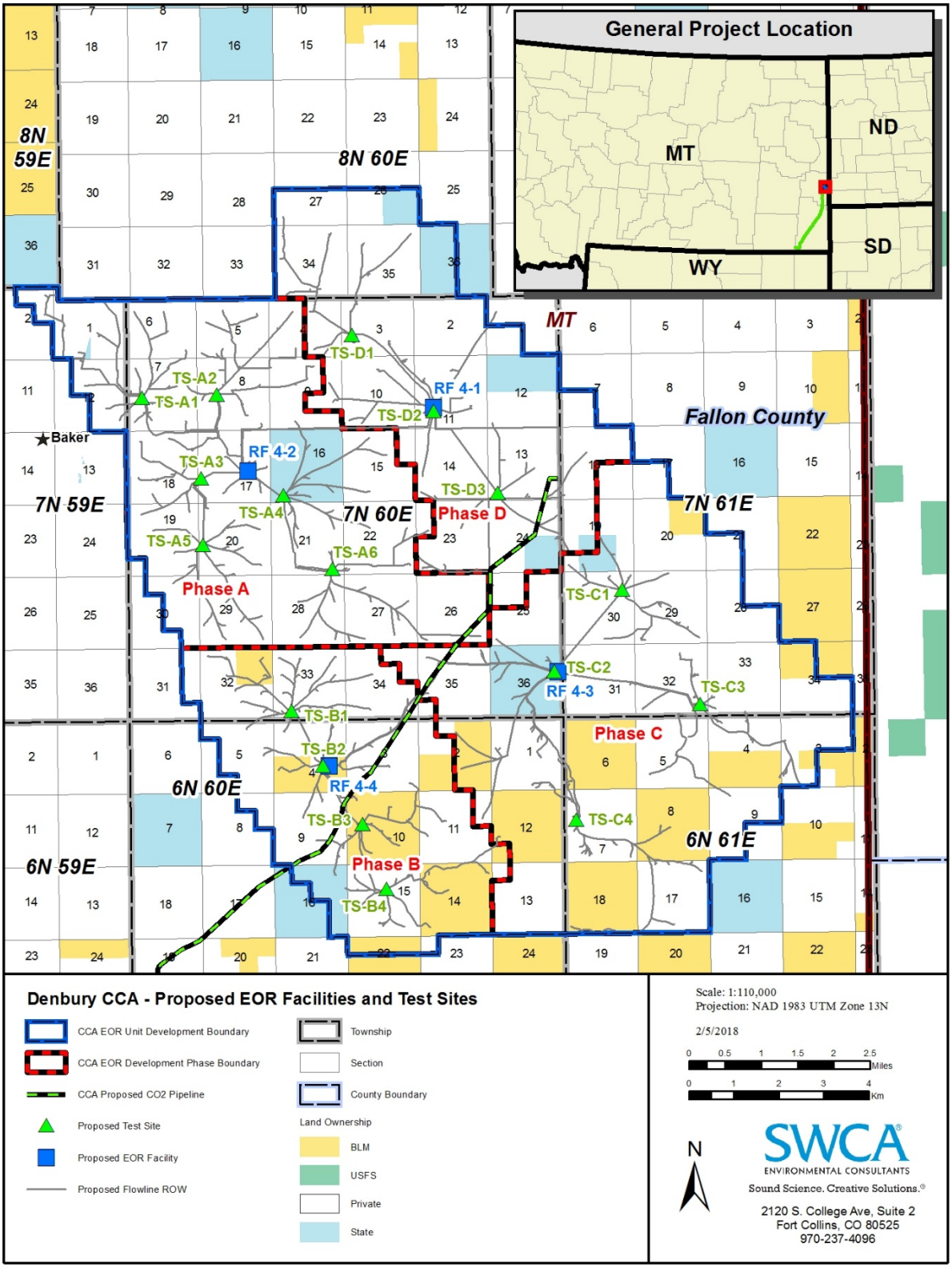


Figure 4-12. Proposed EOR facilities and test sites.

4.6 EOR FACILITIES

Four EOR facilities are proposed to be constructed during the EOR unit development process. Table 4-10 outlines the land requirements for each EOR facility and the location of each facility is illustrated above in Figure 4-12. The facilities will include electric-powered compressors, production vessels, and equipment; storage tanks; a field office; and an electrical substation (Figure 4-13). The EOR facilities will provide the following functions.

- The terminus and delivery point for the CCA CO_2 Pipeline, which will supply the CO_2.
- Compression for recycling CO_2 and pumps for moving fluids for EOR injection or to produced water disposal wells.
- Processing equipment to separate produced fluids.
- Storage of fluids (oil and water).

CO_2 that enters the facilities from the proposed CO_2 Pipeline will go to the test sites, and from the test sites to individual injection wells. Flowlines from the production wells will move produced fluids from the wells to the test sites, and ultimately to the EOR facilities.

The EOR facilities will process the produced fluids by separating CO_2, water, and oil. After separation, the CO_2 will be recompressed for reinjection, the oil will be stored for sale, and the produced water will be either re-injected into the EOR process or disposed. The flow diagram for this process is depicted in Figure 4-14.

Table 4-10. Proposed EOR Facilities and Proposed New Disturbance

EOR Facility	Land Ownership Acres				Township, Range, Section	Development Phase	Unit
	BLM	Private	State	Total			
RF 4-1	0.00	8.26	0.00	8.26	T7N, R60E, S11	Phase D	ELOB
RF 4-2	0.00	8.26	0.00	8.26	T7N, R60E, S17	Phase A	Pennel
RF 4-3	0.00	0.09	8.17	8.26	T7N, R61E, S31; T7N, R60E, S36	Phase C	ELOB
RF 4-4	5.93	2.33	0.00	8.26	T6N, R60E, S04	Phase B	Coral Creek
Total	**5.93**	**18.94**	**8.17**	**33.04**			

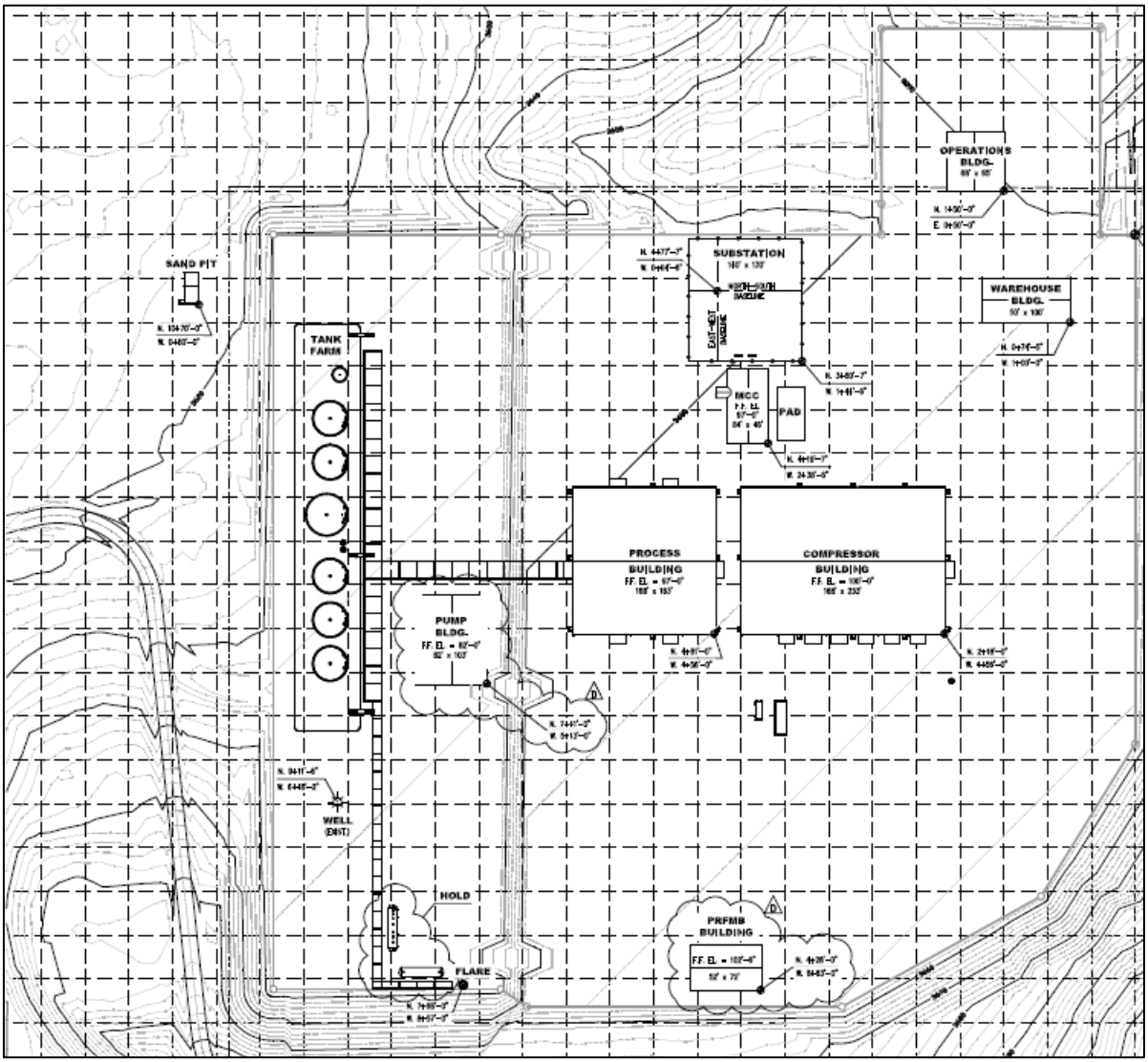


Figure 4-13. Typical site plan for EOR facilities.

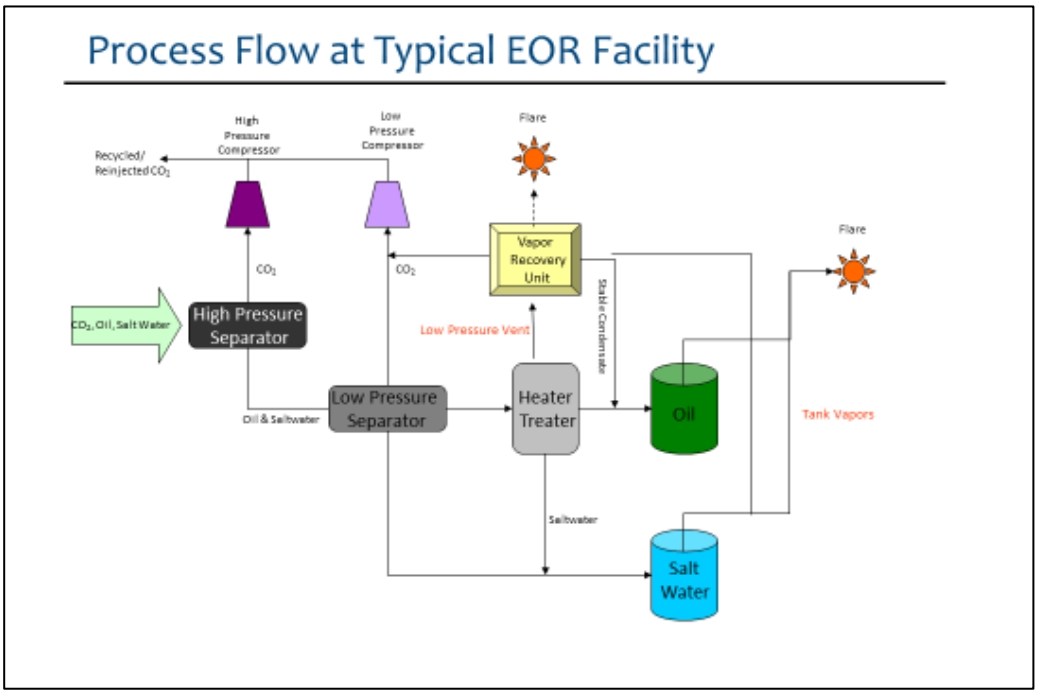


Figure 4-14. Typical process flow at EOR facility.

4.7 PRODUCED WATER MANAGEMENT

The production wells in the CCA will produce saltwater mixed with the CO_2 and oil. After component separation, some of the saltwater will be used for re-injection back into the productive zone it came from (via the WAG process described in Section 3.0); the remainder of the saltwater will be injected into two existing saltwater disposal (SWD) wells listed in Appendix B. Any water injection needs that are not met by the saltwater produced with the oil and CO_2 will be met by saltwater supply wells that currently produce from a separate saltwater source reservoir.

5.0 CONSTRUCTION

5.1 CONSTRUCTION EQUIPMENT

Standard facility pad, access road, and pipeline construction techniques will be implemented in the EOR Units along the flowline routes. Construction typically involves the following sequential operations: clearing, topsoil stripping, grading, infrastructure build-out, and cleanup and restoration.

Typical equipment for construction includes pickup trucks, loaders, various sized dozers, shovels and backhoes, side booms, generators, and bending machines. Equipment typically used for reclamation includes dozers, blades, and track hoes. An estimate of the type and number of each piece of equipment required for construction is included in Table 5-1.

Table 5-1. Construction Equipment Requirements

Facility	Quantity	Construction Phase	Equipment	Count	Duration (days)
EOR Recycle Facility	4	Site Work	Scraper	2	30
			Blade	1	30
			Dozer	1	30
			Crew Truck	2	30
		Civil	Track Hoe	1	60
			Front End Loader	1	60
			Skid Steer	1	60
			Drill Pier Truck	1	60
			Fork Lift	1	60
			Crew Truck	4	60
		Mechanical	Man Basket	3	210
			Fork Lift	3	210
			Track Hoe	2	210
			Front End Loader	1	210
			Welding Machine	3	210
			Crew Truck	11	210
		Electric	Fork Lift	2	120
			Man Basket	2	120
			Crew Truck	4	120
Test Site	17	Site Work	Scraper	2	7
			Blade	1	7
			Dozer	1	7
			Crew Truck	2	7
		Civil	Track Hoe	1	14
			Front End Loader	1	14
			Skid Steer	1	14
			Drill Pier Truck	1	14
			Fork Lift	1	14
			Crew Truck	3	14
		Mechanical	Man Basket	1	60
			Fork Lift	1	60
			Mini Excavator	1	60
			Front End Loader	1	60
			Welding Machine	1	60
			Crew Truck	6	60
		Electric	Fork Lift	2	30
			Man Basket	2	30
			Crew Truck	2	30
		Bulk Lines (4 Line Package)	Side Boom	3	10 per mile
			Track Hoe	3	10 per mile
			Dozer	1	10 per mile
			Blade	1	10 per mile
			Semi-truck	3	10 per mile
			Crew Truck	3	10 per mile

Facility	Quantity	Construction Phase	Equipment	Count	Duration (days)
Existing Well Pad (workover rig)	353	Pad Rework	None needed – existing pad		
		Wellbore Work	Detroit 60 Series 14L 575 HP	1	5
			Semi-truck	1	5
			Crew Truck	1	5
		Road Rework	None needed – existing road		
		Flowline Installation	Track Hoe	1	4 per mile
			Ditcher	1	4 per mile
			Semi-truck	1	4 per mile
			Dozer	1	4 per mile
			Crew Truck	2	4 per mile
New Well Pad	45	New Pad Construction	Scraper	2	7
			Blade	1	7
			Dozer	1	7
			Crew Truck	2	7
		Wellbore Work (Drill)	Generator Sets (1@50% run time, 1@100% run time)	2	23
			Crew Truck	10	23
		Wellbore Work (Completion)	Detroit 60 Series 14L 575 HP	1	5
			Semi-truck	1	5
			Crew Truck	1	5
		New Road Construction	Dozer	1	4 per mile
			Blade	1	4 per mile
			Roller	1	4 per mile
			Crew Truck	1	4 per mile
		Flowline Installation	Track Hoe	1	4 per mile
			Ditcher	1	4 per mile
			Dozer	1	4 per mile
			Semi-truck	1	4 per mile
			Crew Truck	2	4 per mile
Common Pipelines	2	12" CO_2 Pipeline to Pennel Unit (6 miles)	Side Boom	2	7 per mile
			Track Hoe	2	7 per mile
			Dozer	1	7 per mile
			Blade	1	7 per mile
			Semi-truck	2	7 per mile
			Welding Machine	4	7 per mile
			Crew Truck	7	7 per mile
		12" CO_2 Pipeline to Coral Creek Unit (7 miles)	Side Boom	2	7 per mile
			Track Hoe	2	7 per mile
			Dozer	1	7 per mile
			Blade	1	7 per mile
			Semi-truck	2	7 per mile
			Welding Machine	4	7 per mile
			Crew Truck	7	7 per mile

Facility	Quantity	Construction Phase	Equipment	Count	Duration (days)
Electrical Distribution Lines	9.56 miles	Installation of Electrical Distribution Lines	Drill Truck – 400 HP	1	1.25 per mile
			Bucket Truck – 300 HP	2	1.25 per mile
			Crew Truck	2	1.25 per mile

5.2 PRE-CONSTRUCTION ACTIVITIES

5.2.1 Survey Monuments

All survey monuments found within proposed disturbance will be protected. Survey monuments include, but are not limited to, General Land Office and BLM Cadastral Survey Corners, reference corners, witness points, U.S. Coastal and Geodetic benchmarks and triangulation stations, military control monuments, and recognizable civil (both public and private) survey monuments. If any survey monuments found within proposed disturbance are disturbed during Project development, the contractor will immediately report it to Denbury; Denbury will report the incident in writing to the BLM Authorized Officer and the respective installing authority, if known.

5.2.2 Surveying and Staking

Surveys will be conducted to identify the extent of the facility pad(s) and to identify the centerline of the access road(s) and pipeline(s). Denbury's construction inspectors will be responsible for verifying that the limits of authorized construction work areas are abided by during construction.

5.3 CONSTRUCTION PROCESS

The following construction process sections are presented in the order they generally occur. The construction processes specific to the different infrastructure types (facility pads, access roads, and pipelines) are outlined in the infrastructure section.

Best management practices (BMPs) will be installed to limit sediment transport and erosion. The Reclamation, Mitigation, and Monitoring Plan (Appendix D) should be referred to throughout the proposed Project to ensure proper sediment- and erosion-control, mitigation, and reporting procedures are followed, as well as the Applicant Committed Measures (Appendix A).

5.3.1 Clearing

All vegetation, including trees, will be removed from the entire construction area when installing welded steel lines where there are fire concerns. Bulk vegetation will not be removed in standing water or saturated ground wetlands and waterbody areas. Stumps will be left in place except over the trench line or removed as necessary to create a safe and level workspace. The Environmental Inspector will coordinate with the appropriate agency or landowner to locate areas for stump disposal when necessary. Trees will be felled only within the approved working limit boundaries.

5.3.2 Topsoil Stripping

The objective of topsoil handling is to maintain topsoil capability by conserving topsoil for future replacement and reclamation and to minimize the degradation of topsoil from compaction, rutting, loss of organic matter, or soil mixing so that successful reclamation of the construction area can occur. Available topsoil depths vary across the proposed Project but will be stockpiled separately from subsoil when gross differences in soil type exist throughout the excavation column. Topsoil will not be used as fill on the facility pads and access roads or pad the pipeline trench. Topsoil will be used as the final layer of soil during reclamation.

In order to avoid mixing of topsoil and subsoil, rutting greater than 4 inches deep will not be allowed in areas where topsoil is intact. The 4-inch rutting rule will not be enforced in areas that have already been stripped of topsoil (i.e., where equipment is working on subsoil) or areas where topsoil and subsoil are of the same speciation. This rule includes access roads; if the topsoil has not been stripped, ruts cannot exceed 4 inches.

In wetlands and waterbodies (as delineated as an U.S. Army Corps of Engineers wetland or waterbody), wetland soils will be segregated from upland soils and excavated fill material stockpiling. The Environmental Inspector will determine the depth of wetland soil, per site conditions. Dry ephemeral drainages (arroyos and swales) crossed by the ROW will not be blocked with topsoil piles. Topsoil will be placed on the banks of drainages so natural flows are not impeded and soil is not washed away or back into any adjacent wetlands or waterbodies. Any excess wetland soil generated from the project must be stockpiled outside of wetlands, in a position not to cause pollution to surface or ground- water. Guideline regarding wetland soil conservation are located in the Reclamation, Mitigation, and Monitoring Plan (Appendix D).

5.3.3 Front End Grading

In locations where side sloping terrain exists, grading may occur to create a flat, level work area for construction equipment. The grading crew will install timber mats in wetlands (if soil conditions cannot support construction equipment) and over flowing waterbodies. These areas will be restored to the existing natural contours after the trench is backfilled (during the rough grade phase of construction).

5.3.4 Infrastructure

5.3.4.1 Facility Pads

Facility pads will be built up to a level working pad based on engineering designs and BLM and State of Montana guidelines. Onsite facility pad infrastructure will be constructed as described in Section 4.0. Facility pads will be surfaced with rock or gravel, where appropriate, to stabilize the pad and protect against erosion.

5.3.4.2 Access Roads

Vehicles will access the well sites and facilities using existing roads. Improvement to existing roads and construction of new roads may be required in some cases. The roads will be built up and surfaced, with rock or gravel, according to BLM and landowner guidelines to minimize erosion and runoff. The road corridors will be maintained while in use. Any disturbed areas of

the road corridor not being used will be reclaimed within 6 months or as soon as environmental conditions are appropriate after a specific activity has been completed.

5.3.4.3 Electrical Lines and Equipment

Electrical power will be delivered to each well and facility via existing or new electrical distribution lines as outlined in Section 4.4. For safety purposes, the main power service will be located no closer than 100 feet from the wellhead and the variable speed drive will be located at least 50 feet from the wellhead. From the main power service, the electrical line will run underground to a phase shift transformer, into a variable speed drive, into a pulse width modulation filter, into a step up transform, and finally into a junction box before travelling to the wellhead. An example of a typical electrical equipment layout is displayed in Figure 5-1.

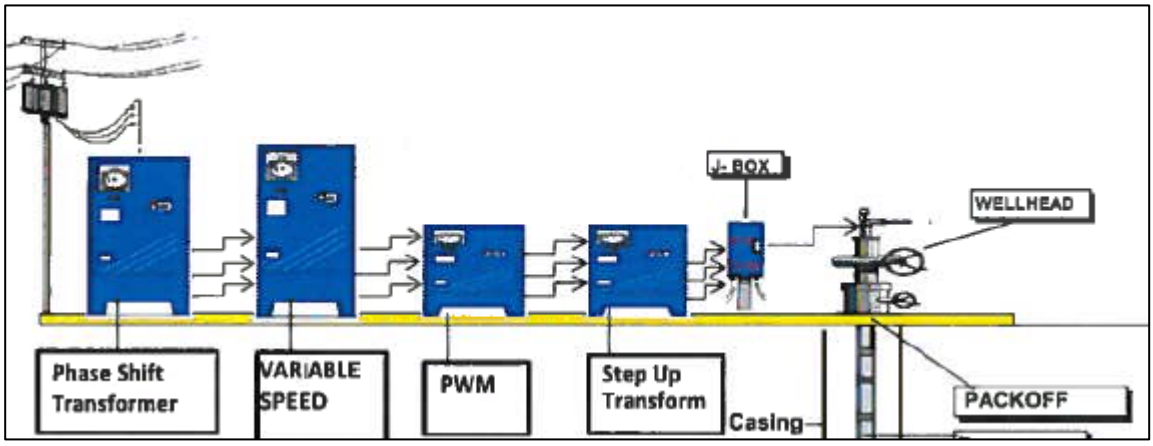


Figure 5-1. Typical electrical equipment layout.

5.3.4.4 Pipelines

Restaking Centerline of the Trench

Following clearing, any centerline or boundary markers removed will be re-established.

Trenching

If a union contractor is selected for construction, it is standard practice for them to excavate the trench prior to stringing. If a non-union contractor is hired, they typically string pipe prior to trenching. Trenches will be excavated using a wheel trencher or backhoe; the method selected will be based on soils, rock, terrain, and/or other related factors. Special excavation equipment or techniques may be used if large quantities of solid rock are encountered.

Stringing

The contractor will string the pipe along the ROW. Stringing trucks will collect and deliver the pipe to the ROW from staging areas and/or the pipe yard. Pipe for road, waterbody, and/or wetland crossings will be stockpiled at temporary use areas near the crossings. Stringing operations will be coordinated with trenching and installation activities in order to properly manage the construction time on a particular tract of land.

Padding and Lowering In the Trench

Specialized padding machines may be used to sift the excavated subsoils to provide rock-free pipeline padding and bedding. In rocky areas, sandbags may be used to pad the bottom of the trench instead of, or in combination with, using soil fines for padding. No topsoil will be used to pad the pipe. Before a pipe section is lowered into the trench, inspection will be conducted to ensure the trench bottom is free of rocks and other debris that could damage the external pipe coating.

Backfilling and Rough Grade

Backfilling will begin after a section of pipe has been successfully placed in the trench. Trench breakers will be installed, as needed. Prior to backfilling the trench, the equipment operator will check the trench for wildlife and/or livestock; any wildlife or livestock found in the trench will be removed before backfilling begins. The backfilling process will use a bulldozer, rotary auger backfiller, padding machine, or other suitable equipment. Backfill material will be subsoil previously excavated from the trench, except in rocky areas where imported select fill material may be needed (properly permitted sand pits for barrow material may need to be identified and used).

Backfill will be graded and to ensure ground stability. Compaction will be done to the extent that there are no voids in the trench. In irrigated agricultural areas, the backfill will be replaced at the same compaction density as the adjacent undisturbed soil. Backfilling at road crossing will be in accordance with the crossing permit. Any excavated materials or materials unfit for backfill will be used elsewhere or properly disposed in conformance with applicable laws or regulations.

Hydrostatic Testing

The pipeline will be hydrostatically tested in compliance with Denbury company standards before being placed into service. Generally, this pressure test occurs at 1.25 times the maximum allowable operating pressure. Test water will be obtained from a permitted source and/or as negotiated with water rights owners or commercial wells and will be required to meet water quality standards prior to use.

5.3.5 Final Cleanup and Reclamation

The final step in the construction process is restoring the disturbed area as closely as possible to its original condition. All construction debris and miscellaneous items will be removed from the construction site and disposed properly by the contractor. No trash will be buried. Fences and roads will be replaced/rebuilt as negotiated with the landowner.

Disturbed portions of the construction workspace will be returned to pre-construction grades and contours as close as possible as described in the Reclamation, Mitigation, and Monitoring Plan (Appendix D). Requirements related to seeding, mulching, slope and trench breaker installation, relieving compaction, restoration of stream banks and slopes, etc. are also included in the Reclamation, Mitigation, and Monitoring Plan (Appendix D).

5.4 BLASTING

Based on a preliminary analysis of geologic conditions, blasting will not be necessary for construction of the CCA infrastructure.

6.0 ADDITIONAL DESIGN FEATURES

6.1 PIPELINE RAILROAD AND ROAD CROSSINGS

All flowline road and railroad crossings will be designed in accordance with applicable federal, state, local, and company standards. Crossings of two-track roads and gravel roads will use open cut techniques (Figure 6-1); paved county roads, state highways and railroads will be crossed via conventional bore (Figure 6-2) or horizontal directional drill (Figure 6-3). Denbury will work with the specific landowner and local agencies to coordinate detours and emergency access. Traffic control is included in Section 7.5.1 of this POD, which includes information regarding road closures, signage, etc. Flowlines will be buried at a minimum depth of 4 feet below the bottom of existing road ditches and 5 feet below the base of the road itself.

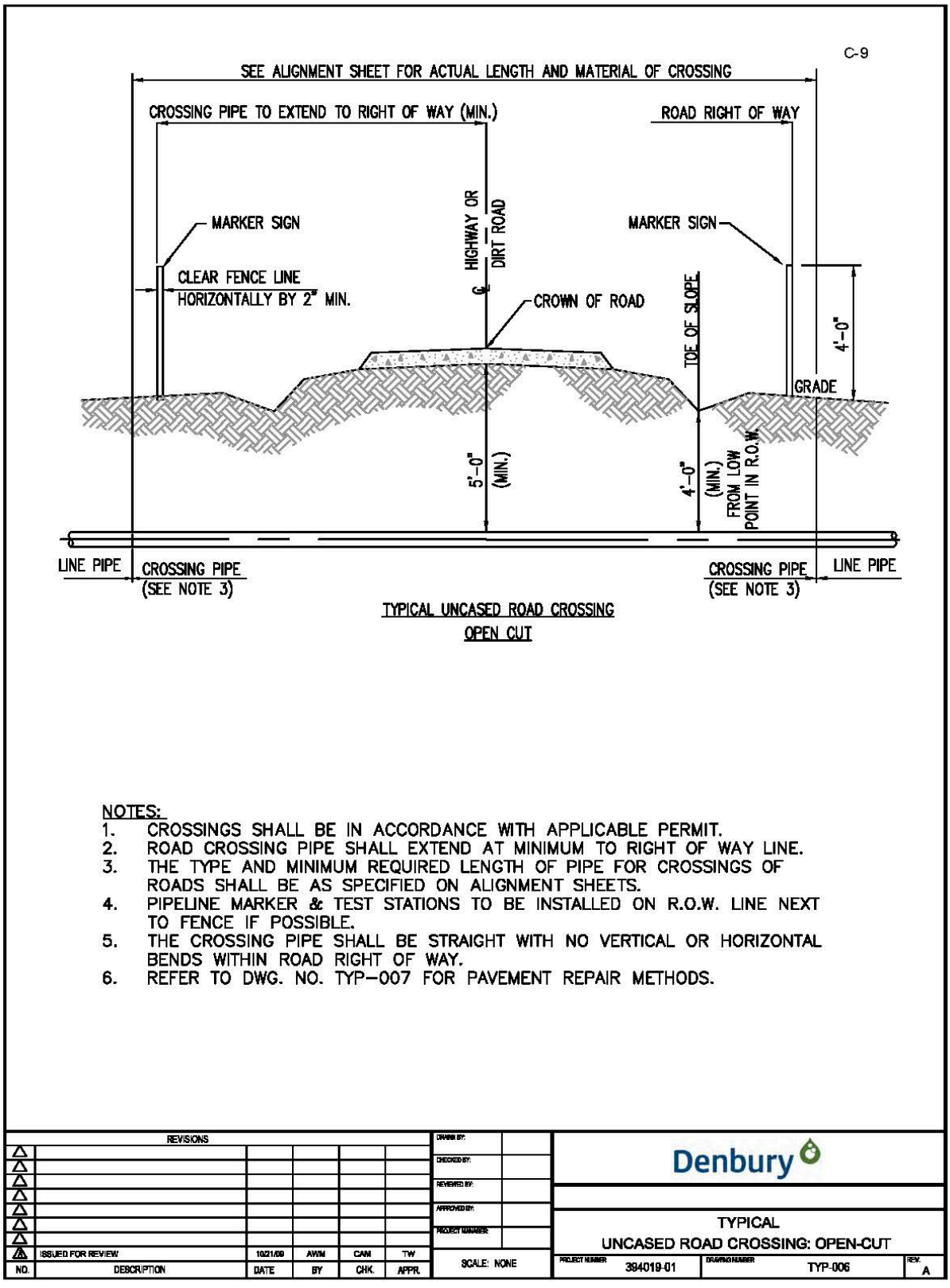
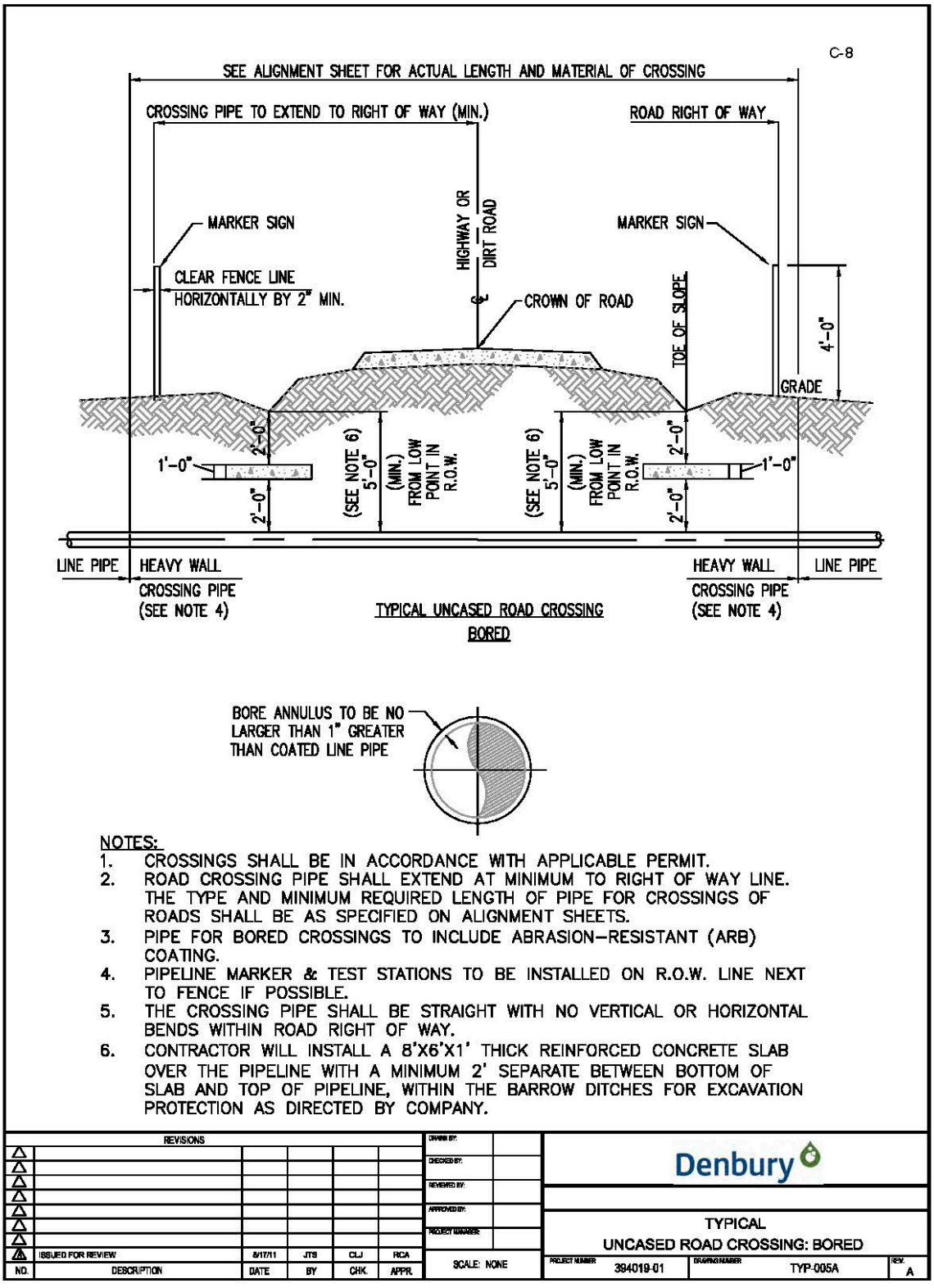


Figure 6-1. Typical open cut road crossing.



NOTES:

1. CROSSINGS SHALL BE IN ACCORDANCE WITH APPLICABLE PERMIT.
2. ROAD CROSSING PIPE SHALL EXTEND AT MINIMUM TO RIGHT OF WAY LINE. THE TYPE AND MINIMUM REQUIRED LENGTH OF PIPE FOR CROSSINGS OF ROADS SHALL BE AS SPECIFIED ON ALIGNMENT SHEETS.
3. PIPE FOR BORED CROSSINGS TO INCLUDE ABRASION–RESISTANT (ARB) COATING.
4. PIPELINE MARKER & TEST STATIONS TO BE INSTALLED ON R.O.W. LINE NEXT TO FENCE IF POSSIBLE.
5. THE CROSSING PIPE SHALL BE STRAIGHT WITH NO VERTICAL OR HORIZONTAL BENDS WITHIN ROAD RIGHT OF WAY.
6. CONTRACTOR WILL INSTALL A 8'X6'X1' THICK REINFORCED CONCRETE SLAB OVER THE PIPELINE WITH A MINIMUM 2' SEPARATE BETWEEN BOTTOM OF SLAB AND TOP OF PIPELINE, WITHIN THE BARROW DITCHES FOR EXCAVATION PROTECTION AS DIRECTED BY COMPANY.

REVISIONS					
NO.	DESCRIPTION	DATE	BY	CHK.	APPR.
1	ISSUED FOR REVIEW	8/17/11	JTS	CLJ	RCA

DRAWN BY: | CHECKED BY: | REVIEWED BY: | APPROVED BY: | PROJECT MANAGER:

SCALE: NONE

Denbury

TYPICAL
UNCASED ROAD CROSSING: BORED

PROJECT NUMBER 394019-01 | DRAWING NUMBER TYP-005A | REV. A

Figure 6-2. Typical conventional bore road crossing.

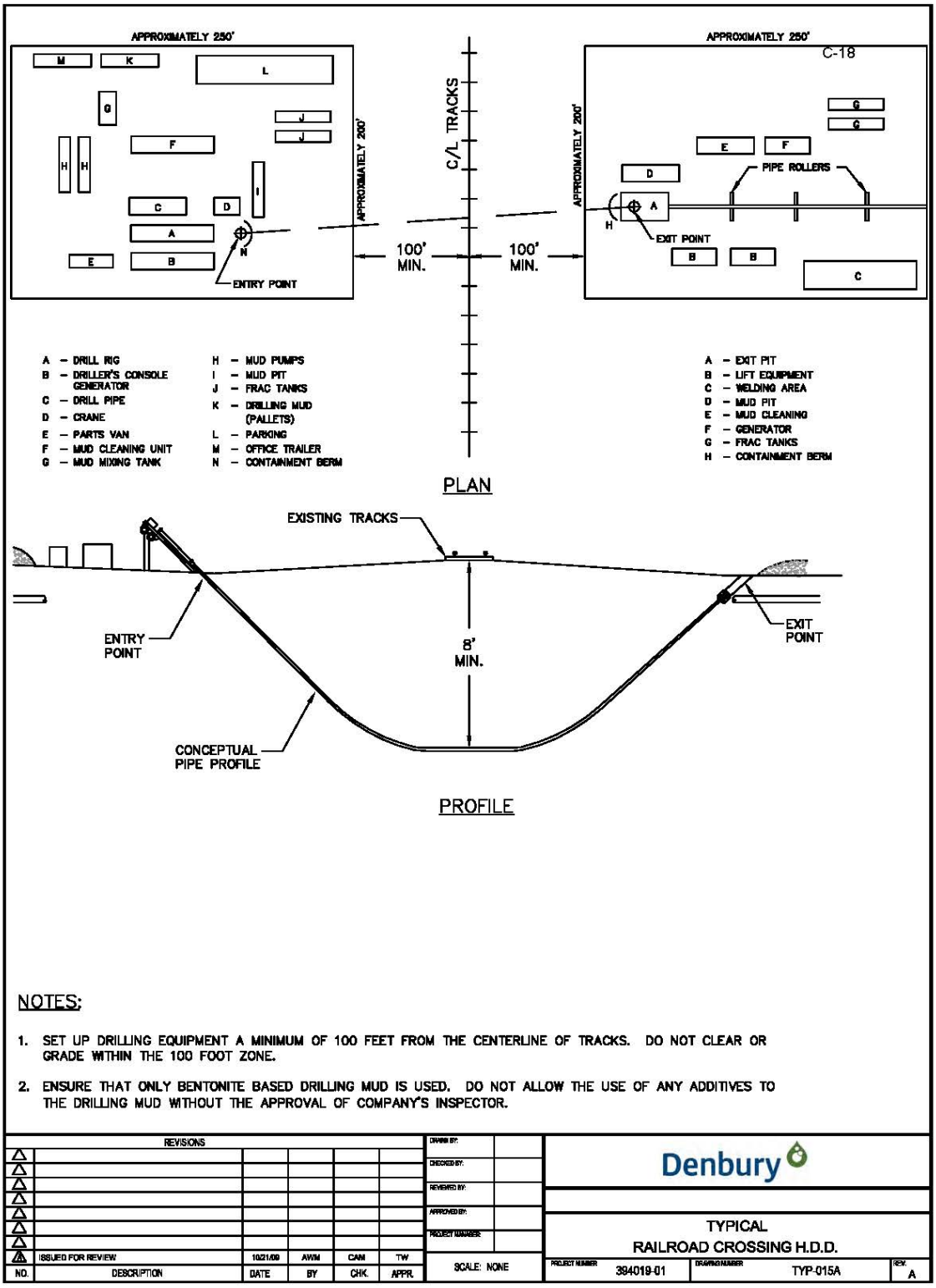


Figure 6-3. Typical horizontal direction drill railroad or road crossing.

6.2 WETLAND AND WATERBODY CROSSINGS

Wetlands and waterbodies that have been delineated within the Project area are identified in the Resource Report for Aquatics, Vegetation, and Wildlife (Appendix F). Crossing techniques, typical construction drawings, erosion- and sediment-control measures, and other mitigative measures, is provided in the Reclamation, Mitigation, and Monitoring Plan (Appendix D).

A wetland is a low area that has wetland vegetation, soil, and hydrology. A waterbody includes any natural or artificial stream, river, canal, or drainage with perceptible flow at the time of crossing, as well as other permanent waterbodies such as ponds or lakes, or has delineated ordinary high water marks.

6.3 FUGITIVE DUST CONTROL

Construction activities and the use of unpaved roads can result in varying degrees of fugitive dust emissions. BMPs that will be used to control fugitive dust during construction, when necessary or during periods of dry conditions, include the following.

- Water and/or non-toxic chemical dust suppressant, alone or in combination with mulches, will be applied to areas of disturbance to minimize fugitive dust emissions. Note: Chemical dust suppressant will not be used on BLM-managed lands.
- Use of wind fences, berms, or covering material such as gravel or textiles in areas of disturbance will minimize fugitive dust emissions.
- Unpaved roads in the construction area that pass within 0.25 mile of inhabited dwellings will be watered or treated with non-toxic chemical dust suppressant.

Water for fugitive dust control purposes will be obtained prior to construction, through permits or purchase contracts with owners of valid existing water rights as necessary. The dust abatement contractor will be responsible for obtaining any necessary permits.

Federal, state, and local air quality standards will be met during construction. Site revegetation will be conducted in accordance with Denbury's reclamation procedures, which will also reduce dust emissions.

Portions of Fallon County are known to contain geologic formations containing erionite, a carcinogen on the Toxic Substance Control Act (TSCA) list. Testing for erionite may be required for fill material used during construction; Denbury will also verify that fill material source locations are properly permitted. In areas known to, or suspected of, containing erionite, additional controls will be implemented, including the following.

- Keep windows and doors to equipment closed while operating and driving down dirt roads.
- Maintain equipment air filters regularly as recommended by the equipment manufacturer.
- Ensure an effective hazard communication program to educate employees on the health effects and hazards of crystalline silica and the potential health effects of erionite.

- Wet the soil or aggregate before disturbing to reduce dust generation.
- Wash protective clothing and other equipment regularly to remove dust, dirt, and other contaminants.

6.4 HEALTH AND SAFETY

As part of the construction mobilization activities, Denbury will provide contractors prevention, response, and safety training to improve awareness of safety requirements, pollution control laws and procedures, and proper operation and maintenance of equipment. Pre-construction safety coordination meetings will be held at each Project work location. The safety meeting will address specific Denbury or contractor concerns and expectations; discuss safety initiatives; and review the safety compliance program, incident reporting, and established protocols for determining, correcting, and documenting safety non-compliance incidents. A detailed discussion of the health and safety measures to be followed is included in the Emergency Response Plan (Appendix E).

6.5 WASTE DISPOSAL

Denbury Construction Inspectors will ensure that the contractor implements the following waste disposal measures.

- No littering will be allowed on site. Construction and operations sites will be maintained in a sanitary condition at all times and waste materials at these sites will be disposed promptly at an appropriate waste disposal site. Waste is defined as all discarded matter including, but not limited to, human waste, discarded food, trash, garbage, refuse, oil drums, petroleum products, blasting boxes, and equipment.
- The contractor will dispose excess or unsuitable materials at commercial disposal sites, commercial recycling centers, and disposal sites approved by Denbury and the State of Montana.
- The contractor will comply with all hazardous waste disposal requirements.
- Human wastes, temporarily located within self-contained facilities (portable toilets), will be removed from the Project site and disposed in accordance with applicable laws and regulations; these facilities will not be placed within 100 feet of a drainage, wetland, or waterbody.

6.6 LIVESTOCK GRAZING AND ASSOCIATED STRUCTURES

Grazing allotments and associated permit infrastructure (fences, gates, cattle guards, water pipelines, etc.) are present within the proposed Project on private, state, and BLM-administered lands. The acres of BLM grazing allotments within the EOR unit development boundary are listed in Table 6-1. Table 6-2 lists all newly proposed infrastructure located within BLM grazing allotments on BLM-owned surface.

Denbury will implement BMPs to maintain current permit operations for grazing permittees during construction and to re-establish permit operations and disturbed infrastructure following construction. Fences impacted by construction will be braced, cut, and temporarily fitted with

gates to permit construction traffic passage. During construction, the opening will be controlled to prevent the escape of livestock. Gates are typically installed with chained locks to allow access to the ROW after construction, as negotiated with the BLM and landowners. Care will be taken to not obstruct or damage existing gates or cattle guards. All livestock facilities (gates, cattle guards, corrals, fences, water sources, etc.) damaged or made inoperable will be repaired to BLM and private landowner satisfaction.

Table 6-1. Grazing Allotments within EOR Unit Development Boundary

Grazing Allotment Name	Land Ownership Acres			Total Acres
	BLM	Private	State	
A. Pinnow	797.86	1,285.41	286.16	2,369.43
Kirschten	457.91	800.14	0.00	1,258.04
Kirschten East	0.00	243.48	0.00	243.48
Koenig-O'Donnell	0.00	2,738.84	4.03	2,742.87
Lang	158.52	1,697.34	0.00	1,855.87
Murphy	2,397.77	5,518.01	640.35	8,556.13
Roger Losing	0.00	162.68	0.00	162.68
Rusley Allotment	1,277.74	1,313.55	0.00	2,591.29
Singer	442.08	1,573.82	0.00	2,015.90
Sonsalla	39.85	749.08	0.00	788.93
Total	**5,571.73**	**16,082.35**	**930.55**	**22,584.63**

Table 6-2. Proposed New Infrastructure on BLM Grazing Allotments

Grazing Allotment Name	Proposed New Infrastructure Type					Total Acres
	EOR Facility	Electrical Line	Well Pad	Test Site	Flowline	
A. Pinnow	0.00	0.00	0.00	2.81	34.77	37.58
Kirschten	0.00	0.00	0.00	0.00	6.15	6.15
Murphy	0.00	2.62	3.45	0.00	30.77	36.84
Rusley Allotment	0.00	0.00	0.00	0.00	4.28	4.28
Singer	5.93	0.00	0.00	0.00	22.37	28.30
Sonsalla	0.00	0.00	0.00	0.00	0.03	0.03
Total	**5.93**	**2.62**	**3.45**	**2.81**	**98.37**	**113.18**

7.0 AREAS OF SPECIAL CONDITIONS

The proposed infrastructure for the Project has been designed to avoid impacts to special environmental resources and sensitive cultural resource locations, as much as possible. Special environmental resources could include wetlands, waterbodies, sensitive wildlife habitats, and wildlife migration corridors. In cases where routing cannot avoid all impacts to areas of special environmental conditions and cultural resource locations, the construction ROW will be reduced to minimize impacts. Additionally, timing restrictions and construction stipulations have been established to help protect these resources in the Resource Report for Aquatics, Vegetation, and Wildlife (Appendix F).

7.1 FEDERALLY LISTED, PROPOSED THREATENED OR ENDANGERED, AND CANDIDATE SPECIES

The U.S. Fish and Wildlife Service identifies one listed endangered species (whooping crane) and two listed threatened species (northern long-eared bat and piping plover) with potential to occur in Fallon County, Montana. For additional information, please refer to Section 5.1 of the Resource Report for Aquatics, Vegetation, and Wildlife (Appendix F of this POD).

7.2 SPECIAL STATUS SPECIES

BLM sensitive wildlife and rare plant species that could potentially occur within the proposed Project area are listed in Section 5.2 of the Resource Report for Aquatics, Vegetation, and Wildlife (Appendix F). The proposed Project area was evaluated for the potential occurrence of special status species based on range, known distribution, and the presence of suitable habitat in the proposed Project area, and field surveys were conducted as discussed in Appendix F. Migratory birds are discussed in the Migratory Bird Conservation Plan (Appendix G), and a discussion related to greater sage-grouse is included in the Greater Sage-grouse Mitigation Planning Approach (Appendix H).

7.3 AQUATIC RESOURCES

SWCA has completed aquatic resource delineations within the EOR unit development boundary. Wetlands, waterbodies, and other aquatic features are described in Appendix F of this POD. Section 404 permits from the U.S. Army Corps of Engineers may be required if these resources are disturbed.

7.4 GENERAL WILDLIFE

The BLM, Montana Fish, Wildlife & Parks, and USFWS cooperatively manage wildlife resources over the Project area with the goal of avoiding or minimizing impacts from Project development. In addition, these agencies also work with other state and federal agencies, Denbury, and landowners to implement protective measures within the Project area.

Denbury acquired wildlife baseline information for the Project area in 2015, 2016, and 2017 (Appendix F). That information will be used to facilitate the BLM's ability to identify concerns, provide guidance for the design of Project plans that encourage conservation, monitor the effectiveness of decisions, and make recommendations to adjust management to address specific situations. Specific biological resources that have been identified as potentially occurring within the Project area are discussed in the Resource Report for Aquatics, Vegetation, and Wildlife in Appendix F of this POD.

Protection and conservation measures will be implemented for the proposed Project as outlined in Appendix F. Additional measures may be included in the Conditions of Approval, BMPs, and recommendations from consultation with the BLM, USFWS, and Montana Fish, Wildlife & Parks.

7.5 RECREATION AREAS

Areas of public recreation exist within the Project area and could be temporarily impacted by construction of the Project. BLM lands with legal public access that could be used for dispersed recreation (e.g., hunting, birding, fishing, hiking, etc.) are located within the proposed Project area. Hunting is the predominant recreational use most affected on BLM land. Construction and reclamation work during hunting season will temporarily exclude hunters from comparatively small areas on BLM land. Denbury will contact the BLM via status update reports throughout construction, which will enable the BLM to notify the public of anticipated road closures or delays to regular traffic patterns to these areas.

7.5.1 Traffic Control Plan

Safety of the public is the primary concern associated with active construction within or near recreation or other public use areas. Signage will be used if safety concerns exist along public roads, Project access roads, and the construction ROW to indicate where the public and/or construction contractor are allowed access.

Designated hard-surfaced roads used during Project construction activities will be maintained in an operable condition to allow access for the public and/or landowners during construction. However, construction activities may in some cases require temporary lane or road closure. Partial closure or closure and detouring of existing roads will be performed only following authorization by the appropriate agency (counties, Montana Department of Transportation, etc.). An alternate route will be provided to residents, contractors, and the emergency response organizations for their approval prior to any road closures. Proper signage will be provided and signage locations will be approved prior to any change in traffic flow. Notification of road closure with detour routes and reopening of roads will be communicated to the appropriate agencies, emergency response personnel, operators, and contractors working onsite. Proper signage such as detour and road closure signs will be placed before the roads are taken out of service.

7.5.2 Visual Resource Management

Visual Resource Management (VRM) classes along with the corresponding VRM objectives have been established for BLM lands within the Project area. These VRM objectives provide standards for evaluating and analyzing proposed projects as well as identifying mitigating measures that serve to minimize visual impacts.

The Project area falls within an established VRM Class IV, the objective of which is as follows.

Class IV Objectives. The objective of this class is to provide for management activities which require major modification of the existing character of the landscape. The level of change to the characteristic landscape can be high. These management activities may dominate the view and be the major focus of viewer attention. However, every attempt should be made to minimize the impact of these activities through careful location, minimal disturbance, and repeating the basic elements.

7.6 SPECIAL OR SENSITIVE SOIL LOCATIONS

A variety of unique or special soils exist within the Project area. Sensitive areas include landscape features, soil attributes, and vegetation community characteristics that may limit the success of reclamation. Denbury will implement reclamation techniques that ensure subsurface integrity and re-establish slope and surface stability while maintaining the biological, chemical, and physical integrity of the soil resource. A more detailed discussion of the specific techniques used during and after construction are included in the Reclamation, Mitigation, and Monitoring Plan (Appendix D). The acreage of sensitive soils within the EOR unit development boundary is summarized in Table 7-1.

No areas of Prime Farmland are located within the proposed Project area.

Table 7-1. Sensitive Soils within EOR Unit Development Boundary

Development Phase	Land Ownership Acres			Total Acres
	BLM	Private	State	
Phase A	0.00	93.29	0.00	93.29
Phase B	0.00	8.17	24.44	32.61
Phase C	91.96	305.40	0.00	397.36
Phase D	0.00	119.63	3.92	123.55
Total	**91.96**	**526.49**	**28.36**	**646.81**

7.7 ENVIRONMENTAL INSPECTIONS

Denbury will be responsible for enforcing environmental compliance for the proposed Project. An Environmental Compliance Plan will be prepared that describes roles and responsibilities as well as reporting procedures for the construction and post-construction phases. Denbury personnel will be responsible for conducting water quality sampling at source and discharge locations.

An annual report will be submitted to the BLM every November that will summarize all construction activities completed during the previous year, all construction activities planned for the upcoming year, reclamation activities planned and completed, and any other relevant information regarding construction status within the EOR unit development boundary.

7.8 NOXIOUS WEED MANAGEMENT

Denbury will be responsible for noxious weed control within the limits of any disturbed areas. Noxious weeds will be monitored and mitigated in accordance with the Noxious Weed Management Plan (see Appendix I).

7.9 AREAS OF CULTURAL SIGNIFICANCE

SWCA Environmental Consultants has completed Class III cultural resource inventories within the EOR unit development boundary. Cultural resource monitoring and trench inspection

activities are detailed in the monitoring and treatment plan (Appendix J) to be approved by the BLM and State Historic Preservation Office prior to construction.

8.0 EMERGENCY PROCEDURES

The Emergency Response Plan is included as Appendix E and includes a Safety Response Plan and Fire Prevention and Suppression Plan. The Emergency Response Plan will be reviewed by all contractors and updated as needed to meet changing conditions and applicability with federal regulations. The Emergency Response Plan will also outline the reliability, safety standards, unit accident data, and damage control program requirements.

9.0 FIRE PREVENTION AND SUPPRESSION

Contractors will comply with Denbury's Fire Prevention and Suppression Plan, which is included in the Emergency Response Plan (Appendix E). This plan details fire control procedures including responsibilities and coordination, notification procedures, emergency fire patrols, fire prevention methods, and fire prevention requirements for construction equipment.

10.0 SPILL PREVENTION AND CONTAINMENT

Spill prevention and containment applies to the use and management of hazardous materials on the construction ROW and all ancillary areas during construction. This includes the refueling or servicing of all equipment with diesel fuel, gasoline, lubricating oils, grease, and hydraulic and other fluids during normal upland applications and special applications on federal lands that are within 500 feet of perennial streams or wetlands.

Denbury has a Spill Prevention Containment and Countermeasures (SPCC) plan for all current operations in accordance with the requirements of 40 CFR 112. Denbury or its contractors will prepare a Project-specific SPCC for all future operations as they are implemented.

10.1 SPILL PREVENTION

The contractor will ensure that all equipment is free of leaks prior to use on the Project and prior to entering or working in or near waterbodies or wetlands. Throughout construction, the contractor will conduct regular maintenance and inspections of the equipment to reduce the potential for spills or leaks.

The following spill prevention measures will be implemented by the contractor to reduce the potential of a spill to impact federal lands.

- Contractor fuel trucks will be loaded at existing bulk fuel dealerships or from bulk tanks set up for that purpose at the staging area. In the former case, the bulk dealer is responsible for preventing and controlling spills.
- Denbury's inspectors will inspect the tank site for compliance with the 500-foot setback requirement and approve the tank site prior to installing bulk fuel or storage tanks on the construction yard.

- Storage of fuel and lubricants will be at least 500 feet away from the water's edge. Refueling and lubrication of equipment will be restricted to upland areas at least 500 feet away from perennial streams and wetlands.
- Contractors will be required to perform all routine equipment maintenance at the construction yard and recover and dispose of wastes in an appropriate manner.
- All fuel storage and dispensing equipment will meet local, state, and federal regulations.
- Construction activities will be conducted to allow for prompt and effective cleanup of spills of fuel and other hazardous materials. Each construction crew, including cleanup crews, will have on-hand sufficient tools and material to stop leaks and supplies of absorbent and barrier materials to allow rapid containment and recovery of spilled materials. Crew members must know and follow the procedure for reporting spills.
- Refueling and lubricating of construction equipment will be restricted to upland areas at least 500 feet away from waterbodies, perennial streams, and wetlands located on federal lands. Where this is not possible (e.g., trench dewatering pumps), the equipment will be approved in advance by the BLM Authorized Officer and fueled by designated personnel with special training in refueling, spill containment, and cleanup. The Environmental Inspector will ensure that signs are installed identifying restricted areas. Spent oils, lubricants, filters, etc. will be collected and disposed of at an approved location in accordance with state and federal regulations.
- Equipment will not be washed within 500 feet of waterbodies, streams, or wetlands.
- Stationary equipment will be placed within a secondary containment if it will be operated or require refueling within 500 feet of a wetland or waterbody boundary.

Denbury may allow modification of the above specifications as necessary to accommodate specific situations or procedures. Any modifications must comply with all applicable regulations and permits.

If a spill occurs on navigable waters of the United States, Denbury will notify the National Response Center at 1-800-424-8802. For spills that occur on federal lands, which includes surface waters or into sensitive areas, the BLM Authorized Officer also will be notified.

10.2 SPILL CONTAINMENT AND COUNTERMEASURES

In the event of a spill of hazardous material, contractor personnel will complete the following steps.

- Notify the appointed Denbury representative.
- Identify the product hazards related to the spilled material and implement appropriate safety procedures, based on the nature of the hazard.
- Control danger to the public and personnel at the site.
- Implement spill contingency plans and mobilize appropriate resources and manpower.
- Isolate or shutdown the source of the spill.

- Block culverts to limit spill travel.
- Initiate containment procedures to limit the spill to as small an area as possible to prevent damage to property or areas of environment concern (e.g., watercourses).
- Commence recovery of the spill and cleanup operations.

When notified of a spill, the Denbury representative will immediately ensure the following procedures are completed.

- Action is taken to control danger to the public and personnel at the site.
- Spill contingency plans are implemented and necessary equipment and manpower are mobilized.
- Measures are taken to isolate or shutdown the source of the spill.
- All resources necessary to contain, recover, and clean up the spill are available.
- Any resources requested by the contractor from Denbury are provided.
- The appropriate agencies are notified. For spills that occur on federal lands, which includes surface waters or into sensitive areas, the BLM Authorized Officer will also be notified and involved in the incident.

For a land spill, berms will be constructed with available equipment to physically contain the spill. Personnel entry and travel on contaminated soils will be minimized. Sorbent materials will be applied or, if necessary, heavily contaminated soils will be removed to an approved facility. Contaminated sorbent materials and vegetation will also be disposed of at an approved facility.

For a spill threatening a wetland or waterbody, berms or trenches will be constructed to contain the spill prior to entry into the wetland or waterbody. Deployment of booms, skimmers, and sorbent materials will be necessary if the spill reaches the water. The spilled product will be recovered and the contaminated area will be cleaned up in consultation with spill response specialists and appropriate government agencies.

11.0 WELL INTEGRITY

11.1 PLUG AND ABANDON/DRILL AND ABANDON EVALUATION PRIOR TO CO_2 INJECTION

Plug & Abandon (P&A) and/or Drill & Abandon (D&A) wells exposed directly to CO_2 flood intervals and located within a 1-mile radius of the EOR unit development boundary will be included in the P&A/D&A evaluation process. Shallow utility wells such as coal bed methane (CBM) and gas storage wells that do not penetrate the proposed CO_2 flood interval will not be evaluated because of sufficient vertical geologic separation.

The main purpose of the P&A/D&A assessment is to help ensure that fluids (oil, water, and CO_2) from the flooded interval remain in their intended zone and do not pose a potential threat to the environment above or below the surface. The P&A/D&A assessment process is thorough

and consistent in terms of scope, data investigation, and scoring methodology. The scoring system allows wells to be prioritized according to the degree of deviation from the current Denbury and/or State standards, as well as proximity to the CO_2 flood.

P&A/D&A wells exposed to the CO_2 flood interval are evaluated using a 100-point grading system that considers the following factors.

- Flooded interval plug integrity.
- Flooded interval plug consequences.
- Plugging operator integrity.
- Underground source of drinking water plug.
- Surface shoe plug.
- Surface plug.

Once scoring is complete, the wells are then graded according to the following criteria which results in recommended action and priority.

- Score – downhole mechanical condition of wellbore.
- Underground source of drinking water – protection/isolation from contamination of reservoir fluids.
- Cultural impact – proximity to dwellings, businesses, public areas, highways, etc.
- Environmental impact – proximity to ponds, streams, environmentally sensitive areas.
- Accessibility – culture, encroachment.
- Safety impact.
- Conformance – isolation of zones, opportunity for crossflow.
- Ability to improve the condition of the well – parted/collapsed pipe, fish.

11.2 RESERVOIR MANAGEMENT

Denbury's CO_2 EOR development plan is designed to use existing wellbores where possible. Those wells were originally drilled and completed to prevent any migration of reservoir fluids between geologic strata. The EOR development plan is designed to eliminate the risk of any future out-of-zone fluid migration. Development of the unit for tertiary CO_2 production will include the examination and reconfiguration of each well for its particular use. All wells will have isolation cement and tubulars evaluated through logging and pressure testing to confirm mechanical integrity. All wells not being used in the CO_2 flood will be evaluated for mechanical integrity and secured to eliminate any possible fluid migration risk. Those wells will either be P&A, temporarily abandoned, or configured to monitor fluid movement and pressure. Injectors will have periodic injection profile logs, temperature logs, and daily tubing and casing pressures recorded to confirm well integrity. Production wells will be chemically treated for corrosion and all fluids monitored to ensure proper treatment rates. Existing P&A wells will be evaluated for any potential migration pathway prior to commencement of the flood and any requiring

remediation will be properly secured. Another monitoring method that will be performed is continuous monitoring of CO_2 use. The accounting of the fluid injected versus the fluids produced allows for the identification of any fluid losses.

12.0 OPERATION AND MAINTENANCE ACTIVITIES

For all approved wells and facilities discussed above, a Sundry Notice will be submitted for any proposed new federal action ground disturbance activities. All operation and maintenance activities will be completed in accordance with the POD appendices, the Environmental Assessment Decision Notice, and applicable regulatory guidance and laws. Specific operation and maintenance activities for additional infrastructure are further described in this section.

12.1 WELLS

Well operation will be conducted according to BLM and State of Montana guidelines, as applicable. Figure 12-1 illustrates a typical new grass roots well drilling pad with reclaimed areas during operations. Wells will be inspected weekly for the life of the well. Maintenance activities will be conducted as needed, including boundary fence repair, if applicable, vegetation treatment on the pad, erosion control measures, adding surfacing, and/or well repair. Emergency well repairs or well type changes could require a workover rig and crew to be present on the site for several days. All production wells will be pressurized using rod pump methods or by electrical submersible pump.

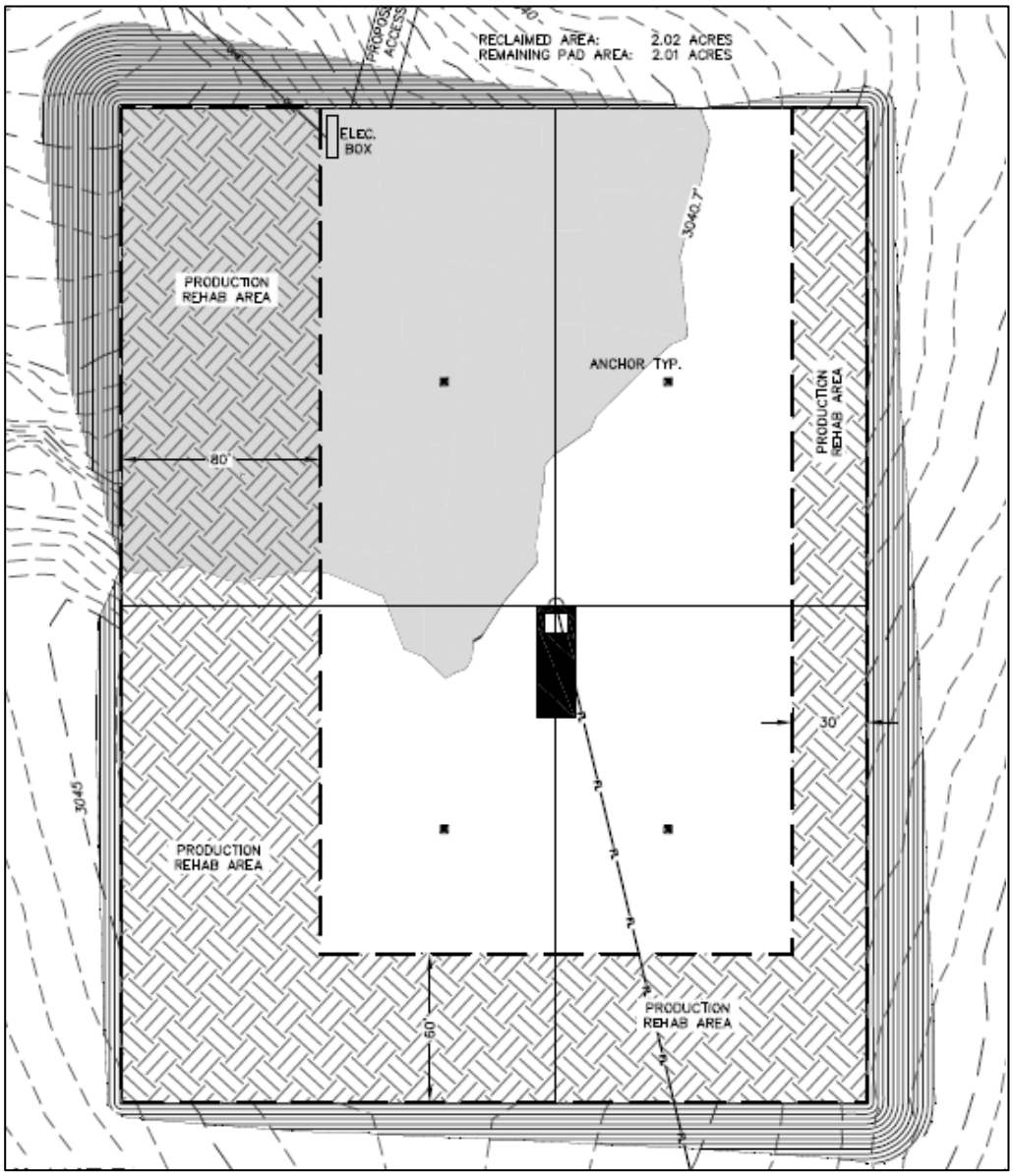


Figure 12-1. Typical layout of drilling pad for new grass roots wells during operations.

12.2 TEST SITES

Test sites will have appropriate automation installed to remotely monitor equipment performance and intervene when deviations occur. Maintenance activities will be conducted as needed, including boundary fence repair, if applicable, vegetation treatment on the pad, erosion control measures, adding surfacing, and/or test site component repair or replacement.

12.3 EOR FACILITY

Daily activity will likely occur at EOR facilities as part of the facility operation. Large and small machinery and multiple vehicles and people may be present at the facility at a given time. Maintenance activities will be conducted as needed, including boundary fence repair, if

applicable, vegetation treatment on the pad, erosion control measures, adding surfacing, and/or facility component repair or replacement.

12.4 ROADS

The road corridors will be maintained while in use, including stability, surfacing, noxious weed management, and erosion control. Any disturbed areas of the road ROW not being used will be reclaimed within 6 months after a specific activity has been completed or as soon as environmental conditions are appropriate. Livestock and access restriction gates will be maintained during the operational use of the road. Roads will be maintained in accordance with BLM guidelines and landowner contracts, as applicable.

12.5 FLOWLINES

Flowline ROWs will be maintained in accordance with BLM guidelines and landowner contracts, as applicable. Maintenance activities will be conducted as needed, including boundary fence repair, if applicable, noxious weed management, and erosion control management.

12.6 ELECTRICAL DISTRIBUTION LINES

Electrical distribution line ROWs will be maintained in accordance with BLM guidelines and landowner contracts, as applicable. Maintenance activities by the electrical distribution line company will be conducted as needed. Maintenance activities will occur within the ROW.

13.0 TERMINATION AND ABANDONMENT

After termination and abandonment is complete, all surface areas will be reclaimed according the guidelines outlined in Appendix D, Mitigation, Reclamation, and Monitoring Plan.

13.1 WELLS

Wells will be plugged and abandoned according to BLM, State of Montana, and/or landowner guidelines, as applicable. Final reclamation will start within 6 months after the wells are plugged and abandoned, or as soon as environmental conditions are appropriate.

13.2 TEST SITES

Test site removal will be determined by surface owner and Denbury agreements. Test sites scheduled to be decommissioned on BLM surface will have infrastructure and excess pad material removed, the ground ripped to reduce compaction, graded to match surrounding area contours, and reclaimed according to guidelines in Appendix D.

13.3 EOR FACILITY

EOR facility removal will be determined by surface owner and Denbury agreements. EOR facilities scheduled to be decommissioned on BLM surface will have infrastructure and excess

pad material removed, the ground ripped to reduce compaction, graded to match surrounding area contours, and reclaimed according to the guidelines in Appendix D.

13.4 ROADS

Road removal will be determined by surface owner and Denbury agreements. Roads scheduled to be decommissioned will have excess material removed, the ground ripped to reduce compaction, graded to match surrounding area contours, and reclaimed according to guidelines in Appendix D.

13.5 FLOWLINES

Flowlines will be decommissioned according to BLM, State of Montana, and/or landowner guidelines, as applicable. Any areas disturbed during decommissioning activities will be reclaimed according the guidelines in Appendix D.

13.6 ELECTRICAL DISTRIBUTION LINES

Electrical distribution lines will be decommissioned according to BLM, State of Montana, and/or landowner requirements, as applicable. Any areas disturbed during decommissioning activities will be reclaimed according the guidelines in Appendix D.

14.0 UNANTICIPATED DISCOVERY PLAN

Denbury prepared a separate monitoring and treatment plan for cultural resources (Appendix J) and paleontological resources (Appendix K) that details the procedures to be followed by Environmental Inspectors, construction personnel, and cultural and paleontological resource monitors in the event of cultural or paleontological resource discoveries during construction. The cultural resource plan has been submitted to the BLM as the lead federal agency for State Historic Preservation Office and other consulting party review and concurrence. Procedures outlined in the plan will be reviewed during construction contractor training.

15.0 GLOSSARY

APD	Application for Permit to Drill
ATWS	additional temporary work space
BLM	Bureau of Land Management
BMP	best management practice
CCA	Cedar Creek Anticline
CO_2	carbon dioxide
D&A	drill and abandon
Denbury	Denbury Onshore, LLC
ELOB	East Lookout Butte
EOR	Enhanced Oil Recovery
P&A	plug and abandon
POD	plan of development
ROW	right-of-way

16.0 REFERENCES

Davis, J. 2013. *History of the Cedar Creek Anticline, Southeast Montana*. Available at: www.searchanddiscovery.com/abstracts/html/2013/90169rms/abstracts/. AAPG Datapages, Inc., Search and Discovery. Accessed November 2015.

U.S. Department of Energy. 2013. *Enhanced Oil Recovery Untapped Domestic Energy Supply and Long Term Carbon Storage Solution.* Department of Energy, Office of Fossil Energy. Available at: http://energy.gov/fe/science-innovation/oil-gas/enhanced-oil-recovery. Accessed December 2015.

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APPENDIX B

Programmatic Agreement

PROGRAMMATIC AGREEMENT

AMONG

THE BUREAU OF LAND MANAGEMENT,

THE MONTANA DEPARTMENT OF NATURAL RESOURCES AND CONSERVATION, THE MONTANA STATE HISTORIC PRESERVATION OFFICE, THE ADVISORY COUNCIL ON HISTORIC PRESERVATION, DENBURY GREEN PIPELINE – MONTANA, LLC, THE CHEYENNE RIVER SIOUX TRIBE,

THE CROW TRIBE, THE CROW CREEK SIOUX TRIBE, THE FORT BELKNAP INDIAN COMMUNITY, THE FORT PECK TRIBE, THE LOWER BRULE SIOUX TRIBE, THE MANDAN, HIDATSA, AND ARIKIRA NATION, THE NORTHERN ARAPAHO NATION, THE NORTHERN CHEYENNE TRIBE, THE OGLALA SIOUX TRIBE, THE ROCKY BOY RESERVATION, THE ROSEBUD SIOUX TRIBE OF INDIANS, THE SISSETON-WAHPETON OYATE, THE SPIRIT LAKE SIOUX TRIBE, THE STANDING ROCK SIOUX TRIBE, THE TURTLE MOUNTAIN BAND OF CHIPPEWA, AND THE YANKTON SIOUX TRIBE

REGARDING

RESOLUTION OF ADVERSE EFFECTS TO HISTORIC PROPERTIES RESULTING FROM DENBURY CO_2 PIPELINE

WHEREAS, Denbury Green Pipeline - Montana, LLC (Proponent) has submitted an application for a right-of-way (ROW) grant and a temporary use permit (TUP), on federal lands to the Bureau of Land Management (BLM) in Powder River, Carter and Fallon Counties, Montana in order to construct the Denbury CO_2 Pipeline Project (Project); and

WHEREAS, the Project is an approximately 110-mile-long carbon dioxide (CO_2) gas pipeline and related operations starting from the existing Denbury Greencore CO_2 Pipeline at the Belle Creek Oil Field in Powder River County, Montana, across federal, state, and private lands ending near Baker, Montana at the Cedar Creek Anticline Oilfield; and

WHEREAS the BLM has established the Area of Potential Effect (APE) for this Undertaking as defined in 36 CFR 800.16(d) to include new cultural resource inventory, cultural resource site information, and existing inventory data. The APE encompasses the proposed pipeline ROW grant/TUP, workspaces, roads, storage and staging areas; and

WHEREAS, if the BLM approves the ROW grant/TUP, the Proponent intends to construct, operate, maintain, and decommission the Project according to general parameters contained Plan of Development (POD); and

WHEREAS, the BLM on behalf of the United States is the agent-of the final pipeline decision; and

WHEREAS, the BLM has determined that issuance of the ROW grant/TUP is an Undertaking as defined at Title 36 Code of Federal Regulations (CFR) Part 800.16(y) that triggers the requirements of Title 54 United States Code (USC) § 306108, commonly known as Section 106 of the National Historic Preservation Act (NHPA) of 1966 (54 USC § 300101 et seq., as amended), hereinafter referred to as Section 106, on affected federal and non-federal lands during the planning, construction, operation, maintenance, and decommissioning of the Undertaking; and

WHEREAS, Pursuant to 36 CFR 800.4, the BLM authorized a cultural resources contractor on behalf of the Proponent who conducted Class III cultural resource inventories of the proposed pipeline corridor, access roads and ancillary sites and BLM provided formal reports of the findings to Montana Department of Natural Resources Conservation (DNRC), the Montana State Historic Preservation Office (SHPO), and Invited Signatories to this Programmatic Agreement (PA); and

WHEREAS, the BLM has consulted with the Montana SHPO under Section VIII(D) of the Case by Case Provisions of the 2015 Protocol implementing BLM's National Programmatic Agreement for

Cultural Resources with the National Conference of State Historic Preservation Officers and the Advisory Council on Historic Preservation (ACHP); and

WHEREAS, the BLM has determined that the Undertaking may have direct, indirect, and cumulative effects on cultural resources included in or eligible for inclusion in the National Register of Historic Places (NRHP), hereinafter called historic properties; and

WHEREAS, BLM recognizes its government-to-government obligation to consult with federally recognized Native American Tribes and has consulted with several of the Invited Signatories to this PA through formal correspondences with THPOs from the 17 consulting Tribes; and a formal meeting regarding this project in Billings, Montana on November 1 and 2, 2017 with Chairman & THPOs representing the Cheyenne River Sioux Tribe, the Crow Tribe, the Crow Creek Sioux Tribe, the Fort Belknap Indian Community, the Lower Brule Sioux Tribe, the Fort Peck Tribe, the Mandan, Hidatsa, and Arikara Nation, the Northern Arapaho Nation, the Northern Cheyenne Tribe, the Oglala Sioux Tribe, the Rocky Boy Reservation, the Rosebud Sioux Tribe of Indians, the Sisseton-Wahpeton Oyate, the Spirit Lake Sioux Tribe, and the Standing Rock Sioux Tribe, the Turtle Mountain Band of Chippewa and Yankton Sioux; and

WHEREAS, Invited Signatories may include any party who assumes responsibilities under this PA; and;

WHEREAS, the following Native American tribes have participated as Invited Signatories to the PA, [list to be completed prior to final document]; and

WHEREAS, the regulations at 36 CFR Part 800.6(c)(1–3) recognize two types of Signatories to this PA: Signatories and Invited Signatories, which are referred to collectively as the Parties or the Consulting Parties. Signatories and Invited Signatories may include any party who assumes responsibilities under this Agreement. The refusal of any Invited Signatory to sign does not invalidate the PA; however, the decision not to sign shall not preclude their continued or future participation as Consulting Parties to this Undertaking; and

WHEREAS, BLM has afforded the Advisory Council on Historic Preservation (ACHP) an opportunity to comment on the Denbury CO_2 Pipeline PA and the effects to historic properties, and that the BLM has taken into account the potential for future effects to these historic properties; and

WHEREAS, BLM has afforded the United State Army Corps of Engineers (USACE) an opportunity to comment on the Denbury CO_2 Pipeline PA and the effects to historic properties, and that the BLM has taken into account the potential for future effects to these historic properties; and

WHEREAS, BLM has afforded Denbury Green Pipeline Green LLC. an opportunity to comment on the Denbury CO_2 Pipeline PA and the effects to historic properties, and that the BLM has taken into account the potential for future effects to these historic properties; and

WHEREAS, BLM has afforded the Montana DNRC an opportunity to comment on the Denbury CO_2 Pipeline PA and the effects to historic properties, and that the BLM has taken into account the potential for future effects to these historic properties; and

WHEREAS, BLM has analyzed and determined, as concurred by the Montana SHPO, that there are portions of the APE where surface disturbance and construction activities are proposed which have not had initial identification efforts related to 36 CFR 800.4(b)(2) therefore, a PA is necessary pursuant to 36 CFR 800.14(b)(1)(ii) and (v);

NOW, THEREFORE, the BLM, the Montana SHPO, Denbury Green Pipeline Montana LLC., USACE, Montana DNRC, and the ACHP agree that implementation of the stipulations will mitigate adverse effects to historic properties and allow for the completion of identification of cultural resources related to the Project.

BLM shall ensure the following stipulation are carried out:

STIPULATIONS

I. GENERAL

BLM shall require the Proponent to comply with all stipulations and other provisions in this PA**.**

A. Prior to any ground disturbance, at least ten weeks, the Proponent through their cultural resource contractor, will fully record and evaluate the unrecorded historic site in T3S., R58E., Sec. 8 SE1/4SE1/4, Sec. 9 S1/2SW1/4, and Sec. 16 N1/2NW1/4, NE1/4; in Carter County, Montana (See Appendix 2). The proponent will forward its findings to the BLM, and BLM will forward to the Montana SHPO and the Invited Signatories for comments on eligibility and effect.

B. Prior to any ground disturbance, at least ten weeks, the Proponent through their cultural resource contractor, will provide additional detailed context and evaluate the portions of 24FA0888, U.S. Highway 12 where the proposed pipeline intersects the site (See Appendix 2). The proponent will forward its findings to the BLM and BLM will forward to the Montana SHPO and the Invited Signatories for comments on eligibility and effect.

C. Prior to any ground disturbance, at least ten weeks, the Proponent through their cultural resource contractor, will inventory locations where proposed surface disturbance, workspaces and accesses within the APE were not previously covered by a cultural resource inventory. Lands that need a cultural resource inventory are identified in Appendix 1. Upon the proponent's submission of the reports, BLM will make the results of the inventory available to the, Montana SHPO, Montana DNRC and the Invited Signatories.

D. The BLM will require that a Class III inventory be conducted for any variances or amendments to the ROW grant/TUP or any other changes to the Undertaking that are outside the currently inventoried APE (including changes in construction ROW, temporary spaces, etc.). Where the BLM determines that additional inventory is needed, no ground disturbance will be authorized in the area of the variance or amendment to the ROW grant/TUP or any other changes to the Undertaking until the inventory, the determinations of eligibility, the findings of effect, and any required on-site mitigation measures are completed. The BLM will issue a notice to proceed after Section 106 requirements are fulfilled for the added area. The BLM will determine where construction may continue while the additional work is being completed.

E. If cultural resources are located in the unsurveyed areas listed in Appendix 1 they are to be fully identified, recorded, evaluated and if avoidance is not feasible, BLM and the proponent will prepare a site specific treatment plan in consultation with the Signatories and the Invited Signatories.

F. If the proponent, through their cultural resource contractor, finds or identifies undocumented sites during the construction of the project or associated activities they will follow processes outlined in the *Denbury CO2 Pipeline Treatment, Monitoring and Unanticipated Discoveries Plan* (Appendix 3) and notify the BLM and Signatories to this Agreement.

G. Information provided to BLM from any of the Invited Signatories will be protected from public disclosure to the extent consistent with the National Historic Preservation Act, Section 304, and the Archaeological Resources Protection Act, Section 9(a), cultural resources data will be treated as confidential by all Signatories and Signatory contractors.

H. If human remains are encountered in the course of the project the proponent shall follow the procedures outlined in the *Treatment, Monitoring and Unanticipated Discoveries Plan* (Appendix 3) as appropriate, and notify the BLM and Signatories to this Agreement.

I. The BLM shall ensure that all historic preservation work (inventory, recording, evaluation, monitoring and reporting) conducted pursuant to this PA is conducted by, or under the direct supervision of, persons meeting qualifications set forth in the *Secretary of the Interior's Professional Qualification Standards* (36 CFR 61) or equivalent experience and who have been permitted for such work on public lands by the BLM and all work is documented to BLM standards found in *H-8110-1 - Guidelines for Identifying Cultural Resources.*

J. The Proponent, in cooperation with the BLM and the Montana SHPO, shall ensure that all its personnel, and all the personnel of its contractors, are directed not to engage in the illegal collection of historic and prehistoric materials. The Proponent shall cooperate with the BLM to ensure compliance with the Archaeological Resources Protection Act (ARPA) of 1979 (16 USC 470) on public lands, and Montana DNRC's administrative rules (A.R.M. 36.2.801-813) that implement the Montana State Antiquities Act (Title 22, Chapter 3, Part 4).

K. If the Proponent cannot gain access to private land to allow the cultural resource contractor to conduct additional cultural resource work as per stipulations contained in this Agreement the BLM will consult further with the Signatories and Invited Signatories on resolution of effects and a path forward toward completion of the Section 106 process.

L. Signatories and Invited Signatories will have 30 days to review new reports and forms completed and submitted to the BLM. The BLM will submit this information to the Signatories and Invited Signatories subsequent its review.

II. DISPUTE RESOLUTION

A. Should any Signatory or Invited Signatory to this PA provide notice to the BLM of its objection to an action under this PA, or implementation of the measures stipulated in this PA, within 30 days of becoming aware of an action, the BLM shall consult with the Signatories and Invited Signatories to this PA to resolve the objection. If the BLM determines that the objection cannot be resolved, the BLM will forward all documentation relevant to the dispute to the ACHP, per 36 CFR Part 800.5(c)(2). The objecting party must provide reasons for, and a justification of, its objection at the time it initially submits its objection to the BLM. Within 30 days after receipt of all pertinent documentation, the ACHP shall either:

1. Provide the BLM with recommendations, which the BLM shall take into account in reaching a final decision regarding the dispute;

2. Notify the BLM that it will comment within an additional 30 days. Any ACHP comment provided in response to such a request will be taken into account, and responded to by the BLM with reference to the subject of the dispute; or

3. Notify the BLM that it will not comment, in which case the BLM may proceed with a final decision regarding the dispute. If the BLM receives no response from the ACHP within the allotted timeframe, the BLM may proceed with a final decision regarding the dispute.

B. The BLM's responsibility to carry out all actions under this PA that are not the subject of the dispute will remain unchanged.

III. AMENDMENT

A Signatory or Invited Signatory may request an amendment to this PA. The PA may be amended after a 30-day review and consultation among the Signatories and Invited Signatories. If the parties agree to the amendment, the amendment will be effective on the date signed by all Signatories and Invited Signatories.

IV. TERM of AGREEMENT

This Agreement will terminate in 10 years on December 31, 2028. If the Signatories and Invited Signatories agree, the Agreement may be extended by Amendment to a later termination date.

V. TERMINATION:

A. Any Signatory or Invited Signatory to this PA may seek termination by providing written notice to the other Signatories of their intent. After notification by the initiating party, the remaining Signatories and Invited Signatories shall have 30 business days to consult to seek agreement on amendments or any other actions that would address the issues and avoid termination.

B. In the event that this PA is terminated, the BLM shall comply with 36 CFR 800.6 (c)(8) and will take reasonable steps to avoid adverse effects on historic properties until another PA has been executed or will request, take into account, and respond to ACHP comments, in accordance with 36 CFR 800.7. The BLM will notify all parties to this agreement as to the course of action it will pursue.

SIGNATORIES:

Bureau of Land Management:

_____ _____

Eastern Montana/Dakotas District Manager Date

Montana State Historic Preservation Office:

_____ _____

State Historic Preservation Officer Date

Denbury Green Pipeline – Montana, LLC

_____ _____

Advisory Council on Historic Preservation:

_____ _____

Executive Director Date

United State Army – Corps of Engineers:

_____ _____

Montana Program Manager Date

Montana Department of Natural Resources and Conservation:

_____ _____

Director Date

INVITED SIGNATORIES:

Cheyenne River Sioux Tribe:

_____ _____

Tribal Chairman Date

Crow Tribe:

_____ _____

Tribal Chairman Date

Crow Creek Sioux Tribe:

_____ _____

Tribal Chairman Date

Fort Belknap Indian Community:

_____ _____

Tribal Chairman Date

Fort Peck Tribe:

_____ _____

Tribal Chairman Date

Lower Brule Sioux Tribe:

_____ _____

Tribal Chairman Date

Mandan, Hidatsa, and Arikara Nation:

_____ _____

Tribal Chairman Date

Northern Arapaho Nation:

_____ _____

Tribal Chairman Date

Northern Cheyenne Tribe:

_____ _____

Tribal President Date

Oglala Sioux Tribe:

_____ _____

Tribal Chairman Date

Rocky Boy Reservation:

_____ _____

Tribal Chairman Date

Rosebud Sioux Tribe of Indians:

_____ _____

Tribal President Date

Sisseton-Wahpeton Oyate:

_____ _____

Tribal Chairman Date

Spirit Lake Sioux Tribe:

_____ _____

Tribal Chairman Date

Standing Rock Sioux Tribe:

_____ _____

Tribal Chairman Date

Turtle Mountain Band of Chippewa Cree:

_____ _____

Tribal Chairman Date

Yankton Sioux Tribe:

_____ _____

Tribal Chairman Date

APPENDIX 1
LANDS REQUIRED TO BE INVENTORIED AT THE CLASS III LEVEL

The lands are located within Carter County and are described as follows:

Principal Meridian, Montana
T. 6 S., R. 57 E.,
Sec. 6: SE1/4SW1/4, SW1/4SE1/4;
Sec. 7: NW1/4NE1/4, NE1/4NW1/4, SE1/4NW1/4, SE1/4SW1/4;
Sec. 18: Lot 1, NE1/4NW1/4.

T. 1 S., R. 60 E.,
Sec. 19: NE1/4NW1/4, SW1/4NE1/4, NW1/4SE1/4, SW1/4SE1/4, SE1/4SE1/4;
Sec. 20: SW1/4SW1/4, SE1/4SW1/4.

T. 2 S., R. 59 E.,
Sec. 1: SE1/4SE1/4.

T. 2 S., R. 60 E.,
Sec. 6: NE1/4SW1/4.

T. 3 S., R. 58 E.,
Sec. 8: SE1/4SE1/4;
Sec. 9: SW1/4SW1/4;
Sec. 16: SE1/4SW1/4, NW1/4NE1/4, SW1/4NE1/4, SE1/4NE1/4, NE1/4NW1/4.

T. 7 S., R. 56 E.,
Sec. 8: NW1/4NE1/4, SW1/4NE1/4, NW1/4SE1/4;
Sec. 10: NW1/4NE1/4, NE1/4NW1/4, NW1/4SW1/4, SE1/4NW1/4, NE1/4SW1/4, NE1/4SW1/4, SW1/4SW1/4;
Sec 15: NW1/4NW1/4;
Sec. 16: NE1/4NE1/4, SE1/4NE1/4, SE1/4;
Sec. 21: NE1/4NW1/4, SW1/4NW1/4, SE1/4NE1/4, NW1/4SW1/4.

T. 8 S., R. 56 E.,
Sec. 19: Lots 3 & 4.

APPENDIX 2
CULTURAL PROPERTIES TO BE RECORDED OR EVALUATED

COUNTY	LEGAL LOCATION	SITE(S) PRESENT	ELIGIBILITY STATUS
Carter	T. 3 S., R. 58 E., Sec. 8 SESE; Sec. 9 SWSW, SESW; Sec. 16 NE, NENW;	Unrecorded Historic Site	Unknown
Fallon	T. 7 N., R. 60 E., Sec. 13 SWSE, SESE; Sec. 24 NENE, NWNE;	24FA0888	Undetermined

APPENDIX 3
Denbury CO_2 Pipeline Treatment, Monitoring and Unanticipated Discoveries Plan

APPENDIX 4
Map of Proposed Denbury CO_2 Pipeline Route

APPENDIX C

Air Quality Analysis

1.0 INTRODUCTION

This appendix provides estimates of air quality emissions and their impact on nearby and distant receptors. The emission estimates relate primarily to the proposed Cedar Creek Anticline Enhanced Oil Recovery (EOR) and CO_2 Pipeline projects. The estimates include both the on-going operation of the EOR facilities themselves (and associated wells), and the construction emissions. The estimates further include the construction, operation and maintenance of the CO_2 Pipeline project.

Unlike a typical industrial facility, air pollutant project-wide (EOR and Pipeline) emissions would occur intermittently over a large area and over a period of several years. Construction activities, which include site reclamation, would vary within and among four, two-year project phases from 2019 through 2026.

This Appendix characterizes air quality effects of those activities (on-going and temporary) by evaluating localized, and to some extent regional, air pollutant concentrations and rates of pollutant emissions that occur over various areas and time periods. The analysis includes detailed emission calculations. The methodology for the analysis is contained in the following sections. Exhibits 1 through 13 in Attachment 2 of this Appendix provide the details of the analysis and results.

2.0 EXISTING AIR QUALITY

The project area (EOR facilities, wells and pipeline) and surrounding region is generally flat, open grassland. It is sparsely populated and contains very little industrial activity. The project area encompasses multiple existing oil wells, many of which would be reworked or reactivated as part of the Proposed Action. Air quality in the region is generally rated as "good" according to the USEPA's Air Quality Index. Air Quality Index reports are included as Attachment 1 of this appendix. The index reports the two Montana counties for which data are available and that are closest to the project area.

More specifically, there are a several ambient monitoring stations operated by the Montana Department of Environmental Quality which have been established for the general purpose of measuring ambient air quality near existing and proposed oil and gas well operations. The nearest stations to the project are located in Birney, Broadus and Sidney.[1] The 2017 ambient data is summarized in the table below.

Ambient Air Quality Data: 2017[2]

Monitor Location	NO_2 (Annual Mean)[a]	O_3 (1-hr 2nd Max)[a]	O_3 (8-hr 2nd Max)[a]	$PM_{2.5}$ (98th %ile)[b]	$PM_{2.5}$ (Mean)[b]
Birney	3	70	6	11	5
Broadus	1	70	61	22	7
Sidney	*(no data)*	70	60	*(no data)*	*(no data)*
Ambient Air Quality Standards					
National	53	120	70	35	12
Montana	50	100	n/a	n/a	n/a

[a] Units = parts per billion (ppb)

[b] Units = micrograms per cubic meter ($\mu g/m^3$)

The ambient data indicates concentrations within the project area are compliant to the National and Montana ambient air quality standards. The data is typical of background ambient air quality for this region.

[1] http://deq.mt.gov/Portals/112/Air/AirMonitoring/Documents/2017%20Network%20Plan_FINAL.pdf

[2] The monitoring data was retrieved on July 25, 2018 from:
https://www.epa.gov/outdoor-air-quality-data/air-quality-statistics-report

3.0 AIR QUALITY IMPACT

The impacts to air quality that the project (EOR facilities, wells and CO_2 Pipeline) may have on nearby (near-field) and distant (far-field) locations are discussed below. The analysis is derived primarily from recent investigations applicable to this project.

3.1 Near-field.

As part of the current Miles City Field Office Approved Resource Management Plan (MCFO RMP) (BLM 2015), the BLM published an Air Resources Technical Support Document (ARTSD) (BLM 2014). The ARTSD reports methods used to evaluate ambient air quality and air-quality-related values (AQRVs) that could potentially result from activities located at and near a generic well pad similar to those contemplated by the EOR and well facilities. Three scenarios were modeled:

- Construction, with dust from surface disturbance and road traffic and exhaust from vehicles and mobile equipment.
- Drilling, with exhaust from drill rig engines and boilers and dust from road traffic.
- Well completion and fracking, with exhaust from completion engines and flaring and dust from road traffic.

For each of these scenarios, production-related activities were simultaneously modeled[3] in the ARTSD at four surrounding well pads spaced approximately 4 km away in each of four directions. Emissions sources associated with each of these nearby pads were a pumpjack engine, a glycol heater, flare operations, storage tank fugitive leaks, and traffic road dust.

The analysis was intentionally designed to model conservatively high impacts from operations representing a combination of sources from both oil and gas wells. Construction and drilling activities at well pads for the Cedar Creek Anticline (CCA) EOR facilities would be similar in type and scope. The CCA EOR facilities will emit pollutants at lower rates than those modeled in the ARTSD because proposed production wells would not include flares, glycol heaters, or storage tanks, nor would drill rigs require boilers. Nevertheless, impacts projected for the ARTSD represent an upper bound of localized impacts that could be anticipated by the CCA EOR facilities.

Modeled worst-case criteria air pollutant concentrations resulting from the above scenarios were compared to current National Ambient Air Quality Standards (NAAQS) and Montana Ambient Air Quality Standards (MAAQS). In all cases, modeled impacts were below the NAAQS and MAAQS.

[3] The EPA-approved "AERMOD" model was primarily used for this near-field analysis.
https://www.epa.gov/scram/air-quality-dispersion-modeling-preferred-and-recommended-models#aermod

Modeled worst-case HAP concentrations resulting from the above scenarios were compared to relevant acute and chronic health-based thresholds. All modeled maximum concentrations were well below the thresholds.

In addition to assessing ambient air quality impacts, the ARTSD evaluated near-field aesthetic effects from field development activities in or near a well or EOR facility site. Emissions from a theoretical drill rig were modeled to determine the degree to which an exhaust plume would be visible near a Class I or sensitive Class II area. Results were well below Federal Land Manager guideline thresholds.

Non-drilling activities related to the Proposed Action test site construction would be similar to those related to well pad construction, and the area of surface disturbance for both would be nearly the same. Consequently, ambient air quality impacts related to test site construction are expected to be similar to those modeled for well pad construction.

Denbury will be required to obtain an air quality permit from the Montana Department of Environmental Quality (MDEQ) before commencing construction on each of four planned (recycle) EOR facilities. MDEQ would determine which appropriate emissions controls would be used and that acceptable air quality impacts would result as a condition of issuing each permit.

Near-field dispersion modeling of air quality impacts associated with constructing roads, pipelines, and electrical power lines is impractical and unwarranted. Air dispersion models are generally designed to simulate steady-state emissions from stationary sources. None of the emissions sources associated with constructing these linear facilities fit the modeling input requirements particularly well. Linear facility construction activities would be widely dispersed, constantly moving, and transitory. Any potential impacts would be temporary and would likely deposit or dissipate a short distance from the project activity.

3.2 Far-field.

In addition to evaluating near-field air quality impacts associated with constructing and operating a single well site, the ARTSD reports estimated cumulative contributions to regional haze and visibility impairment from projected region-wide development activities. Modeling results demonstrated acceptable impacts at Class I and sensitive Class II areas within the BLM Miles City Field Office jurisdiction.

The BLM has recently completed a regional photochemical grid modeling study for the Montana Dakotas region. This modeling study supplements and expands on previous modeling completed to support the Miles City Resource Management Plan. The *BLM Montana Dakotas State Office Photochemical Grid Modeling (PGM) Study* (Sept. 2016)[4] analyzed potential impacts from reasonably foreseeable oil and gas development within Montana, and parts of North and South Dakota. The analysis included estimates of, primarily, criteria air pollutants from a multitude of

[4] "Bureau of Land Management Montana/Dakotas State Office PGM Modeling Study Air Resource Impact Assessment," Final report, Ramboll Environ US Corporation, Kleinfelder, Inc, #06-632912, Sept. 2016.

sources and scenarios. The emission sources included reasonably foreseeable oil and gas facilities and operations that could be the result of BLM actions within the Montana/Dakotas region over the next 20 years. The modeling effort was used to estimate ambient concentrations of criteria air pollutants and impacts to air quality-related values including visibility (regional haze) and atmospheric deposition.

The results of the PGM Study are instructive for this EA. To begin, none of the modeling (emissions and impact) scenarios yielded values in excess of any national or state ambient air quality standard (40 CFR 50) for ozone, $PM_{2.5}$, PM_{10}, SO_2, NO_2 or CO and impacts to air quality and public health are expected to be minimal in future years at the predicted rate of oil and gas development.

The modeling study also predicted impacts to air quality related values at Class I areas in eastern Montana and western North Dakota. A portion of the impacts to visibility can be attributed to Federal oil and gas development and are predicted to be in excess of the 0.5 and 1.0 dv[5] thresholds at the Theodore Roosevelt, Fort Peck and Medicine Lake Class I areas. The modeling study also predicted the potential for small impacts due to atmospheric deposition of nitrogen compounds. In response to the predicted results and concerns from federal land managers at the Class I areas, the BLM (with input from other federal and state partners) has initiated a monitoring study in the Medicine Lake, Montana area to measure key pollutants of concern over time and compare to predicted impacts. It should be noted that the modeling study analyzed potential impacts from all reasonable foreseeable oil and gas development within the region over the next 20 years. This EOR project and pipeline would represent only a small fraction of the potential development that was included in the modeling study and would be expected to have little to no impact on air quality, visibility, or atmospheric deposition. Among the reasons are:

- The nearest Class I areas (Theodore Roosevelt National Park and Medicine Lake National Wildlife Refuge) are located roughly 80 and 230 km, respectively, from the northern boundary of the pipeline. The long distance separating the project area and Class I areas, combined with small emission rates of SO_2, NOx and fine particulate from the EOR and pipeline project should result in minimal impacts.
- Mitigation strategies to be implemented will yield lower emission rates than those assumed in the model. Some of those strategies (e.g. electric powered compressor engines, Tier IV drill rig engines, vapor recovery units, etc.) are shown in Section 5.5.

For these reasons we conclude that the EOR project and associated CO_2 pipeline would not be expected to result in significant impacts to air quality or air quality related values.

[5] A deciview is a unit of measurement to quantify human perception of visibility. It is derived from the natural logarithm of atmospheric light extinction coefficient. One (1) deciview is roughly the smallest change in visibility (haze) that is barely perceptible. (40 CFR 301)

4.0 PROJECT AIR EMISSIONS - CALCULATION METHODOLOGY

The Proposed Action would create air pollutant emissions resulting from five primary categories of activities:

- on-road transport of personnel, materials, and equipment;
- surface disturbance related to construction and reclamation;
- use of nonroad mobile and portable equipment for construction and well drilling;
- operating and maintaining field assets; and,
- indirectly, processing and ultimate combustion of recovered crude oil (life cycle emissions).

On-road transport would be associated with all construction and operation activities and would produce fugitive road dust and engine combustion pollutant emissions. Surface disturbance would result from all construction activities and would produce fugitive dust due to the construction activities themselves (e.g., grading, clearing, and trenching) and from wind erosion of exposed surfaces.

Proposed Action assets can be categorized as linear or confined facilities. The Proposed Action's linear assets would comprise new access roads, new electrical power transmission and distribution lines, network pipelines (also referred to as flowlines), and the main CO_2 pipeline. Confined facilities would comprise new EOR Recycle Facilities, test facilities, and wells and well pads.

Pollutants of concern that would be emitted as a result of the Proposed Action and that are addressed in this EA are:

- "Criteria" pollutants for which state and federal ambient concentration limits apply. Criteria pollutants addressed in this report are:
  - Nitrogen dioxide (NO2), represented by all oxides of nitrogen (NOX)
  - Carbon monoxide (CO)
  - Sulfur dioxide (SO2)
  - Ozone which is represented for emission purposes as volatile organic compounds (VOC), often (over) represented by total hydrocarbons (THCs) or just hydrocarbons
  - Particulate matter less than 10 microns in diameter (PM10)
  - Particulate matter less than 2.5 microns in diameter (PM2.5)

NO_2, CO, SO_2, and VOC are products of fuel combustion and, for this Proposed Action, would result mainly from engines in on-road vehicles and nonroad mobile construction equipment. VOC emissions would also result from leakage of piping and storage systems handling crude oil.

PM_{10} is a subset of particulate matter, or dust, that has been identified as harmful to human health because it can lodge deep into the lungs and potentially enter the bloodstream. Ten microns is approximately one-fifth the diameter of a typical human hair. (A micron, or micrometer, is one one-thousandth of a millimeter.) Fine beach sand averages about 90 microns in diameter. $PM_{2.5}$ is a subset of PM_{10} and is visible only with an electron microscope. It is mainly formed in combustion reactions and in reactions between chemicals in the atmosphere.

- Hazardous Air Pollutants (HAPs)
    - Benzene
    - Ethylbenzene
    - Formaldehyde
    - Hexane
    - Toluene
    - Xylene

HAP emissions would result from engine emissions associated with on-road vehicles and nonroad mobile construction equipment.

- Greenhouse gases (GHGs)
    - Carbon Dioxide (CO_2)
    - Methane (CH_4)
    - Nitrous Oxide (N_2O)

GHG emissions are quantified in this report as carbon dioxide equivalent (CO_2e) emissions. Calculations of CO_2e emission rates combine CO_2, CH_4, and N_2O emissions into a single value considering the estimated warming effects from each pollutant.

As a matter of interest, the CO_2e values may be represented as a 20-year, 100-year or 500-year global warming potential (GWP).[6] The GWP is typically calculated and presented based on the 100-year horizon. Regardless, this EA presents CO_2e values for both the 20-year and 100-year horizon. In this case, the two numbers for the two time periods are nearly identical most of the time. Nonetheless, the analysis and data that follows include both the 20-year and 100-year values.

[6] Global warming potential (GWP) is a relative measure of how much heat a greenhouse gas traps in the atmosphere. It compares the amount of heat trapped by a certain mass of the gas in question to the amount of heat trapped by a similar mass of carbon dioxide. A GWP is calculated over a specific time interval, commonly 20, 100 or 500 years. GWP is expressed as a factor of carbon dioxide (whose GWP is standardized to 1). In the Fifth Assessment Report of the Intergovernmental Panel on Climate Change, methane has a lifetime of 12.4 years and with climate-carbon feedbacks a global warming potential of 86 over 20 years and 34 over 100 years in response to emissions.
Source: *http://www.babylon-software.com/definition/global_warming_potential/english.*

5.0 PROJECT AIR EMISSIONS: DIRECT AND INDIRECT

Several factors influence air pollutant concentration impacts. One of the primary factors is pollutant emission rates. This section estimates rates at which Proposed Action activities would emit air pollutant emissions as an indicator of potential air quality and climate impact intensity. Summaries of project criteria and HAPs emissions are included in Exhibit 13 of Attachment 2 and are categorized for the following Project Developments:

- Development 1: Phase A Construction of Linear and Confined Facilities
- Development 2: Main CO_2 Pipeline Construction
- Development 3: Post-Construction Operation and Maintenance

Development 1 summarizes the emissions associated with constructing linear facilities, such as new roads and flowlines, and of new confined facilities such as test sites and well pads. The linear and confined facilities will be constructed in four phases – Phase A, B, C, and D. Phase A accounts for the largest amount of emissions from the construction of linear and confined facilities. It was used to estimate emissions and is further described in Section 5.1. Development 2 addresses the emissions associated with constructing the main CO_2 pipeline individually. The facilities and equipment associated with Development 1 will connect to the CO_2 pipeline. Development 3 accounts for emissions associated from the operation and maintenance of the facilities and equipment constructed in Developments 1 and 2.

Emissions for Developments 1, 2, and 3 are calculated within Exhibits 1 – 13 by major project segment: construction activities; production; and crude processing, distribution, and use (i.e., life cycle). These major segments are further classified into subcategories as shown in Table E-1.

Table E-1: Emissions Categories

Major Project Segment	Subcategory 1	Subcategory 2
Construction	Dust	Road dust (On-road support and transport vehicles, access roads)
		Surface disturbance
		Wind erosion
	Exhaust	On-road support and transport vehicles
		Nonroad mobile equipment
Production	EOR facilities	EOR facility operation
	Fugitive leaks	Tanks
		Piping
	Operations and maintenance vehicle traffic	Vehicle travel within EOR area
Life cycle	Crude oil	Transport produced oil for processing and refining; distribute refined products to sales outlets; combust products as fuel

Each project segment is analyzed, when applicable, for Project Developments 1, 2, and 3 to calculate a summary of emissions. Project criteria pollutant and HAPs emission summaries are included in Exhibit 13 of Attachment 2 for each Project Development.

GHG emissions are summarized in Exhibit 12 of Attachment 2 for 20- and 100-year GWPs. The GHG totals account for direct and indirect emissions associated with project development and production. This includes GHG emissions associated with transporting CO_2 pipeline material by railcar to the project area and the life cycle emissions of crude oil produced by the EOR facilities. The life cycle emissions account for the transportation and processing of produced oil, distribution of refined products, and combustion of fuel products.

Emission calculation methods, inputs, and assumptions are further discussed in this section. Detailed calculations are presented in Attachment 2 as Exhibits 1 through 13 following the discussion.

5.1 Construction Activities

The "Plan of Development"[7] (POD) describes construction activities that would occur in both the CO_2 Pipeline and EOR Development phase. Attachment 2, Exhibit 1 summarizes construction activities by project phase (A, B, C, and D) which include the construction of linear facilities, such as new roads and flowlines, and construction of new confined (i.e., non-linear) facilities such as test sites and well pads. Of the four project phases, Project Phase A activities would disturb the greatest surface area and would include the most confined facilities and greatest length of linear facilities. This report therefore estimates potential emissions associated with Linear and Confined facilities that would result from Phase A construction activities as an upper bound. Annual construction-related emissions for the other project phases would be less.

Emissions associated with construction of the main CO_2 pipeline are calculated from the disturbed acreage from June through November 2019 as detailed in Exhibit 1.

5.1.1 Dust Emissions

5.1.1.1 Road Dust

Transport and support on-road vehicles would produce particulate emissions, or dust, from traveling on un-paved access roads within the pipeline and EOR development area. PM_{10} and $PM_{2.5}$ are two components of road dust that are also regulated air pollutants. Potential emissions of both are presented in Exhibit 4 and are estimated using emission factors calculated based on a method described in Chapter 13.2.2 of USEPA's AP-42 emission factor document (USEPA 2006). The emission factors require estimates of average surface soil silt content, average annual road moisture content, and the mean number of days with precipitation equal to or greater than 0.01 inches. Estimates for these parameters are provided in the referenced AP-42 chapter. The emission factors also require an estimate of average vehicle speed, which in this case was assumed to be 40 miles per hour for trucks and larger support vehicles traveling on unpaved access roads.

Road dust emissions estimates assume the average round trip would be 10 miles, which approximately represents the greatest straight-line distance across the area. Project design features include controlling road dust emissions using watering and chemical dust suppressant application as needed and other best practices. These are estimated to reduce dust emissions by 50 percent. Exhibit 2 summarizes data reported in the POD regarding the number of support vehicle round trips that would be required for each construction phase of each type of facility.

[7] Two PODs were prepared on behalf of Denbury Onshore, LLC dated April 2018. The PODs were developed and submitted to BLM in support of the two projects and this EA. The PODs are titled: "Cedar Creek Enhanced Oil Recovery Unit Development Project," and "Cedar Creek Anticline CO_2 Pipeline Project."

5.1.1.2 Construction Surface Disturbance

Construction activities would disturb surface soils and thereby generate fugitive dust containing PM_{10} and $PM_{2.5}$. The Western Regional Air Partnership has estimated that PM_{10} is generated from surface disturbances related to construction activities at a rate of approximately 0.11 tons per acre per month of activity (WRAP 2006). The related $PM_{2.5}$ emissions rate is estimated to be one-tenth of that value. An emissions control factor of 50 percent is applied to account for dust control practices. To estimate potential PM_{10} and $PM_{2.5}$ emissions, these factors are applied to area disturbance values shown in Exhibit 1 with the following exception.

The emission factors assume continuous activity within a defined area. Applying the factors to the reported length of a linear facility, such as a new road, would assume continuous construction along the entire length of the facility. Because activity related to linear facilities would progress in sequential segments, applying the emission factors to the whole facility would significantly overestimate emissions. To adjust for this, the linear facility total area is divided by 52, creating an effective active working area equal to the portion of the whole that would be worked on for a two-week period. Construction of the adjusted area would continue throughout the two-year project phase.

Monthly emission rates produced by the emission factors and disturbed surface area values are multiplied by 12 to estimate annual particulate matter emissions per EOR facility type and for combined Phase A construction. The CO_2 pipeline construction monthly emissions values are multiplied by the pipeline's 6-month construction period. Calculations and results are presented in Exhibit 5.

5.1.1.3 Wind Erosion

AP-42, Chapter 13.2.5 (USEPA 2006), presents a method for estimating particulate emissions that would result from wind erosion of exposed surfaces containing fine particles. An empirical equation produces emission factors for PM_{10} and $PM_{2.5}$ based on local "fastest mile" wind speeds and surface friction velocity. As shown in Exhibit 6, the wind speed value used for this evaluation is the average fastest-mile observation for the Billings, Montana, area observed between 1939 and 1987. This observation time range is the most recent available for the region, and the average value was used in the ARTSD to calculate wind erosion emissions. A surface friction value for "Scoria (roadbed material)" is provided in Table 13.2.5-2 of the AP-42 chapter.

Using empirical particle size factors, the equation produces PM_{10} and $PM_{2.5}$ emission factors in units of g/m^2/disturbance. The emissions estimation method assumes that fine particles are liberated from a surface only when wind speeds exceed a calculated threshold friction velocity and that, after an emissions event, fine material is not available until the surface is mechanically disturbed. Consistent with emissions estimates for the ARTSD, emissions estimates for this report assume only an initial disturbance. Reclamation practices that would limit surface disturbance areas and the amount of time surfaces remain exposed are included in the overall project design see the CCA EOR and CO_2 Pipeline PODs). Emissions related to construction activity surface disturbances are accounted for separately within this report.

Exhibit 6, Table 6-1 reports estimated PM_{10} and $PM_{2.5}$ emissions that would result from wind erosion of surfaces exposed by construction of EOR Recycle Facilities and of the main CO_2 pipeline.

5.1.2 Exhaust Emissions

5.1.2.1 On-Road Transport and Support Vehicle Traffic

On-road light duty diesel trucks (LDTs) and heavy-duty diesel vehicles (HDVs) would be used to transport personnel, equipment, and materials to construction sites. In addition to producing fugitive road dust as described above, these vehicles would produce air pollutant emissions from engine exhaust. Emission rates for these pollutants are estimated using pollutant- and vehicle-class-specific emission factors and project design vehicle requirements estimates.

LDT and HDV exhaust emission factors, derived from USEPA mobile source emissions data as reported in the ARTSD, are used in this evaluation. The factors are provided in units of grams of emissions per mile traveled. As noted above, an average round trip on access roads would be approximately 10 miles. Exhibit 2 summarizes LDT and HDV vehicle-miles-traveled (VMT) for each confined facility and for the main CO_2 pipeline, and shows VMT per mile of each linear facility. Exhibit 1 reports the number of confined facilities and the number of miles of each linear facility that would be constructed during Phase A.

The ARTSD does not estimate HAP emissions or provide HAP emission factors for on-road vehicle exhaust. To estimate potential HAP emissions related to the Proposed Action, a factor for each HAP of concern is developed using nonroad equipment emission factors reported in Exhibit 8. The factors are calculated by dividing the average of equipment-specific factors for each HAP by the average of equipment-specific VOC factors. These ratios are then applied to on-road vehicle VOC emission rates (reported in Exhibit 7, Tables 7-4 and 7-5) to calculate HAP emission estimates shown in Exhibit 7, Table 7.

Total greenhouse gas (GHG) emissions for Phase A and main CO_2 pipeline construction are summarized as CO_2 equivalent (CO_2e) emissions in Exhibit 7, Tables 7-4 and 7-5. CO_2e emissions combine CO_2, CH_4, and N_2O emissions by applying a pollutant-specific Global Warming Potential (GWP) factor to each and then adding the resultant products. GWPs are reported on a in the IPCC report "Climate Change 2013 The Physical Science Basis, 5th Assessment, Chapter 8, Page 714. The GWP for CO_2 is defined as equal to one. A GWP of 86 for CH_4 indicates that atmospheric CH_4 is 86 times more effective than CO_2 at trapping solar radiation as heat (20-year period). Values based on both the a 20-year and 100-year period were calculated to provide more information for this analysis.

5.1.2.2 Nonroad Construction Equipment

EOR field and main CO_2 pipeline construction would require the use of large mobile equipment such as bulldozers, cranes, and backhoes. These would emit air pollutants from engine exhaust. Exhibit 3 summarizes mobile construction equipment requirements for Phase A and main CO_2

pipeline construction activities. The exhibit also shows calculated values for total energy expended per type of equipment. These values are applied in Exhibit 9 to pollutant- and equipment-specific emission factors provided in Exhibit 8. The factors are expressed in units of mass emissions per unit of energy expended (g/hp-hr).

Emission factors derive from the USEPA Motor Vehicle Emission Simulator model MOVES2014a and are used with corresponding load factors also provided by the USEPA (USEPA 2010). Not all the equipment descriptions provided in the design documents match the equipment descriptions in the emission factors model. To match equipment with appropriate emission factors, each equipment type is assigned an index number corresponding to an equipment category included in the model output.

Exhibit 9, Tables 9-1 through 9-5 report annual criteria pollutant, HAP, and GHG emissions associated with Phase A and major CO_2 pipeline construction activities.

5.1.2.3 Rail Transport Exhaust

GHG emissions from rail transport were considered in the analysis. More specifically, emissions from locomotive exhaust were analyzed for transporting pipe used for the proposed CO_2 pipeline from the manufacturer in Houston, TX to the staging area at Gascoyne, ND, a total distance of 1,631 miles.

Emission estimates were made based on diesel combustion in locomotives. The emission factors used in the calculations are those published by "Emission Factors for Greenhouse Gas Inventories" (EPA 2018). Exhibit 7B contains the detailed calculations and results of this investigation.

5.2 Production Emissions

Air pollutant emissions sources related to oil recovery would include gas leaks from piping systems at well and test sites, various EOR Recovery Facility equipment, and vehicle traffic associated with operations and maintenance of field facilities.

5.2.1 Fugitive Leaks

Piping system joints, fittings, and functional components such as pumps would emit small amounts of CO_2, volatile organic compounds (VOCs), and hazardous air pollutants (HAPs). Well and test sites have fugitive VOC and HAP emissions associated with the piping and equipment at those locations. Exhibit 10 provides an estimation of potential VOC and HAP emissions from these sites. For CO_2, the fugitive emissions sources would be concentrated mainly at the EOR Recycle Facilities where it is separated from crude oil and returned to individual wells. Data reported to the USEPA for the Bell Creek Field EOR Recycle Facility indicate that an average of 0.93 percent of delivered CO_2 escapes into the atmosphere (Denbury 2018). The Proposed Action would transfer up to 50 million standard cubic feet per day (2,860 tons per day) of CO_2 through four

new EOR Recycle Facilities. A commensurate leakage rate would result in 9,709 tons per year of CO_2 emissions from fugitive leaks (see Exhibit 10).

GHG leakage from piping fittings and other components would be negligible. The IPCC describes CO_2 emissions from pipelines as "virtually all of the fugitive emissions from a carbon capture and storage (CCS) system will be associated with the initial CO_2 capture and compression facilities at the start of the pipeline and the injection facilities at the end of the pipeline with essentially no emissions from the pipeline itself." (IPCC 2006, page 5.10)

CO_2 has been used for enhanced oil recovery for several years. Denbury has used it in the Bell Creek oil field in Southeastern Montana since 2010 and has monitored its effectiveness in association with the Energy and Environmental Research Center at the University of North Dakota. According to a fact sheet published by the EERC, CO_2 used for EOR is recycled multiple times as oil is withdrawn from a well, and at the end of the extraction process "nearly all of the purchased CO_2 remains naturally trapped in the reservoir." (EERC 2017)

VOC and HAP emissions from new wells and test sites account for the total number of locations to be constructed for the project – accounting for 82 new wells and 17 test sites. The number of components for each well pad and test site are based on estimated component counts detailed in 40 CFR 98 Subpart W. Each test site is assumed to contain a "Header" and "Separator". Emission factors are obtained from the EPA Protocol for Equipment Emissions Estimates, EPA-453/R-95-017, 11/95. The calculations are fully detailed in Exhibit 10 of Attachment 2. VOC and HAP emissions are calculated from their percent by weight apportionment in total organic compounds (TOCs). The total VOC, total HAP, and speciated HAP stream profile weight percentages are based on the fluid-vapor analysis from fugitive emissions detailed in Montana Air Quality Permit (MAQP) #4740-03 for the Bell Creek EOR Recycle Facility. The fluid-vapor analysis is representative for the proposed project area.

5.2.2 EOR Recycle Facilities

Denbury operates an EOR Recycle Facility located at the origin of the proposed main CO_2 pipeline. Four new EOR Recycle Facilities associated with the Proposed Action would be similar in size and function and would emit similar quantities of air pollutants. The Bell Creek EOR Recycle Facility operates according to limits and conditions in Montana Air Quality Permit #4740-03 (MDEQ 2015). The analysis section of the permit reports the facility's potential air pollutant emissions as follows.

Table E-2: Denbury Bell Creek EOR Recycle Facility Air Pollutant Emissions (tons/year)

NO_x	CO	SO_2	VOC	HAPs	H_2S	PM
13.2	14.1	0.15	71.7	5.7	0.03	1.3

Each proposed new EOR Recycle Facility would require a Montana Air Quality Permit from the Montana Department of Environmental Quality (MDEQ) as a condition of construction and

operation. The permitting process would result in limits and conditions to assure protection of air quality.

5.2.3 Operations and Maintenance Vehicle Traffic

To quantify road dust and exhaust emissions that would result from vehicles traveling access roads within the EOR area, five light duty truck round trips per day and 0.5 heavy duty vehicle round trips per day are estimated for field maintenance, inspection, and operation. Exhibits 2, 4, and 7 describe emissions calculations and calculation results for post-construction access road traffic.

5.3 Crude Oil Life Cycle Emissions (Indirect Emissions)

Life cycle GHG emissions would result from transporting produced oil for processing, refining it, distributing refined products to sales outlets, and combusting the products as fuel. The Proposed Action would produce an estimated 270 million additional barrels of oil using CO_2 injection. Oil production would peak at approximately 26,000 barrels of oil-equivalent per day (BOEPD) (9.5 million barrels of oil per year), and production during Construction Phase A (in 2026) is expected to average approximately 13,600 BOEPD (5.0 million barrels of oil per year).

Life cycle GHG emissions are estimated in Exhibit 11. The estimates are based on a published study that analyzes 2014 baseline life cycle GHG emission factors for the United States and projects factors through 2040 (Cooney, et. al 2016). Derived factors are expressed as mass units of CO_2e emitted per unit of energy released by combusting each of these refined products: gasoline, diesel, and jet fuel. To use the factors, the following values are required:

- Average percentage of gasoline, diesel, and jet fuel produced from crude oil in the United States. These data were collected for 2017 by the U.S. Energy Information Administration (USEIA 2018). Gasoline, diesel, and jet fuel production accounted for over 90 percent of combustible refinery products.
- Energy density for gasoline, diesel, and jet fuel (Neutrium 2014).

A composite factor using weighted averages of the three petroleum products is applied to estimates of various oil production rates. The crude oil produced as a result of the Proposed Action is projected to result in 143 million metric tons of total life cycle CO_2e emissions. The maximum annual GHG life cycle emission rate expected during construction is 2.6 million metric tons, which includes emissions related to baseline and incremental production. Maximum annual life cycle GHG emissions for the Proposed Action would be 4.2 million metric tons of CO_2e.

5.4 Other Emissions Sources

Additional potential emissions sources often associated with oil and gas production projects are described in the following table.

Table E-3. Evaluation of Additional Potential EOR Activities

Activity	Proposed Action Status
Drill rig boilers	Drill rigs used at Proposed Action well sites will not include boilers.
Completion flaring and/or venting	The Proposed Action would not include flaring or venting. All crude oil and associated gases would be captured at the wells and piped to one of the proposed EOR Recycle Facilities for processing.
Reserve pits	No reserve pits would be associated with the Proposed Action.
Pneumatic valves at well sites	Well sites that would be constructed, reworked, or converted would not contain pneumatic gas valves.
Indirect production increases	The Proposed Action would not affect production at any well sites outside the Proposed Action scope.

5.5 Emissions Reduction Measures

The project proponent has committed to numerous environmental impact mitigation measures and monitoring. These include but are not limited to:

- Tier IV drill rig engines
- Electric motor driven compressors for the EOR facilities
- BACT for the facility sites to include Vapor Recovery Units and flares as backup
- Dust abatement during construction
- Closed loop drilling; no drilling reserve pits
- No venting during completions

Additional information regarding these and other measures are described in reclamation, mitigation, and monitoring plans included as appendices with the CCA EOR and CO_2 Pipeline PODs. Additionally, activities on federally controlled lands will be subject to applicable mitigation and monitoring requirements of the MCFO RMP (BLM 2015). The MDEQ, in coordination with the BLM, will continue to monitor air quality in the region.

5.6 Summary

Types and intensities of air pollutant emission sources related to the Proposed Action fit well within the envelope of scenarios whose air quality impacts were evaluated in the ARTSD. Those impacts were determined to be acceptable and, by extension, indicate acceptable impacts that would result from the Proposed Action.

Emission rates of criteria, hazardous, and GHG pollutants that would result from the Proposed Action have been estimated and are presented in Attachment 2 to this Appendix. Exhibits 12 and

13 summarize potential GHG and criteria air pollutant emissions that would result from the Proposed Action. Annual emission rates are estimated for activities associated with main CO_2 pipeline construction, which would occur during 2019; with construction activities associated with the most intense of the four construction phases (Phase A during 2025 through 2026); and with post-construction operations, inspections, and maintenance activities. Site reclamation is part of construction, and reclamation-related emissions are included in emissions reported for construction activities. An annual period is appropriate for evaluating air quality impacts from criteria and hazardous air pollutants because effects are generally short-lived and because air quality regulations typically address annual emission rates, helping contextualize project-related emissions.

Air quality effects associated with Proposed Action construction and with much of the post-construction activities would be mitigated because these activities would be short-lived and geographically widely dispersed. Emissions related to operating the four proposed EOR Recycle Facilities would be long-lived and stationary. Air pollutant emissions from these facilities would be limited by permit conditions imposed by the Montana Department of Environmental Quality.

Criteria and hazardous air pollutant emissions that would result from constructing the Proposed Action would not occur under the No Action alternative. Production-related emissions of these pollutants are relatively small and, with one exception, would be similar under both the No Action and Proposed Action alternatives. The exception would be emissions related to operating four EOR Recycle Facilities under the Proposed Action alternative, which would be regulated by permit.

Annual GHG emission rate values related to the No Action and Proposed Action alternatives can be compared with emissions reported by governments and industrial sources. It is also useful to evaluate life-of-project GHG emissions because potential GHG effects are cumulative and long-lasting. Exhibit 12 presents cumulative annual and life-of-project GHG emissions and compares emissions for the No Action and Proposed Action alternatives.

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Appendix C

Attachment 1

Air Quality Index Data

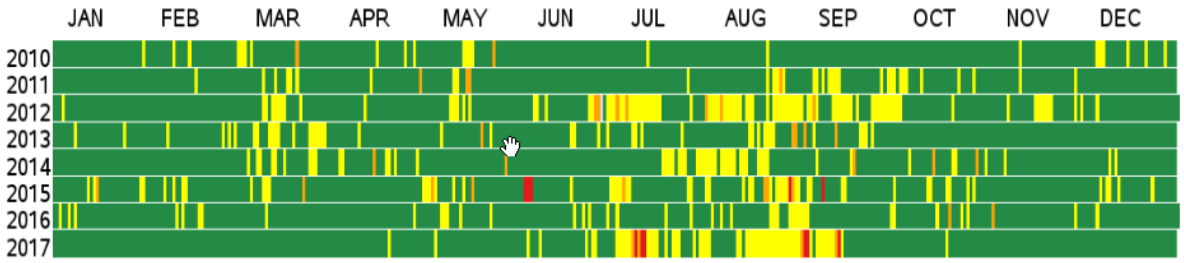
Appendix C
Attachment 1

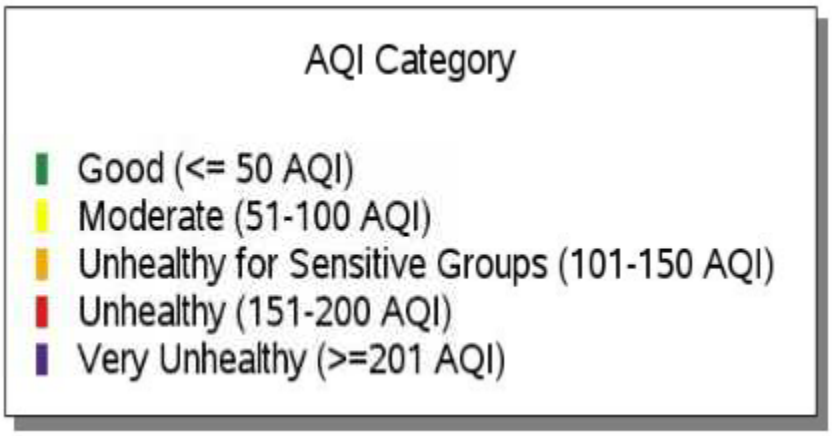
Cedar Creek Anticline CO_2 Pipeline and EOR Development Environmental Assessment
Existing Air Quality in Nearby Counties

Air Quality Index Report

Geographic Area: Rosebud County, MT
Summary: by County
Year: 2017

		Number of Days when Air Quality was...					AQI Statistics			Number of Days when AQI Pollutant was...					
County	# Days with AQI	Good	Moderate	Unhealthy for Sensitive Groups	Unhealthy	Very Unhealthy	Maximum	90th Percentile	Median	CO	NO2	O3	SO2	PM2.5	PM10
Rosebud County, MT	365	301	54	4	6	.	184	61	38	.	1	277	.	78	9



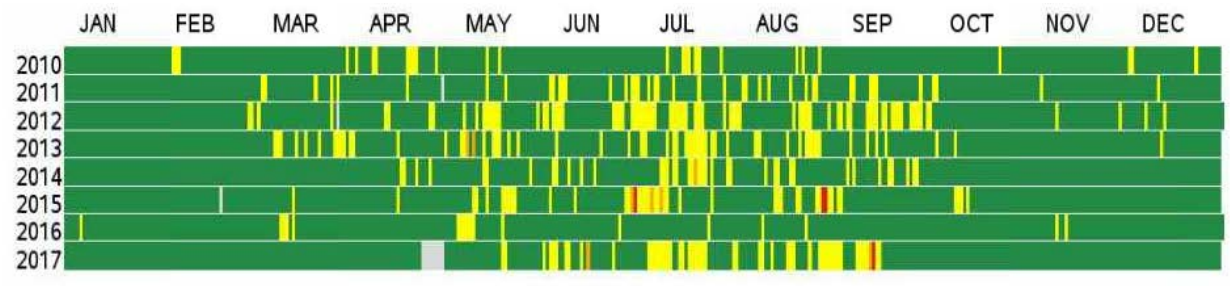


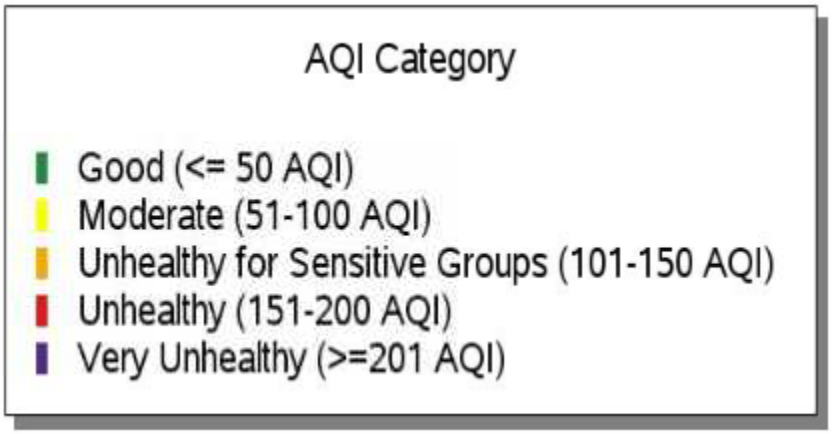
Source: U.S. EPA AirData <https://www.epa.gov/air-data>
Generated: July 13, 2018

Air Quality Index Report

Geographic Area: Richland County, MT
Summary: by County
Year: 2017

		Number of Days when Air Quality was...					AQI Statistics			Number of Days when AQI Pollutant was...					
County	# Days with AQI	Good	Moderate	Unhealthy for Sensitive Groups	Unhealthy	Very Unhealthy	Maximum	90th Percentile	Median	CO	NO2	O3	SO2	PM2.5	PM10
Richland County, MT	358	306	49	2	1	.	153	57	37	.	.	290	11	54	3





Source: U.S. EPA AirData <https://www.epa.gov/air-data>
Generated: July 13, 2018

Appendix C

Attachment 2

Emission Calculations

Exhibits 1 through 13

Appendix C, Exhibit 1
Phased Construction Data

Table 1-1. Field Development (Tertiary Recovery) Project Phase Values

Phase	A	B	C	D
Phase Years	2025-2026	2023-2024	2021-2022	2019-2020
Number of Confined Facilities				
EOR Facilities	1	1	1	1
Existing Wells	122	74	83	47
New Well Pads	45	--	22	15
Test Sites	6	4	4	3
Length of Linear Facilities (miles)				
Common 12" Pipeline--Pennel Unit	12	--	--	--
Common 12" Pipeline--Coral Creek Unit	--	14	--	--
Electrical Distribution Lines (new)	1.9	--	3.3	4.4
Flowlines, 50- and 140-foot ROW	44	23	29	16
Flowlines, 100-foot ROW	18	8.9	22	17
New Roads	1.4	0.1	0.4	1.6
Total	77	46	54	39
Disturbed Area (acres)				
Electrical Distribution Lines (new)	5.7	0.1	10	13
EOR Facilities	8.3	8.3	8.3	8.3
Flowlines	439	222	373	274
New Well Pads	42	--	46	42
New Roads	4.4	0.3	2.4	4.8
Test Sites	17	1.1	10	6.7
Total	516	232	450	349

Table 1-2. Main CO2 Pipeline Construction: June through November 2019

Feature	Disturbed Area (acres)	Length (miles)
Permanent ROW	668	110
Temporary Workspace	760	N/A
Permanent Access Roads	30	10
Temporary Access Roads	282	95
Total	1740	215

Appendix C, Exhibit 2
On-Road Vehicle Data

Constants and Conversion Factors

365 days/yr

General Project Design Values

10 miles/round trip; average distance traveled on access roads
1 round trip/day; assumed for each vehicle
5 average LDT round trips per day for maintenance and inspection (estimate)
0.5 average HDV round trips per day for maintenance and inspection (estimate)

Table 2-1. Requirements per Facility and Construction Phase -- Confined Facilities

Facility	Construction Phase	LDTs	HDVs	Duration (days)
EOR Facility	Civil	4	--	60
	Electrical	4	--	120
	Mechanical	11	--	210
	Site work	2	--	30
Existing Pad Workover	Well bore work	1	1	5
New Well Pad	New pad construction	2	--	7
	Well bore completion	1	1	5
	Well bore work (drill)	10	--	23
Test Site	Civil	3	--	14
	Electrical	2	--	30
	Mechanical	6	--	60
	Site work	2	--	7

Table 2-2. Total VMTs per Confined Facility (miles)

Facility	LDTs	HDVs
EOR Facility	30,900	--
Existing Pad Workover	50	50
New Well Pad	2,490	50
Test Site	4,760	--

Table 2-3. Requirements per Facility and Construction Phase -- Linear Facilities

Facility	LDTs	HDVs	Duration (days/mile)
Common 12" Pipeline--Pennel Unit	7	2	7
Common 12" Pipeline--Coral Creek Unit	7	2	7
Electrical Distribution	2	--	1
Flowlines, 50- and 140-foot ROW	2	1	4
Flowlines, 100-foot ROW	3	3	10
New Roads	1	--	4

Table 2-4. Total VMTs per Linear-Facility-Mile (miles/mile)

Facility	LDTs	HDVs
Common 12" Pipeline--Pennel Unit	490	140
Common 12" Pipeline--Coral Creek Unit	490	140
Electrical Distribution	25	--
Flowlines, 50- and 140-foot ROW	80	40
Flowlines, 100-foot ROW	300	300
New Roads	40	--

Table 2-5. Number of Round Trips per Activity--Main CO2 Pipeline Construction

Activity	Construction LDT	Construction HDV	Mobilization & Demobilization HDV
Backfill	480	60	4
Clearing ROW	600	240	4
Corrosion Protection	240	60	4
Operation	200	18	12
Reclaim	600	60	8
Stringing	800	500	4
Testing	240	80	4
Trenching	960	80	4
Welding, Lower	1,920	60	4
X-Ray	640	0	4
Total LDT	6,680	---	---
Total HDV		1,158	52

Table 2-6. Total VMTs--Main CO2 Pipeline Construction

LDTs	HDVs
66,800	12,100

Table 2-7. Total VMT/year--Post-Construction Inspection and Maintenance

LDTs	HDVs
18,250	1,825

Appendix C, Exhibit 3

Non-Road Equipment Data

General Project Values

10 hrs/day; nominal daily work schedule

Table 3-1. Non-Road Construction Equipment Requirements for Confined Facilities--Phase A

Facility Quantity	Facility	Construction Phase	Equipment	Horsepower	Count	Duration (days)	Hp-hrs	Index #
1	EOR Facility	Site work	Blade	261	1	30	78,300	9
1	EOR Facility	Site work	Dozer	240	1	30	72,000	5
1	EOR Facility	Civil	Drill pier truck	140	1	60	84,000	11
1	EOR Facility	Civil	Fork lift	65	1	60	39,000	17
1	EOR Facility	Electrical	Fork lift	65	2	120	156,000	17
1	EOR Facility	Mechanical	Fork lift	65	3	210	409,500	17
1	EOR Facility	Civil	Front end loader	232	1	60	139,200	25
1	EOR Facility	Mechanical	Front end loader	232	1	210	487,200	25
1	EOR Facility	Electrical	Man basket	67	2	120	160,800	13
1	EOR Facility	Mechanical	Man basket	67	3	210	422,100	13
1	EOR Facility	Site work	Scraper	240	2	30	144,000	9
1	EOR Facility	Civil	Skid steer	95	1	60	57,000	22
1	EOR Facility	Civil	Track hoe	236	1	60	141,600	8
1	EOR Facility	Mechanical	Track hoe	236	2	210	991,200	8
1	EOR Facility	Mechanical	Welding machine	35	3	210	220,500	13
122	Existing Pad Workover	Well bore work	Drill Rig	575	1	5	3,507,500	27
45	New Well Pad	New pad construction	Blade	261	1	7	822,150	9
45	New Well Pad	Well bore completion	Drill Rig	575	1	5	1,293,750	27
45	New Well Pad	New pad construction	Dozer	240	1	7	756,000	5
45	New Well Pad	Well bore work (drill)	Generator sets	50	1.5	23	776,250	21
45	New Well Pad	New pad construction	Scraper	240	2	7	1,512,000	9
6	Test Site	Site work	Blade	261	1	7	109,620	9
6	Test Site	Site work	Dozer	240	1	7	100,800	5
6	Test Site	Civil	Drill pier truck	140	1	14	117,600	11
6	Test Site	Civil	Fork lift	65	1	14	54,600	17
6	Test Site	Electrical	Fork lift	65	2	30	234,000	17
6	Test Site	Mechanical	Fork lift	65	1	60	234,000	17
6	Test Site	Civil	Front end loader	232	1	14	194,880	25
6	Test Site	Mechanical	Front end loader	232	1	60	835,200	25
6	Test Site	Electrical	Man basket	67	2	30	241,200	13
6	Test Site	Mechanical	Man basket	67	1	60	241,200	13
6	Test Site	Mechanical	Mini excavator	57	1	60	205,200	13
6	Test Site	Site work	Scraper	240	2	7	201,600	9
6	Test Site	Civil	Skid steer	95	1	14	79,800	22
6	Test Site	Civil	Track hoe	236	1	14	198,240	8
6	Test Site	Mechanical	Welding machine	35	1	60	126,000	13

Table 3-2. Non-Road Construction Equipment Requirements for Linear Facilities--Phase A

Facility-Miles	Facility	Equipment	Horsepower	Count	Duration (days/mile)	Hp-hrs/mile	Index #
12	Common 12" Pipeline	Blade	261	1	7	219,240	9
12	Common 12" Pipeline	Dozer	240	1	7	201,600	5
12	Common 12" Pipeline	Side boom	305	2	7	512,400	4
12	Common 12" Pipeline	Track hoe	236	2	7	396,480	8
12	Common 12" Pipeline	Welding machine	35	4	7	117,600	13
44	Flowlines, 50- and 140-foot ROW	Ditcher	120	1	4	208,800	25
44	Flowlines, 50- and 140-foot ROW	Dozer	240	1	4	417,600	5
44	Flowlines, 50- and 140-foot ROW	Track hoe	236	1	4	410,640	8
1.4	New road construction	Blade	261	1	4	14,616	9
1.4	New road construction	Dozer	240	1	4	13,440	5
1.4	New road construction	Roller	145	1	4	8,120	17
18	Flowlines, 100-foot ROW	Blade	261	1	10	475,020	9
18	Flowlines, 100-foot ROW	Dozer	240	1	10	436,800	5
18	Flowlines, 100-foot ROW	Side boom	305	3	10	1,665,300	4
18	Flowlines, 100-foot ROW	Track hoe	236	3	10	1,288,560	8
1.9	Electrical Distribution Line	Bucket truck	300	2	1	14,250	11
1.9	Electrical Distribution Line	Drill truck	400	1	1	9,500	11

Table 3-3. Non-Road Phase A Construction Equipment, Total Hp-Hrs per Equipment Class (Constrained and Linear Facilities)

Index#	Equipment Class		Hp-hrs
4	Cranes		2,177,700
5	Crawler Tractor/Dozers		1,998,240
8	Excavators		3,426,720
9	Graders		3,576,546
11	Off-highway Trucks		225,350
13	Other Oil Field Equipment		1,734,600
17	Rollers		1,135,220
21	Signal Boards/Light Plants		776,250
22	Skid Steer Loaders		136,800
25	Tractors/Loaders/Backhoes		1,865,280
27	Drill Rig Engine		4,801,250

Table 3-4. Non-Road Construction Equipment Requirements for Main CO2 Pipeline (Phase D)

Equipment	Horsepower	Count	Duration (days)	Hp-hrs	Index #
Air Compressor	85	2	60	102,000	13
Air Compressor/dryer	400	2	40	320,000	13
Backhoe	110	12	200	2,640,000	25
Blade	200	10	280	5,600,000	9
Blade	260	8	120	2,496,000	9
Dozer	240	20	340	16,320,000	5
Excavator	236	16	200	7,552,000	8
Excavator w/ vacculift	428	2	80	684,800	8
Farm Tractor	190	4	60	456,000	5
Generator	10	5	140	70,000	21
Generator	50	7	260	910,000	21
Paint Truck	185	2	60	222,000	11
Roller	145	2	60	174,000	17
RT Crane	185	4	160	1,184,000	4
RT forklift	65	6	200	780,000	17
Sideboom	305	10	80	2,440,000	4
Skid truck	185	4	160	1,184,000	22
Tack Rig	255	2	80	408,000	5
Trencher	420	1	30	126,000	26
Water Pump	150	2	40	120,000	13
Water Truck	185	12	280	6,216,000	11
Welding Machine	35	14	80	392,000	13
Welding Truck	300	10	80	2,400,000	11

Table 3-5. Non-Road Main CO2 Pipeline Construction Equipment, Total Hp-Hrs per Equipment Class

Index#	Equipment Class	Hp-hrs
4	Cranes	3,624,000
5	Crawler Tractor/Dozers	17,184,000
8	Excavators	8,236,800
9	Graders	8,096,000
11	Off-highway Trucks	8,838,000
13	Other Oil Field Equipment	934,000
17	Rollers	954,000
21	Signal Boards/Light Plants	980,000
22	Skid Steer Loaders	1,184,000
25	Tractors/Loaders/Backhoes	2,640,000
26	Trenchers	126,000

Appendix C, Exhibit 4
Support and Transport Vehicles Road Dust Emissions

Constants and Conversion Factors

2000 lb/ton

Emission Factor Equations and Variables (USEPA 2006)

$E = k * (s/12)^{a} * (S/30)^{d}) * (M/0.5)^{-c} * ((365 - P)/365)$

lb/VMT; size-specific emission factor (Equation 1b)[1]

k_{pm10} =	1.8	lb PM_{10} /VMT; particle-size-specific factor
$k_{PM2.5}$ =	0.18	lb $PM_{2.5}$ /VMT; particle-size-specific factor
a =	1	unitless empirical exponent
c =	0.2	unitless empirical exponent
d =	0.5	unitless empirical exponent
s =	5.1	%; assumed average silt content for access roads (USEPA 2006)[2]
S =	40	miles/hr; assumed average speed
M =	1.3	%; annual average road moisture content[3]
P =	90	days; mean number of days with precipitation ≥0.01 inches[4]

Emission Factor Results

E_{PM10} =	0.55	lb PM_{10}/VMT, emission factor for LDTs, calculated
$E_{PM2.5}$=	0.05	lb $PM_{2.5}$/VMT, emission factor for LDTs, calculated

Project Values

10	miles/round trip, average distance on unpaved access roads
2	years of construction per development phase
1	years of construction for main CO2 pipeline
50%	emissions control due to watering and other best practices

Table 4-1. Confined Facility Emission Rates, Phase A Field Construction

Facility Type	VMT / Facility	Facilities	lbs PM_{10} / year	lbs $PM_{2.5}$ / year	tons PM_{10} / year	tons $PM_{2.5}$ / year
EOR facility	30,900	1	4,247	425	2	0.2
Existing well workover	100	122	1,677	168	0.8	0.08
New well pad	2,540	45	15,709	1,571	8	1
Test site	4,760	6	3,925	393	2	0.2
Phase A construction subtotal	--	--	25,559	2,556	13	1
Main CO2 Pipeline	78,900	1	21,688	2,169	11	1

Table 4-2. Linear Facility Emission Rates, Phase A Field Construction

Facility Type	VMT / Facility-Mile	Facility-Miles	lbs PM_{10} / year	lbs $PM_{2.5}$ / year	tons PM_{10} / year	tons $PM_{2.5}$ / year
Common 12" Pipeline--Pennel Unit	630	12	1,039	104	0.52	0.05
Common 12" Pipeline--Coral Creek Unit	630	--	--	--	--	--
Electrical Distribution	25	1.9	6.53	0.65	0.00	0.00
Flowlines, 50- and 140-foot ROW	120	44	717	72	0.4	0.04
Flowlines, 100-foot ROW	600	18	1,501	150	0.8	0.08
New Roads	40	1.4	8	0.8	0.00	0.00
Phase A construction subtotal	--	--	3,272	327	2	0.2

Table 4-3. Total Road Dust Emissions, Phase A Construction

lbs PM_{10} / year	lbs $PM_{2.5}$ / year	tons PM_{10} / year	tons $PM_{2.5}$ / year
28,830	2,883	14	1

Table 4-4. Total Road Dust Emissions, Post-Construction Operation and Maintenance

VMT/yr	lbs PM_{10} / year	lbs $PM_{2.5}$ / year	tons PM_{10} / year	tons $PM_{2.5}$ / year
20,075	11,037	1,104	6	1

Notes

[1] Emission factor for vehicles traveling on publicly accessible unpaved roads dominated by light duty vehicles. Note that the "C" term is omitted as it is too small to materially affect the results.

[2] USEPA 2006, Table 13.2.2-1, Western surface coal mining, plant road.

[3] Assumes annual average road moisture content is 10th percentile of range evaluated to develop emission factors.

[4] From AP-42 Figure 13.2.2-1 (11/06).

References

USEPA. 2006. AP 42, Fifth Edition, Volume I, Section 13.2.2, Unpaved Roads, U.S. Environmental

Appendix C, Exhibit 5
Construction Activities Dust Emissions Factor

Conversion Factors

43,560 ft^2/acre
5,280 ft/mile

Emission Factors

0.11 tons PM_{10}/acre/month; construction soil handling emissions factor (WRAP 2006)
0.011 tons $PM_{2.5}$/acre/month; construction soil handling emissions factor (WRAP 2006)

Project Design Values

6 months; expected main CO2 pipeline construction period
0.02 acre/linear facility segment; area adjustment factor for linear facilities[1]
50% emissions control due to watering and other best practices

Table 5-1. Construction Activities Dust Emissions

Facility Type	Area (acres)	Adjusted Area (acres)[1]	tons PM10 / month	tons PM2.5 / month	tons PM10 / year	tons PM2.5 / year
Electrical Distribution Lines (new)	6	0.1	0.01	0.00	0.1	0.01
EOR Facilities	8	8	0.5	0.05	5	1
Flowlines	439	8	0	0.0	6	1
New Well Pads	42	42	2	0.2	28	3
New Roads	4	0.08	0.00	0.00	0.06	0.01
Test Sites	17	17	1	0.1	11	1
Total Phase A Construction	516	76	4	0	50	5
Main CO2 Pipeline	1,740	33	4	0.4	22	2

Notes

[1] The emission factors used in these calculations assume continuous activity within a defined area. Activity related to linear facilities would progress in sequential segments. The adjustment factor assumes that each segment will require two weeks of work.

References

WRAP 2006. *WRAP Fugitive Dust Handbook.* Western Governors' Association, Western Regional Air Partnership (WRAP). September 7, 2006.

Appendix C, Exhibit 6
Wind Erosion Dust Emissions Factor

Constants & Conversion Factors

1,609	m/mile
3,600	second/hr
4,047	m^2/acre
454	g/lb
2,000	lb/ton

Equations and Variables (USEPA 2006a)

$$E = k \sum_{i=1}^{N} P_i$$

g/m^2 per instance; Industrial wind erosion emission factor, Equation 2

$$P_i = 58(U^* - U_t)^2 + 25(U^* - U_t)$$

g/m^2; Wind erosion potential, Equation 3

$$U^* = 0.053(U_{10}^+)$$

m/s; Friction velocity, Equation 4 (USEPA 2006)

k_{PM10} =	0.5	PM_{10} particle size multiplier
$k_{PM2.5}$ =	0.075	$PM_{2.5}$ particle size multiplier
N =	1	number of disturbances per year[1]
U_{10}^+ =	58.3	mile/hr; fastest mile[2]
U_{10}^+ =	26.1	m/second; fastest mile (calculated)
U_t =	1.33	m/second; threshold friction velocity, roadbed material (Table 13.2.5-2)
U* =	1.38	m/second; maximum friction velocity, caclulated (Equation 4)
P_{TSP} =	1.44	g TSP/m^2/disturbance, wind erosion potential, calculated (Equation 3)

Additional Inputs and Emission Factors

1	Disturbances per year, estimated[3]
0.72	g/m^2/year; PM_{10} wind erosion potential, calculated (Equation 3)
0.11	g/m^2/year; $PM_{2.5}$ wind erosion potential, calculated (Equation 3)
6.4	lb/acre/year; PM_{10} wind erosion potential, calculated
1.0	lb/acre/year; $PM_{2.5}$ wind erosion potential, calculated

Table 6-1. Wind Erosion Emissions

Facility Type	Area (acres)	lbs PM_{10} / year	lbs $PM_{2.5}$ / year	tons PM_{10} / year	tons $PM_{2.5}$ / year
Electrical Distribution Lines (new)	6	36	5	0.02	0.00
EOR Facilities	8	53	8	0.03	0.00
Flowlines	439	2,809	421	1	0.2
New Well Pads	42	269	40	0.1	0.02
New Roads	4	28	4	0.01	0.00
Test Sites	17	108	16	0.05	0.01
Total Phase A Construction	516	3,302	495	2	0.2
Main CO2 Pipeline	1,740	11,132	1670	5.57	0.83

Notes

[1] Calculation method assumes an erosion event removes all erodible fines. Consequently, no more erosion occurs until the surface is again disturbed and additional fine material is exposed. After construction, the surface will only be disturbed once for reseeding.

[2] Average of maximum annual fastest mile observations for Billings, MT between 1939 and 1987 (NIST 2016). Fastest mile recording is no longer common and data resources are limited.

[3] Assumes area is inactive after construction ends. Particulate emissions generated during construction are accounted for elsewhere. This method corresponds to the method used to estimate wind erosion emissions from disturbed areas in the BLM Miles City Field Office Resource Management Plan (BLM 2014).

References

NIST 2016. Billings, Montana Historical Non-Directional Wind Speeds from website: *Extreme Wind Speed Data Sets: Non-Directional Wind Speeds.* National Institute of Standards and Technology (NIST). Updated October 3, 2016. Available at: http://www.itl.nist.gov/div898/winds/nondirectional.htm. Accessed March 9, 2018.

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Appendix C, Exhibit 7
Support and Transport Vehicle Exhaust Emissions

Constants & Conversion Factors

453.6	g/lb		
2,000	lb/ton		
86	20-year global warming potential, CH_4[1]	34	100-year global warming potential, CH_4[1]
268	20-year global warming potential, N_2O[1]	298	100-year global warming potential, N_2O[1]

Table 7-1. Emission Factors

Vehicle Class	NOx g/mi	PM10 g/mi	PM2.5 g/mi	SO2 g/mi	CO g/mi	VOC g/mi	CO2 g/mi	CH4 g/mi	N2O g/mi
LDT	2.31	0.11	0.09	0.01	6.25	2.75	410	0.002	0.05
HDV	2.72	0.28	0.23	0.01	1.72	0.35	792	0.04	0.04

Source: MOBILE6.2.03a as reported in MCFO RMP

General Project Values

10	miles/round trip, average distance on unpaved access roads
2	years, planned Phase A construction period
1	year, period within which main CO2 construction would be completed

Table 7-2. Confined Facility Emission Rates, Phase A Field Construction and Main CO2 Pipeline Construction

Facility Type	LDTs VMT / Facility	HDVs VMT / Facility	Facilities	NOx lb/yr	PM10 lb/yr	PM2.5 lb/yr	SO_2 lb/yr	CO lb/yr	VOC lb/yr	CO_2 lb/yr	CH_4 lb/yr	N_2O lb/yr
EOR facility	30,900	--	1	79	4	3	0.3	213	94	13,948	0.1	2
Existing well workover	50	50	122	34	3	2	0.1	54	21	8,078	0.3	0.7
New well	2,490	50	45	292	14	12	1	776	341	52,542	0	7
Test site	4,760	--	6	73	3	3	0.3	197	87	12,892	0.1	2
Confined facility Phase A construction subtotal	--	--	--	477	24	20	2	1,239	542	87,459	1	11
Main CO2 Pipeline	66,800	12,100	1	413	24	19	2	966	414	81,427	1	9

Table 7-3. Linear Facility Emission Rates, Phase A Field Construction

Facility Type	LDTs VMT / Facility-Mile	LDTs VMT / Facility-Mile	Facility-Miles	NOx lb/yr	PM10 lb/yr	PM2.5 lb/yr	SO2 lb/yr	CO lb/yr	VOC lb/yr	CO_2 lb/yr	CH_4 lb/yr	N_2O lb/yr
Common 12" Pipeline--Pennel Unit	490	140	12	20	1	1	0.1	44	18	4,120	0.1	0.4
Common 12" Pipeline--Coral Creek Unit	490	140	--	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Electrical Distribution	25	--	2	0.1	0.01	0.00	0.00	0.3	0.1	21	0.00	0.00
Flowlines, 50- and 140-foot ROW	80	40	44	14	1	1	0.1	27	11	3,089	0.1	0.3
Flowlines, 100-foot ROW	300	300	18	30	2	2	0.1	48	19	7,230	0.3	0.6
New Roads	40	--	1	0.1	0.01	0.01	0.00	0.4	0.2	25	0.00	0.00
Linear facility Phase A construction subtotal	--	--	--	65	5	4	0.3	120	49	14,487	0.4	1

Table 7-4. Total On-Road Vehicle Exhaust Emissions for Phase A Construction

Units	NOx	PM10	PM2.5	SO_2	CO	VOC	CO_2e 20	CO_2e 100
lb/year	542	29	23	2	1,359	590	105,286	105,587
tons/year	0.3	0.01	0.01	0.00	1	0.3	53	53

Table 7-5. Total On-Road Vehicle Exhaust Emissions for Main CO_2 Pipeline Construction

Units	NOx	PM10	PM2.5	SO_2	CO	VOC	CO_2e 20	CO_2e 100
lb/year	413	24	19	2	966	414	83,951	84,149
tons/year	0.2	0.01	0.01	0.00	0.5	0.2	42	42

Table 7-6. Total On-Road Vehicle Exhaust Emissions for Post-Construction Operation and Maintenance

LDTs VMT / year	HDVs VMT / year	NOx lb/yr	PM10 lb/yr	PM2.5 lb/yr	SO_2 lb/yr	CO lb/yr	VOC lb/yr	CO_2 lb/yr	CH_4 lb/yr	N_2O lb/yr	CO_2e - 20 lb/yr	CO_2e - 100 lb/yr
18,250	1,825	104	6	5	0.4	258	112	19,661	0.2	2	20,301	20,358

Table 7-7. Total Construction-Related On-Road Vehicle Exhaust HAP Emissions (lb/year)

Major Category	Benzene	EtBenz	CH_2O	Hex	Toluene	Xylene
Phase A	20	3	149	1	17	13
Main CO2 Pipeline	14	2	105	0.9	12	9
Post-Construction	4	0.6	28	0.2	3	2

Note: Based on average HAP/VOC ratios shown in **Exhibit 8.**

Notes

[1] 2013 IPCC Report, AR5, Chapter 8, Anthropogenic and Natural Radiative Forcing, P. 714

Appendix C, Exhibit 7B
Rail Transport (Pipeine Segments) Exhaust Emissions

Pipeline Material Weight (Calculated)

Value	Units and Notes
107	miles; total pipeline length (Grade X 70 Pipe)[a]
3.3	miles; total pipeline length (Grade X 65 Pipe)[a]
92.2	lb/foot; pipeline weight (Grade X 70 Pipe)[a]
119.4	lb/foot; pipeline weight (Grade X 65 Pipe)[a]
26,045	tons; Grade X 70 Pipe
1,040	tons; Grade X 65 Pipe
27,085	tons; total pipe material

Conversion Factors & Constants

453.6	g/lb
2,000	lb/ton
1,000	g/kg
1.609	km/mi

Global Warming Potentials (unitless) [(e)]

These values are used to convert CO_2, CH_4, and N_2O emissions to CO2e

100-Year		*20-Year*
1	CO_2	1
34	CH_4	86
298	N_2O	268

Train and Transport Characteristics

27,085	short tons pipeline material/train (calculated above)
125	cars/train
286,000	lb/car, loaded (BNSF n.d.)
143	tons/car, loaded; calculated
17,875	tons/train; loaded train gross weight (without locomotives); calculated
1,631	rail miles[b]
848	ton-mile/gal diesel, loaded gross weight basis[c] (BNSF 2015)
34,380	gallons of diesel/loaded train (1,631 miles); calculated
1.27	gallons of diesel per ton of pipeline material in a loaded train (1,631 miles); calculated

Estimated emissions from transporting pipline material from manufacturer to construction region via rail

Constituent	Emission Factor (kg/gallon) diesel[d]	Loaded train Emissions, complete trip (metric tons/yr)
CO_2	10.21	351
CH_4	0.00041	1.41E-02
N_2O	0.00008	2.75E-03
CO_2e - 20 Year		353
CO_2e - 100 Year		352

Notes

General: "tons" are US short tons.

(a) Pipe material specifications detailed in Table 3-3 of the Cedar Creek Anticline CO2 Pipeline Project Plan of Development.

(b) Distance from Houston, TX to Gascovne, ND via BNSF rail. http://www.bnsf.com/bnsf.was6/RailMiles/RMCentralController

(c) Indicates ability to move 848 tons of train (cargo plus train weight minus weight of locomotives) one mile with one gallon of diesel.

(d) https://www.epa.gov/sites/production/files/2018-03/documents/emission-factors_mar_2018_0.pdf

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https://www.epa.gov/sites/production/files/2018-03/documents/emission-factors_mar_2018_0.pdf

Appendix C, Exhibit 8
Nonroad Equipment Exhaust Emissions Factors

Table 8-1. Construction and Oil & Gas Equipment Criteria and GHG Emission Factors (g/hp-hr) and Load Factors[1]

Index#	Equipment Description	LF[2]	NOx	PM10	PM2.5	SO2	CO	VOC	CO_2	CH_4
1	Bore/Drill Rigs	0.43	3.323	0.166	0.161	0.003	1.087	0.264	531	0.012
2	Cement & Mortar Mixers	0.43	3.342	0.140	0.136	0.003	1.138	0.253	531	0.012
3	Concrete/Industrial Saws	0.59	3.179	0.126	0.123	0.003	0.974	0.207	589	0.017
4	Cranes	0.43	1.901	0.076	0.074	0.003	0.491	0.184	531	0.014
5	Crawler Tractor/Dozers	0.59	2.990	0.105	0.102	0.003	0.850	0.233	536	0.017
6	Crushing/Proc. Equipment	0.43	2.166	0.089	0.087	0.003	0.597	0.190	535	0.014
7	Dumpers/Tenders	0.21	4.024	0.692	0.671	0.004	4.653	0.880	693	0.028
8	Excavators	0.59	0.838	0.029	0.028	0.003	0.219	0.160	540	0.013
9	Graders	0.59	0.897	0.074	0.072	0.003	0.394	0.169	540	0.014
10	Off-Highway Tractors	0.59	2.199	0.105	0.102	0.003	0.772	0.199	536	0.015
11	Off-Highway Trucks	0.59	2.506	0.062	0.060	0.003	0.575	0.215	536	0.018
12	Other Construction Equipment	0.59	1.984	0.135	0.131	0.003	0.942	0.199	537	0.014
13	Other Oil Field Equipment	0.59	2.129	0.077	0.074	0.003	0.525	0.195	532	0.015
14	Pavers	0.59	1.630	0.113	0.110	0.003	0.828	0.179	549	0.014
15	Paving Equipment	0.59	1.629	0.146	0.142	0.003	0.994	0.205	559	0.015
16	Plate Compactors	0.43	4.533	0.350	0.339	0.004	2.391	0.520	589	0.042
17	Rollers	0.59	2.042	0.110	0.107	0.003	0.829	0.179	582	0.015
18	Rough Terrain Forklifts	0.59	2.205	0.128	0.124	0.003	0.922	0.197	537	0.014
19	Rubber Tire Loaders	0.59	2.207	0.106	0.102	0.003	0.740	0.190	544	0.014
20	Scrapers	0.59	1.499	0.093	0.090	0.003	0.910	0.168	536	0.014
21	Signal Boards/Light Plants	0.43	3.687	0.135	0.130	0.003	0.782	0.222	589	0.018
22	Skid Steer Loaders	0.21	4.098	0.733	0.711	0.004	4.994	0.950	693	0.029
23	Surfacing Equipment	0.59	4.149	0.322	0.313	0.004	2.170	0.455	587	0.039
24	Tampers/Rammers	0.43	4.495	0.396	0.384	0.004	4.454	0.654	588	0.052
25	Tractors/Loaders/Backhoes	0.21	3.063	0.366	0.355	0.004	1.824	0.530	626	0.028
26	Trenchers	0.59	2.026	0.124	0.121	0.003	0.796	0.203	536	0.014
27	Drill Rig Engine[3]	0.59	0.300	0.015	0.020	0.005	2.600	0.140	530	0.004

Table 8-2. Construction and Oil & Gas Equipment HAP Emission Factors (g/hp-hr)[1]

Index#	Equipment Description	Benzene	EtBenz	CH_2O	Hex	Toluene	Xylene
1	Bore/Drill Rigs	0.007	0.002	0.062	0.001	0.006	0.006
2	Cement & Mortar Mixers	0.007	0.002	0.059	0.001	0.006	0.006
3	Concrete/Industrial Saws	0.010	0.001	0.058	0.000	0.007	0.003
4	Cranes	0.005	0.001	0.045	0.001	0.006	0.005
5	Crawler Tractor/Dozers	0.005	0.001	0.054	0.001	0.007	0.007
6	Crushing/Proc. Equipment	0.006	0.001	0.047	0.001	0.006	0.005
7	Dumpers/Tenders	0.024	0.006	0.203	0.002	0.019	0.017
8	Excavators	0.003	0.001	0.036	0.001	0.005	0.005
9	Graders	0.004	0.001	0.040	0.001	0.005	0.005
10	Off-Highway Tractors	0.005	0.001	0.047	0.001	0.006	0.006
11	Off-highway Trucks	0.003	0.001	0.048	0.001	0.007	0.008
12	Other Construction Equipment	0.006	0.001	0.049	0.001	0.006	0.005
13	Other Oil Field Equipment	0.005	0.001	0.047	0.001	0.006	0.005
14	Pavers	0.005	0.001	0.044	0.001	0.006	0.005
15	Paving Equipment	0.006	0.001	0.050	0.001	0.006	0.005
16	Plate Compactors	0.026	0.002	0.148	0.000	0.019	0.006
17	Rollers	0.007	0.001	0.046	0.000	0.006	0.004
18	Rough Terrain Forklifts	0.006	0.001	0.048	0.001	0.006	0.005
19	Rubber Tire Loaders	0.006	0.001	0.047	0.001	0.006	0.005
20	Scrapers	0.005	0.001	0.041	0.001	0.005	0.005
21	Signal Boards/Light Plants	0.011	0.001	0.063	0.000	0.008	0.003
22	Skid Steer Loaders	0.026	0.006	0.218	0.002	0.020	0.018
23	Surfacing Equipment	0.024	0.002	0.132	0.000	0.017	0.006
24	Tampers/Rammers	0.033	0.003	0.185	0.000	0.023	0.008
25	Tractors/Loaders/Backhoes	0.018	0.003	0.131	0.001	0.015	0.010
26	Trenchers	0.006	0.001	0.049	0.001	0.006	0.005
27	Drill Rig Engine[4]	0.007	0.002	0.062	0.001	0.006	0.006
	Average	0.01	0.00	0.08	0.00	0.01	0.01
	Avg HAP/Avg VOC	3%	1%	25%	0.2%	3%	2%

Table 8-3. Pollutant Abbreviations

Atmospheric CO2	CO_2
Carbon Monoxide (CO)	CO
Ethyl Benzene	EtBenz
Formaldehyde	CH_2O
Hexane	Hex
Oxides of Nitrogen (NOx)	NOx
Primary Exhaust PM10 - Total	PM_{10}
Primary Exhaust PM2.5 - Total	$PM_{2.5}$
Sulfur Dioxide (SO2)	SO_2
Volatile Organic Compounds	VOC

Notes

[1] Emission factors are averages of all days in year 2019 for Fallon County, Montana. They are generated by USEPA model MOVES2014a, run March 22, 2018, for diesel nonroad equipment in the construction and oil field sectors. Load factors are from (EPA 2010) Tables 9 and 10.

[2] A load factor was not provided for 'Other Oil Field Equipment' category. The factor for 'Other Construction Equipment' class is assumed to be adequately representative.

[3] Source: (BLM 2014). Based on Tier 4 non-road diesel emission factors for NOx, particulate, CO, and NMHC (assumed equal to VOC) -- see 40 CFR 1039.101, Table 1. SO2 factor based on ultra low sulfur (15 ppm) fuel and diesel heating value. The highest alternative load factor is assumed.

[4] (BLM 2014) did not provide HAP emissions factors directly for this equipment type. This analysis assumes HAP factors equal those for "Bore/Drill Rig" generated by MOVES2014a.

References

EPA. 2010. Median Life, Annual Activity, and Load Factor Values for Nonroad Engine Emissions Modeling. EPA-420-R-10-016. NR-005d. Assessment and Standards Division, Office of Transportation and Air Quality, U.S. Environmental Protection Agency. July.

Appendix C, Exhibit 9
Nonroad Mobile Equipment Exhaust Emissions

Constants & Conversion Factors

453.6	g/lb		
2000	lb/ton		
86	20-year global warming potential, CH_4[1]	34	100-year global warming potential, CH_4[1]
268	20-year global warming potential, N_2O[1]	298	100-year global warming potential, N_2O[1]

Table 9-1. Potential Criteria and GHG Pollutant Emission Rates, Total and Per Equipment Class; Phase A Construction, Constrained and Linear Facilities

Index#	Equipment Class	Hp-hrs	NOx (ton/yr)	PM_{10} (ton/yr)	$PM_{2.5}$ (ton/yr)	SO_2 (ton/yr)	CO (ton/yr)	VOC (ton/yr)	CO_2 (ton/yr)	CH_4 (ton/yr)
4	Cranes	2,177,700	2	0.1	0.1	0.00	0.5	0.2	548	0.01
5	Crawler Tractor/Dozers	1,998,240	4	0.1	0.1	0.00	1	0.3	697	0.02
8	Excavators	3,426,720	2	0.1	0.1	0.01	0.5	0.4	1,204	0.03
9	Graders	3,576,546	2	0.2	0.2	0.01	0.9	0.4	1,255	0.03
11	Off-highway Trucks	225,350	0.4	0.01	0.0	0.00	0.1	0.0	79	0.00
13	Other Oil Field Equipment	1,734,600	2	0.1	0.1	0.00	0.6	0.2	601	0.02
17	Rollers	1,135,220	2	0.1	0.1	0.00	0.6	0.1	430	0.01
21	Signal Boards/Light Plants	776,250	1	0.0	0.0	0.00	0.3	0.1	217	0.01
22	Skid Steer Loaders	136,800	0.1	0.02	0.02	0.00	0.2	0.03	22	0.00
25	Tractors/Loaders/Backhoes	1,865,280	1	0.2	0.2	0.00	0.8	0.2	270	0.01
27	Drill Rig Engine	4,801,250	0.9	0.05	0.1	0.02	8	0.4	1,655	0.01
N/A	Total	N/A	17	0.9	0.8	0.03	6	2	5,321	0.1

Table 9-2. Potential Criteria and GHG Pollutant Emission Rates, Total and Per Equipment Class; Main CO2 Pipeline Construction (Phase D)

Index#	Equipment Class	Hp-hrs	NOx (ton/yr)	PM_{10} (ton/yr)	$PM_{2.5}$ (ton/yr)	SO_2 (ton/yr)	CO (ton/yr)	VOC (ton/yr)	CO_2 (ton/yr)	CH_4 (ton/yr)
4	Cranes	3,624,000	3	0.1	0.1	0.01	0.8	0.3	911	0.02
5	Crawler Tractor/Dozers	17,184,000	33	1	1	0.03	9	3	5,993	0.19
8	Excavators	8,236,800	4	0.2	0.2	0.01	1	0.9	2,894	0.07
9	Graders	8,096,000	5	0.4	0.4	0.01	2	0.9	2,841	0.07
11	Off-highway Trucks	8,838,000	14	0.4	0.3	0.02	3	1	3,082	0.10
13	Other Oil Field Equipment	934,000	1	0.0	0.0	0.00	0.3	0.1	323	0.01
17	Rollers	954,000	1	0.1	0.1	0.00	0.5	0.1	361	0.01
21	Signal Boards/Light Plants	980,000	2	0.1	0.1	0.00	0.4	0.1	274	0.01
22	Skid Steer Loaders	1,184,000	1	0.20	0.2	0.00	1	0.3	190	0.01
25	Tractors/Loaders/Backhoes	2,640,000	2	0.2	0.2	0.00	1	0.3	383	0.02
26	Trenchers	126,000	0.2	0.01	0.01	0.00	0.1	0.02	44	0.00
N/A	Total	N/A	68	3	3	0.09	21	7	17,252	0.5

Table 9-3. Potential HAP Emission Rates, Total and Per Equipment Class; Phase A Construction Equipment, Constrained and Linear Facilities

Index#	Equipment Class	Hp-hrs	Benzene (lb/yr)	EtBenz (lb/yr)	CH2O (lb/yr)	Hex (lb/yr)	Toluene (lb/yr)	Xylene (lb/yr)
4	Cranes	2,177,700	11	2	93	1	12	10
5	Crawler Tractor/Dozers	1,998,240	13	3	140	2	18	18
8	Excavators	3,426,720	13	4	163	3	22	24
9	Graders	3,576,546	17	5	184	3	25	25
11	Off-highway Trucks	225,350	1	0	14	0.3	1.9	2
13	Other Oil Field Equipment	1,734,600	11	2	105	2	14	12
17	Rollers	1,135,220	10	1	69	0.6	9	6
21	Signal Boards/Light Plants	776,250	8	0.8	47	0.04	5.9	2
22	Skid Steer Loaders	136,800	2	0.4	14	0.1	1.3	1
25	Tractors/Loaders/Backhoes	1,865,280	15	2	113	0.9	13	8
27	Drill Rig Engine	4,801,250	45	11	385	4	40	37
N/A	Total	N/A	102	22	940	14	121	109

Table 9-4. Potential HAP Emission Rates, Total and Per Equipment Class; Main CO2 Pipeline Construction Equipment (Phase D)

Index#	Equipment Class	Hp-hrs	Benzene (lb/yr)	EtBenz (lb/yr)	CH2O (lb/yr)	Hex (lb/yr)	Toluene (lb/yr)	Xylene (lb/yr)
4	Cranes	3,624,000	18	4	154	2	20	16
5	Crawler Tractor/Dozers	17,184,000	114	30	1,204	21	153	155
8	Excavators	8,236,800	32	10	391	8	53	58
9	Graders	8,096,000	39	10	416	7	56	57
11	Off-highway Trucks	8,838,000	37	15	548	13	75	90
13	Other Oil Field Equipment	934,000	6	1	57	0.8	7	7
17	Rollers	954,000	8	1	58	0.5	8	5
21	Signal Boards/Light Plants	980,000	11	0.9	59	0.05	7	3
22	Skid Steer Loaders	1,184,000	14	3	120	1	11	10
25	Tractors/Loaders/Backhoes	2,640,000	22	4	160	1	18	12
26	Trenchers	126,000	1	0.2	8	0.1	1	1
N/A	Total	N/A	301	80	3,165	54	408	413

Table 9-5. Potential GHG Emission Rates, Total and Per Major Project Component

Project Component	$CO2e^2$ 100-year (ton/year)	$CO2e^2$ 20-year (ton/year
Phase A Construction	5,371	5,374
Main CO2 Pipeline Construction	17,422	17,433

Notes

[1] 2013 IPCC Report, AR5, Chapter 8, Anthropogenic and Natural Radiative Forcing, P. 714

[2] N_2O emission factors were not generated by the MOVES2014a model run used for this analysis. CH_4 and N_2O emission factors for HDVs, as shown in Exhibit 8, are nearly equal. This analysis for non-road mobile equipment emissions assumes the same.

Appendix C, Exhibit 10
EOR Facility CO2 Leakage

Constants & Conversion Factors

28.3	liters/ft^3
365	days/yr
2000	lb/ton
8.741	ft^3/lb; CO2 density at standard conditions

Design Values

50	million standard cubic feet per day; main CO2 pipeline delivery capacity (design)
2,860	tons/day; main CO2 pipeline delivery capacity (calculated)
0.93	percent; estimated CO2 leakage rate, percent of total delivered to EOR Facility[1]

Calculated Emission Rate

9,709	tons/yr; annual CO2 leakage rate, delivery to field via EOR Facilities

Note

[1] Denbury Onshore, LLC. 2018. Bell Creek EOR Facility, Data for GHG Reports, 40 CFR 98, Subparts UU and W. Transmitted as e-mail attachment to Kevin Mathews from Rusty Shaw. February 23.

Appendix C, Exhibit 10 (Continued)
Well Pad and Test Site VOC Fugitives

Constants & Conversion Factors

2.20462	lb/kg

Design Values

8760	hr/yr; Hours of Operation
81%	by weight; VOC Weight Fraction of TOC[1]
2%	by weight; HAPs Weight Fraction of TOC[1]
82	New Project Wells; Total for all Phases
17	Test Sites; Total for all Phases[2]

Calculated Emission Rate

Number of Components at Well and Test Sites

Components	Per Well[3]	Total Wells	Per Test Site[4]	Total Test Sites	TOTAL Components
Valves	11	902	11	187	**1089**
Pump Seals	0	0	0	0	**0**
Others	0	0	0	0	**0**
Connectors	36	2952	14	238	**3190**
Flanges	0	0	22	374	**374**
Open-Ended Lines	1	82	0	0	**82**

The "other" equipment type was derived from compressors, diaphragms, drains, dump arms, hatches, instruments, meters, pressure relief valves, polished rods, relief valves, and vents. This "other" equipment type should be applied to any equipment type other than connectors, flanges, open-ended lines, pumps, or valves.

Emission Factors [5]

Component	TOC (kg/hr/source)	TOC (lb/hr/source)
Valves	4.5E-03	9.9E-03
Pump Seals	1.3E-02	2.9E-02
Others	1.4E-02	3.1E-02
Connectors	2.1E-04	4.6E-04
Flanges	3.9E-04	8.6E-04
Open-Ended Lines	2.0E-03	4.4E-03

Emissions Calculations

Component	TOCs (lbs/hr)	VOCs (lbs/hr)	VOCs (Tons/yr)	HAPs (lbs/hr)	HAPs (lbs/yr)
Valves	10.80	8.75	38.33	0.18	1576
Pump Seals	0.00	0.00	0.00	0.00	0.00
Others	0.00	0.00	0.00	0.00	0.00
Connectors	1.48	1.20	5.24	0.02	215
Flanges	0.32	0.26	1.14	0.01	47
Open-Ended Lines	0.36	0.29	1.28	0.01	53
Total Emissions	**12.96**	**10.50**	**46.0**	**0.2**	**1891**

HAPs Speciation [1]

Compound	Stream Profile (wt %)	HAPs (lbs/yr)	*HAPs (tons/yr)*
Benzene	0.0049%	6	*0.003*
Ethylbenzene	0.01%	11	*0.006*
Formaldehyde[6]	N/A	N/A	*N/A*
n-Hexane	0.92%	1045	*0.522*
Toluene	0.02%	23	*0.011*
Xylenes	0.71%	806	*0.403*

Total Well Pads and Test Sites Operational Fugitive Leak Emissions (Phases A - D)

VOCs (tons/yr) =	**46**
HAPs (lbs/yr) =	**1891**
HAPs (tons/yr) =	*0.95*

Notes:

(1) Total VOC, Total HAP, and speciated HAP weight % based on the fluid-vapor analysis from fugitive emissions detailed in Montana Air Quality Permit #4740-03 for the Bell Creek EOR Recycle Facility which is representative of the proposed project area.

(2) Assumes Test Sites contain both a Header and Separator system. Also assumes all Test Sites associated with the project are new.

(3) Well component count from Table W-1B to Subpart W of Part 98 - Default Average Component Counts for Major Onshore Natural Gas Production Equipment and Onshore Petroleum and Natural Gas Gathering and Boosting Equipment. Natural gas component count was used because it produces highest emission totals.

(4) Test Site component count sums the count for "Header" and "Separator" equipment in Table W-1C to Subpart W of Part 98 - Default Average Component Counts For Major Crude Oil Production Equipment for the Western U.S.

(5) Emission factors are from Table 2-4 of Protocol for Equipment Emissions Estimates, EPA-453/R-95-017, 11/95. Tabe 2-4 provides factors for Gas, Heavy Oil, Light Oil, and Water/Oil. The worst-case (largest) emission factor by "service type" was used for each component to ensure worst-case scenario emissions.

(6) Formaldehyde is a product of combustion and is not applicable to fugitive leak emissions.

Appendix C, Exhibit 11
Crude Oil Life Cycle Emissions
(Emissions associated with oil: well to wheels)

Conversion Factors

0.004	m^3/gal
1,000	g/kg
1,000	kg/tonne
42	gal/barrel of oil
365	days/yr
33,867	MJ/m^3, energy density for gasoline[1]
37,184	MJ/m^3, energy density for diesel[1]
38,346	MJ/m^3, energy density for jet fuel[1]

Project Design Values

270	million barrels, estimated oil recoverable from CO2 EOR
26,000	BOEPD, projected peak daily field production rate (including CO2 EOR)
9.5	million barrels/yr, estimated peak annual field production (including CO2 EOR)
13,600	BOEPD, projected daily field production rate during Phase A construction (2026)
5.0	million barrels/yr, estimated annual field production during Phase A construction (2026)

No-Action Production Values (Without CO_2 EOR)

70	years; projected maximum remaining field life
4,200	BOEPD, current gross field daily production rate
1.5	million barrels/yr, extrapolated annual oil recovery rate
107	million barrels, extrapolated total recoverable oil

2017 Average US Refinery Yields[2]

47	percent, finished motor gasoline
29	percent, distillate fuel oil (diesel)
10	percent, kerosene-type jet fuel

Emission Factors

96.2	g CO2e/MJ gasoline combusted[3]
92.0	g CO2e/MJ diesel combusted[3]
88.0	g CO2e/MJ jet fuel combusted[3]

Calculated Emission Factors

12	kg CO2e/gallon gasoline combusted (calculated)
13	kg CO2e/gallon diesel combusted (calculated)
13	kg CO2e/gallon jet fuel combusted (calculated)
12.6	kg CO2e/gallon fuel, weighted average (calculated)[4]

Calculated Emission Rates

Life-of-Field

143 MMT of CO2e; life cycle emissions attributed to Proposed Action

57 MMT of CO2e; life cycle emissions at currenct production (i.e. without Proposed Action the No Action)

200 MMT of CO2e; life cycle emissions, total from Proposed Action

Annual Rates

5.0 MMT of CO2e/yr; total peak annual life cycle emissions including CO2 EOR

2.6 MMT of CO2e/yr; life cycle emissions from oil recovered during Phase A (2026)

0.8 MMT of CO2e/yr; current nominal annual life cycle emissions (without CO2 EOR)

4.2 MMT of CO2e/yr; peak annual incremental life cycle emissions from CO2 EOR

Notes

[1] (Neutrium 2014).

[2] (EIA 2018). Average gasoline, jet fuel, and diesel production ratios for US refineries in 2017.

[3] (Cooney, et. al 2016, Table 1, page 983). Value is life cycle well-to-wheels emission factor for gasoline representing a US national average for 2014.

[4] Effective carbon intensity for crude oil based on weighted average 2016 US refinery yields for motor gasoline, diesel oil, and jet fuel.

Acronyms

BOEPD = barrels of oil-equivalent per day

MMT = million metric tons

References

Cooney, et. al. 2016. *Updating the U.S. Life Cycle GHG Petroleum Baseline to 2014 with Projections to 20140 Using Open-Source Engineering-Based Models* . Published November 22, 2016. American Chemical Society Publications. Available at: https://pubs.acs.org/doi/10.1021/acs.est.6b02819. Accessed July 4, 2018.

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Appendix C, Exhibit 12
Cumulative Project-related GHG Emissions

Constants & Conversion Factors

1.1	short ton/metric ton
2000	lb/ton

Design Values

30	years; expected economic life of field

Maximum Project Cumulative CO2e Emissions During Construction (2026), metric ton/yr

(20-Year)	*(100-Year)*	
48	48	On-road transport, Phase A construction
4,885	4,882	Nonroad equipment, Phase A construction
6,619	6,619	CO2e leakage rate from **three** operating EOR Facilities (considers construction phase of final EOR facility)
2.63E+06	2.63E+06	Life cycle emissions from oil recovered during Phase A (2026)
2.64E+06	2.64E+06	Total CO2e annual emission rate during construction

Maximum Project Cumulative CO2e Emissions During Pipeline Construction, metric ton/yr

38	38	On-road transport, Main CO2 Pipeline construction
353	352	Rail transport (pipe segments from manufacturer)
15,848	15,838	Nonroad equipment, Main CO2 Pipeline construction
1.62E+04	1.62E+04	Total CO2e annual emission rate during construction

Maximum Project Cumulative CO2e Emissions, Post-Construction, metric ton/yr

(20-Year)	*(100-Year)*	
9.2	9.3	Post-construction operations and maintenance vehicle exhaust
8,826	8,826	CO2e leakage from **four** operating EOR Facilities (full capacity)
5.02E+06	5.02E+06	Annual life cycle emissions from peak oil recovery rate
5.03E+06	5.03E+06	Total CO2e annual emission rate post-construction

No-action CO2e Emissions, metric ton/yr

(20-Year)	*(100-Year)*	
810,752	810,752	Annual life cycle emissions without CO2 EOR (at current nominal daily production)

Life-of-Field CO2e Emissions, million metric tons

(20-Year)	*(100-Year)*	
0.3	0.3	Lifetime CO2e leakage from four operating EOR Facilities
0.04	0.04	Total construction CO2e emissions
143	143	Life cycle emissions attributed to Proposed Action
57	57	Life cycle emissions at current production rates
200	200	Total CO2e emissions from Proposed Action[1]

Project Direct GHG Emissions Summary (metric tons/year)

Excludes life-cycle emissions (in-direct source)

Project Phase	CO2e (20-Year GWP)	CO2e (100-Year GWP)
Max Annual Construction Emissions	11,553	11,550
Max Annual Operational Emissions	8,835	8,835

Notes

[1] Emissions estimates do not include exhaust from vehicles required for operations, inspections, and maintenance. Those emissions would be very small compared to life cycle emissions and would be similar for both the No Action and Proposed Action scenarios.

Appendix C, Exhibit 13
Annual Criteria Pollutant Emission Totals

Table 13-1. Phase A Construction

Source Type	NOx (ton/yr)	PM10 (ton/yr)	PM2.5 (ton/yr)	SO2 (ton/yr)	CO (ton/yr)	VOC (ton/yr)	HAPs (ton/yr)
Road Dust	--	14	1	--	--	--	--
Construction Disturbance	--	50	5	--	--	--	--
Wind Erosion	--	2	0.2	--	--	--	--
On-Road Traffic Exhaust	0.3	0.01	0.01	0.00	1	0.3	0.1
Off-Road Equipment Exhaust	17	0.9	0.8	0.03	6	2	1
Total	17	67	8	0.03	6	2	1

Table 13-2. Main CO2 Pipeline

Source Type	NOx (ton/yr)	PM10 (ton/yr)	PM2.5 (ton/yr)	SO2 (ton/yr)	CO (ton/yr)	VOC (ton/yr)	HAPs (ton/yr)
Road Dust	--	13	1	--	--	--	--
Construction Disturbance	--	22	2	--	--	--	--
Wind Erosion	--	6	0.8	--	--	--	--
On-Road Traffic Exhaust	0.2	0.01	0.01	0.00	0.5	0.2	0.1
Off-Road Equipment Exhaust	68	3	3	0.1	21	7	2
Total	68	43	7	0	21	7	2

Table 13-3. Post-Construction Operation and Maintenance

Source Type	NOx (ton/yr)	PM10 (ton/yr)	PM2.5 (ton/yr)	SO2 (ton/yr)	CO (ton/yr)	VOC (ton/yr)	HAPs (ton/yr)
Road Dust	--	6	1	--	--	--	--
On-Road Traffic Exhaust	0.1	0.00	0.00	0.00	0.1	0.06	0.02
4-New EOR Recycle Facilities[(1)]	53	5	5	0.6	56	287	23
New Well Pads and Test Sites	--	--	--	--	--	46	0.95
Total	53	11	6	1	57	333	24

Notes:
(1) EOR facility emissions scaled from emissions associated with Montana Air Quality Permit #4740-03 for the Bell Creek EOR Recycle Facility. The new facilites will function and emit similar to the Bell Creek facility so emissions in Table 13-3 represent the equivalent emissions limits of (4) new EOR facilities. Emissions limits for the Bell Creek facility are as follows:

Bell Creek Emission Inventory

Source Type	NOx (ton/yr)	PM10 (ton/yr)	PM2.5 (ton/yr)	SO2 (ton/yr)	CO (ton/yr)	VOC (ton/yr)	HAPs (ton/yr)
Bell Creek EOR Facility	13.2	1.3	1.3	0.15	14.1	71.7	5.7

APPENDIX D

Cumulative GHG Analysis

1.0 INTRODUCTION

As part of evaluating the Proposed Action's emissions impacts in the region and on a broader scale, an analysis was conducted for greenhouse gas (GHG) emissions from all fossil-fuel based energy produced in the planning area. This analysis assessed potential emissions from downstream use of fossil fuels (coal, oil and natural gas) produced in the planning area.

As explained in more detail in this appendix, this analysis is based on data from the Miles City Field Office Proposed Resource Management Plan and Final Environmental Impact Statement (MCFO RMP) (BLM 2015) and an associated Air Resources Technical Support Document (ARTSD) (BLM ARTSD 2014). BLM provided further direction on coal, oil and natural gas production within the Resource Management Plan (RMP) boundaries in a memo to files dated July 27, 2018 (BLM 2018).

The following sections outline the methodology used in completing the GHG emissions inventory and summarize the results of the emissions calculations. A brief comparison of emissions from the RMP area with relevant GHG totals at local, state, national, and global scales is also provided.

2.0 GHG EMISSIONS ASSESSMENT

GHG emissions in Appendix C were calculated for the Proposed Action from five primary categories of activities: on-road transport of personnel, materials, and equipment; surface disturbance related to construction and reclamation; use of nonroad mobile and portable equipment for construction and well drilling; operating and maintaining field assets; and, indirectly, processing and ultimate combustion of recovered crude oil (life cycle emissions). This work in Appendix D expands that analysis by also considering the "downstream emissions" not related to this project, but from combustion of coal, oil and natural gas produced in the broader RMP planning area regardless of the outcome of the proposed project.

This analysis considers the following greenhouse gases (GHGs):

- Carbon Dioxide (CO_2)
- Methane (CH_4)
- Nitrous Oxide (N_2O)

GHG emissions are quantified in this report as carbon dioxide equivalent (CO_2e) emissions. Calculations of CO_2e emission rates combine CO_2, CH_4, and N_2O emissions into a single value using Global Warming Potential (GWP) factors.

The Intergovernmental Panel on Climate Change (IPCC) uses the following to describe GWP: "The Global Warming Potential (GWP) is defined as the time-integrated RF (*radiation forcing*) due to a pulse emission of a given component, relative to a pulse emission of an equal mass of CO_2" (2013 IPCC Report, AR5, Chapter 8, Anthropogenic and Natural Radiative Forcing, P. 710). GWP is calculated over a specific time; typically, 100 years. It was requested that this time period include a 20-year horizon as well. Thus, both the 100-year and 20-year values are included in this appendix as well as Appendix C.

3.0 METHODS AND PROJECTED EMISSIONS

This section estimates GHG emission rates from direct and in-direct (downstream) activities associated with use of fossil fuels produced in the RMP planning area. Emissions are addressed by fossil fuel and by activity associated with delivering that fuel to market, where appropriate, and combustion of the fuel itself. For example, coal was analyzed based on non-local transportation (train) to market. This analysis is classified into subcategories as shown below.

Fossil Fuel	Subcategory	Assumptions
Coal	Offsite Transport	Coal produced from 2 of the mines is utilized by coal-fired generating facilities within the planning area. Coal produced from 2 other mines within the planning area is assumed to be transported an estimated 1500 miles and combusted at electric generating units outside of the planning area.
	Combustion	Coal is combusted in a coal-fired generating facility. Based on EPA emissions factor for sub-bituminous coal.
Crude Oil	Well to wheels emissions	Based on emission factor for "well to wheels" emissions from production, refining, and use of products derived from crude oil.
Natural Gas (including coal bed natural gas)	Combustion	Based on EPA emission factor for combustion of natural gas.

Emission calculation methods, inputs, and assumptions are discussed in this section. Detailed calculations are presented as Exhibits 1 – 5. Exhibit 2 includes direct GHG emissions for activities in the planning area (as calculated in Alternative E of the MCFO ARMP). It utilizes regional CO_2, CH_4, and N_2O emissions provided in Alternative E of the MCFO RMP but also applies 20 year GWPs to CH_4 and N_2O emissions. This results in larger CO_2e totals than calculated by the MCFO RMP. Exhibits 3 – 5 calculate in-direct emissions resulting from the activities of Alternative E.

3.1 Coal

This analysis estimates potential GHG emissions that would result from transport and combustion of coal produced within the MCFO RMP planning area.

3.1.1 Transport Emissions

Coal produced in the region is primarily used for generating electricity in coal-fired generating units. Coal production from four active mines was assumed in this analysis. Two of the coal mines, Rosebud and Savage, serve local facilities and it was assumed that coal produced at these mines would be transported less than 50 miles from production to point of consumption and transport emissions would be minimal. For the other two mines in the planning area, Spring Creek and Decker, it was assumed that 100% of the coal produced at these mines is consumed outside of the planning area. A coal haul distance of 1,500 miles by rail is assumed as an upper bound. GHG emissions are calculated for both a loaded train trip, and an empty return trip. Calculations and assumptions for transport via locomotive are shown in Exhibit 3.

An average fuel efficiency of 848 ton-mile/gallon of diesel was used (BNSF 2015). Emissions factors from EPA's Emissions Factors for Greenhouse Gas Inventories (https://www.epa.gov-/sites/production/files/2018-03/documents/emission-factors_mar_2018_0.pdf) were then used to calculate CO_2, CH_4, and N_2O emissions for loaded and empty train trips for coal produced at the Decker and Spring Creek mines. GWP factors were used to convert to CO_2e. Production from these two mines was assumed to be 95% of their permitted values (as included in the associated air permits for each mine) to account for estimated coal mining production in 2020 and applied in determining total annual GHG emissions from transportation of coal.

3.1.2 Combustion Emissions

All coal produced in the region is assumed to be combusted in a coal-fired generating facility. The total coal combusted was assumed to be 56,227,555 tons per year which was used in emissions calculated for the "Future Coal Mining Emission Estimates" found in the ARTSD (p. A-79) and is consistent with future coal production activities described in the MCFO RMP. EPA emission factors were used to calculate CO_2, CH_4, and N_2O from coal combustion and appropriate GWP factors were utilized to calculate CO_2e (EPA, 2018).

Exhibits 1 and 3 present annual GHG emissions associated with coal transport and combustion from the planning area.

3.2 Crude Oil

Future crude oil production within the planning area was assumed to be 3,044,100 barrels per year as described in the MCFO RMP under Alternative E and used in the ARTSD for Alternative E. Like the approach in Appendix D, Exhibit 4, an emissions factor accounting for "well to wheels" emissions from crude oil production, refining and combustion was applied to the crude oil production numbers to calculate CO_2, CH_4, and N_2O emissions from petroleum products combustion. Applicable GWP factors were then utilized to calculate CO_2e. It was assumed that 100% of future oil production would be used for combustion as gasoline, diesel, and jet fuel within the United States.

Exhibits 1 and 4 display annual GHG emissions associated with crude oil produced within the planning area.

3.3 Natural Gas

Future production of natural gas in the planning area was assumed to be 5,110,000 MCF/year for conventional natural gas and 7,982,550 MCF/year for coal bed natural gas as described under Alternative E in the MCFO RMP and was used for emissions calculations in the ARTSD, p. E-31 and E-56. The combination of the two types of wells presents a maximum annual production per Alternative E. EPA emissions factors for natural gas combustion are applied to calculate CO_2, CH_4, and N_2O emissions from natural gas combustion and converted to CO_2e with applicable 100-yr and 20-yr GWP potentials. It was assumed that 100% of future natural gas production would be used for energy/heat production within the U.S.

Exhibits 1 and 5 present annual GHG emissions associated with natural gas production and combustion from the planning area.

4.0 SUMMARY

The purpose of this analysis was to assess total GHG emissions from energy produced within the BLM planning area. This was accomplished by combining the calculated "downstream" emissions from coal, oil and natural gas not originally analyzed in the FEIS. (BLM 2014). The underlying production numbers for those resources were retrieved from the FEIS (BLM 2014) and confirmed with the 2018 memo (BLM 2018).

Table 4-1 contains the summary emissions. It should be noted that the table includes 'projected' emissions per the Resource Management Plan (RMP) Revision and Final Environmental Impact Statement (FEIS) (BLM 2014) as well as the additional emissions from non-RMP and non-project related energy production and use.

Table 4-1: Summary of Estimated Emissions

Emissions Reference	GHG Emissions				
	CO_2 (Million Metric Tons/year)	CH_4 (Metric Tons/Year)	N_2O (Metric Tons/Year)	CO_2e 100-Year[a] (Million Metric Tons/Year)	CO_2e 20-Year[b] (Million Metric Tons/Year)
Miles City Field Office RMP: Chapter 4 (Alternative E) Mineral Resource Production Subtotal: Oil, Natural Gas, Coal Bed Natural Gas, Coal Mining	0.20	491	2	0.20	0.22
Downstream Coal Rail Transport (not project related)	0.92	37	7	0.93	0.93
Downstream Coal Combustion (not project related)	94.24	10,683	1,574	95.07	95.58
Downstream Crude Oil Wells-to-Wheels (not project related)	--	--	--	1.61	1.61
Downstream Natural Gas Combustion (not project related)	0.71	13	1	0.71	0.71
TOTAL Emissions =				98.52	99.05

Notes:

[a] CO2e emissions based on 100-year Global Warming Potential (GWP) for CO_2, CH_4, and N_2O.

[b] CO2e emissions based on 20-year Global Warming Potential (GWP) for CO_2, CH_4, and N_2O.

For context, these values can be compared with local, state, national, and global totals reported by EPA and IPCC in Table 4-2. One source of GHG emissions data for comparison are for large industrial sources that report to EPA annually as part of EPA's Greenhouse Gas Reporting Program (GHGRP). These data are available through EPA's GHGRP Flight Tool (EPA 2018b) at both county and statewide levels. Fallon County has one facility reporting, a compressor station, for total 2016 emissions of 22,877 Metric Tons of CO_2e. Montana GHG emissions from large industries reporting in 2016 totaled 21.1 million Metric Tons of CO_2e.

Project related direct GHG emissions during construction are approximately 50% of the Fallon County 2016 GHG emissions reported for an operating compressor station.. Once the facility goes into full operation, project direct GHG emissions are approximately 40% of the 2016 reported GHG emissions in the county.

For additional perspective, direct and indirect project emissions can be compared with GHG emissions reported on EPA's GHG Equivalencies webpage[1] as follows:

- GHG emissions during construction are approximately equivalent to those generated by 1200 homes or 2500 passenger vehicles.
- GHG emissions post construction are approximately equivalent to those generated by 1000 homes or 1900 passenger vehicles.
- Calculated life cycle (well to wheels) GHG emissions from the project (5 Million Metric Tons of CO_2e/year) are approximately equivalent to GHG emissions from 540,000 homes or 1.1 million vehicles.

Regional mineral resource production GHG emissions in Table 4-1 can be compared with Montana GHGRP 2016 totals for large industrial sources in Table 4-2; they are about 1.2% of those statewide emissions. Cumulative GHG emissions for mineral resources (coal, oil, and gas) produced within the RMP planning area, including emissions not related to the EOR/Pipeline project and "downstream" emissions, are approximately 1% of US total, and approximately 0.2% of global anthropogenic GHG emissions.

[1] EPA's Greenhouse Gases Equivalencies Calculator – Calculations and References, reports passenger vehicles at 4.67 Metric Tons CO_2e/year and homes at 9.26 Metric Tons CO_2e/year (EPA 2018c).

Table 4-2: Local, National, Global Greenhouse Gas Emissions Totals (Million Metric Tons CO2e per Year)

EPA GHGRP Montana Emissions[2]		US GHG Emissions[3]	Global GHG Emissions[4]
Fallon County	Statewide	National	Global
0.0	21.1	6,511	54,000

[2] EPA's Greenhouse Gas Reporting Program – Flight Tool, 2016 Greenhouse Gas Emissions from Large Facilities, reported for all of Montana, and Fallon County (22,877 Metric Tons CO_2e) (EPA 2018b).

[3] In 2016, approximately 6,511 Mt-CO_2e were emitted in the US (EPA 2018a).

[4] Global anthropogenic GHG emissions totaled approximately 54,000 Mt of CO_2e (Mt-CO_2e) in 2010 (IPCC 2014).

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Appendix D, Exhibit 1

Cumulative Emissions from Regional Industrial Sources
Downstream Processing and Combustion Emisions

Emissions Summary

Emissions Reference	GHG Emissions				
	CO_2 (Million Metric Tons/year)	CH_4 (Metric Tons/Year)	N_2O (Metric Tons/Year)	CO_2e 100-Year[a] (Million Metric Tons/Year)	CO_2e 20-Year[b] (Million Metric Tons/Year)
Miles City Field Office RMP: Chapter 4 (Alternative E) Mineral Resource Production Subtotal: Oil, Natural Gas, Coal Bed Natural Gas, Coal Mining	0.20	491	2	0.20	0.22
Downstream Coal Rail Transport (not project related)	0.92	37	7	0.93	0.93
Downstream Coal Combustion (not project related)	94.24	10,683	1,574	95.07	95.58
Downstream Crude Oil Wells-to-Wheels (not project related)	--	--	--	1.61	1.61
Downstream Natural Gas Combustion (not project related)	0.71	13	1	0.71	0.71
TOTAL Emissions =				98.52	99.05

Notes:

[a] CO2e emissions based on 100-year Global Warming Potential (GWP) for CO_2, CH_4, and N_2O.

[b] CO2e emissions based on 20-year Global Warming Potential (GWP) for CO_2, CH_4, and N_2O.

GWP Factors

100-Year	*20-Year*
$CO_2 = 1$	$CO_2 = 1$
$CH_4 = 34$	$CH_4 = 86$
$N_2O = 298$	$N_2O = 268$

Source: "2013 Climate Change The Physical Science Basis," IPCC, 5th Assessment, Chapter 8, Page 714.

Appendix D, Exhibit 2
Miles City Field Office Resource Management Plan Data
Regional Projected GHG Emissions

Global Warming Potentials (unitless) [a]

These values are used to convert CO_2, CH_4, and N_2O emissions to CO2e

100-Year		*20-Year*
1	CO_2	1
34	CH_4	86
298	N_2O	268

20-Year and 100-Year GHG Emissions for MCFO RMP Area Emissions

Field Office RMP under Alternative E. Calculated CO2e emission totals also utilize larger GWP values for the 20-year column than calcuated in MCFO RMP Alternative E. As a result, table calculated CO2e emissions represent an overestimation of Alternative E CO2e totals.

Resource or Resource Use	Emissions (Tons per Year)					Emissions (mtpy)	
	CO_2	CH_4	N_2O	CO_2e 100-Year (Calculated)	CO_2e 20-Year (Calculated)	CO_2e 100-Year (Calculated)	CO_2e 20-Year (Calculated)
Oil and Gas Development and Production							
Oil	60,573	296	1	70,935	86,297	64,351	78,287
Natural Gas	19,118	85	-	22,008	26,428	19,965	23,975
Coal bed Natural Gas	18,726	109	-	22,432	28,100	20,350	25,492
Coal Mining	104,684	1	1	105,016	105,038	95,269	95,289
Vegetation Management	34	-	-	34	34	31	31
Fire Management[b]	289,046	121	24	300,312	305,884	272,439	277,494
Forestry and Woodland Products	524	-	-	524	524	475	475
Livestock Grazing	1,382	2,656	-	91,686	229,798	83,176	208,469
Recreation – Trails and Travel Management	78	-	-	78	78	71	71
General Purpose BLM Fleet Travel	304	-	-	304	304	276	276
Road Maintenance	147	-	-	147	147	133	133
Total Emissions[c]	**494,616**	**3,267**	**26**	**613,442**	**782,546**	**556,506**	**709,915**

Mineral Resource Use Subtotal Under Alternaitve E

Resource or Resource Use	Emission (Tons per Year)					Emissions (mtpy)	
	CO_2	CH_4	N_2O	CO_2e 100-Year (Calculated)	CO_2e 20-Year (Calculated)	CO_2e 100-Year (Calculated)	CO_2e 20-Year (Calculated)
SUBTOTAL: Oil, Natural Gas, Coal Bed Natural Gas, Coal Mining	203,101	491	2	**220,391**	**245,863**	**199,936**	**223,043**

Notes:

(a) CO2e emissions based on 20-year and 100-year Global Warming Potential (GWP) for CO_2, CH_4, and N_2O.
https://www.epa.gov/sites/production/files/2018-03/documents/emission-factors_mar_2018_0.pdf

(b) Excludes smoke emissions from wildfires, but includes smoke emissions from prescribed fires. Estimates of wildfire emissions are included in the Air Resource Technical Support Document.

(c) CO2e emission totals utilize larger GWP values than calculated in MCFO RMP Alternative E. As a result, these emissions represent an overestimation of Alternative E.

References:

BLM. 2015. Miles City Field Office (MCFO) Resource Management Plan (RMP) and Final Environmental Impact Statement (EIS). Chapter 4: Environmental Consequences, Table 4-16 BLM Source Greenhouse Gas Emissions Under Alternative D.

Appendix D, Exhibit 3
Locomotive Air Pollution Emissions
Coal Rail Transport from Mine to Destination

NOTE: Values used to calculate emissions are identified by unique letters (i.e., "Value ID"). The source of values are either referenced or are calculated using the formulas provided, with inputs identified by Value ID.

Coal Production Values

Value	Units and Notes
56,227,555	tons/year[a]; Total MCFO RMP Estimated Coal Production
38,000,000	tons/year; Total MCFO RMP Coal Production to be transported 1,000 miles (16 Mtons from Decker + 24 Mtons via Spring Creek both @ 95%. See M Hovey 7/28/18 memo to files)
38	Mton/year; Total MCFO RMP Estimated Coal Production to be Transported out of Region

Conversion Factors & Constants

1,000	kg/tonne
2,000	lb/ton
1,000	g/kg

Train and Transport Characteristics

15,250	short tons coal/train
125	cars/train
286,000	lb/car, loaded (BNSF n.d.)
143	tons/car, loaded; calculated
17,875	tons of coal/train; loaded train gross weight (without locomotives); calculated
2,625	tons/train; empty train gross weight (without locomotives); calculated
1,500	mi/one-way trip[b]
3000	mi/round trip
848	ton-mile/gal diesel, loaded gross weight basis[c] (BNSF 2015)
2,492	trains/year to haul total production; calculated
31,619	gallons of diesel/loaded train (1,500 miles); calculated
4,643	gallons of diesel/empty train (1,500 miles): calculated
2.07	gallons of diesel per ton of coal in a loaded (1,500 mile) train; calculated

Global Warming Potentials (unitless) [d]

These values are used to convert CO_2, CH_4, and N_2O emissions to CO2e

100-Year		20-Year
1	CO_2	1
34	CH_4	86
298	N_2O	268

Estimated emissions from transporting 38 Mt coal from mine to destination via rail

Constituent	Emission Factor (kg/gallon) diesel	One-way, Loaded train Emissions (metric tons/yr)	One-way, Empty train Emissions (metric tons/yr)	Total Round-trip Emissions (metric tons/yr)
CO_2	10.21	804,416	118,131	922,548
CH_4	0.00041	32	5	37
N_2O	0.00008	6	1	7
CO_2e - 20 Year		808,884	118,787	927,671
CO_2e - 100 Year		807,393	118,568	925,961

Notes

General: "tons" are US short tons.

(a) Annual production represents year 2020 high scenario Powder River Basin projections and RFD guidance relative to existing permitted production limits. Provided by BLM Miles City Field Office (MCFO) Resource Management Plan (RMP) and Final Environmental Inpact Statement (EIS) Air Resource Technical Support Document (2014) and M. Hovey Memo to file of 7/27/18.

(b) Upper bound rail transport distance for coal produced in MCFO region (Spring Creek mine to Houston, TX = 1,548 miles). The upper bound distance overestimates total emissions associated with rail transport since total MCFO regional coal production will be transported to closer destinations along with apportioned transport to Houston. However, the overprediction also accounts for rail transport emissions from short-haul mine mouth facilities in the MCFO region whose coal transport throughput was not directly included in the transport analysis.

(c) Indicates ability to move 848 tons of train (cargo plus train weight minus weight of locomotives) one mile with one gallon of diesel.

(d) https://www.epa.gov/sites/production/files/2018-03/documents/emission-factors_mar_2018_0.pdf

References

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(Continued)

Appendix D, Exhibit 3

Coal Combustion Air Pollution Emissions

General Power Generation from MCFO Regional Coal Production

Coal Production Values

Value	Units and Notes
56,227,555	tons/year[a]
56.2	Mton/year

Conversion Factors

1,000	kg/tonne

Typical Subituminous Coal Characteristics

8,628	Btu/lb coal, as-received basis (AP-42, Table 11.9-6 Mine III)

GREENHOUSE GAS EMISSIONS CALCULATIONS

Conversion Factors

453.6	g/lb

Global Warming Potentials (unitless) [b]

These values are used to convert CO_2, CH_4, and N_2O emissions to CO2e

100-Year		20-Year
1	CO_2	1
34	CH_4	86
298	N_2O	268

GHG Emission Factors[c]

1,676	=	kg CO_2/ton (sub-bituminous)
0.19	=	kg CH_4/ton (sub-bituminous)
0.028	=	kg N_2O/ton (sub-bituminous)

Estimated TOTAL Emissions from Combusting 56.2 MMt of Coal Produced by BLM MCFO Regional Mines.

	CO_2	CH_4	N_2O	CO2e : 100 yr	CO2e : 20 yr
Emissions: Metric tons/year	9.42E+07	10,683	1,574	9.51E+07	9.56E+07

Notes

General: "tons" are US short tons.

(a) Annual production represents year 2020 high scenario Powder River Basin projections and RFD guidance relative to existing permitted production limits. Provided by BLM Miles City Field Office (MCFO) Resource Management Plan (RMP) and Final Environmental Inpact Statement (EIS) Air Resource Technical Support Document (2014). Confirmed via 7/27/18 Memo to File.

(b) https://www.epa.gov/sites/production/files/2018-03/documents/emission-factors_mar_2018_0.pdf

(c) GHG emission factors obtained from EPA Center for Corporate Climate Leadership Emission Factors for Greenhouse Gas Inventories. https://www.epa.gov/sites/production/files/2018-03/documents/emission-factors_mar_2018_0.pdf

Appendix D, Exhibit 4
Potential Crude Oil GHG Life Cycle Emissions
MCFO Regional Crude Oil Production

Crude Oil Production Values

3,044,100 barrels/year[a]
3.04 Mbb/year

Conversion Factors

0.004 m^3/gal
1,000 g/kg
1,000 kg/tonne
42 gal/barrel of oil
365 days/yr
33,867 MJ/m^3, energy density for gasoline[b]
37,184 MJ/m^3, energy density for diesel[b]
38,346 MJ/m^3, energy density for jet fuel[b]

2017 Average US Refinery Yields[c]

47 percent, finished motor gasoline
29 percent, distillate fuel oil (diesel)
10 percent, kerosene-type jet fuel

Emission Factors

96.2 g CO2e/MJ gasoline combusted[d]
92.0 g CO2e/MJ diesel combusted[d]
88.0 g CO2e/MJ jet fuel combusted[d]

Calculated Emission Factors

12 kg CO2e/gallon gasoline combusted (calculated)
13 kg CO2e/gallon diesel combusted (calculated)
13 kg CO2e/gallon jet fuel combusted (calculated)
12.6 kg CO2e/gallon fuel, weighted average (calculated)[e]

Estimated TOTAL Emissions from 3.0 million barrels per year Produced by BLM MCFO Regional Wells.

	CO2e : 100 yr	CO2e : 20 yr[f]
Emissions: Tons/year	1.61E+06	1.61E+06

Notes

(a) Maximum year annual oil production; Alternative E of RMP. Confirmed via 7/27/18 Memo to File. 417 wells * 20 BOPD *
(b) (Neutrium 2014).
(c) (EIA 2018). Average gasoline, jet fuel, and diesel production ratios for US refineries in 2017.
(d) (Cooney, et. al 2016, Table 1, page 983). Value is life cycle well-to-wheels emission factor for gasoline representing a US national average for 2014.
(e) Effective carbon intensity for crude oil based on weighted average 2016 US refinery yields for motor gasoline, diesel oil, and jet fuel.
(f) Emission factors account for total 10-year GWP CO2e rather than individual GHG pollutants (CO2, CH4, N2O). Absence of pollutant emissions prevent the calculation of 20-year GWP. However, 20-year GWP assumed equivalent to 100-year GWP as seen in other combustion calculations due to smaller fraction of CH4 and N2O emissions from combustion in comparison to

Acronyms

Mbbl = Million barrels of oil
MMT = million metric tons

References

Cooney, et. al. 2016. *Updating the U.S. Life Cycle GHG Petroleum Baseline to 2014 with Projections to 20140 Using Open-Source Engineering-Based Models*. Published November 22, 2016. American Chemical Society Publications. Available at: https://pubs.acs.org/doi/10.1021/acs.est.6b02819. Accessed July 4, 2018.

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Appendix D, Exhibit 5

Natural Gas Combustion Air Pollution Emissions
MCFO Regional Natural Gas Production

Gas Production Values

5,110,000	*(Natural Gas)*
7,982,550	*(CBM)*
13,092,550	mcf/year[a]

Conversion Factors

1,000	scf/mscf
1000	kg/tonne
1,000	g/kg
1.31E+10	scf/year

Emission Factors[b]

0.05444	kg CO_2/scf natural gas combusted
1.03E-06	kg CH_4/scf nautral gas combusted
1.00E-07	kg N_2O/scf natural gas combusted

Global Warming Potentials (unitless) [(b)]

These values are used to convert CO_2, CH_4, and N_2O emissions to CO2e

100-Year		*20-Year*
1	CO_2	1
34	CH_4	86
298	N_2O	268

Estimated TOTAL Emissions from 13,093 MMscf produced by BLM MCFO regional wells.

	CO_2	CH_4	N_2O	CO2e : 100 yr	CO2e : 20 yr
Emissions: Metric tons/year	712,758	13	1	713,607	714,269

Notes

(a) Maximum year annual oil production; Alternative E of RMP.Confirmed via 7/27/18 Memo to File. Natural Gas: ≈ 350 wells * 40 MCFD * 365 days and CBM: ≈ 486 wells * 45 MCFD * 365.

(b) GHG emission factors for natural gas combustion obtained from EPA Center for Corporate Climate Leadership Emission Factors for Greenhouse Gas Inventories. https://www.epa.gov/sites/production/files/2018-03/documents/emission-factors_mar_2018_0.pdf

Acronyms

mcf = thousand cubic feet
scf = standard cubic foot

References

EPA. Original 2015. Emission Factors for Greenhouse Gas Inventories. "Natural Gas" EPA, Center for Corporate Climate Leadership, Modified March 2018.
https://www.epa.gov/sites/production/files/2018-03/documents/emission-factors_mar_2018_0.pdf