Environmental Assessment
Monell/Arch Units Oil and Gas Development

BLM

Rock Springs Field Office, Wyoming

December 2013

The BLM's multiple-use mission is to sustain the health and productivity of the public lands for the use and enjoyment of present and future generations. The Bureau accomplishes this by managing such activities as outdoor recreation, livestock grazing, mineral development, and energy production, and by conserving natural, historical, cultural, and other resources on public lands.

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WY-040-EA13-127

Environmental Assessment
Monell/Arch Units Oil and Gas Development

Anadarko Petroleum Corporation

WY-040-EA13-127

List of Acronyms and Abbreviations

°F	degrees Fahrenheit
µeq/l	micro equivalents per liter
µg/m^3	micrograms per cubic meter
AAQS	Ambient Air Quality Standards
ACM	applicant-committed measure
AML	Appropriate Management Level
amsl	above mean sea level
ANC	acid neutralizing capacity
APC	Anadarko Petroleum Company
APD	Application for Permit to Drill
APE	area of potential effect
AQRVs	Air Quality Related Values
AUM	animal unit months
BACT	Best Available Control Technology
BEA	U.S. Bureau of Economic Analysis
bgs	below ground surface
BLM	Bureau of Land Management
BMP	Best Management Practices
CAA	Clean Air Act
CCS	Center for Climate Strategies
CDA	Concentrated Development Area
CD-C	Continental Divide-Creston
CESA	cumulative effects study area
CFR	Code of Federal Regulations
CH_4	methane
CO	carbon monoxide
CO_2	carbon dioxide
CO_2e	carbon dioxide equivalent
COAs	Conditions of Approval
CR	County Road
CSU	controlled surface use
CWA	Clean Water Act of 1972
D	distance from a Class I area (related to AQRVs)
dBA	decibels on the A-weighted scale
EA	Environmental Assessment
EO	Executive Order
EOR	Enhanced Oil Recovery
EORI	Enhanced Oil Recovery Institute
ESA	Endangered Species Act
FLAG	Federal Land Manager's Air Quality Related Values Workgroup
FLM	Federal Land Managers

FLPMA	Federal Land Policy and Management Act
FR	Federal Register
GHG	greenhouse gas
GIS	Geographic Information System
GLO	Government Land Office
gpm	gallons per minute
GRRMP	Green River Resource Management Plan
H_2S	hydrogen sulfide
HAP	hazardous air pollutant
HMA	Herd Management Area
Hp	horsepower
I.M.	Instruction Memorandum
I-80	Interstate 80
IPCC	Intergovernmental Panel on Climate Change
km	kilometer
kV	kilovolts
LACT	lease automatic custody transfer units
MACT	Maximum Achievable Control Technology
MBTA	Migratory Bird Treaty Act
mg/l	milligrams per liter
MLRA	Major Land Resource Area
Mm^{-1}	Inverse megameter
MOU	Memorandum of Understanding
N_2O	nitrous oxide
NAAQS	National Ambient Air Quality Standards
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act of 1966, as amended
NO_2	nitrogen dioxide
NO_X	oxides of nitrogen
NPS	National Park Service
NRCS	Natural Resources Conservation Service
NRHP	National Register of Historic Places
NSPS	New Source Performance Standards
NWI	National Wetland Inventory
NW ReGAP	Northwest Regional Gap Analysis Project
O_3	ozone
P&A	Plugged and Abandoned
PFYC	Potential Fossil Yield Classification
PM	particulate matter
PM_{10}	particulate matter with an aerodynamic diameter of 10 microns or less
$PM_{2.5}$	particulate matter with an aerodynamic diameter of 2.5 microns or less
ppb	parts per billion
ppm	parts per million
PRPA	Paleontological Resources Preservation Act
PSD	Prevention of Significant Deterioration

Q	annual emissions reaching a Class I area (related to AQRVs)
RCS	recycled compression stations
RFFAs	reasonably foreseeable future action
RFO	Rawlins Field Office
RMP	Resource Management Plan
ROD	Record of Decision
ROW	right-of-way
RSFO	Rock Springs Field Office
SCEMA	Sweetwater County Emergency Management Agency
SHPO	State Historic Preservation Office
SO_2	sulfur dioxide
SPCC	Spill Prevention, Control, and Countermeasures
SWPPP	Storm Water Pollution Prevention Plan
TCPU	Transportation, Communication, and Public Utilities
TDS	Total Dissolved Solids
tpy	tons per year
TSS	total suspended sediment
U.S.	United States
UPLR	Union Pacific Land Resources
UPRR	Union Pacific Railroad
USACE	U.S. Army Corps of Engineers
USC	United States Code
USDA	U.S. Department of Agriculture
USEPA	U.S. Environmental Protection Agency
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
UW	University of Wyoming
VRM	Visual Resource Management
WAS	Western Archaeological Services
WDEQ	Wyoming Department of Environmental Quality
WGFD	Wyoming Game and Fish Department
WOGCC	Wyoming Oil and Gas Conservation Commission
WQD	Water Quality Division
WS	Wyoming Statute
WSEO	Wyoming State Engineer’s Office
WYCRIS	Wyoming Cultural Resources Information System
WYNDD	Wyoming Natural Diversity Database

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1.0 Introduction

Anadarko Petroleum Company (APC) has notified the Bureau of Land Management (BLM) Rock Springs Field Office (RSFO) that they propose to develop new oil and gas wells in the Monell and Arch units, which are part of the Patrick Draw Field. The units are located approximately 31 miles east of Rock Springs and 23 miles west of Wamsutter in Sweetwater County, Wyoming (**Figure 1-1**).

APC is requesting BLM approval to expand oil and gas drilling and production in the Monell Unit through enhanced oil recovery (EOR) techniques and to develop a limited number of wells in the Arch Unit. The proposed project involves a total of 9 years of development with up to 85 wells in the Monell Unit and up to 40 wells in the Arch Unit. The Monell Unit wells would all be located on existing well pads. In the Arch Unit, APC proposes to develop up to 38 oil or carbon dioxide (CO_2) injector wells and two water injection wells on 21 new pads. The total well life is projected to be approximately 30 years for both units. An environmental assessment (EA) was completed under BLM guidance that meets the requirements of the National Environmental Policy Act (NEPA) of 1969. BLM prepared this EA to evaluate the impacts associated with construction, operation, and maintenance of the proposed development in the Monell and Arch units.

1.1 Background

The Monell Unit was initially developed in 1964. APC currently holds all leases and operates 204 active wells in the Monell Unit, with 124 plugged and abandoned (P&A) wells. There are currently 13 active wells in the Arch Unit and 113 P&A wells, with all leases held by APC. APC owns 100 percent of the working interest in the Monell Unit and 65.6 percent of the working interest in the Arch Unit.

In 2006, the BLM RSFO prepared the Monell Enhanced Oil Recovery Project Environmental Assessment (BLM 2006a, WY-040-EA05-161) (“2006 EA”). In the 2006 EA, APC proposed to drill a maximum of 126 wells, including 46 wells on federal lands in the Monell Unit. Since the signing of the Decision Record for the 2006 EA, 95 wells have been drilled with 31 wells remaining to be drilled. Reclamation efforts, as stipulated in the 2006 EA and in the Surface Use Plans for the Application for Permit to Drill (APDs), will continue. In the 2006 EA, APC agreed to recontour and reseed the unused portion of well pads within 1 year following installation of production equipment, or if a well is determined to be unproductive, the entire well pad and road corridor would be recontoured and reclaimed within 1 year using stockpiled topsoil and appropriate seeding techniques.

At the time of the 2006 EA, it was assumed that each well pad would have an average initial disturbance of approximately 2 acres, and interim reclamation would reduce surface disturbance to approximately 1 acre per well pad. Disturbed areas have been or will be recontoured and reseeded except for permanent production areas, new construction areas, and a few of the main corridors that are proposed for disturbance in the near future. Some of the reclaimed well pads, as well as some interim reclamation, may be re-entered during construction and drilling proposed under this document.

In total, the project area encompassing the Monell and Arch units consists of 22,657 acres on public, state, and private land, as shown in **Table 1-1**. The public lands in the project area are administered by the BLM in the RSFO. A small portion of the Monell Unit (201 acres or 0.9 percent of the project area) is located on private lands within the Rawlins Field Office area. No development is proposed for this area.

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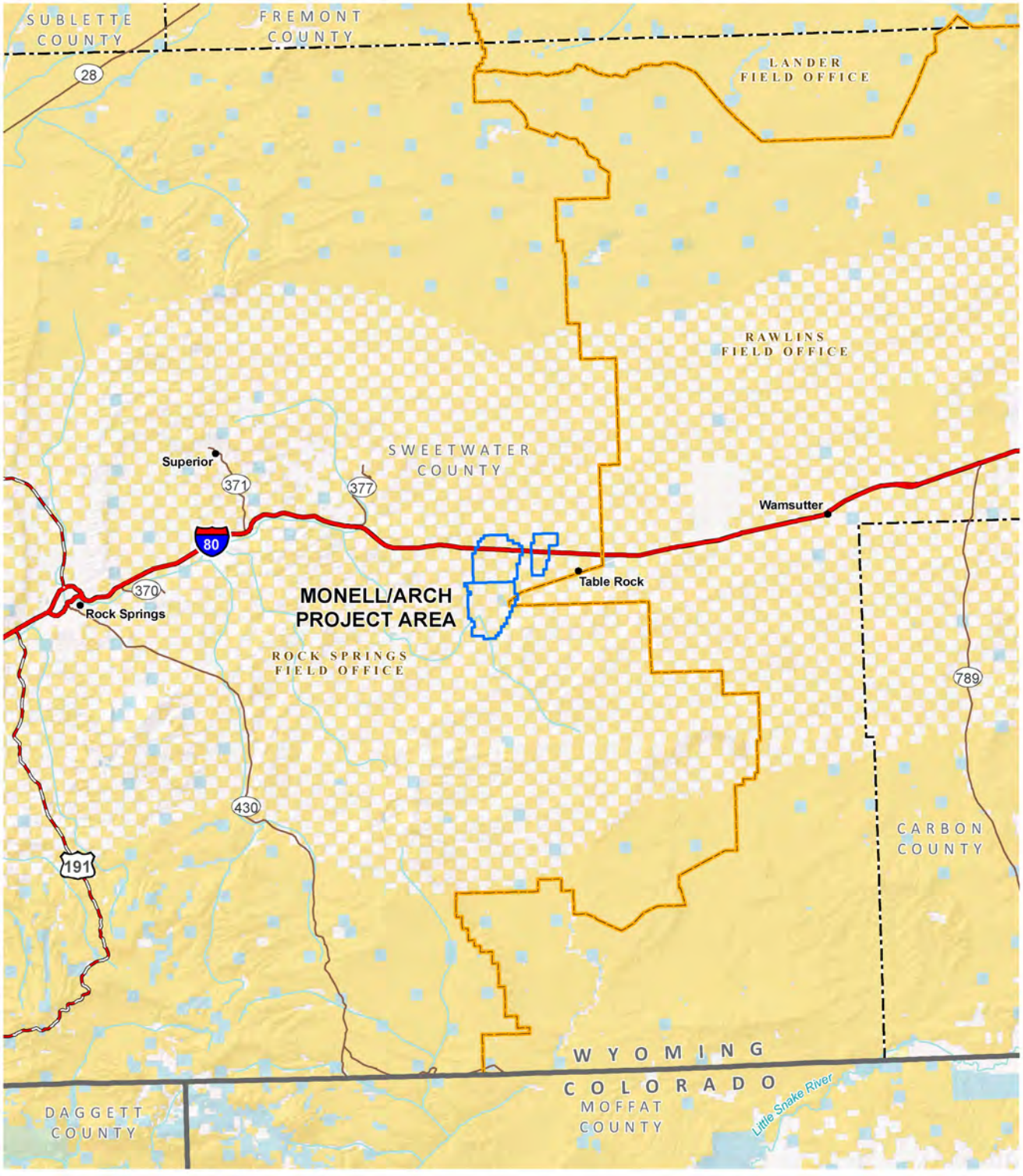

Legend

- City or Town
- Project Boundary
- Interstate Highway
- U.S. Highway
- State Highway
- BLM Field Office Boundary

Land Owner

- Bureau of Land Management
- Bureau of Reclamation
- Forest Service
- Private
- State

Figure 1-1

Project Area Location

0 2 4 6 8 10 20 Miles

1:800,000

N

Table 1-1 Project Area Surface and Mineral Ownership

Owner	Surface (acres)
Monell Unit	
BLM	4,631
State of Wyoming	365
Private/Fee	5,128
Monell Total	**10,124**
Arch Unit	
BLM	6,291
State of Wyoming	0
Private/Fee	6,242
Arch Total	**12,533**
Project Area Total	**22,657**

The initial oil production in the Monell Unit resulted from primary and secondary production methods. Primary production methods use natural pressure or pumping to bring oil to the surface. As oil is produced, natural reservoir pressure declines over time, which results in decreased oil production from the field. The most common type of secondary recovery used in Wyoming is waterflooding, where water is injected into the field to displace additional oil and increase pressure. Waterflooding can result in an incremental increase of up to approximately 25 percent recovery, or a total recovery (primary plus secondary) of approximately 40 percent of the original-oil-in-place (BLM 2003).

EOR, in particular CO_2 flooding as a tertiary method, represents an important part of oil production in Wyoming. The Enhanced Oil Recovery Institute (EORI) has estimated that an additional recovery of oil from Wyoming's oil fields could total more than 1 billion barrels of additional production over the next 20 years (EORI 2013). In 2009, approximately 12 percent of the oil produced in Wyoming was the result of EOR projects.

Arch Unit. The Arch EOR Project has been proposed as a means by which the declining oil and gas production in the Arch Unit can be reversed in an economical and technologically sound fashion. The proposed Arch EOR Project would increase oil recovery in the Arch Unit by using CO_2 flooding. By implementing the Arch EOR Project in combination with the Monell EOR, increased incremental production of oil would occur in these units that would not be possible using natural or water flooding methods. The incremental production of oil would extend the economic life of the Monell and Arch units and benefit both state and local economies.

The development of federal oil and gas leases by private industry is an integral part of the national policies regarding energy development. The project would support the federal government's policy to foster and encourage energy development, as expressed in the Mining and Minerals Policy Act of 1970, Federal Land Policy and Management Act of 1976 (FLPMA), the Federal Onshore Oil and Gas Leasing Reform Act of 1987, and the Energy Policy Act of 2005.

Monell Unit. The purpose of the APC's action is to increase recoverable reserves by decreasing spacing of wells, develop its federal mineral leases, and allow the lessee to exercise its right to develop its leases subject to applicable federal and state laws and BLM policy.

1.2 Purpose and Need for the Proposed Action

Under the NEPA, the purpose and need statement is intended to explain the reason that the proposed project is needed by the lead agency (BLM in this case) and serves as the basis for developing alternatives for analysis. The purpose is to analyze in accordance with NEPA an APC proposal to expand oil and gas drilling and production in the Monell Unit and to develop new wells in the Arch Unit and provide access to the wells consistent with federal lease rights. The need for the action is established by the BLM's responsibility under regulations including the Minerals Leasing Act of 1920, the Energy Policy Act of 2005, the FLPMA, as amended, and 43 Code of Federal Regulations (CFR) 3160.

1.3 Decision to be Made

Following review of the analysis in this EA, the BLM will decide whether to allow implementation of the proposed oil and gas development, and if so, under what terms and conditions.

1.4 Relationship to Statutes, Regulations, Plans or Other Environmental Analyses

The approved Record of Decision (ROD) (1997) for the Green River Resource Management Plan (GRRMP) is the document that directs management of federal lands within the BLM RSFO. The objective for management of oil and gas resources, as stated in the GRRMP, is to provide for leasing, exploration, and development of oil and gas while protecting other resource values. In addition, the GRRMP states that public lands within the checkerboard land pattern, which encompasses the project area, are open to mineral leasing and development in order to promote mineral recovery on behalf of the United States (U.S.), along with appropriate mitigation of disturbance on a case-by-case basis. The BLM RSFO issued a Notice of Intent in February 2011 to revise the GRRMP and be replaced by Rock Springs RMP. The GRRMP will be the guidance document until the Rocks Springs RMP is finalized.

BLM Onshore Oil and Gas Orders, Conditions of Approval (COAs), and general requirements constitute the range of standard operating procedures and environmental protection measures that are applied to individual operators and projects, as applicable, authorized by 43 CFR 3160. The exploration and production of domestic oil and gas reserves is in accordance with the President's National Energy Policy, set forth in Executive Order (EO) 13212 (2001), and with the Energy Policy Act of 2005 (42 United States Code [USC] 15801).

State agencies have authority over various aspects of oil and gas development, including the Wyoming Department of Environmental Quality (WDEQ), which has jurisdiction over air and water quality, and the Wyoming Oil and Gas Conservation Commission (WOGCC) that has regulations and standards affecting well spacing, permits, and safety.

The proposed project would comply with all applicable federal, state, and local laws, plans, and permits required for this activity. In addition to compliance with the GRRMP, **Table 1-2** summarizes other relevant authorities, guidance, and permits that may apply, depending on the location of the action and the regulatory authority.

1.5 Scoping and Public Involvement

A Scoping Notice and project area map were posted to the BLM website by the RSFO to announce the 30-day public scoping period from November 1 through 30, 2012. In response to the Scoping Notice, eight comment letters were received from the Coalition of Local Governments (representing the County Commissions and Conservation Districts for Carbon, Fremont, Lincoln, Sweetwater, Uinta, and Sublette counties); Theodore Roosevelt Conservation Partnership; Green River Chamber of Commerce; Rock

Springs Chamber of Commerce; WDEQ; Wyoming Game and Fish Department (WGFD); Wyoming Outdoor Council; and APC. Internal scoping was conducted with the BLM Interdisciplinary Team to identify resources to be analyzed in the EA.

Table 1-2 Major Laws, Regulations, and Permits that May Apply

Issuing Agency	Permit Name: *Purpose of Approval or Action*	Authority
BLM	Permit to Drill, Deepen or Plug Back (APD Process): *Controls drilling for oil and gas on federal onshore lands*	Mineral Leasing Act of 1920 (30 USC 181 *et seq*.): 43 CFR §3162
	Right-of-Way (ROW) grants and temporary use permits: *Issue ROW grants on BLM-managed lands*	Mineral Leasing Act of 1920 (30 USC 185); 43 CFR §2880 & §2800; FLPMA (43 USC 1761-1771)
	Antiquities, Cultural, and Historic Resource Permits: *Issue antiquities and cultural resources use permits to inventory, excavate or remove cultural or historic resources from BLM-managed lands*	Antiquities Act of 1906 (16 USC 431- 433); Archaeological Resources Public Protection Act of 1979 (16 USC 470aa – 470ll); Preservation of American Antiquities (43 CFR §3); National Historic Preservation Act (NHPA) Section 106 (36 CFR 800)
	Approval to Dispose of Produced Water: *Controls disposal of produced water from federal leases*	Mineral Leasing Act of 1920 (30 USC 181 *et seq*.); 43 CFR §3164; Onshore Oil and Gas Order No. 7
U.S. Army Corps of Engineers (USACE)	Section 404 Permit (Nationwide and Individual): *Controls discharge of dredged or fill materials into waters of the United States*	Section 404 of the Clean Water Act of 1972 (CWA)
U.S. Fish and Wildlife Service (USFWS)	Protects federally listed threatened and endangered species through coordination and consultation process	Section 7 of the Endangered Species Act (ESA) of 1973, as amended (Public Law [P.L.] 93-205)
	Determine compliance through internal review or external review with the USFWS	Migratory Bird Treaty Act (MBTA) of 1918, as amended; Bald and Golden Eagle Protection Act of 1940
Wyoming Department of Agriculture	Controls introduction and spread of weeds and pests	Wyoming Weed and Pest Control Act (Wyoming Statute [WS] 11-5-102)
WDEQ – Air Quality Division	Permits to construct and operate certain emissions sources	Clean Air Act (CAA) of 1990 and implementing regulations in 40 CFR §70; Wyoming Environmental Quality Act (WS 35-11-201 through 35-11-21)

Table 1-2 Major Laws, Regulations, and Permits that May Apply

Issuing Agency	Permit Name: *Purpose of Approval or Action*	Authority
WDEQ – Water Quality Division	Wyoming Pollutant Discharge Elimination System Permit: *Controls offsite storm water runoff from construction activities resulting in 1 acre or more of disturbance and any discharges to "waters of the State".*	Wyoming Environmental Quality Act; Section 405 of the CWA (40 CFR §122, 123, and 124); WDEQ Water Quality Rules and Regulations, Chapters 1, 2, and18
WOGCC	Permit to drill, deepen, or plug back (APD process): *Regulates drilling of oil and gas wells in the state.*	WOGCC Regulations Chapter 3, Section 8. WS 30-5-104 (d)(i)(C). WS 30-5-115
	Well location (part of the APD process): *Regulates downhole well location of all oil and gas wells by reservoir or pool*	WOGCC Rule: Chapter 3 Section 2, WS 30-5-109
	Protection of surface waters and productive formations (part of APD process): *Provides general drilling, casing, and cementing rules for oil and gas wells*	WOGCC Rule: Chapter 3, Section 22
	Well control (part of APD process): *Provides requirements for blowout preventers*	WOGCC Rule: Chapter 3, Section 23
	Authorization approving drilling and spacing units: *Regulates well spacing and pooling of interests by reservoir or pool*	WS 30-5-104(d)(ii)(F)(iv). WS 30-5-109(a),(b),(c) and (f)
	Permit to drill to a nonstandard Location: *Provides for well relocation while maintaining existing well spacing*	WOGCC Rule: Chapter 3, Section 3, WS 30-5-109
	Permit to directionally drill: *Provides the notification requirements for controlled directional drilling*	WOGCC Rule: Chapter 3, Section 25
	Plugging and abandonment of a well (applies to non-federal lands): *Provides procedures and regulates the plugging and abandonment of oil and gas wells*	WOGCC Rule: Chapter 3, Section 18, Chapter 4, Section 2. WS 30-5-104 (d)(vi)(B)
	Measurement of oil and gas production: *Regulates the measurement and reporting of oil and gas production*	WOGCC Rule: Chapter 3, Section 30 and 31, WS 30-5-104 (d)(vi)(B)
	Permit to complete a well in multiple zones or pools (commingling): *Regulates the production of oil and gas from more than one pool in one well*	WOGCC Rule: Chapter 3, Section 35
	Authorization to flare or vent gas: *Regulates the safe venting or flaring of gas to prevent waste*	WOGCC Rule: Chapter 3, Section 40

Table 1-2 Major Laws, Regulations, and Permits that May Apply

Issuing Agency	Permit Name: *Purpose of Approval or Action*	Authority
	Permit to use an earthen pit (applies to nonfederal lands): *Regulates construction, use and closure of noncommercial reserve, production and emergency pits on drilling and producing locations*	WOGCC Rule: Chapter 4, Section 1, WS 30-5-104 (d)(vi)(A)
	Spills and fires: *Requires notification, with a prevention and cleanup plan, of accidental deaths, fires, or releases of 10 or more barrels of non-potable fluids that enter or threaten the waters of the State*	WOGCC Rule: Chapter 4, Section 3
	Workmanlike operations: *Regulates the safety and environmental protection of well production facilities*	WOGCC Chapter 4, Section 4
	Permit underground disposal of water: *Regulates the noncommercial underground disposal of non-potable water and oil field wastes*	WOGCC Chapter 4, Section 5, WS 30-5-104 (d)(vi)(B)
	Permit to close a natural gas processing facility: *Regulates closure of infield gas gathering and processing facilities*	WOGCC Rule: Chapter 4, Section 13 (b)
Wyoming State Engineer's Office (WSEO)	*Water well permit: Issue permit to appropriate groundwater*	WS 41-3-938
Wyoming State Lands and Investments Office	ROWs and easements on state lands	WS 36-9-118
Wyoming State Historic Preservation Office	Cultural resource protection	NHPA and Advisory Council Regulations (36 CFR §800)
Sweetwater County Planning and Zoning Department	Compliance with the International Fire Code	WS 35-9-121
	Construction/Use Permit: *Ensure all structures comply the health, safety and welfare standards of Sweetwater County Development Code*	WS 18-5-201 et seq.
	Zone Change: *If necessary, to ensure that the proposed use of the land is coordinated with the Sweetwater County Zoning Map and Land Use Plan*	WS 18-5-201 et seq. and 9-8-301 et seq.

Table 1-2 Major Laws, Regulations, and Permits that May Apply

Issuing Agency	Permit Name: *Purpose of Approval or Action*	Authority
	County Road (CR) Permits and Licenses including road access, road crossings, and new structures or facilities	WS 24-3-101 et seq.
Sweetwater County Engineering Department	Coordination regarding movement of heavy equipment on CRs and the proper use and maintenance of said roads	WS 24-3-101 et seq.
Sweetwater County Health Department	Small wastewater permits	WS 35-11-101 et seq.
Local Emergency Planning Committee	Hazardous Materials Inventory: *To ensure the storage of the hazardous materials is properly coordinated with emergency providers*	Emergency Planning and Community Right-to-Know Act 42 USC 116
Sweetwater County Weed and Pest Control District	Control of Noxious Weeds	WS 11-5-101 et seq.

Issues for analysis identified during scoping include:

- Consider beneficial uses of produced water;
- Design roads to maintain hydrologic functions of surface water resources;
- Identify methods for detecting and reporting spills and leaks of produced water;
- Consider effects to surface and groundwater resources;
- Consider locating facilities to avoid floodplains, ephemeral drainages, riparian areas, and other surface water features;
- Consider the BLM/U.S. Geological Survey (USGS) document entitled “Regional Framework for Water Resources Monitoring Related to Energy Exploration and Development” for developing a monitoring strategy for measuring and mitigating impacts to water resources;
- Consider effects to soils and vegetation due to surface disturbance and the potential for erosion;
- Minimize effects to riparian areas and seeps;
- Control the spread of invasive plants and implement weed (noxious and non-natives) management;
- Minimize effects on wildlife populations and habitats including big game and greater sage-grouse;
- Apply applicable wildlife seasonal stipulations to development activities;
- Minimize effects to the Bitter Creek drainage and associated aquatic species including flannelmouth sucker, mountain sucker, and speckled dace;
- Protect conservation agreement species such as bluehead sucker, flannelmouth sucker, and roundtail chub;

- Minimize effects to rangeland and livestock operations;
- Consider management of vehicular traffic and transportation planning;
- Consider fishing, hunting, and wildlife-related activities as part of the economy when evaluating project effects;
- Conduct reclamation of disturbed areas;
- Consider monitoring and mitigation including funding for fish and wildlife management;
- Incorporate science-based mitigation for fish and wildlife resources;
- Foster coordination between fish and wildlife managers, land owners, and affected stakeholders to ensure fish and wildlife sustainability;
- Provide coordination with interested agencies regarding rangeland management, vegetation, and reclamation;
- Identify beneficial effects of the proposed project on local economy;
- Apply relevant Best Management Practices (BMPs) and Conditions of Approval (COAs) to protect environmental resources;
- Consider information from the conference entitled *"Restoring the West, Balancing Energy Development and Biodiversity"* (October 30 and 31, 2012 at Utah State University) regarding mitigation of impacts from energy development; and
- Follow guidance in the June 23, 2011 Memorandum of Understanding between the BLM, USEPA, and the Forest Service regarding NEPA analyses of air quality issues.

On June 11, 2013, the BLM began a 30-day comment period on the Monell/Arch Units Oil and Gas Development EA. Nine comment letters were received. As a result of the public comments, clarifications and changes to the EA were incorporated. **Appendix A** is included to summarize public comments and provide the BLM responses.

2.0 Proposed Action and Alternatives

This chapter describes the components of the Proposed Action and alternatives analyzed in detail. These alternatives must meet the BLM's project's purpose and need while minimizing or avoiding environmental impacts. This practical range of reasonable alternatives is formulated to address issues and concerns raised during scoping.

Reasonable alternatives are defined by the Council on Environmental Quality as those that are technically, economically, and environmentally practical and feasible. In compliance with NEPA guidance, the analysis includes the No Action Alternative for comparison to the other alternatives analyzed in the EA. Several alternatives were considered but eliminated from detailed analysis, as discussed in Section 2.4 of this chapter.

2.1 Alternative 1 – No Action Alternative

The No Action Alternative serves as a basis for comparison of environmental impacts among alternatives. Under the No Action Alternative, the current proposal would not be implemented. However, APC would continue to access its valid existing lease rights within the project area. APC would continue to drill and develop wells in the project area under previously approved authorizations. The No Action Alternative does not mean, therefore, that there would be no impacts to the lands in the project area.

Current oil and gas operations and maintenance activities would continue. In the Monell Unit, approximately 1,450 acres of land are currently disturbed for fluid minerals facilities, including service roads, pipelines, well pads, and ancillary facilities. Total existing disturbance in the Arch Unit is approximately 297 acres, including the 13 active wells and 113 P&A wells. Under the Monell EA approved in 2006, APC was authorized to drill and develop a maximum of 126 wells, including 46 wells on federal lands. Of the 126 authorized wells, there are still 31 additional wells to be drilled under the 2006 EA authorization. Reclamation efforts, as stipulated in the 2006 Monell EA and the subsequent APDs, will continue.

Management of fluid mineral development would continue to be governed by current BLM policy and procedures with APDs approved on a case by-case basis. Development would continue on state and private lands. Reasonable access across BLM-administered surface to proposed well pads and facilities on state and private lands would continue under the No Action Alternative, as allowed by federal regulations.

2.2 Alternative 2 – Proposed Action

2.2.1 Overview

APC proposes on-going and increased use of EOR development by CO_2 injection to the approximately 1,747 acres of land currently subject to EOR development and activity in the Monell and Arch units. Over a 9-year period, APC proposes to develop up to 85 oil wells (producers) in the Monell Unit using an EOR process accomplished by CO_2 flooding; all to be located on existing well pads. APC proposes to develop up to 38 oil producer or CO_2 injection wells (injectors), likely to be 20 oil producers and 18 CO_2 injectors, plus 2 water injectors, all on 21 new pads in the Arch Unit. Oil would be the primary product, but natural gas also would be recovered as part of the process.

Proposed development would occur over a proposed 9-year period, and consist up to 85 wells in the Monell Unit, all of which would be located on existing well pads to limit the number of new wells. There also would be two new production facilities and one new compressor station. CO_2 produced with oil would be separated and recycled to the CO_2 injection system for re-injection. Anticipated facilities would include injection and production wells, injection and production pipelines, production test and treating

facilities, injection manifold headers, lease automatic custody transfer units (LACT), tank batteries, recycled compression stations (RCS), and associated electrical lines. The proposed surface locations for well pads and other surface facilities illustrated in **Figure 2-1** are conceptual for this stage of the project design. Actual locations for these facilities would be determined at the project implementation phase during the onsite process with consideration of factors such as technical and economic feasibility, topography, cultural resources, wildlife habitats, and other site specific conditions. For the purpose of this EA, the approximate locations of new facilities are shown in **Figure 2-1**.

Proposed development in the Arch Unit would involve up to 38 oil and CO_2 injector wells and two water injection wells on 21 new pads. There also would be one new header facility/LACT unit.

APC proposes to minimize surface disturbance by utilizing existing well pads by co-locating new wells with existing wells or by establishing multi-well pads where possible. In the Monell Unit, all new wells would be located on existing pads, making use of existing access roads and other facilities in the unit. New pipelines in the Monell Unit would utilize existing road ROWs rather than creating new surface disturbance where practical. Because there is little existing development in the Arch Unit, new well pads, access roads, power lines, and pipelines would be needed, but wells would be co-located on the same pad for approximately half of the proposed new wells. The actual amount of new surface disturbance would depend on the terrain and whether nearby existing facilities can be utilized. This is because in EOR, the arrangement of production and injection wells follows a pattern. The injection pattern for a field is based on the location of the existing wells and the reservoir size and shape. APC would design roads for efficiency and to minimize surface disturbance. Topsoil removed during construction would be stockpiled and used for reclamation. In addition, APC would work with the BLM to identify and reclaim unused, redundant, and/or unnecessary roads.

2.2.2 Detailed Plan of Development

Over a 9-year period, APC proposes to develop up to 85 oil wells (producers) in the Monell Unit using an EOR process accomplished by CO_2 flooding; all to be located on existing well pads. APC proposes to develop up to 38 oil producer or CO_2 injection wells (injectors), likely to be 20 oil producers, 18 CO_2 injectors, and 2 water injectors, all on 21 new pads in the Arch Unit. Oil would be the primary product, but natural gas also would be recovered as part of the process.

The target formation for all proposed wells is the Almond Formation, from which both oil and gas would be recovered. APC plans to utilize a combination of vertical and directional drilling techniques that would result in continued efficient development of remaining oil and gas reserves while minimizing surface disturbance by using existing pads, roads, gathering lines, injection wells, and ancillary facilities where feasible. Producing wells would be hydraulically fractured as needed in the Almond Formation.

In both units, well production would be enhanced by injecting CO_2 into the reservoir through a series of injection wells. CO_2 would be delivered to the project area through an existing pipeline constructed in 2003.

Approximately 13 miles of pipelines and 5.5 miles of new roads would be constructed to serve the new wells in the Arch Unit. APC would utilize existing well pads, roads, and pipelines in the Monell Unit, but pads would be enlarged where new wells are drilled to allow room for drill rigs, wellheads, and other equipment, as needed. Each APD a well and ROW application would be subject to further NEPA compliance and would include a Master Drilling Plan.

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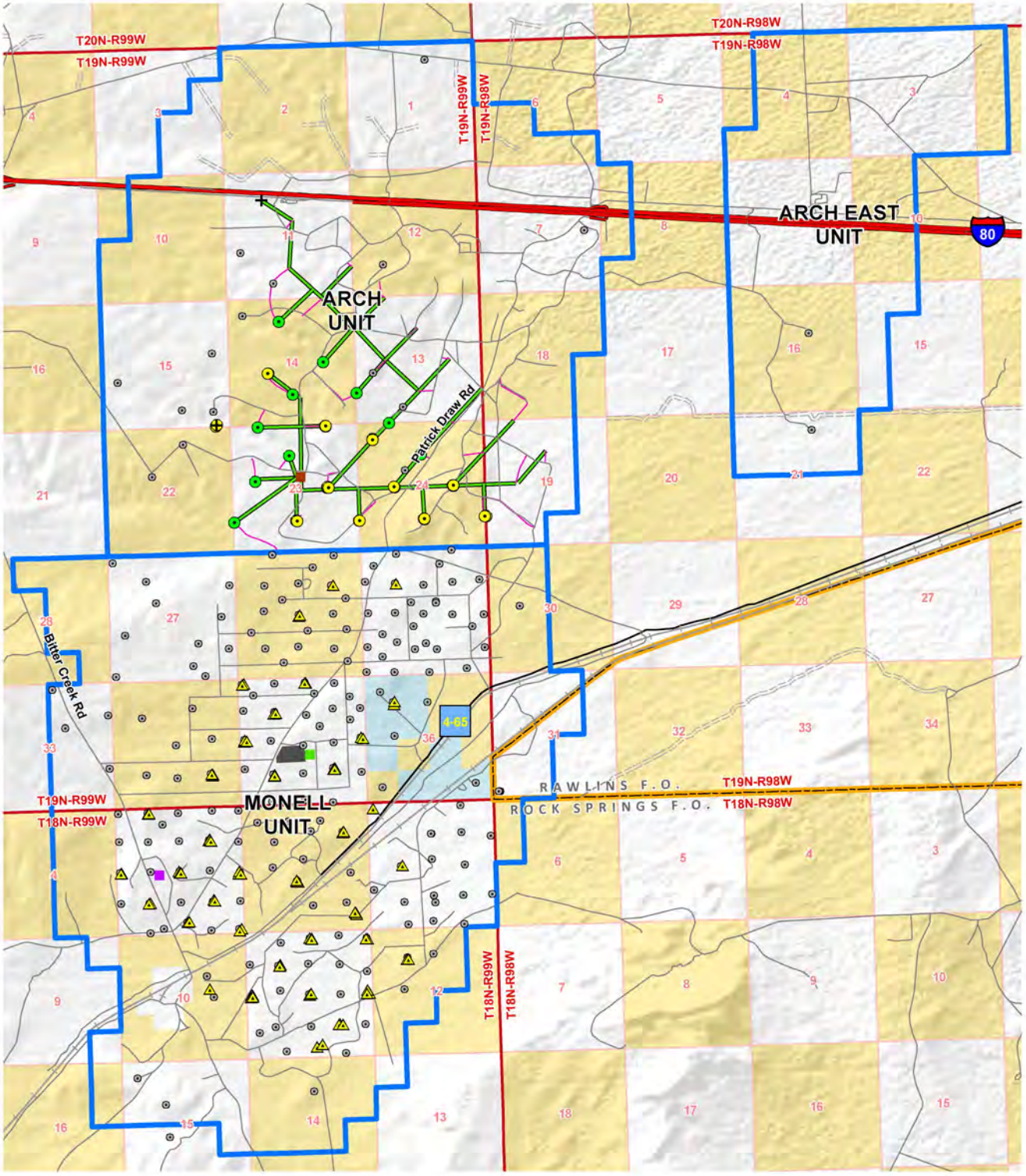


Legend

Existing Facilities
- Production
- Interstate Hwy
- County Road
- Local Road
- Vehicular Trail
- Railroad
- Existing Well
- Injection Well

Proposed Wells (2013-2016)
Arch Unit Wells
- Single well Pad
- Multi-well Pad

Monell Unit Wells
- Multi-well Pad
- Proposed Pipeline
- Proposed Road

Conceptual Facilities
- Production
- Production/Header
- Production/ Compressor Station

Land Owner
- Bureau of Land Management
- Private
- State

0 0.25 0.5 1 1.5 Miles

1:75,000

N

Figure 2-1

Existing Wells and Proposed Project Components in the Monell and Arch Units

The new wells in the Monell Unit are anticipated to be “free-flowing” and would most likely not need artificial lift. New wells in the Arch Unit would utilize artificial lift during the initial life of the wells. The produced water would be piped to the existing main tank battery location (Section 35, Township 19 North [T19N], Range 99 West [R99W]) where tanks, dehydrators, heaters, gas-fired engines are located. A LACT Unit would be located at the main tank battery facility in the Arch Unit (approximate location in Section 23, T19N, R99W).

Power is currently supplied to the Monell Unit through overhead transmission lines from a substation located in Section 35, T19N, R99W. A new main power line approximately 2.1 miles long and a power line grid from the main line would be installed to transport power to the Arch Unit wells from this substation. The new electrical lines would be buried.

Equipment would be powered by electricity where practical, including monitoring equipment and pump jacks for the oil producer wells. Natural gas would be used to operate the separation vessels, heater treaters and freewater knockouts at the Tank Battery, as well as the treater and relief tank at each well pad. The telemetry at the wells in the Monell Unit is currently powered by electricity.

2.2.3 Drilling and Completion Operations

During drilling, most equipment would be powered by diesel fuel. The drilling rigs would utilize Tier 2 diesel engines. Tier 2 engine refers to an engine subject to the Tier 2 emission standards listed in 40 CFR §89.112(a), which defines exhaust emission standards for oxides of nitrogen (NO_X), carbon monoxide (CO), hydrocarbon, and particulate matter (PM) from non-road engines.

It is estimated to take approximately 6 days to drill and 10 days to complete each well. Drilling water would be stored in a reserve pit on the well pad unless otherwise specified in the APD. The reserve pit for a single well would be approximately 100 feet by 50 feet and 10 feet deep. Water to be used for completion would be stored separately in tanks onsite. The following information describes the drilling and operation activities.

2.2.3.1 Road Construction

Proper authorizations would be obtained for all roads. Procedures for designing, constructing, and upgrading roads on federal lands would follow guidelines specified in the BLM Manual 9113: Roads (BLM 1985). As required in the GRRMP (BLM 1997) and Wyoming Air Quality Standards and Regulations (Chapter 3, Section 2(f)(i)(A), construction of roads and other surface disturbance activities would be designed with dust control measures to reduce particulate matter. Control measures identified in the GRRMP would include the use of water on dirt roads and the covering of materials in open-bodied trucks that could cause airborne dust. Road authorization and use would be secured by the applicant through ROWs or sundry notice. The average travel surface width for gravel-surfaced resource roads would be 20 feet. For the analysis of project impacts in this EA, all roads are considered resource roads. Because roads and gathering lines would be constructed within a single corridor where possible, a corridor width of approximately 60 feet would be used during construction. No new roads would be required to cross Bitter Creek, since an existing road can be used for access. If flowlines are required to cross Bitter Creek, these lines would be bored.

Well pad and access road construction would require approximately 4 workers for a period of approximately 5 days per location. These workers would include both heavy equipment operators engaged in road and well pad construction and truck drivers hauling heavy equipment to and from locations. Construction workers would likely be hired locally and contracted by APC or its agents.

Primary access to the project area would be via CR 4-26 and CR 4-24, which traverse the area. All roads on federal land would be surfaced with appropriate materials according to BLM guidelines. Available topsoil (up to 12 inches) would be stripped from all road corridors prior to commencement of construction activities, stockpiled, and then redistributed and reseeded on backslope areas of the borrow ditch after

completion of road construction activities. Borrow ditches would be reseeded in the first appropriate season after initial disturbance. If a well is determined to be unproductive, the entire road corridor would be recontoured and reclaimed within 1 year using stockpiled topsoil and appropriate seeding techniques. Road segments on private land could be reclaimed or kept, as decided by the landowner. Any large rocks that occurred on the corridor prior to construction would be scattered over the disturbed area after reseeding. Total surface disturbance for roads is estimated to be about 40 acres (19 acres on public land) during construction and 34 acres (16 acres on public land) after reclamation.

2.2.3.2 Well Pad Design and Construction

Major components of each well pad would include a level area for placement/support of the drilling rig and other equipment and an earthen reserve pit to contain drilling fluids (**Figure 2-2**). Reserve pits are an acceptable method to deal with drilling muds when operated under the standard conditions of approval. Other methods such as closed-loop pitless mud systems would be evaluated by APC and permitted at the APD level. The entire well pad would be cleared of vegetation, and up to 12 inches of topsoil would be removed from all areas of cut, fill, and/or subsoil storage. After topsoil is removed, the pad would be graded using standard earth-moving equipment (e.g., dozers, scrapers) to prepare a level-working surface. Each well location would be designed so that the amount of cut-and-fill material would roughly balance, where feasible, thereby minimizing the need to stockpile excess subsoil adjacent to the well location until site reclamation. Construction traffic for well pads and infrastructure development are provided in Section 2.2.4.

In the event a reserve pit is required, the pit would be excavated using appropriate equipment. Materials excavated from the reserve pit would be stockpiled, backfilled and reclaimed per the APD. Reserve pits would be fenced to protect livestock and wildlife until the pit is reclaimed per the Conditions of Approval (COAs) from the APD. Reserve pit fluids would be allowed to dry by evaporation and reclaimed within 1 year prior to reserve pit closure and drill site reclamation.

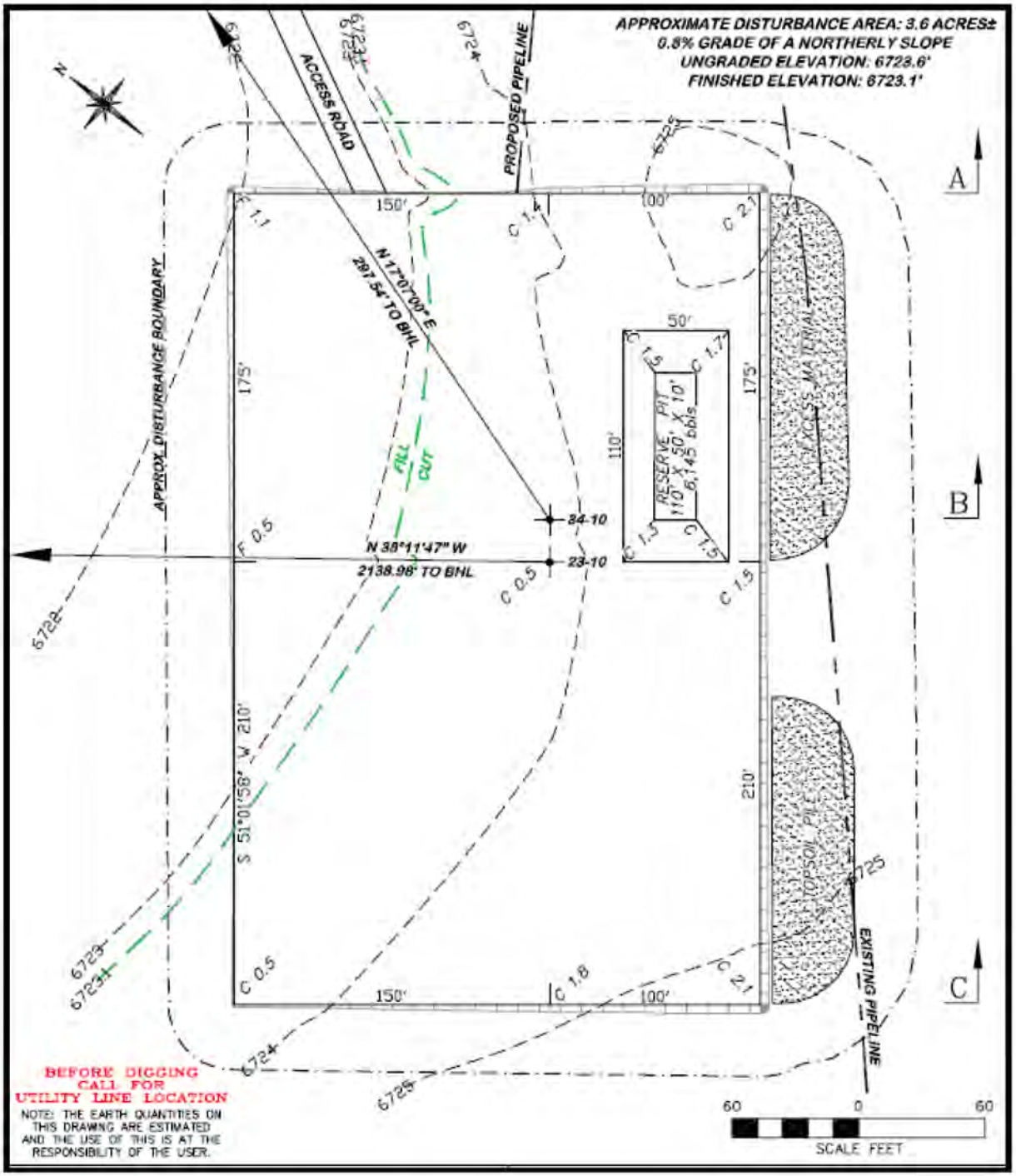
The level area of the well pad required for initial drilling and completion operations would be approximately 350 feet x 250 feet, including a reserve pit approximately 100 feet x 50 feet and 10 feet deep, which would represent an average surface disturbance of approximately 2 acres per well or 4.2 acres for a four-well head pad.

Erosion control would be implemented, as necessary, at each well location through prompt revegetation of disturbed areas and by constructing surface water drainage controls such as berms, diversion ditches, sediment ponds, and silt fences in accordance with the approved reclamation and Storm Water Pollution Prevention Plans (SWPPPs). All diversion ditches and other surface water and erosion control structures at each location would be shown on maps provided with each APD.

2.2.3.3 Drilling Operations

Following construction of the well pad and access road for a given well, a rotary drilling rig would be transported via truck to the well pad and erected on-site. Typically, one rig would be used for drilling. If available, two rigs could occasionally be operating at the same time. Each drilling operation would require transport of drilling-related equipment and materials to facilitate the drilling operation. Vehicle trips for the drilling operations are provided in Section 2.2.4. This includes transportation of the drill rig, drill pipe, drilling fluid products, and related support equipment, but does not include the truck traffic required for re-supplying the operation (e.g., fuel, drilling fluid additives, etc.). Additional traffic would be variable, depending on the phases of the drilling operation, but should not exceed six or seven vehicles per day per drill site throughout the drilling activity.

Approximately 6 days would be required to drill, log, and case each well using a conventional rotary drill rig and associated rig equipment. Wells would be drilled to sandstones in the Almond Formation at depths of approximately 4,000 to 5,500 feet. Cuttings and all drilling fluids would be contained in the reserve pit, and drilling fluids would be recovered and re-used whenever practical.



Note: Disturbance area would be approximately 2 acres per well or 4.2 acres for a four-well head pad.

Figure 2-2 Example Pad Layout

In the event that undesirable materials (e.g., hydrocarbon liquids) are inadvertently discharged to a reserve pit, they would be removed immediately and disposed of in accordance with appropriate and applicable requirements depending on the materials that are discharged. Upon completion, if hydrocarbons are present in the pit (as evidenced by sheen on the water surface) and not immediately removed, the pit would be netted or screened to protect waterfowl. Netting would remain in place until fluids are removed or evaporated. No abnormal temperatures, high pressures, or hydrogen sulfide are anticipated to be encountered during drilling. Water requirements for drilling are discussed in Section 2.2.5.

A typical drilling rig would require 5 workers per 12-hour shift (or tour), with 1 crew on shift and 1 crew off. These crews would reside at their own homes or other living quarters in nearby towns (e.g., Rock Springs). A number of additional personnel may be required to be on location during various stages of the drilling operation, including a geologist, a mud logger, and other service personnel. In some cases, these individuals would be required to remain on location 24 hours a day during drilling operations, and trailers would be provided on-site for their use. The trailers would provide restroom facilities for the workers. Upon completion of operations, or as needed, human waste would be removed from the location and disposed of at an approved sewage disposal facility.

If any spills of reportable quantities for oil, gas, or other fluids occur, as defined in BLM NTL-3A, APC would immediately contact the BLM and any other regulatory agencies (e.g., U.S. Environmental Protection Agency [USEPA] National Response Center, State of Wyoming) as required by law or regulation. Strict cleanup efforts would be initiated as soon as practicable. Proper final remediation and reporting to the appropriate agencies would be completed by APC. These actions would occur at any stage of drilling, completion, operation, or abandonment of facilities.

During drilling and subsequent operations, all equipment and vehicles would be confined to access roads, well locations, and other areas specified in approved APDs, except in emergency situations.

Freshwater aquifers and potentially mineable coal seams would be protected by running steel casing into the open borehole and cementing the casing into place. Cementing also would isolate all other formations in the hole and would effectively eliminate communication between hydrocarbon zones and/or water aquifers and other mineral resources. Individual well casing design would be approved by the BLM during the APD process.

2.2.3.4 Completion and Production Testing

Once a well has been drilled and cased, completion operations would commence approximately 2 to 3 weeks after drilling is complete, depending on availability of crews and equipment. These completion operations would typically consist of cleaning out the wellbore, pressure testing the casing, perforating, hydraulic fracturing, and the running of production tubing and equipment if commercial production is established.

In conjunction with these completion operations, selected intervals would be hydraulically fractured within the target formation in order to “stimulate” production. These hydraulic fracturing operations would typically consist of pumping a thick fluid mixture, consisting of 99.5 percent sand and water into the production formation under pressure. Various chemical additives would be added to the fracturing fluids to improve performance. The mixture then would be pumped through the perforations into the production formation. As the formation is fractured, resultant fissures (fractures) would be filled with sand or other proppant, which props the fractures open and facilitates the flow of oil and gas into the wellbore and subsequently to the surface. The WOGCC requires operators to disclose the types and amounts of hydraulic fracturing chemicals that would be used prior to stimulation (WOGCC Rules and Regulations, Chapter 3 § 45(d)). For additional information on hydraulic fracturing, including a list of APC’s hydraulically fractured wells, refer to the national hydraulic fracturing chemical registry at fracfocus.org.

Upon completion of the hydraulic fracturing operation, the well would be flowed back to the surface through temporary production equipment to recover as much of the hydraulic fracturing fluids as practicable, and to clean excess proppant out of the well prior to setting production equipment on location and commencing production. All fluids returned during the flow-back procedure would be captured in steel tanks on the well pad. The well would be flowed back until 100 percent of hydraulic fracturing fluids are recovered or until the well starts flowing oil, water, and CO_2 at normal production rates. Any oil produced with the flowback would be transported (depending on the unit) to either the Arch or Monell main tank battery for cleanup and sales. Flowback water would either be transported to an approved disposal facility or placed into the produced water system within the Arch or Monell units, with approval from all applicable regulatory agencies, depending on composition. Disposal sites would be identified after well completion in accordance with the Onshore Oil and Gas Order No 7. APC is currently investigating alternatives for recycling and re-use of flowback and produced water through pilot programs in other assets and basins. If technologically and economically viable alternatives are identified, water recycling technologies may be implemented in the project area. Flowback gas, which is predominantly CO_2, would be vented for a period of time to be determined on a well-by-well basis. Venting would be halted once all hydraulic fracturing fluids are recovered or the well reaches normal oil, water, and CO_2 rates. Other options to capture this gas are currently being evaluated. Operational limitations hinder the gathering of flowback gas. This is mainly due to the pressure that the wells would have to flow against, which would lessen the effectiveness of the flowback and potentially leave hydraulic fracturing fluids in the formation.

Production would, on average, require two workers for every 60 wells for the life of the project. Existing Monell Unit personnel would be utilized. Telemetry would be utilized in an effort to minimize unnecessary travel and time spent at the well site.

After reclamation of disturbed areas no longer needed after drilling, each production and injection well location typically would occupy an area of approximately 1 acre (**Figure 2-3**).

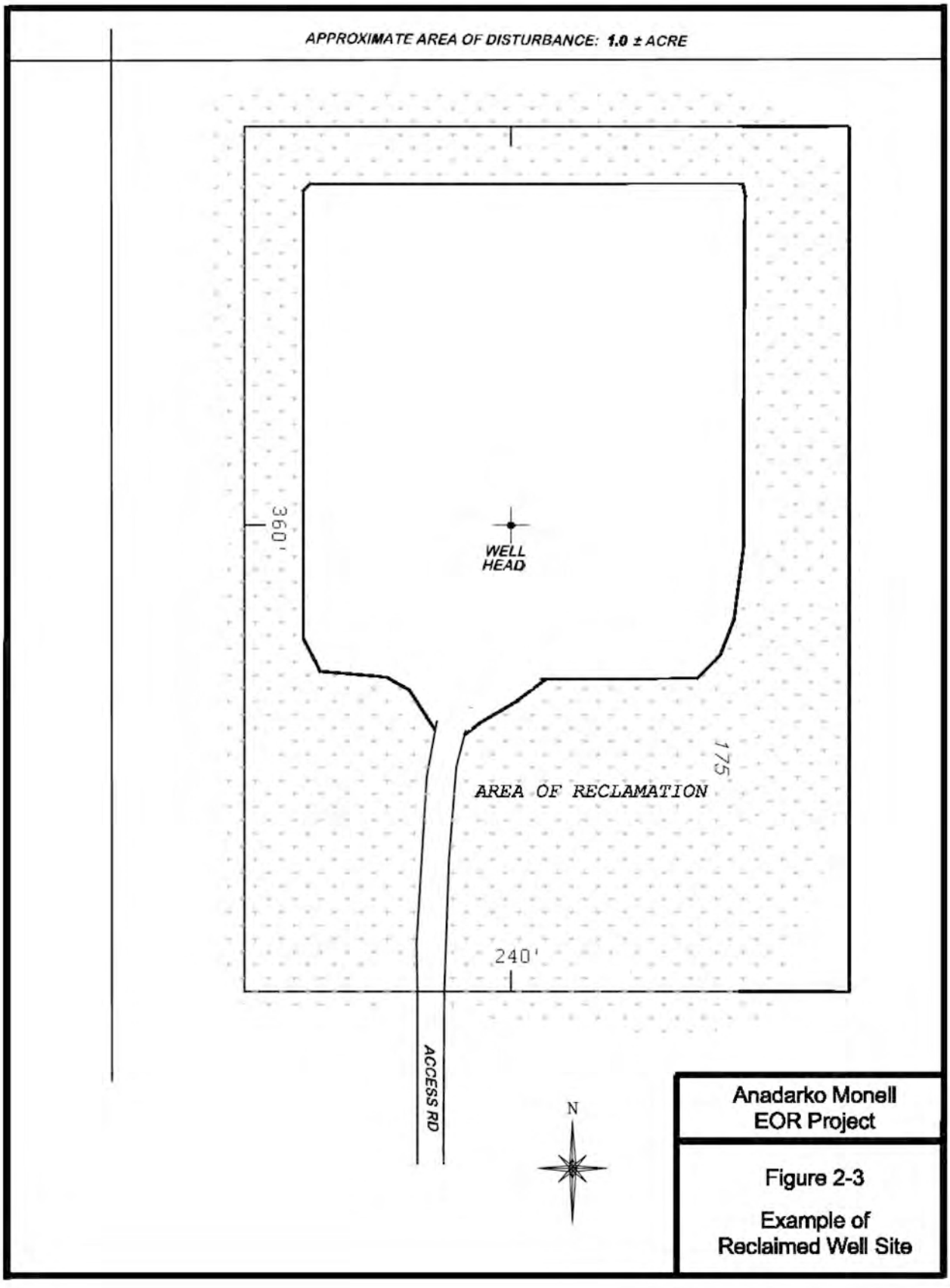
Project traffic estimates for completion, production testing, reclamation, and production are provided in Section 2.2.4.

2.2.3.5 Production Pipelines

Production collection lines for in-field fluid collection (gathering system) would be installed to bring oil/water/gas/CO_2 from individual well sites to a production/header facility and the interconnect pipeline. Production collection lines generally would be located adjacent to roads, where feasible, and all necessary authorizing actions for the lines would be addressed prior to installation.

Sufficient topsoil to facilitate reclamation would be removed from collection line ROWs and stockpiled before construction. Suitable topsoil material removed in conjunction with clearing and stripping would be conserved in stockpiles within the ROW. Topsoil would be stripped to a minimum depth of 6 inches.

A trench approximately 5 feet deep would be excavated with a trencher or backhoe. Up to 12-inch-diameter steel with high density polyethylene liner or poly-lined flow pipe would be buried at depths of 3 to 4.5 feet, except at major road and railroad crossings, where the depth would be at least 6 feet. Spoil and topsoil would be windrowed separately. If pipelines are required to cross Bitter Creek, these lines would be bored. Automatic shutoff valves would be used at fluid pipeline crossings on Bitter Creek. Intermittent pipeline crossings would be located in areas that would not affect channel stability or stream flows.


APPROXIMATE AREA OF DISTURBANCE: 1.0 ± ACRE
360'
WELL HEAD
175'
AREA OF RECLAMATION
240'
ACCESS RD
N
Anadarko Monell EOR Project
Figure 2-3
Example of Reclaimed Well Site

2.2.3.6 Compressor Station

A new compressor station would be constructed in Section 35, T19N, R99W in the Monell Unit at a location adjacent to or across the road from an existing production facility (**Figure 2-1**). The purpose of the compressor station is to obtain maximum recycled compression for new wells that the current system is unable to deliver. The engines for this compressor would be gas or electric driven and be in compliance with WDEQ guidelines.

2.2.3.7 Oil Production

Wells requiring artificial lift would use various methods, including but not limited to, rod-types pumping units of submersible pumps. Water produced during initial production operations could be used for slipstream purposes. Slipstream keeps the wells from freezing in the tubing and flowline. Water that is not used for this purpose would be disposed of in the existing water disposal wells. Injection wellheads and pumping unit motors may be enclosed by small shelters to protect the equipment from the elements.

All wells would be operated in a safe manner according to standard industry operating procedures. Routine maintenance of the producing wells would be necessary to maximize performance and to detect operational difficulties. Each well site would be monitored daily to ensure operations are proceeding safely and efficiently. Routine on-site equipment maintenance also would be performed as necessary. All roads and well sites would be regularly inspected and maintained (e.g., regraded, resurfaced, and watered) to minimize dust and erosion and to ensure safe operations.

Workovers are implemented on an as-needed basis and are undertaken to increase or maintain production from the current downhole producing zone; to recomplete in a new zone; to lower operating costs by reducing water and/or sand production; or to return the well to its production objective by pulling and replacing leaking tubing or pulling and repairing lift equipment. Workovers normally take 1 to 4 days and would be scheduled to minimize potential adverse effects to sensitive environmental resources.

2.2.3.8 Production Facilities

Three new production/header facilities would be constructed for the proposed project. Two new production/header facilities and a new compressor station would be constructed in the Monell Unit. The approximate location of the compressor station and one of the production/header facilities would be in Section 35, T19N, R99W. The approximate location of the second production facility would be in Section 3, T18N, R99W. The approximate location of a new production facility/LACT facility in the Arch Unit would be in Section 23, T19N, R99W.

Each header building would include the appropriate well testing equipment, where individual well production would be tested and measured. The RCS recompresses the CO_2 to a higher pressure for reinjection down hole. Wellhead production volumes would be transported to the manifold header facility via new flow lines. Production would be comingled at the production test header building, gas and liquid split by bulk separators and routed in separate gathering systems. Where feasible, new flow lines would be designed and constructed along existing roads and surface disturbance.

The injection system is centralized in the injection header building instead of installed at the well heads. One new injection manifold would be housed in the same building as the production manifold. The injection fluid CO_2 would be delivered to the header building via newly constructed pipeline segments tied in the existing CO_2 distribution system.

2.2.4 Drilling Schedule, Work Force, and Project Traffic

The dates of construction, drilling, and completion would be determined by multiple factors including, but not limited to, site-specific conditions of approval and APD approval by the BLM, market fluctuations, drill rig availability, and weather conditions. Construction, drilling and completion of all 125 wells would occur over a 9-year period, with approximately 14 wells drilled annually. The life of each productive well is

anticipated to be approximately 30 years. The anticipated life of the field is approximately 49 years. The life of the field is estimated based on the last productive well drilled in the last year of the 9-year drilling phase, an anticipated 30-year life of the producing well, and an estimated 10 years to achieve successful final reclamation.

For drilling, completion, and maintenance operations, up to 250 temporary workers would be employed at peak construction times. For maintenance and day-to-day operations, APC may add up to 10 employees, most of who would come from the surrounding communities.

Traffic estimates for the various phases of the project are provided in **Table 2-1**. The traffic numbers do not include vehicles from Interstate 80 (I-80) or the MGR Patrick Draw Plant, which is not part of the Proposed Action. It also should be clarified that as production facilities and pipelines are phased in during development, the well facilities would be eliminated or reduced, which would result in a decrease in pumper truck traffic.

Table 2-1 Traffic Estimated for the Proposed Action

Estimated Traffic under the Proposed Action					
Project Feature	**Vehicle Type**	**Average Weight (pounds)**	**Approximate Daily Round Trips**	**Approximate Round Trips Per Well Pad/Well[1]**	**Approximate Total Round Trips Over Life-of-Project or Appropriate Project Phase[2]**
Construction					
Well Pad Construction Traffic	Haul Trucks	80,000	1 per well	3	375
	Light Trucks	20,000	2 per well	6	750
Infrastructure Development Traffic[3]	Misc. Trucks and Construction Equipment Vehicles	NA	10	NA	36,500
Drilling and Completion					
Drilling Traffic	Haul Trucks	80,000	2 per well	16	2,000
	Logging/Mud Trucks	70,000	1 per well	8	1,000
	Water Trucks	60,000	3 per well	24	3,000
	Light Trucks	8,000	5 per well	40	5,000
Completion Traffic	Semi/Transport/ Water/Sand	80,000	7 per well	49	6,125
	Haul Trucks	80,000	2 per well	14	1,750
	Light Trucks	8,000	7 per well	49	6,125

Table 2-1 Traffic Estimated for the Proposed Action

Estimated Traffic under the Proposed Action					
Project Feature	**Vehicle Type**	**Average Weight (pounds)**	**Approximate Daily Round Trips**	**Approximate Round Trips Per Well Pad/Well[1]**	**Approximate Total Round Trips Over Life-of-Project or Appropriate Project Phase[2]**
Interim Reclamation and Production					
Interim Reclamation Traffic[4]	Haul Trucks	80,000	1 per well	3	375
	Light Trucks	8,000	1 per well	3	375
Operational Traffic[5]	Crude Oil Tanker Trucks	80,000	7	NA	102,200
	Produced Water Trucks	80,000	11	NA	160,600
	Light Trucks	8,000	7	NA	102,200
Total Traffic Estimates					
Total Vehicle Trips over the Life-of-Project	NA	NA	NA	NA	428,375

[1] Well pad construction is based on the upward estimate of 3 days needed to construct each pad. Per well drilling and completion traffic estimates are based upon a 6-day drilling period per well.

[2] Infrastructure development traffic is calculated over a 10-year development phase. Operational traffic totals are conservatively calculated over a 40-year operational period (i.e., 10-year development phase + up to 30-year life of the proposed wells).

[3] Infrastructure development includes approximately 5 vehicles per day (10 round trips) for construction and installation of the access roads, pipelines, power lines, compressor station, central tank batteries, water treatment facilities, and other surface facilities.

[4] Interim reclamation traffic assumes that interim reclamation activities could be completed in a 3-day period per well pad and associated ROWs.

[5] Operational traffic includes approximate number of tanker trucks per day for hauling crude oil to refineries and produced water for disposal, light vehicle traffic from pumpers, and other field operation traffic needed to service the proposed 125 wells. Operational traffic totals are calculated over a 40-year life of the Proposed Action. Total vehicle traffic equals number of round trips multiplied by two (inbound and outbound traffic).

2.2.5 Water Requirements

It is estimated that approximately 5,000 barrels (210,000 gallons or 0.64 acre-foot) of water would be needed to drill and complete each well, and an estimated 0.13 acre-foot of water would be needed per well to control fugitive dust during dry and windy conditions for the Proposed Action. Thus, total water need for the proposed project would be approximately 96.25 acre-feet (0.77 acre-foot x 125 wells), averaging about 10.69 acre-feet per year over the 9-year development period. No water would be required for hydrostatic testing of production flowlines.

The water for the drilling and completions would be sourced from either of the two water supply wells located within the Monell Unit, as described in **Table 2-2**, or an outside source if this water is not suitable. Water obtained from permitted water sources (WSW 1 and WSW 2 water wells) would be considered historic depletions (permitted prior to January 1988). Further discussion on the water depletion evaluation for federally endangered fish species in the Colorado River Basin is provided in

Section 4.1.8.2. The water would be transported from the supply well location to the drilling/completion location via truck transport. Additional water sources may include water obtained through private transactions.

Table 2-2 Water Sources for Drilling, Completion, and Dust Abatement

API Number	Water Right Permit Number	Filing Date	Expiration Date	Well Name	Surface Location	Formations and Cemented Depth
49-037-07027	P1881.0W	03/23/1967	None Listed	WSW 1	T18N, R99W, Section 2, 2280'/NL, 2540'/WL	Lance and Fox Hills Formations Cemented Depth: 3,720 feet
49-037-06464	P1882.0W	03/23/1967	None Listed	WSW 2	T18N, R94W, Section 25, NW¼, SE¼NW¼	Lance and Fox Hills Formations Cemented Depth: 3,615 feet

Produced water would be handled via flowlines and surface facilities. The produced water would be reinjected in a water curtain well to the Almond Formation at a gradient above the CO_2 flood operation. This effectively keeps CO_2 from migrating up and out of the primary flooding area. Produced water and makeup water from source wells in the Monell Unit also would be injected via two disposal wells into the Fox Hills Formation (Monell Unit 179, Section 34, T19N, R99W and Monell Unit 54-33, Section 33, T19N, R99W). In the Arch Unit, two existing producer wells in Section 23 would be converted to disposal wells for injection into the Fox Hills Formation. Produced water also can be used for heat transfer purposes.

2.2.6 Surface Disturbance

Existing roads and ROWs would be utilized to the extent possible. Surface disturbance would result from construction of new well pads, roads, and pipelines. Following initial construction, disturbed areas not needed for operational purposes would be reclaimed by grading, seeding, or other approved means of stabilization.

2.2.6.1 Arch Unit

Up to 5.5 miles of new roads within 60-foot ROWs would be constructed to access all new wells by the end of the project. New roads would be surfaced with gravel and designed to meet current Gold Book standards, using culverts or water bars as needed. Typical roads would have a 20-foot running surface with 20 feet on either side for surface water ditches. The site-specific road design features would be identified during staking and as part of the APD process in cooperation with the BLM.

Of the 21 new well pads proposed in the Arch Unit, four are proposed to be 2-well pads (including 1 pad with 2 new injector wells), 6 would be 3-well pads, 1 would be a 4-well pad, and 10 would be single well pads.

An estimated 13 miles of new pipelines would be installed over the life of the project. Only about 1 mile of pipeline would be located along new road ROWs, so the remainder would result in new surface disturbance that would be revegetated following construction.

Approximately 2.1 miles of new power lines would be constructed, primarily along road ROWs. The route of each power line would only be mowed, not bladed, so no bare ground would result other than the

small area needed to excavate each pole. Most new pipelines in the Arch Unit would be located along proposed new road ROWs, but a few would require additional disturbance for pipeline installation. All disturbed areas within pipeline ROWs would be stabilized. All disturbed areas not required for road running surface and ditches would be stabilized.

The main battery/production and injection facility/LACT/RCS would require approximately 15 acres to construct and would be reclaimed back to 12 acres. Equipment at the facility would include a separator, main tank battery, CO_2 booster, two water tanks, two oils tanks, a flare, LACT system, and the RCS system.

2.2.6.2 Monell Unit

APC would utilize existing roads, well pads, pipelines, and power lines in the Monell Unit to the maximum extent possible. However, pads would be enlarged where new wells are drilled to allow room for drill rigs, wellheads, and reserve pits, as needed. New surface disturbance would result from the expansion of well pads to accommodate the 85 new wells. It is projected that 36 existing pads would be expanded to add new producing wells. See **Table 2-3** for a summary of the number of additional wells per pad.

Table 2-3 Number of New Wells per Pad and Surface Disturbance Acreage by Pad Type

Unit	Pad Type	New Wells per Pad	Number of Pads	Number of New Wells	Initial Surface Disturbance (acres)	Long-term Surface Disturbance (acres)
Arch	Multi-well (Water Injectors)	2	1	2	2.6	1.0
	Multi-well Pad (Oil/Gas Producers or CO_2 Injectors)	2	3	6	7.8	3.0
		3	6	18	20.4	9.0
Arch (cont.)		4	1	4	4.2	2.0
	Single well Pad (Oil/Gas Producers)	1	10	10	18.0	5.0
	Total	**NA**	**21**	**40**	**53.0**	**20.0**
Monell	Multi-well Pad (Oil/Gas Producers) All on existing pads	1	5	5	4.0	2.5
		2	16	32	25.6	16.0
		3	12	36	28.8	18.0
		4	3	12	9.6	6.0
	Total	**NA**	**36**	**85**	**68.0**	**42.5**
Monell/Arch Total		**NA**	**57**	**125**	**121.0**	**62.5**

Two new production facilities (header buildings A4 and A5) and new compression (RCS 2) would be added to the Monell Unit disturbing approximately 10.4 acres during construction and reclaimed back to 9.3 acres. Conceptually, header building A5 would be located in Section 35, T19N, R99W and the new RCS 2 compressor also would be located in this Section. Header building A4 would conceptually be located in Section 3, T18N, R99W.

2.2.6.3 Disturbance Summary

Table 2-3 summarizes the number of wells per pad in each unit. The number of new wells per pad affects the acreage of surface disturbance.

After wells are completed, disturbed areas not needed for operations would be graded to ensure adequate drainage, spread with topsoil, and seeded to reestablish vegetation. The portions of the well pad needed for truck access and operations would be graded and stabilized with gravel. Single well pads and the first well on a new pad would initially disturb 1.8 acres, to be reclaimed back to 0.5 acre of long-term disturbed area. To accommodate additional wells on existing pads while meeting safety requirements, an additional 0.8 acre would be disturbed initially per well, with the disturbed area reclaimed to 0.5 acre per well of long-term surface disturbance for the life of the well. For the four-well pads, a maximum initial disturbance of 4.2 acres would be reclaimed back to 2 acres (0.5 acre per well). If a reserve pit is required on the well pad, it is estimated that approximately 100 feet by 50 feet by 10 feet deep or just over 0.1 acre would be added to the well pad. Note that, in order to conservatively estimate the projected amount of surface disturbance, acreage calculations assume that a reserve pit would be located on each pad. In reality, APC may utilize a closed loop system on the well pad or pipe fluids to a central location.

Table 2-4 summarizes the initial and long-term surface disturbance associated with the Proposed Action. Initial surface disturbance includes the areas disturbed by heavy equipment for construction of roads, pipelines, and well pads, before it is contoured and revegetated. Long-term disturbance includes land that is not revegetated and available for current uses, such as the running surface of roads and the operating surface of well pads.

Table 2-4 Summary of Surface Disturbance

Facility	Quantity	Initial Surface Disturbance (acres)	Long-term Disturbance[1] (acres)
Monell Unit			
New Oil and Gas Wells	85 wells on existing pads	68	42.5
Compressor Station	1	3.5	3.1
Production Facilities	2	6.9	6.2
Arch Unit			
New Wells (oil, gas, injector)	40 wells on 21 pads	53	20
New Roads[2]	5.5 miles	40	34
Pipelines[3]	13.0 miles	39	0
Power Lines[4]	2.1 miles	13	0
Production Facility/LACT	1	15	12
Totals		**238.4**	**117.8**

[1] Long-term disturbed areas would be graveled or revegetated well pads, production facilities, a compressor station, a LACT facility, new roads, power lines around poles, and pipelines, not left as bare ground.

[2] Road disturbance was estimated using ROW widths of 60 feet for initial disturbance and 50 feet for permanent disturbance.

[3] New pipeline disturbance was estimated using a ROW width of 25 feet for initial disturbance.

[4] Power line disturbance was estimated using a ROW width of 50 feet.

2.3 Applicant-committed Environmental Protection Measures

The proposed development analyzed by this EA is already subject to existing lease stipulations federal and state laws, regulations, and policies; all of which will be complied with by the Applicant. In addition, the Applicant is committed to implementing the following environmental protection measures where feasible and practicable:

- Directional drilling to facilitate co-locating wells on pads.
- Use of existing infrastructure in the Monell Unit to avoid construction of new roads and pipelines. Existing well pads would be expanded to accommodate new wells.
- Reuse of drilling water.
- Utilize closed loop systems.
- Remote monitoring of wells to minimize vehicle travel.
- Reclaim areas disturbed by construction and not needed for production by grading and seeding to BLM standards.
- Use of Best Available Control Technology (BACT).
- Utilize green completions.[1]
- Follow the required wildlife management guidance measures and timing stipulations as outlined in the GRRMP.

2.4 Alternatives Considered but not Analyzed in Detail

Several alternatives were considered in the alternatives evaluation, with variations on project time frame, location of new pipelines in the Arch Unit, number of well pads, and the number of roads. Except for project time frame, none of the other options are full alternatives, but instead represent a component of the overall project. The rationale for eliminating these alternatives was based on whether the technique had technical limitations or if it did not meet the purpose and need, as discussed below.

2.4.1 Project Time Frame

The project time frame was originally 5 years for full development with concurrent development in both units. The current project length is 9 years, with Monell Unit development being first. The rationale for eliminating the 5-year time frame is related to economics of developing wells over a short period. The shorter time frame also would reduce the period of air emissions from the construction and operation activities.

2.4.2 Location of New Pipelines in the Arch Unit

In the Arch Unit development, the initial consideration was that new pipelines would be constructed in new road ROWs. This design feature was rejected because following all road ROWs would not be efficient for gathering line construction and flow. The Proposed Action proposes to construct approximately 94 percent (14.6 miles) of the new pipelines in locations that do not follow road ROWs.

2.4.3 Horizontal Wells and Well Pads

EOR techniques have long been utilized by the oil industry to increase hydrocarbon yields from oil and gas bearing structures. Waterflood has been previously used in the Patrick Draw Field. In the last

[1] In green completions, the gas and hydrocarbon liquids that traditionally have been either vented or flared during the completion process are instead captured and processed for use/sale.

20 years, the use of CO_2 as an EOR agent has become increasing popular because it is much more effective at recovering additional trapped oil than waterflooding under certain conditions.

Under the current implementation, APC has demonstrated that CO_2 flooding of the Almond Formation within the Patrick Draw Field substantially increases recovery of remaining oil reserves. These evaluations, however, did not identify alternative EOR techniques that would be economically viable and effective within this field. APC considered horizontal wells to reduce the number of wells used in the EOR project. Due to the age of the field and the vertical layout of the existing wells, it is too late in the process to use this approach. Therefore, this option is not technically sound for use in the Almond Formation and thereby also not an environmentally viable project alternative.

The initial consideration was to construct and develop single vertical wells in the Arch Unit. This approach originally involved 40 new well pads. The single well approach was eliminated and replaced by multi-pad configurations for the purpose of reducing surface disturbance impacts.

2.4.4 New Roads

The initial consideration in the Arch Unit was to construct approximately 50 miles of new roads in order to access single well configurations. After changing the development approach to multi-pad configuration in the Arch Unit, the Proposed Action would only require approximately 5.5 miles of new roads. The reason for reducing road lengths was to minimize surface disturbance in the Arch Unit.

2.4.5 Minimization of Surface Disturbance and Topsoil Removal

One comment letter requested that the EA analyze alternatives which minimize the amount of surface disturbance and topsoil removal. This request does not require a separate alternative because the minimization of surface disturbance was a design objective for various components of the project such as use of existing wells in the Monell Unit, use of multi-pad configuration in the Arch Unit, and collocating new power lines with road ROWs in the Arch Unit.