Appendix B – Operators Manual

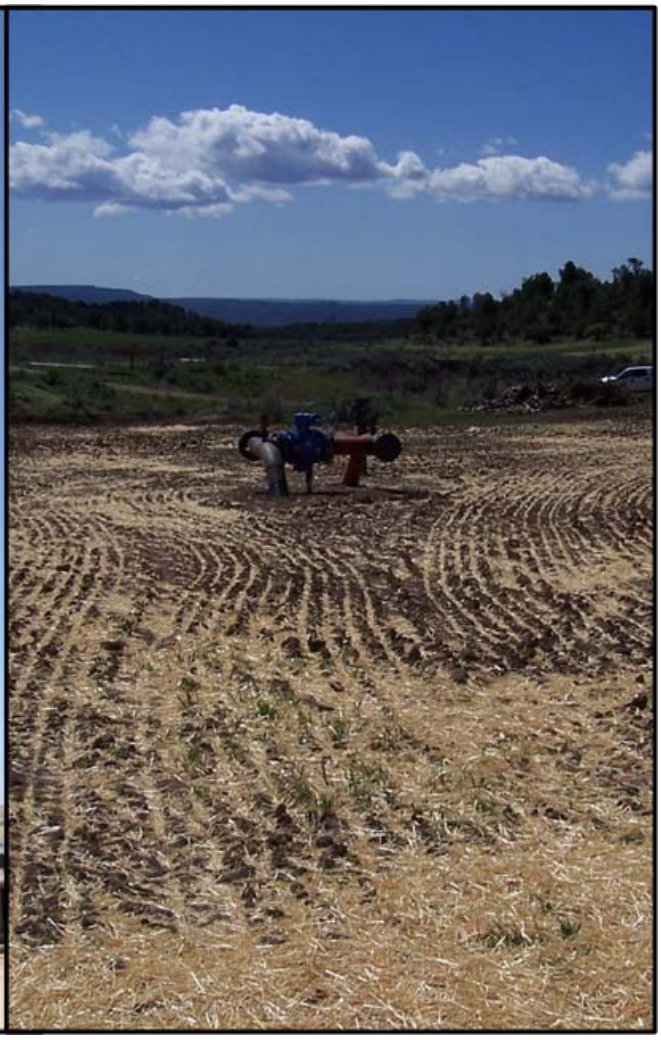
Exploration & Production Operator's Compliance Manual

for

Energy Development Projects

on the

Southern Ute Indian Reservation



Revision Date August 31, 2010

TABLE OF CONTENTS

1 ACRONYMS

API – American Petroleum Institute
BIA – US Department of the Interior, Bureau of Indian Affairs
BLM – US Department of the Interior, Bureau of Land Management
CDP – Central Delivery Point including pipelines, compressor stations, water transfer stations, communications towers, and disposal wells
CERCLA – Comprehensive Emergency Response, Compensation, and Liability Act
COGCC – Colorado Oil & Gas Conservation Commission
DOE – SUIT Department of Energy
DNR – SUIT Department of Natural Resources
E&P – Exploration and Production
EA – Environmental Assessment
EIS – Environmental Impact Statement
EP – Tribal Environmental Programs
EPA – US Environmental Protection Agency
MOU – Memorandum of Understanding
NEPA – National Environmental Policy Act
NPDES– National Pollutant Discharge Elimination System
O&G – Oil and Gas
PEA – Programmatic Environmental Assessment
PPN– Proposed Project Notification
PTS– Permission to Survey
ROW – Right-of-Way
SUIR – Southern Ute Indian Reservation
SUIT – Southern Ute Indian Tribe
SPCC – Spill Prevention, Control and Countermeasure
SWPPP– Stormwater Pollution Prevention Plan
TERO– Tribal Employment Rights Organization
TPY – Tons per year
Tribe/Tribal – Southern Ute Indian Tribe

2 DEFINITIONS

CERCLA Reportable Quantity Spill – Spill at or above quantity for specific chemical, product or waste (hazardous substance) listed under 40 CFR Part 302.
Energy Development Projects – Oil and gas (O&G) projects including pipelines, O&G wells, compressor stations, water transfer stations, central delivery points (CDP), metering stations, and well pad access roads.
Federal Action – Under NEPA, it includes federal projects or projects that are federally funded or assisted, including projects on Tribal land.
Fee Land – Privately owned land on the SUIR.
Off-Lease – Energy development project that extends from one lease to another lease. Examples of off-lease projects include, but are not limited to: 1) well drilling on tribal surface and fee minerals, 2) well drilling on tribal surface and tribal minerals, but directional drilling to fee minerals, and 3) a CDP project on tribal surface that benefits any off-lease operations.
Southern Ute Indian Reservation (SUIR) – The SUIR includes all of the land located within the exterior boundaries of the Southern Ute Indian Reservation.
Split Estates – Land surface ownership and mineral rights are held by separate owners.
Tribal Trust Land – Property held in trust by the United States for an Indian Tribe. These lands include tribal assigned land, and tribal purchased land, but do not include allotted lands[1].

[1] For projects on allotted land, contact the BIA directly.

3 LIMITATIONS

This document provides guidance to Exploration and Production (E&P) Operators on the processes for obtaining 1) authorization to drill an oil and gas (O&G) well and 2) right-of-way (ROW) easements and surface leases on the Southern Ute Indian Reservation (SUIR)[2]. This document also provides stormwater, air permit and spill response compliance guidance for E&P Operators on the SUIR. The document does not, however, substitute for laws and regulations, nor is it a regulation itself. In the future, the Southern Ute Indian Tribe (SUIT) and other applicable regulatory agencies may modify procedures or change the guidance provided in this manual. Nothing in this guidance document shall be construed to be a contract or guarantee by the Southern Ute Indian Tribe, also referred to as the Tribe or Tribal.

4 INTRODUCTION

The purpose of this manual is twofold:

- To provide E&P Operators interested in conducting business within the exterior boundaries of the SUIR guidance on complying with various regulations; and
- To provide E&P Operators with an understanding of the involvement of regulatory agencies in permitting energy development projects.

Due to the complex nature of ownership of the land surface and minerals, and federal agencies' regulations and Tribal requirements within the SUIR, an E&P Operator must take all the necessary steps to obtain approval for energy development projects on the SUIR.

Therefore, it is our hope that this manual will assist E&P Operators in planning and scheduling projects, as well as understanding the nature of doing business on the SUIR.

Detailed flowcharts are provided in Section 13 to assist in determining the jurisdiction and compliance with federal and Tribal rules and regulations, depending on the ownership of the surface and mineral rights.

[2] Additionally, SUIR Crossing Permits, which are required for contractors to access the SUIR, are not discussed in this document. Please contact the Tribal DNR Lands Division for Crossing Permits.

5 AUTHORIZATION PROCESS FOR O&G WELL DRILLING

5.1 Tribal and Agency Jurisdiction

The drilling of an O&G well requires the review and approval of various federal agencies and Tribal departments. The Tribal and agency jurisdiction depends on the ownership of minerals rights and land surface for the subject property or lease. Flowchart 1 reveals the Tribal and regulatory agencies that have jurisdiction under the four types of estate ownership, including split estates.

The Tribal authorization process for drilling an O&G well on the SUIR applies only to estates where the Tribe is the surface land owner. This document does not provide guidance for drilling an O&G well where the land surface is fee-owned[3] (not owned by the Tribe) or allotted land.[4]

Flowchart 1[5] also provides applicable Tribal and agency regulatory requirements required to obtain authorization to drill an O&G well on the SUIR depending on the type of estate ownership. These requirements are discussed in Section 5.2.

5.2 Notification & Authorization Process for O&G Well Drilling

The process required to obtain authorization to drill an O&G well on the SUIR is detailed and involves various Tribal departments as well as federal and state regulatory agencies. As such, Flowchart 2 is provided to assist the E&P Operator in understanding the authorization process, and the coordination amongst parties involved.

In general, compliance steps that are required, as indicated below, for O&G well drilling on the SUIR include the following:

1. Permission to Survey (PTS)

   A Permission to Survey (PTS) is required for O&G well drilling on the SUIR where the Tribe is the surface land owner. PTS (per 25CFR169) requires the submittal of a detailed written application to U.S. Department of Interior, Bureau of Indian Affairs (BIA). Flowchart 2 provides the PTS authorization process. An E&P Operator cannot perform a survey until the operator receives the permission to survey approval from the BIA.

   a. Proposed Project Notification (PPN)

      The BIA submits the PTS package to SUIT DNR which begins the PPN review process. The PPN and its review process are fairly detailed and require that an On-site be conducted.

[3] For property that is fee-owed surface with Tribal-owned minerals, please contact the BLM directly.
[4] For allotted land, contact BIA directly.
[5] Please note that flowcharts provided in this document may have highlighted text, which are links to documents that provide additional information in completing a process. Clicking on the link should open the highlighted document provided the reader has an internet browser open on their computer.

2. On-site

   Once the E&P Operator has received the approved PTS from the BIA, the operator may then have the well site surveyed and provide the survey plats to SUIT Department of Energy (SUIT DOE). The On-site is attended by personnel representing various federal and Tribal entities, depending on jurisdiction (see Flowchart 1). The E&P Operator must contract an archaeologist and biologist that meet Tribal Employment Rights Organization (TERO) requirements, who will attend the On-site and conduct cultural resources and threatened and endangered species surveys, respectively. Survey findings and recommendations will then be provided in a cultural resources report and biological assessment (BA). The cultural resources report will be forwarded to the BIA archaeologist to obtain clearances to proceed with the project. Whereas, the BA will be reviewed by Tribal DNR Wildlife Division in consultation with the U.S. Fish and Wildlife Service, and site specific stipulations are developed to address any threatened or endangered species issues associated with the project. Finally, the SUIT DNR Range Division will generate a Range Report which includes site specific stipulations.

3. Application for Permit to Drill (APD)

   A federal APD is required by the U.S. Department of Interior, Bureau of Land Management (BLM) for all O&G well drilling activities on Tribal Trust Lands. A Colorado APD is required for all O&G well drilling activities on the SUIR (see Flowchart 1), including Tribal Trust lands and minerals[6].

4. Tribal Resolution for Off-Lease Operations

   A Tribal Resolution is required for all off-lease operations involving Tribal Trust Land, including split estates and situations where the Tribal minerals and land surface are separate leases (i.e. when directional drilling is being performed). The resolution process is provided in Flowchart 3.

5. National Environmental Policy Act (NEPA)

   NEPA is required for all federal actions including drilling O&G wells that involve Tribal land or minerals and CDP projects that require ROW easements on Tribal land. The O&G Development on the Southern Ute Indian Reservation Environmental Impact Statement (SUIT EIS) was completed in July 2002. The SUIT EIS approved the current O&G development program on the SUIR. A Programmatic Environmental Assessment (PEA) is currently being conducted for 80-acre infill wells on Tribal land and minerals within the SUIR. For development of 80-acre infill wells within the SUIR, E&P Operators will need to complete a site specific environmental assessment (EA) which will be tiered to the PEA.

[6] The BLM and COGCC have an agreement that allows COGCC participation in the APD process. The SUIT has a Memorandum of Understanding (MOU) with the BLM and BIA, which includes allowances for the BLM/COGCC agreement.

6 AUTHORIZATION PROCESS FOR PIPELINES AND SURFACE LEASE PROJECTS

6.1 Tribal and Agency Jurisdiction

Proposed pipelines and surface lease projects require the review and approval of various federal agencies and Tribal departments. The Tribal authorization process for pipelines and surface lease projects on the SUIR applies only when the SUIT is the surface land owner[7]. This manual does not provide guidance for pipeline or surface lease projects, where the surface is fee-owned (not owned by the Tribe).

6.2 Notification & Authorization Process for Pipelines and Surface Lease Projects

The process required to obtain authorization to proceed with a pipeline or surface lease project on the SUIR is detailed and involves various Tribal departments as well as federal and state regulatory agencies. As such, Flowchart 4 is provided to assist the E&P Operator in understanding the authorization process, and the coordination amongst the parties involved.

In general, compliance steps that are required, as indicated below, for pipeline and surface lease projects on the SUIR include the following:

1. Permission to Survey (PTS)

   A PTS is required for pipeline and surface lease projects on the SUIR where the Tribe is the surface land owner. PTS (per 25CFR169) requires the submittal of a detailed written application via the BIA. Flowchart 4 provides the PTS authorization process. An E&P Operator cannot perform a survey until the operator receives the permission to survey approval from the BIA.

   a. PPN

      The BIA submits the PTS package to SUIT DNR which begins the PPN review process. The PPN and its review process are fairly detailed and require that an On-site be conducted.

2. Notification of Measurement of Gas (Royalties)

   Per 43 CFR Part 3160 *Onshore Oil and Gas Operations* and BLM Onshore Order Number 5, E&P Operators must notify SUIT DOE (Accounting Department) if any contribution of the natural gas being compressed at the proposed facility is tribally owned. This requirement applies even if the land surface is fee-owned. E&P Operators must measure and report natural gas including lease-use (fuel) gas.

3. On-site

   Once the E&P Operator has received the approved PTS from the BIA, the operator may then have the surface lease or ROW surveyed and provide the survey plats to SUIT DOE. The On-site is attended by personnel representing various federal and Tribal entities, including the BIA and SUIT DNR. The E&P

[7] However, notification of measurement of natural gas is required if any contribution of gas is tribally owned, even if the land is fee-owned. Please see paragraph 2 under Section 6.2 for details.

Operator must contract an archaeologist and biologist that meet TERO requirements, who will attend the On-site and conduct cultural resources and threatened and endangered species surveys, respectively. Survey findings and recommendations will then be provided in a cultural resources report and biologist assessment (BA). The cultural resources report will be forwarded to the BIA archaeologist to obtain clearances to proceed with the project. Whereas, the BA will be reviewed by Tribal DNR Wildlife Division in consultation with the U.S. Fish and Wildlife Service and site specific stipulations developed to address any threatened or endangered species issues associated with the project. Finally, the SUIT DNR Range Division will generate a Range Report which includes site specific stipulations.

6. Tribal Resolution for Off-Lease Operations

   A Tribal Resolution is required for all off-lease operations involving Tribal Trust land, including split estates and situations where the Tribal minerals and land surface are separate leases (i.e. when directional drilling is being performed). The resolution process is provided in Flowchart 3.

4. Surface Lease and ROW Easement

   A Surface Lease (aka Business Lease) is required for any surface lease including a CDP (i.e. pipeline, compressor station, water transfer station, disposal well, or an off-lease communications tower). A ROW easement is required for pipelines[8]. The Surface Lease or ROW Easement must be obtained from the Tribe and the BIA with the assistance of SUIT DOE (see Flowchart 5).

5. National Environmental Policy Act (NEPA)

   The NEPA process is required for all federal actions including pipeline and surface lease projects that involve Tribal Land or minerals and projects that require ROW easements on Tribal Land. The O&G Development on the Southern Ute Indian Reservation Environmental Impact Statement (SUIT EIS) was completed in July 2002. The SUIT EIS approved the current O&G development program on the SUIR. For development of pipeline and surface lease projects within the SUIR, E&P Operators will need to complete a site specific environmental assessment (EA).

[8] All road ROW shall be constructed such that the width of disturbance does not exceed 20 feet. All pipeline ROW shall be constructed such that the width of disturbance does not exceed 40 feet, for the pipeline alone or when combined with a road.

7 STORMWATER

O&G construction activities and operations have the potential to contribute pollutants to stormwater. Stormwater runoff from areas disturbed by O&G activities and operations can cause erosion and be contaminated with sediment. Stormwater pollution can result when stormwater runoff comes into contact with industrial and construction materials, such as production fluids and other chemicals, that have been spilled, improperly disposed of, or stored outdoors. Implementation of best management practices (BMPs) can reduce erosion, sedimentation and stormwater pollution from O&G construction activities and operations.

Under the 2005 Energy Policy Act, O&G construction activities on Tribal land are currently exempt from obtaining a National Pollutant Discharge Elimination System (NPDES) permit for stormwater discharges associated with construction activities except in very limited instances. Facilities that have a discharge of a CERCLA (Comprehensive Emergency Response, Compensation, and Liability Act) reportable quantity release or that contribute pollutants (other than non-contaminated sediment) that result in a violation of a water quality standard are required to obtain and maintain NPDES permit coverage for stormwater for the entire operating life of the facility from the Environmental Protection Agency (EPA).

However, the SUIT is requesting that all E&P Operators conducting business on lands subject to the Tribe's jurisdiction adhere to the *Southern Ute Indian Tribe Stormwater Recommendations* (*SUIT Stormwater Recommendations*). The *SUIT Stormwater Recommendations* require that the operator submit a Notice of Intent (NOI) to the Southern Ute Water Quality Program and prepare a Stormwater Pollution Prevention Plan (SWPPP) prior to any project activity.

8 AIR QUALITY PERMIT

Oil & Gas operations have the potential to emit air pollutants from activities associated from wellhead compression to central delivery points. Currently, regulatory oversight is provided by the EPA. However, the SUIT is in the process of developing Clean Air Act (CAA) Programs for all sources on all lands throughout the SUIR. Once approved by the EPA, the SUIT will be the regulatory body that will implement and administer approved CAA Programs.

Currently, with EPA oversight E&P Operators are subject to EPA CAA Programs and regulations. Applicability of an EPA CAA program is dependent on the source's potential to emit (PTE) and in some cases, the source type. The current permitting threshold under EPA's jurisdiction is 100 tons per year (tpy) for any of the regulated air pollutants for a source. This would subject the source to EPA's 40 CFR Part 71 Operating Permits Program, requiring the source to apply for and receive a major source permit to operate from the EPA. Larger sources (i.e. PTE>250tpy) may trigger preconstruction permitting requirements under EPA's New Source Review Permitting Program. In some cases, the source type may trigger notification and reporting requirements under EPA's 40 CFR Part 60 New Source Performance Standards Program.

It is highly recommended that E&P Operators complete an air regulatory applicability determination for its proposed operations and complete and submit all required notices or permit applications to EPA prior to the installation and operation of compressor drivers on the SUIR.

E&P Operators should remain cognizant of upcoming SUIT, BLM or EPA actions that will require installation and operation of internal combustion units meeting NOx Emission Rates[9] that are dependent on the horsepower of the unit (i.e. emissions rates would not be PTE dependent).

[9] Emission rates are to be specified by regulatory agency or pending PEA currently being conducted for 80-acre infill wells on Tribal Trust land and minerals within the SUIR.

9 SPILL RESPONSE AND REPORTING

E&P Operators shall take measures to prevent, control, and cleanup spills, including the development and implementation of a Spill Prevention, Control and Countermeasure (SPCC) Plan as required by EPA regulations (40CFR112).

On the SUIR, a spill of any kind (produced water, condensate, chemicals, etc.) is reportable to the SUIT government, if the spill:

- Exceeds or is equal to one barrel (42 gallons);
- Leaves the location footprint;
- Flows into live water or a dry arroyo;
- Has the potential to reach ground water; or
- Meets the Reportable Quantity under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA).

The following table is provided to assist in determining the need for reporting a spill on the SUIR:

DESCRIPTION/CRITERIA			NOTIFICATIONS
	No	Yes	
Is the spill greater than or equal to **one barrel** (42 gallons)?	No report	►	**To SUIT and BIA** **Oral Notification to Tribal Environmental Programs Division (970-563-0135)** as soon as practicable followed by written within 24 hours. Tribal EP then notifies: • BIA, Realty • SUIT DOE, Lands Office • SUIT DNR, Lands & Range Divisions • SUIT, Office of Risk Mgt **After-hours notification** (**970-563-4401**) shall be made to the Southern Ute Police Department.
Did spill **leave the location footprint**?	No report	►	
Did spill reach **surface water** or **dry arroyo** or **storm sewer** that leads to surface water?	No report	►	
Does spill have the potential to reach **groundwater**?	No report	►	
Did the **spill meet the reporting criteria** of any federal agency (i.e. EPA's CERCLA reportable quantity, USDOT's pipeline release reporting criteria, BLM's spill reporting criteria)?	No Report	►	

Tribal notification should be made to the BIA and to the Tribal Environmental Programs Division (Tribal EP) offices. Tribal EP will then notify the SUIT DOE and SUIT DNR. Use the *Southern Ute Environmental Programs Spill/ Release Report* form to report a spill that took place on the SUIR.

The operator is solely responsible for making non-tribal notifications that might be required, including notifications to the National Response Center, EPA, and BLM.

10 REFERENCES

Reference	Link to Webpage
SUIT DNR *Standard Operating Procedures (SOP) for Field On-Sites and Survey Plats*	http://www.suitdoe.com/Documents/SUITSOPforFieldOn-sitesandSurveyPlats.pdf
SUIT DNR Permission to Survey (PTS) and Proposed Project Notification (PPN) Presentation	http://www.suitdoe.com/Documents/DNRPPNGermaineSanchez.pdf
SUIT Stormwater Recommendations	http://www.suitdoe.com/Documents/SUITStormwaterRecommendations.pdf
SUIT Environmental Programs Spill/Release Report	http://www.suitdoe.com/Documents/SpillReportTemplate-OnReservation.pdf
25 CFR 169 – Rights-of-Ways Over Indian Lands	http://www.access.gpo.gov/nara/cfr/waisidx_03/25cfr169_03.html
40 CFR 60 – Standards of Performance for New Stationary Sources	http://www.access.gpo.gov/nara/cfr/waisidx_07/40cfr60_07.html
40 CFR 71 – Federal Operating Program Permits	http://ecfr.gpoaccess.gov/cgi/t/text/text-idx?c=ecfr&tpl=/ecfrbrowse/Title40/40cfr71_main_02.tpl
43 CFR 3160 – Onshore Oil and Gas Operations; Federal and Indian Oil and Gas Leases; Onshore Oil and Gas Order Number 1, Approval of Operations	http://www.access.gpo.gov/nara/cfr/waisidx_07/43cfr3160_07.html
BLM Onshore Order Number 5 – Measurement of Gas	http://www.blm.gov/pgdata/etc/medialib/blm/co/programs/oil_and_gas.Par.79178.File.dat/ord5.pdf

11 POINTS OF CONTACT

Agency	POC	Title	Phone Number(s)
BIA	John Waconda	Superintendent	970-563-4511 970-563-1224
	Johnna Oberly	Deputy Superintendent	970-563-4511 970-563-1228
	Steve Sullaway	Realty Officer	970-563-4511 970-563-1248
	Jim Friedley	NEPA Coordinator	970-563-4571
BLM	Dave Swanson	Physical Scientist	970-385-1370
SUIT DNR	Lena Atencio	Director	970-563-0125
SUIT Dept. Of Justice & Regulatory	Charlie Flagg	Department Head	970-563-0100 x3303 970-563-0180
SUIT Environmental Programs Div.	Tom Johnson	Division Head	970-563-0100 x2229 970-563-0135
SUIT Water Quality Program	Sal Valdez	Program Manager	970-563-0100 x2217 970-563-0135
SUIT DNR Lands Div.	Germaine Ewing	Division Head	970-563-0100 x2228 970-563-0126
SUIT DNR Range Div.	Jason Mietchen	Division Head	970-563-0100 x3512 970-563-4780/4571
	Deb Koenig	Range Specialist	970-563-0100 x3514 970-563-4780/4571
SUIT DNR Wildlife Div.	Steve Whiteman	Division Head & SUIT NEPA Coordinator	970-563-0100 x2413 970-563-0130
SUIT DOE	Ed Trahan	Land Manager	970-563-5563
	Dee Olguin	Land Specialist	970-563-5571
	Kyle Siesser	Geologist	970-563-5556
TERO	Mark Torres	Division Head	970-563-0100 x2291 970-563-0117
	Floyd Jameson	Compliance Officer	970-563-0100 x2292

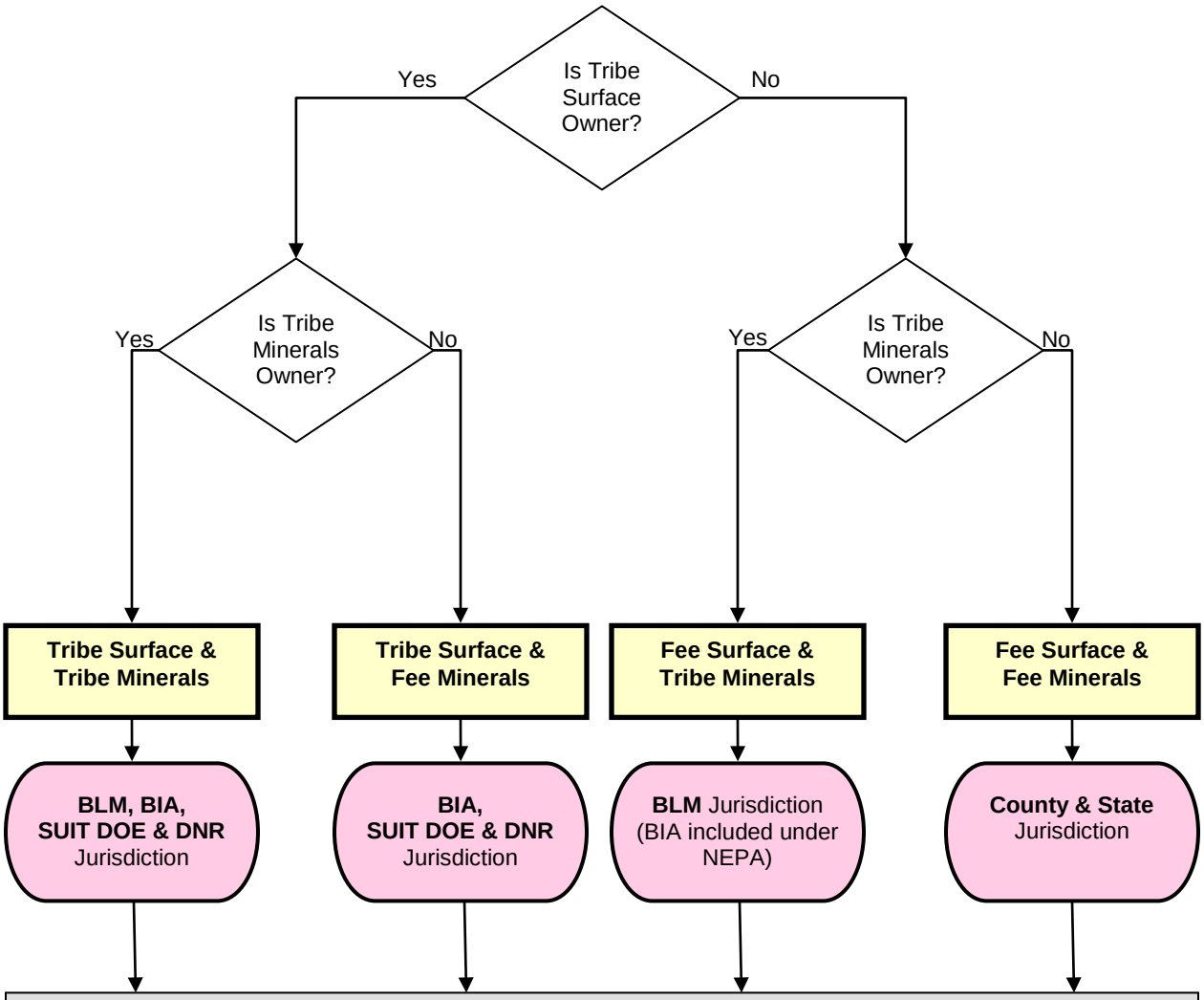
12 REVISIONS

Revision Date	Page(s)	Change(s)
20 March 2008	All	• First Edition Approved
05 August 2008	12	• Updated Points of Contact
05 August 2008	11	• Clarified spill reporting criteria regarding any other agency required notifications
22 October 2008	12	• Added links to web pages
22 October 2008	All	• Added hyperlink to www.suitdoe.com website in footer
19 August 2009	13	• Updated Points of Contact
03 May 2010	17 & 21	• Included requirement for Environmental Assessment in diagramed process
03 May 2010	13	• Updated Points of Contact
03 May 2010	12	• Updated links to webpages for 25 CFR 169 and 40 CFR 71
31 August 2010	13	• Updated Points of Contact

13 FLOWCHARTS

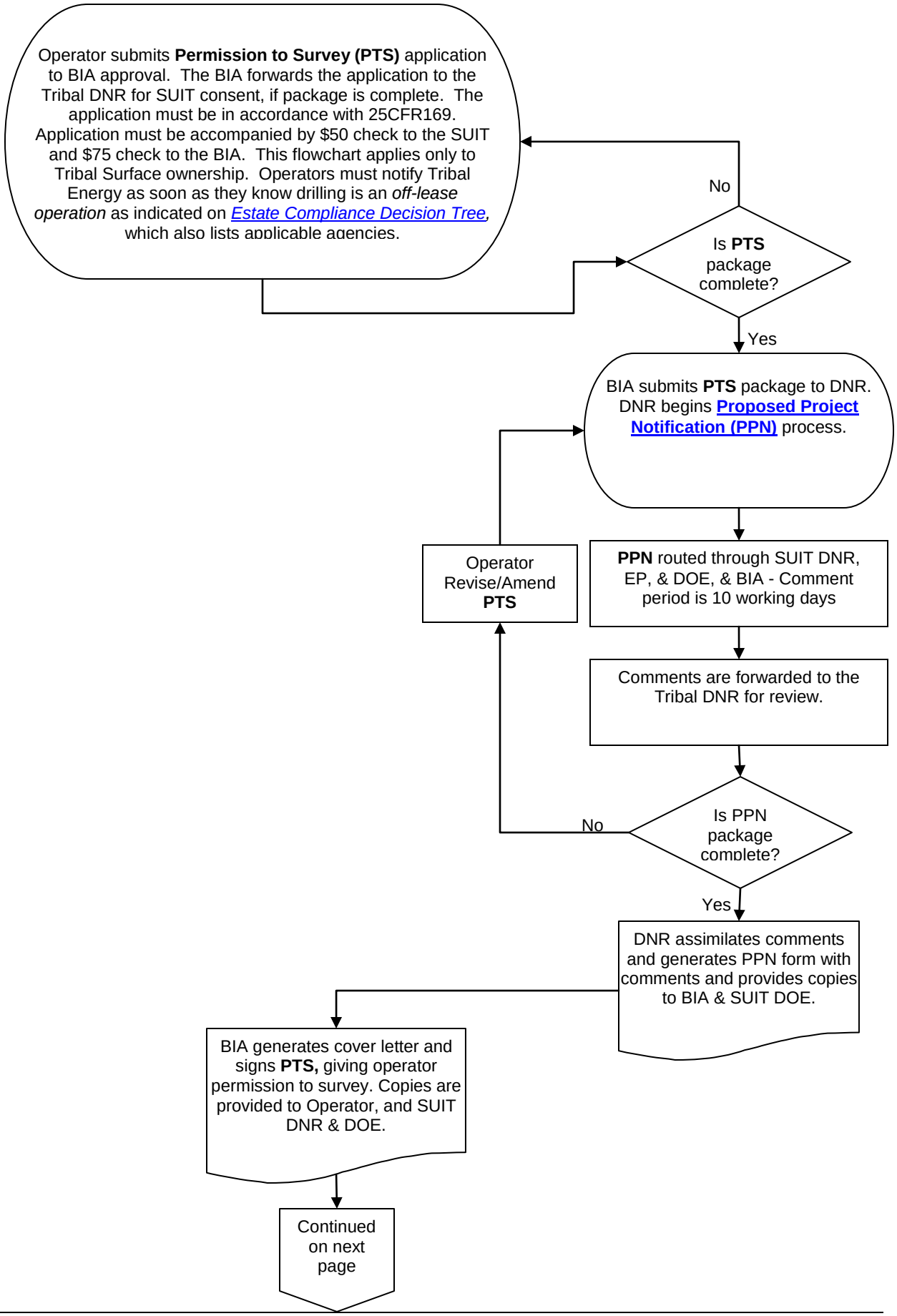
Detailed flowcharts are provided on the following pages to assist in determining the jurisdiction and compliance with federal and Tribal rules and regulations, when proposing to drill an O&G well or applying for a Surface Lease or ROW easement, depending on the ownership of the surface and mineral rights.

Flowchart 1: Estate Compliance Decision Tree for O&G Well Drilling on Southern Ute Indian Reservation

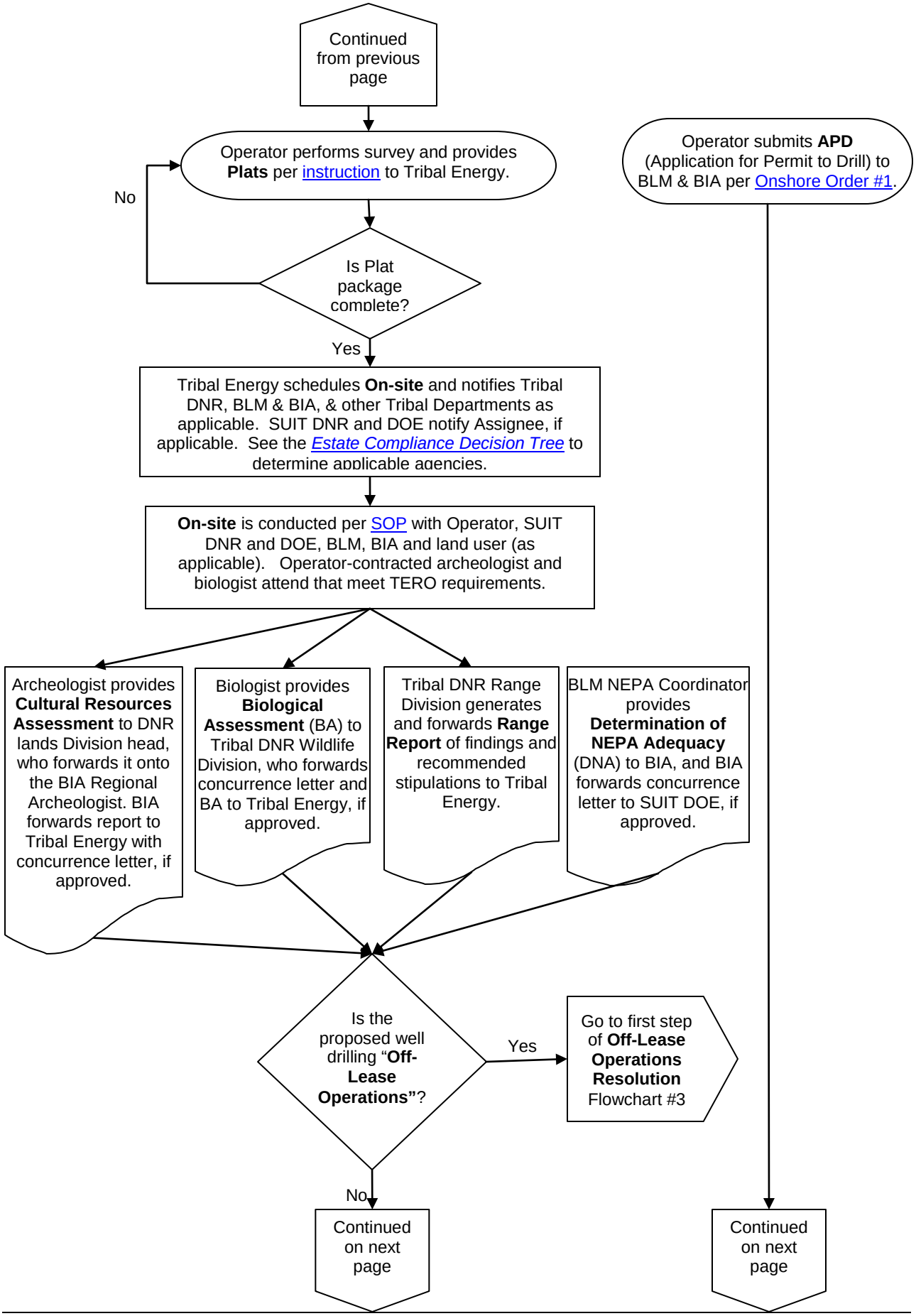


Applicable Requirements for Drilling Authorization for Each Type of Estate (follow down)	
Permission to Survey (PTS), Tribal PPN and Onsite process required (Tribal Surface)	*This document provides no guidance regarding the well drilling authorization processes required in these two estate cases, since there is no Southern Ute Indian Tribe participation in the drilling process. However, if any contribution of oil or gas is tribally-owned, the oil/gas must be measured and SUIT DOE notified per 43 CFR Part 3160*
NEPA Environmental Assessment (EA) required (Federal Action)	
Off-Lease Operations resolution process required, if surface & minerals are on separate leases	**Off-Lease Operations resolution** process required
Federal Application for Permit to Drill (APD) required (per Onshore Order #1)	
State Application for Permit to Drill (APD)	

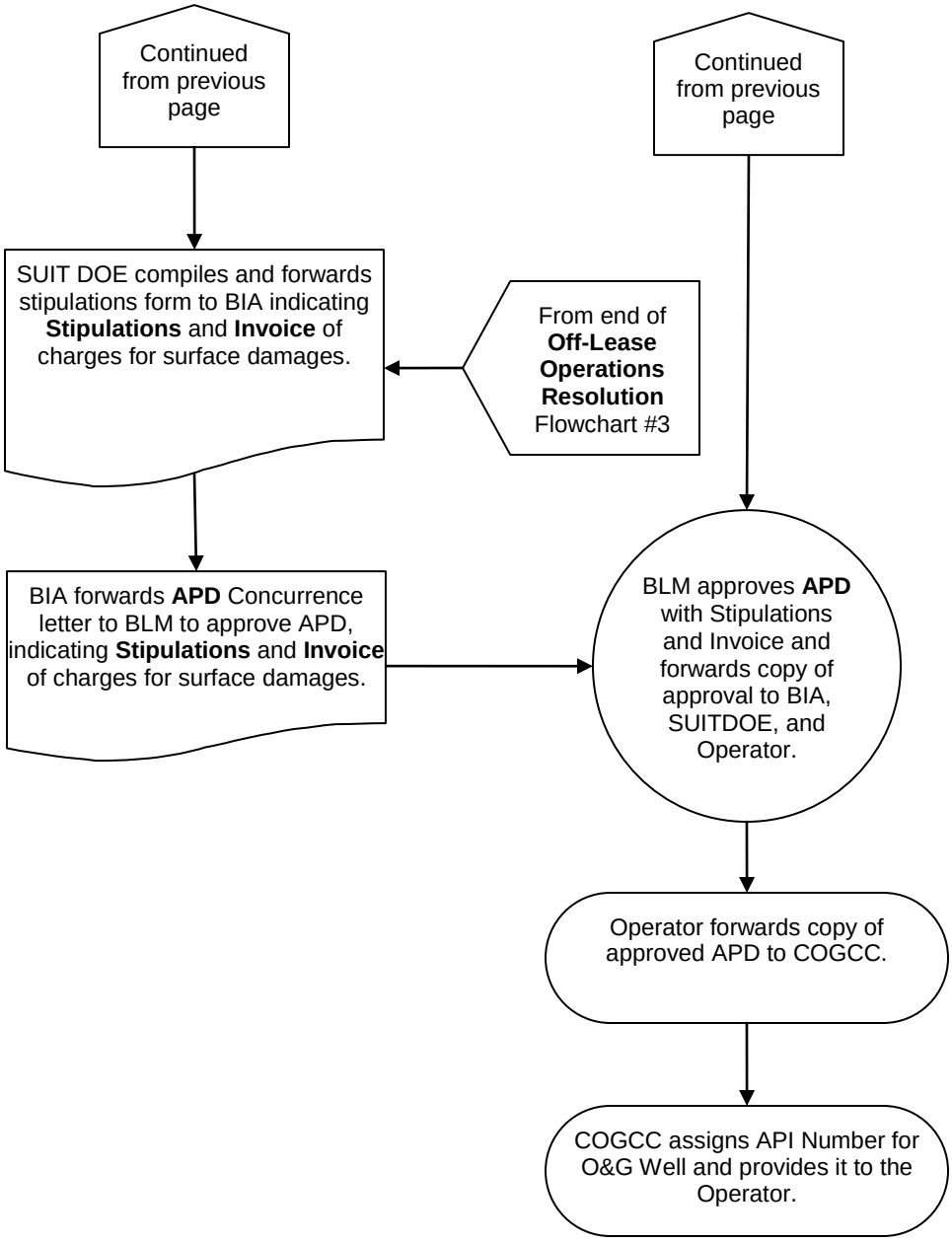
Flowchart 2: Authorization Flowchart for Oil & Gas Well Drilling on the Southern Ute Indian Reservation



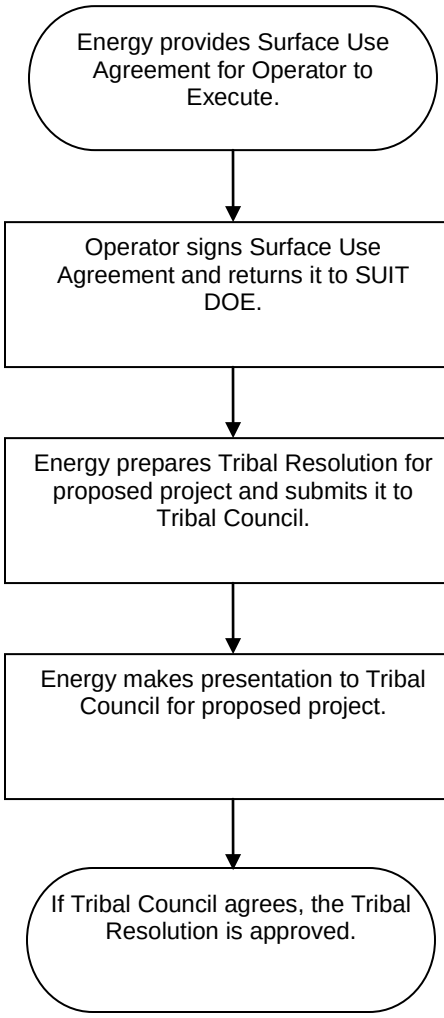
Flowchart 2: Authorization Flowchart for Oil & Gas Well Drilling on the Southern Ute Indian Reservation



Flowchart 2: Authorization Flowchart for Oil & Gas Well Drilling on the Southern Ute Indian Reservation

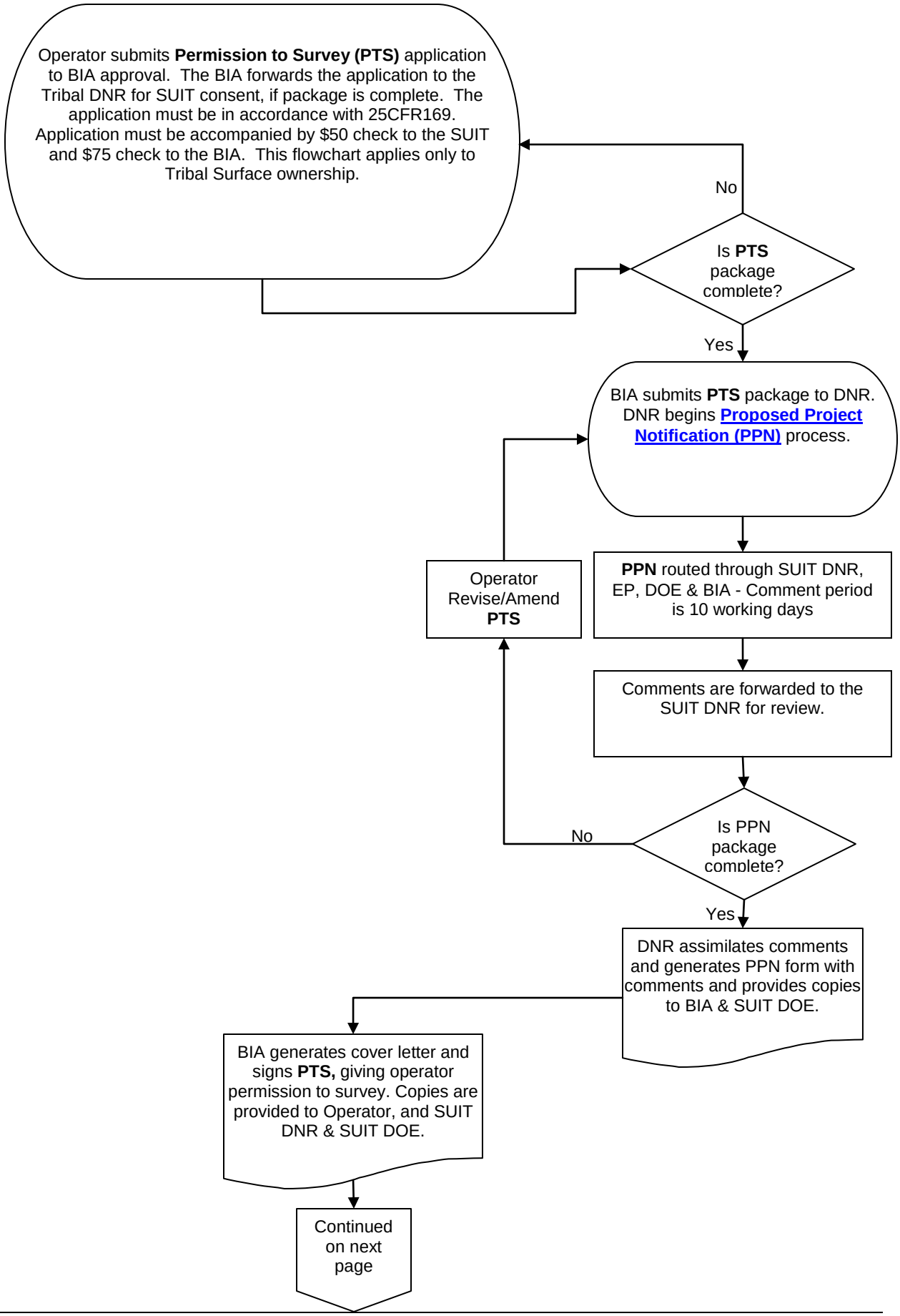


Flowchart 3: Resolution Flowchart for a Off-Lease Operations on the Southern Ute Indian Reservation

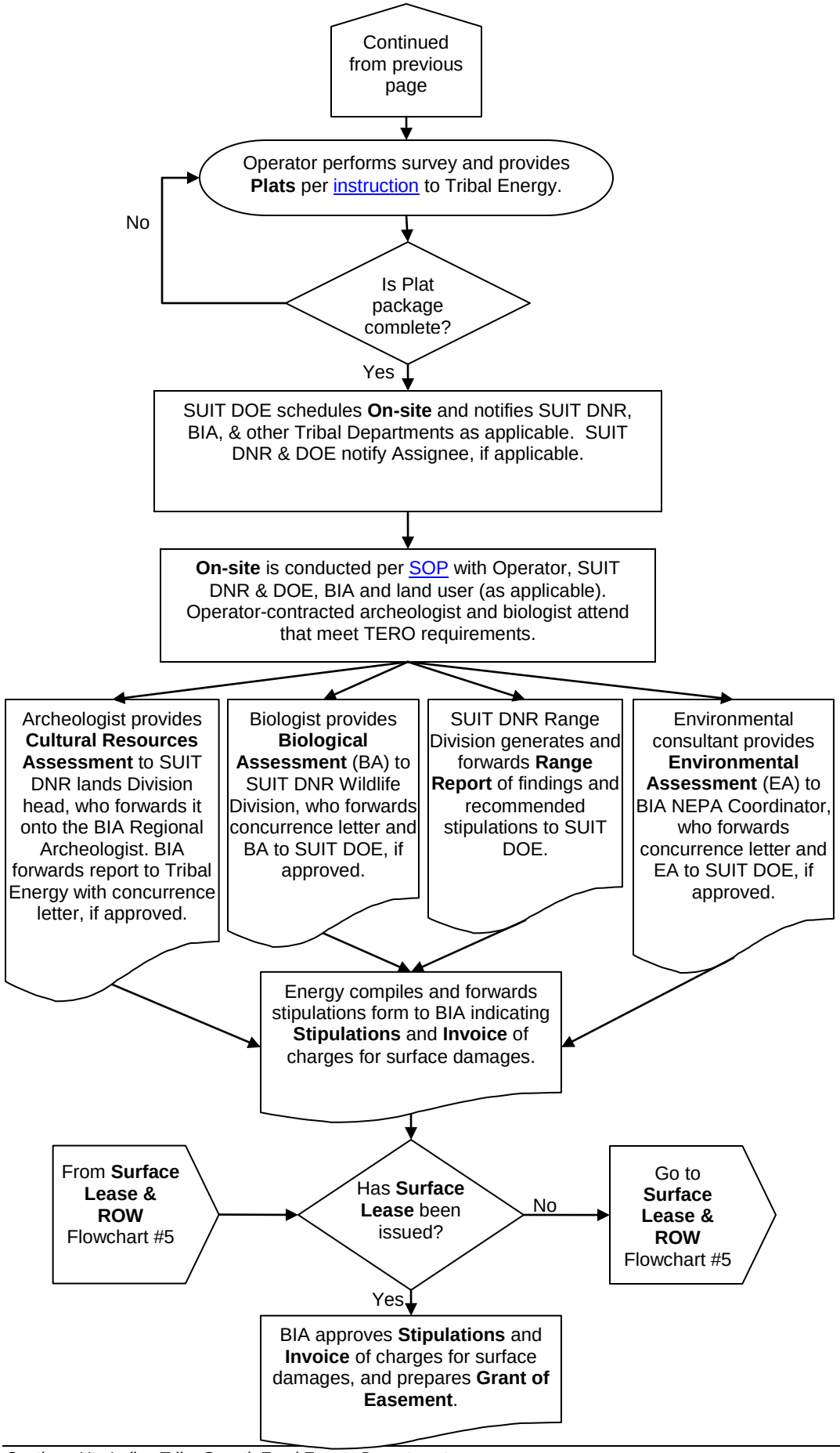


Please refer to the definition of *Off-Lease* under *Section 2 Definitions* of this manual.

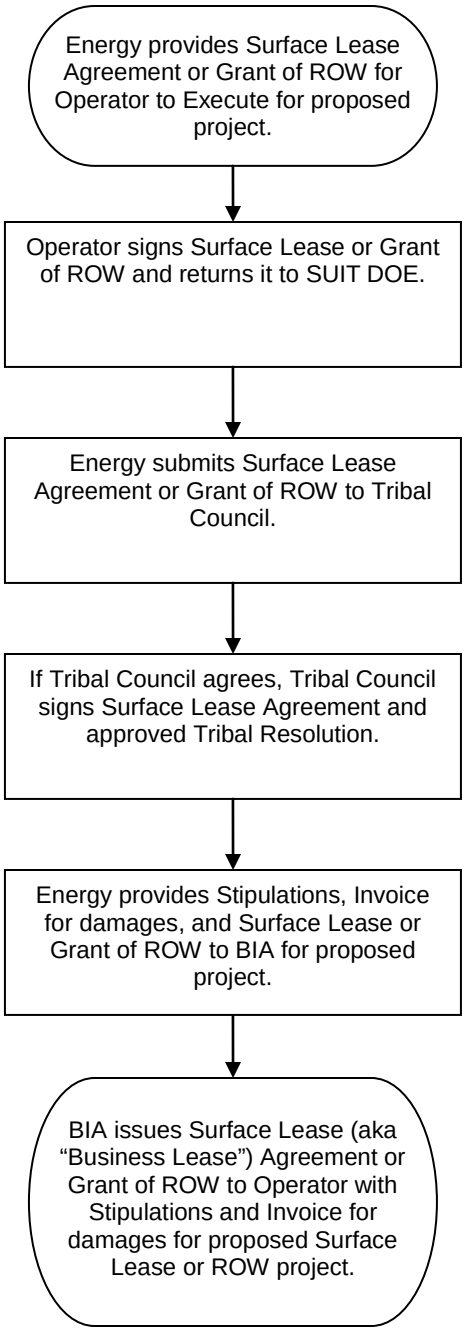
Flowchart 4: Authorization Flowchart for Pipeline and Surface Lease Projects on the Southern Ute Indian Reservation



Flowchart 4: Authorization Flowchart for Pipeline and Surface Lease Projects on the Southern Ute Indian Reservation



Flowchart 5: Flowchart for a Surface Lease and ROW Easement on the Southern Ute Indian Reservation



Appendix C – Authorizing Actions

Agency and Permit/Approval	Nature of Action	Authority	Application
FEDERAL PERMITS, APPROVALS, AND AUTHORIZING ACTIONS			
USDI Bureau of Land Management (BLM)			
Decision Record for Preferred Alternative	Evaluate environmental impacts of Preferred Alternative	National Environmental Policy Act of 1969, 42 USC 4321 et seq. Council on Environmental Quality, 40 CFR 1501, 1502	Proposed Action
Permit to Drill, Deepen, or Plug Back (APD)	Provide for compliance with regulations and requirements during the drilling and completion phase of the well	Mineral Leasing Act of 1920 (30 USC 181 et seq.), 43 CFR 3160; Federal Oil and Gas Royalty Management Act of 1982, 43 CFR Part 3160 series, subparts 3160.0-1 Purpose, 3160.0-1 Authority, and 3161.1 Jurisdiction; Secretarial Order No. 3087, Amendment No1, February 7, 1983; Indian Mineral Development Act of 1982, 43 CFR, Part 3160.0-3	Gas production wells
USDI Bureau of Indian Affairs (BIA)			
Approval of Unitization	Provide for efficient and timely development and production of Tribal oil and gas leases	Indian Mineral Development Act of December 22, 1982, 25 USC 21022108, 25 CFR Part 225	Unit area
Rights-of-Way	Grant rights-of-way and issue temporary permits	Act of March 3, 1901, c. 832 ss 4.31.Stat.108; 209. DM. 8 Secretaries Order 3150 and 3177, as amended, 10 BIAM, bulletin 13, as amended, and Albuquerque Area Addendum Release 9401	Pipelines, roads
Archaeological Clearance	Issue antiquities or archaeological resource permits to remove or excavate archaeological resources on land administered by BIA	Antiquities Act of 1906, 16 USC Secs. 431-433; Archaeological Resources Protection Act of 1979 (16 USC Secs. 470a-47011), 43 CFR, Parts 3 and 7; National Historic Preservation Act, Sec. 106 and 36 CFR Part 800	All Proposed Action components
US Army Corps of Engineers			
Section 404 Permit	Issue a permit for placement of fill or dredged material in waters of the United States or their adjacent wetlands	Sec. 404, Clean Water Act, 40 CFR Parts 122-123; 33 USC Sec. 1344; 33 CFR, Parts 323 and 325	Pipelines, road, and well pads
USDI Fish and Wildlife Service			
Consultation Process, Endangered or Threatened Species	Review of impact on federally listed and candidate threatened and endangered fish, wildlife, and plant species	Sec. 7 of the Endangered Species Act of 1973, as amended (16 USC Sec. 1344), 33 CFR Parts 323 and 325	All Proposed Action surface-disturbing activities

Agency and Permit/Approval	Nature of Action	Authority	Application
US Environmental Protection Agency			
Produced-Water Disposal	Issue a permit to allow for underground injection of produced water	Safe Drinking Water Act (42 USC 300F-300-9), 40 CFR Parts 144 and 147	Underground injection control
Permit for Underground Injection Control	Regulate underground injection of nitrogen	CRS 1973, 34-60-106(2)(d) and 3460-106(9)	Underground injection control
Section 401 Water Quality Certification	Issue a permit to allow for discharge to State or Tribal waters, including wetlands	Sec. 401, Clean Water Act, 33 USC Section 1341	Well pads and pipelines; road construction
Minor New Source Review Permits	Regulate minor new stationary sources of air pollution	40 CFR Parts 49 and 51	Well Sites, Smaller Stationary Sources (emissions driven permit)
New Source Review – Prevention of Significant Deterioration Permits	Regulate major new stationary sources of air pollution	40 CFR Part 52	Major Compressor Facility (emissions driven permit)
TRIBAL PERMITS, APPROVALS, AND AUTHORIZING ACTIONS			
Southern Ute Indian Tribe			
Approval of Unitization	Provide for efficient and timely development and production of Tribal oil and gas leases	Indian Mineral Development Act of December 22, 1982, 25 USC 21022108, 25 CFR Part 225	Unit area
Rights-of-Way and Permits to Drill	Approve rights-of-way, temporary permits, and permits to drill	Act of March 3, 1901, c.832 ss. 4.31.Stat.1084; 209 DM 8 Secretaries Order 3150 and 3177, as amended, 10 BIAM, Bulletin 13, as amended, and Albuquerque Area Addendum Release 9401	Pipelines, facilities, and well locations
Air emissions inventory and monitoring data	Accumulating emissions data	Clean Air Act	All air pollutant emission sources
Stormwater Pollution Prevention Plans (SWPPP)	Oversee implementation of Stormwater Recommendations for Oil and Gas Operators on Tribal Lands within the Reservation	Clean Water Act, 40 CFR Section 401	Any disturbance over 1 acre for oil and gas activity

Agency and Permit/Approval	Nature of Action	Authority	Application
Operating Permits	Regulate major stationary sources of air pollution	40 CFR Part 70	Compressor Facility (emissions driven permit)
STATE PERMITS, APPROVALS, AND AUTHORIZING ACTIONS			
Colorado State Historic Preservation Office			
Archaeological Clearance	Programmatic agreement and/or consultation for cultural resource inventory, evaluation, and mitigation	National Historic Preservation Act, Sec. 106 and 36 CFR Part 800	Pipelines and unit area
Colorado Department of Highways			
Transport Permit	Issue a permit for oversize, over-length and overweight loads	CRS 42-4-409; 2 CCR 602-4	Transportation of equipment and materials on state roads
Utility Permit	Issue a permit for right-of-way easement crossing state highways	CRS 43-1-105	Pipeline highway crossings
Colorado Department of Natural Resources - Oil and Gas Conservation Commission			
Approval of Unitization	Provide for efficient and timely development and production of non-federal and non-Tribal oil and gas leases	Cause 112, Order #112-122 issued June 9, 1996	Unit area
Utility Notification Center of Colorado			
Point of Contact Before Excavating	Advise on existence and locale of underground facilities	CRS 9-15-103	Pipelines and wells

This permit and approval list is not all inclusive. It is the responsibility of the operator to ensure that all permits and approvals are secured before the project may proceed.

Source: USDI 2002

Appendix D – Response to Public Comment

Comment #	Commenter	Topic	Comment summary	Action	Response
1	Chris Ribera	Air Quality	Rig and workover engines should be tuned up to minimize exhaust and noise.	Already in Document	The Design Features in the North Carracas POD include the following air emissions limitations for engines and they will meet New Source Permit Standard (NSPS) requirements ahead of regulatory deadlines. (EA page 19) a) All new and replacement internal combustion gas field engines must meet, at minimum, recently promulgated (January 18, 2008, 73 Federal Register 3568) New Source Performance Standards (NSPS) (40 CFR [Code of Federal Regulations] 60, Subpart JJJJ). Additionally, all new and replacement internal combustion gas field engines greater than or equal to 500 design-rate hp (or site de-rated hp values, as long as manufacturer de-ration values and emission factors are supplied and current demonstration compliant with appropriate emission rate requirement) must not emit more than 1 gram of nitrogen oxides (NOx) per horsepower hour upon issuance of the Decision document, as opposed to being delayed under the NSPS. Additionally, at a minimum the SUIT will require operators to meet noise level standards no less stringent than those imposed by the Colorado Oil and Gas Conservation Commission (COGCC) on lands within its jurisdiction.
2	Chris Ribera	Air Quality	Request an air quality monitoring station be installed near the east end of the development.	Beyond Scope of EA	No new air quality monitoring station is planned for installation with this POD. The nearest air quality monitoring stations to North Carracas POD location are in Ignacio and Durango, Colorado. Please see Air Quality Modeling and Impact Analysis in Appendix F for details.
3	Chris Ribera	Air Quality	Please confirm whether gas venting and flaring be allowed.	Already in Document	Under the POD, there would be no gas flaring but there would be gas venting. Volatile organic compounds (VOC) emissions for venting are expected to be minimal as coal bed methane does not have a significant reactive volatile component. Please see Emissions Inventory in Appendix F for details. In addition, in the United States Geological Survey (USGS) Notice to Lessees and Operators of Onshore Federal and Indian Oil and Gas Leases (NTL-4A), Section III.C. states that “Lessees or operators are hereby authorized to vent or flare gas on a short-term basis without incurring a royalty obligation in the following circumstances: (C) Initial Production Tests. During initial well evaluation tests, not exceeding a period of 30 days or the production of 50 MMcf of gas, whichever occurs first, unless a longer test period has been authorized by the appropriate State regulatory agency and ratified or accepted by the Supervisor.” The confirmation of whether gas venting or flaring will (or will not) occur, is provided on page 19 of the POD’s Emission Inventory, which is within Appendix F of the Preliminary EA. In addition, to limit the amount of venting, green completion technology will be used during the flowback stage.
4	Mauricio Ribera	Big Game	Big game wintering, migration, calving, and fawning range - have seen deer and elk within the area all months of the year. Bear population as well. Well pad disturbance will greatly affect the established winter habitat and migration area.	Already in Document	As noted on page 6 of the Preliminary EA, additional big game and wildlife protections have been implemented to minimize wildlife impacts related to the North Carracas POD. "The Tribe has developed the Southern Ute North Carracas Energy Development: Guidance and Protocol to Reduce Wildlife Impacts (SUIT 2010a)… Since the area comprises a large portion of the Reservation that the Tribe has historically treated as sensitive because of its cultural and ecological significance, wildlife protection measures generally exceed those in place elsewhere on the Reservation." Additionally, the use of existing infrastructure and drilling multiple wells from single well pads would minimize surface disturbance and impacts to wildlife from habitat loss and alteration. Refer to Section 4.7 of the EA.
5	Chris Ribera	Comment Period Extension	Please accommodate our request by postponing the deadline for comments, handing out printed EA information, and	Covered by Admin Procedure	In compliance with the National Environmental Policy Act (NEPA), the general public and other interested parties were notified of the availability of the Preliminary EA for comment and review through notices published in the Durango Herald and Southern Ute Drum (5/31/13) and the Pagosa

Comment #	Commenter	Topic	Comment summary	Action	Response
			conducting a public meeting in the Carracas Community.		Sun (6/6/13). Also, a Tribal Outreach meeting was held on March 27, 2013 to provide a project overview and a forum for the Tribal Membership input for the project. The Bureau of Land Management (BLM) and Bureau of Indian Affairs (BIA) Interdisciplinary Team conducted internal scoping in August 2011. It is optional for the BLM to conduct external scoping on actions analyzed by an EA
6	Hopi Tribe (6/10/13)	Cultural Consultation	Defer to SUIT to develop mineral resources regarding alternatives. Request consultation on any proposal in SW Colorado with the potential to adversely affect prehistoric Ancestral Pueblo cultural resources. Request cultural survey report.	Already in Document	Comment noted.
7	Santa Ana Pueblo (6/10/13)	Cultural Resources	THPO comfortable that proposed actions will avoid significant cultural resources.	Already in Document	Comment noted.
8	Mauricio Ribera	Cultural Resources	Archaeological site density is high. There are concerns about impacting cultural resources.	Already in Document	Additional cultural resource surveys will be completed before ground-disturbing activities occur. Page 9 of Preliminary EA "Each well pad would be subject to additional site-specific environmental and cultural analysis at the time of the APD submittal, as determined by the BLM and BIA, or the Tribe." Page 89 of the Preliminary EA "All significant and potentially significant cultural resources would be avoided by the proposed action in consultation with SUIT and BIA Southwest Regional Office cultural resource managers. In addition, per SUIT guidelines, all prehistoric sites considered non-eligible to the National Register of Historic Places would also be avoided."
9	Chris Ribera	Cultural Resources	Request to preserve descanso near the Altura area.	Already in Document	See Page 89 of the Preliminary EA. "Descansos (roadside memorials), if present, would be avoided and construction crews made aware of their presence to ensure no incidental impacts. If avoidance is not possible, an attempt to contact the family maintaining the descanso would be made. In the event that a family could not be reached, the descanso would be removed and secured safely in storage. Following reclamation, the stored descanso would then be placed back in its original location and in its pre-construction state."
10	Irene Ribera	Electrification of Well Pad	Can this well (in Section 22) be electrified to avoid engine smells and noise pollution?	Beyond the Scope of EA	There is insufficient electrical infrastructure along CR 500 to electrify well pads and facilities.
11	Chris Ribera	Environmental Justice	Please help us in understanding your project by reaching out to us so that we can be assure that we, the Carracas Community, will not be subject to disproportionately high and adverse human or environmental effects on our low-income/minority population.	Edit EA	The Preliminary EA was modified to include low-income communities in census tracts with poverty rates higher than the remainder of the county in the Environmental Justice analysis. In addition, site-specific environmental review will be completed for each well pad prior to ground-disturbing development. Mitigation measures will be implemented to minimize impacts to surrounding landowners and communities as well as to comply with COGCC and OSHA standards even though SUIT is not subject to these regulations. Mitigation measures will be implemented to minimize impacts to surrounding landowners and communities and the SUIT will require operators to meet standards no less stringent than those imposed by COGCC and Occupational Safety and Health Administration (OSHA). In addition, all operations will comply with BLM Onshore Orders, Gold Book Standards and Practices, as well as the 43 CFR.

Comment #	Commenter	Topic	Comment summary	Action	Response
12	Chris Ribera	Floodplains	Some proposed wellpad locations are within 100-year floodplain. Suggests a setback from San Juan River of 100-year floodplain or 1/4 mile.	Already in Document	Design Features in the Preliminary EA page 21 include the following: "There will be no permanent structure constructed within the 100-year floodplain boundaries of streams unless it can be demonstrated on a case-by-case basis that there is no physically practical alternative. In cases where floodplain construction is approved, additional constraints and BMPs such as flood protection measures or construction timing restrictions may be applied."
13	Umberto	General	Shoot, who would have thought that it was that easy?	Beyond Scope of EA	Comment noted.
14	Mauricio Ribera	Groundwater Quality	There are concerns about drinking water contamination from the well located in Section 22. Particularly the shallow groundwater aquifer located near/on Ribera Family Ranch. Domestic Water well is 20 feet deep.	Already in Document	The North Carracas POD includes the following design features to protect groundwater and shallow drinking water aquifers (EA page 21): a) Monitor water quality, conduct bradenhead testing, and evaluate data accordingly. b) Cement all surface and production casing strings to the surface by circulation methods. c) If cement in the surface and/or production string is not circulated to the surface and a cement bond log or temperature log shows sufficient coverage and cement bond to isolate the appropriate zones, including the Fruitland Coal gas-bearing zone, and casing shoe tests positive, drilling will proceed. Otherwise, remediation will be performed. d) Site-specific stormwater pollution prevention plans and spill control and countermeasure plans (if needed) will be developed. e) Containment structures such as dikes, containment walls, drip pans, or equivalent protection actions would be constructed and maintained around qualifying fluid/chemical facilities or storage tanks. f) Self-contained, closed-loop systems would be utilized to drill the natural gas wells in this proposed POD. g) All spills would be promptly reported to the SUIT Department of Energy and BIA, in accordance to the SUIT Spill/Release Reporting Policy and reported to the BLM in accordance with BLM-Notice to Lessees NTL-3A. h) In the event that any surface water body or usable groundwater aquifer is degraded by any of the proposed action, the problem would be immediately reported and remediated or other corrective action taken as determined by the appropriate agency.
15	Maxine Sena	Land Status	The statement below appears in the North Carracas Environmental Assessment information. What 'private lands' is this referring to? "In one instance, however, the surface of private lands where a well would be located (Section 22, Township 32 North, Range 4 West) has been acquired by the Tribe and placed into federal trust status since approval of the NDMA, subject to pre-existing private mineral development rights."	Already in Document	To clarify, this parcel was purchased by the Tribe and then placed into federal trust status after the approval of the Non-development Minerals Agreement for leases in the North Carracas area. This means that this particular parcel is not subject to the terms and conditions of the Non-development Minerals Agreement, which prohibits locating wells on Tribal land in the area. Therefore, a well pad can be developed on this specific Tribal Trust parcel.
16	Maxine Sena	Landowner Notification	There are concerns that private property owners were not notified as in previous developments?	Beyond Scope of EA	The North Carracas POD does not authorize any development; rather it provides an overview of the development that could occur in the area. In compliance with the NEPA, the general public, including private landowners in the area, and other interested parties were notified of the availability of the Preliminary EA for comment and review through notices published in the Durango Herald and Southern Ute Drum (5/31/13) and the Pagosa Sun (6/6/13). Also, see Response to Comment 36.

Comment #	Commenter	Topic	Comment summary	Action	Response
17	Irene Ribera	Landowner Notification	Request that private land owners be notified in writing or email of future plans of development that will potentially affect our property.	Already in Document	The North Carracas POD includes design features such as "Work with surface owner, when possible, to pick sites for roads, pipelines, and well pads " (EA page 27) that address communications and participation of landowners affected by the NC POD.
18	Mauricio Ribera	Noise	Proposed new well location would be reduced by east-west ridge between new well location and private property in Section 22. West winds and topography will have a negative effect on ambient noise level for proposed well development and pumps.	Already in Document	The exact well pad locations are expected to be in the same general locations, but would be adjusted based on future site-specific environmental and cultural analyses (page 9). Further site-specific analysis will be completed for each well pad prior to ground-disturbing activities (see Response to Comment 8). In addition, the North Carracas POD includes the following design features that would be implemented on a case-by-case basis to minimize noise impacts (EA Page 24 and 28) a) Reduce noise by using current and effective sound dampening devices or techniques such as hospital grade mufflers, equipment housing, insulation, installation of sound barriers, earthen berms, and vegetative buffers. b) Specific sound dampening mitigation can be determined for new facilities at a site-specific level in consultation with SUIT DNR/DWRM. Motors or compressors will be located and/or oriented to reduce noise transmission. c) Unless otherwise authorized, the Tribe will require operators to meet noise standards no less stringent than those imposed by the COGCC on lands within its jurisdiction.
19	Chris Ribera	Noise	Drilling and workover rigs should have sufficient exhaust mufflers installed to keep noise levels to a minimum.	Already in Document	Please see response to Comment 18.
20	Chris Ribera	Noise	Please have production of wells include silent pump jack operations.	Already in Document	Please see response to Comment 18.
21	Chris Ribera	Noise	How will low frequency noise produced by compressors be mitigated?	Already in Document	Please see response to Comment 18.
22	Yulia	None	Comment is not legible.	Already in Document	Comment noted.
23	Chris Ribera	Odor	An odor of chemical and none natural stink is quite prevalent near the East pilot multi-well location. Please investigate and remediate these odors. Ensure that other well locations do not have this odor.	Beyond the scope of the EA	Comment noted. All components of the proposed action would be developed in accordance with applicable federal, state, and tribal regulations.
24	Maxine Sena	Private Landowner Impacts	What are the impact/effects to private land owners?	Already in Document	Please see response to Comment 17. Also, refer to Section 4.12 – Land Use in the Preliminary EA for an analysis to private landowners. Impacts to private landowners would vary depending upon the site-specific location of the POD components and cannot be determined at this time. Some of the potential impacts could include increases in traffic, fugitive dust, noise, and emissions during construction. The intensity of these impacts would vary depending on the distance to private landowners residing or working in the area. These impacts would be localized near the development occurring (e.g., road, pad, or pipeline construction, compressor construction and operation, well drilling and completion). These impacts would be short-term for the duration of construction, drilling, and completion. During operation, there would be minor increases in traffic, fugitive dust, noise, and emissions that may also impact private landowners depending on location. If all or a portion of the development would be located on private land, the applicant would consult with the landowner and negotiate a surface use agreement. The productivity or use of private land where development could occur may be converted to an industrial use for the long term. The landowner would be compensated

Comment #	Commenter	Topic	Comment summary	Action	Response
					for surface damages incurred.
25	Chris Ribera	Public Notice	I researched the published information and did not find that it was published in the Durango Herald. The publication in the Pagosa Sun came out on June 6th, six days after the comment period began. The publication in the Southern Ute Drum was on June 14th, two weeks after the comment period began and in a newspaper not subscribed by private landowners.	Covered by Admin Procedure	Publication dates were as follows: Durango Herald and Southern Ute Drum 5/31/13 and in the Pagosa Sun on 6/6/13. The public comment period commenced on June 1, 2013. Affidavits/proofs of publish dates are contained in the project record.
26	Chris Ribera	Public Scoping	EA did not take into account Carracas Community in scoping or public participation process. Suggest a community meeting be held prior to final EA. Additional outreach is needed for the Carracas community.	Beyond the Scope of EA	Please see response to Comments 5, 16, and 38.
27	Chris Ribera	Reclamation	Reclamation of pipeline corridor with grass is not sufficient to replace lost roosting habitat for turkeys. Should include shrubs and trees for fruit and roost for turkeys and traditional use for Native Americans.	Already in Document	Site-specific impact analysis will be completed prior to any ground-disturbing activities At that time, any sensitive areas or vegetation would be identified and design features or other mitigation measures implemented. Design features in the POD include: a) Avoid areas containing sensitive vegetation types, such as wooded riparian vegetation or known sites with culturally important plants, to the fullest extent possible.
28	Chris Ribera	Reclamation	Recommends catch ponds to hold water in natural state after well locations and roads have vegetation removed.	Already in Document	Site-specific impact analysis will be completed prior to any ground-disturbing activities. As noted in the Preliminary EA (Page 10), some of the stormwater mitigation activities could include water retention ponds. "When site-specific locations are identified during the on-site process, appropriate stormwater controls such as ditches, berms, waterbars, culverts, silt fence or water retention ponds would be developed on a case-by-case basis, to reduce stormwater run-on/run-off and retain sediment on or near the location."
29	Chris Ribera	Road Dust	Dust abatement procedures need to be implemented on CR 500.	Already in Document	The Design Features for the North Carracas POD include dust abatement measures that would be implemented on CR 500 as required. (EA Page 19) a) Roads would be surfaced or dust inhibitors would be used (e.g., surfacing materials, non-saline dust suppressants, water, etc.), as appropriate, on roads and well locations constructed on soils susceptible to wind erosion, to reduce the amount of fugitive dust generated by traffic, or other activities. b) Speed limits would be enforced to the extent practicable on roads in and adjacent to the project area, to further reduce fugitive dust.
30	Chris Ribera	Road Improvements	CR 500 is not designed for heavy vehicles. Also CR 500 is narrow and has obstructed views past CR 557 and will require improvements to safely handle heavy vehicles.	Already in Document	The Design Features for the North Carracas POD include speed limits and measures to mitigate impacts to county roads. (EA page 24).Design and maintain access roads in light of the anticipated volume of traffic and the weight and speed of vehicles using these roads to minimize environmental damage, including the generation of fugitive dust and contribution of sediment to downstream areas.
31	Chris Ribera	Road Improvements	CR 500 roadway condition is deteriorated and requires some replacement culverts based on traffic study in 1990s.	Already in Document	Please see response to Comment 30.

Comment #	Commenter	Topic	Comment summary	Action	Response
32	Chris Ribera	Road Improvements	CR 500 road surface has soft spots that appear after heavy truck traffic. These soft spots have caused an accident with minor injuries. Road surface degradation must be identified and addressed before heavy truck traffic is allowed.	Already in Document	Please see response to Comment 30.
33	Chris Ribera	Road Improvements	Using current ADT, would acceleration and deceleration lanes be needed at intersection of CR 500 and SH 151.	Already in Document	Please see response to Comment 30.
34	Chris Ribera	Road Maintenance	Maintenance of CR 500 must be completed to keep road surface safe for travel and Archuleta County Road and Bridge should not be relied on for maintenance.	Already in Document	Please see response to Comment 30.
35	Chris Ribera	Road Maintenance	A winter shutdown would minimize ruts in roads by increased traffic.	Already in Document	Please see response to Comment 30. Additionally see EA Page 24 “Unless otherwise agreed by SUIT DNR/DWRM, no drilling activities will be allowed from December 1st through April 30th (“Closure Period”) for any projects more than a 1/3-mile distance from Archuleta County Road 500 (“Buffer Area”). Routine maintenance, construction, and/or completion activities being conducted outside of the Buffer Area, during the Closure Period, may only occur between 8:30 am and 3:30 pm. Prior approval of SUIT DNR/DWRM is required for drilling activities outside of the Buffer Area prior to April 30th.”
36	Chris Ribera	Socioeconomics	The EA failed to include residents of the Carracas Community as stakeholders in the planning process or to receive employment and other economic benefits.	Beyond Scope of EA	As a non-tribal stakeholder, the Carracas Community is included in the planning process according to the process set up in the Memorandum of Understanding (MOU) between SUIT and Archuleta County dated May 3, 2011. This MOU outlines process for land users affected by development of tribally owned oil and gas facilities to notify the County of impacts. Through the MOU process, Archuleta County can review locations and make recommendations to respond to land owners complaints or impacts. Archuleta County was notified regarding NC POD in September 2011 and for the release of the Preliminary EA according to the MOU requirements.
37	Chris Ribera	Soils	Pipeline route through the Altura or old railroad grade have highly erodible soils and steep terrain.	Already in Document	Comment noted. EA page 74 finds that no areas of highly erodible soils would be impacted by the proposed action. However, further site-specific analysis will be completed prior to any ground-disturbing activities. If erodible soils will be disturbed by pipeline route, proper mitigation measures would be implemented.
38	Irene Ribera	Surface and Groundwater Quality	There is an arroyo that runs just northeast of the proposed well site that floods heavily during the spring and monsoon season. It has flooded and eroded much of the existing soil around its path for many years. What happens if this floods and sends contaminants down the arroyo or into our water table?	Already in Document	The North Carracas POD (EA page 75-76) includes specific design features to minimize surface and groundwater contamination including containment structures sufficiently impervious to prevent a discharge to waters of the U.S., such as containment dikes, containment walls, drip pans, or equivalent protection actions would be constructed and maintained around qualifying fluid/chemical facilities or storage tanks. Further site-specific analysis prior to ground-disturbing activities will determine if noted arroyo would be affected and if mitigation measures beyond design features will be required.
39	Chris Ribera	Traffic	Please use current ADT information in the analysis and confirm with actual traffic counts to make sure that the road surface will not be damaged.	Already in Document	The most current ADT data available was used in the EA analysis (EA page 61). However, further site-specific traffic analysis will be completed prior to ground-disturbing activities and if better data are available, they will be used in that analysis. In addition, the North Carracas POD includes design features to minimize road surface damage. See response to Comment 30.

Comment #	Commenter	Topic	Comment summary	Action	Response
40	Irene Ribera	Traffic Levels	Since you plan on using a closed-loop system to recycle the fluid you use, there will be added traffic to this site when these are transported to your disposal site.	Already in Document	Estimated traffic trips for North Carracas POD are included in Table 4-12 page 92 of the Preliminary EA and include trips associated with cutting and fluid disposal in Drilling and Completion/Testing trips.
41	Chris Ribera	Traffic Signage	Speed control would be better with signs erected at either end of the development area and at CR 557.	Already in Document	Comment noted. Also, see response to Comment 30.
42	Chris Ribera	Traffic Speed	Traffic associated with drilling and completion is a major concern - particularly vehicle speed.	Already in Document	Estimated traffic trips for North Carracas POD are included in Table 4-12 on page 92 and include trips associated with Drilling and Completion/Testing. Design features included in the POD to address traffic concerns include (EA Page 23-24): a) Minimize the number of well-monitoring trips by coordinating well visits to limit traffic or by installing automated monitoring systems. b) Design and maintain access roads in light of the anticipated volume of traffic and the weight and speed of vehicles using these roads to minimize environmental damage, including the generation of fugitive dust and contribution of sediment to downstream areas.
43	Chris Ribera	Vegetation	Ancient prairie cottonwood trees could be affected by pipeline. Please address how these trees will not be damaged..	Already in Document	The exact well pad, pipeline and road locations are expected to be in the same general locations, but would be adjusted based on future site-specific environmental and cultural analyses Potential impacts to vegetation, including cottonwood trees are listed in the EA in Table 4-10 and discussed on pages 80-85. Cottonwood trees would be extended additional consideration as potential nesting habitat for bald eagles (see EA page 85); therefore, additional mitigation measures would be implemented to accommodate nesting eagles.
44	Irene Ribera	Water Well Monitoring	We are also asking that we receive help from Red Willow to monitor our water well for at least 3 to 5 years after well construction to prevent water contamination.	Beyond the Scope of EA	Water well monitoring does not prevent water contamination, it only identifies whether there is contamination by an industrial cause or domestic (e.g., septic tank influence). Domestic water well sampling will be performed to meet or exceed COGCC water sampling methods and guidelines. The applicants have already committed to sampling in a manner consistent with COGCC rule 608b, as stated in the EA. Therefore, they already sampled the Ribera water well before drilling of a nearby CBM well and 1 year following the completion. Additionally, per 608, they will do follow-up samples at 3 years and 6 years thereafter. Since drilling of that CBM well nearby, the Ribera's drilled a second water well. As a courtesy, Red Willow sampled this well also. However, because this wasn't "baseline testing" before completion, rule 608 didn't apply and Red Willow was not planning on collecting another sample from the second well. However, if the landowners observe a change in water quality, they can contact Red Willow and discuss the need for additional samples. If the drilling of a new CBM well north of CR 500, or any CBM well for that matter, triggers the need for additional water well sampling, the Ribera wells, including the 2nd water well, could be brought into the sampling program at that time.
45	Chris Ribera	Water/Stormwater	Concerned that trash, chemical spills will runoff downstream into Ribera Ranch land.	Already in Document	The POD includes design features proposed to minimize surface and groundwater contamination including (EA page 75-76): a) Effective stormwater management BMPs to contain stormwater runoff from project facilities. b) Appropriate containment of chemicals stored on site during operation, pursuant to requirements. In addition, the Stormwater Recommendations for Oil and Gas Operations on Tribal Lands within the Southern Ute Indian Reservation would be implemented to minimize impacts from runoff.

Comment #	Commenter	Topic	Comment summary	Action	Response
46	Daniel Ribera	Well Location/Surface Ownership Status (Map #3)	Riberas have existing lease with Energen for surface occupancy on Northeast Corner of property on CR 500. Will well-spacing eliminate well-pads on ranch location?	Beyond the Scope of EA	Energen's lease with the Riberas in Sec. 22 references future negotiations on a well site agreement and call for certain setbacks to their barn and house. Such a location would be very tight. Energen believes that the location north of CR 500 on tribal land will be better location. The exact location of the well has not yet been determined.
47	Irene Ribera	Well Location/Surface Ownership Status (Map #3)	We are specifically asking that you consider relocating the proposed well just north of our home (T32N R4W Section 22) further north or preferably at a different location further northeast or northwest.	Beyond Scope of EA	The exact well pad, pipeline and road locations are expected to be in the same general locations, but would be adjusted based on future site-specific environmental and cultural analyses. Prior to ground-disturbing activities, further impact analysis and notification will be conducted and this request will be considered at that time if still applicable.
48	Chris Ribera	Wildlife	Wildlife injuries and death associated with road traffic and vehicle speed. Gas field personnel must be given an orientation on wildlife preservation with major emphasis on vehicle speed.	Already in Document	Potential impacts to wildlife associated with vehicles are analyzed in the EA in Section 4.7.1 page 83. Design features included in the POD to minimize wildlife impacts include: a) Maintain appropriate speed limits on access roads to minimize wildlife injuries or mortalities due to vehicle-wildlife collisions.
49	Irene Ribera	Wildlife	How will they be they be protected from the noise and traffic? What will happen to their habitat?	Already in Document	Please see Response to Comment 48.
50	Chris Ribera	Winter Closure	Recommends winter shutdown to minimize impacts to big game turkey and bald eagles.	Already in Document	Please see Response to Comment 35 and 43.
51	Pam Leschak (6/4/13)	Consultation	As previously requested during the EA draft reviews, please remove my name from the IDT Team member list and instead include it on the list of individuals consulted during EA Preparation (Page 132, Section 7: Consultation and Coordination).	Edit EA	Completed.

Appendix E – General Stipulations

SOUTHERN UTE INDIAN TRIBE Revised.wst.doc

GENERAL WELL SITE CONDITIONS OF APPROVAL

COMPANY: Operator DATE: March 11, 2013

WELL NAME: Project Name

LOCATION: Section X, T XX N, R XX W, N.M.P.M., La Plata County, Colorado,
Surface Location XXXX feet from the N line, and XXXX feet from the W line.
Bottom Hole Location: Lease Tribal – XXXXXXXX.

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Boldface and/or underlined text denotes site specific stipulations.

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General Stipulations

These Stipulations shall govern the development of the above named project. In instances, where definite procedures are not outlined in these Site Specific Stipulations, the General Stipulations shall apply. If the operator has questions regarding these or any stipulations they should contact SUIT DOE at etrahan@sudoe.us, dolguin@sudoe.us, ksiesser@sudoe.us; or Southern Ute Range Division at gwesterman@southern-ute.nsn.gov.

1. A preliminary onsite review of new well pads and access roads by Tribal, BIA, BLM, and archaeological representatives is required.

2. A preliminary survey plat shall be submitted to the Energy Office at P.O. Box 1500, Ignacio, Colorado 81137 at least five (5) days prior to the onsite inspection, and an "as built" survey plat shall be submitted to the Energy Office within 30 days following completion of construction.

3. The company shall notify Southern Ute Energy Landman, Ed Trahan at 970-563-5563 (office) or 970-759-4412 (cell) or by email etrahan@sudoe.us and Range Technician, Gus Westerman at 970-563-4780 EXT. 3515 (office) or 970-749-8840 (cell) or by email at gwesterman@southern-ute.nsn.gov 5 business days prior to construction of project.

4. Proper Crossing Permits shall be obtained from the Southern Ute Indian Tribe prior to entering Tribal Lands.

5. Surface damage compensation and/or right-of-way grant of permission assessment will be paid to the Southern Ute Indian Tribe at a rate determined by the Southern Ute Department of Energy as stated in the Tribal Council Policy regarding right-of-way and surface damage compensation for oil and gas facilities. All assessments shall be paid prior to construction.

6. All surface disturbance shall be confined to the 13 point surface use plan submitted with the Application for Permit to Drill. All land-altering activity outside the surface use plan will require permission by the Department of Energy Office. A copy of the APD and these conditions of approval shall be kept on location at all times.

7. All activity shall be confined to the areas surveyed for cultural resources. If subterranean cultural resources are encountered, all land-altering activities shall be halted and the following shall be notified immediately:

Southern Ute Energy Resources - (970) 563-5550
BIA Area Archaeologist - (505) 563-3407
BIA Southern Ute Agency - (970) 563-4514

All people who are in the area will be informed by the operator that they are subject to prosecution for disturbing archaeological sites or picking up artifacts.

8. The gas well pad shall be properly identified with a permanent readable sign, which shall include:
   Company name
   Well name
   Legal description
   Lease Number

9. All drilling and completion rigs shall be escorted by pilot cars when traveling on all roads on the Southern Ute Indian Reservation.

10. Ample notification shall be given to the Southern Ute Department of Energy at (970) 563-5550 when construction will hamper ingress and egress to Tribal lands.

11. The company shall use Best Management Practices (BMP's) which eliminate or minimize adverse impacts to the environment, public health and the Tribes natural resources.

12. Restroom facilities shall be provided on the jobsite during construction.

13. Warning signs and reflectors indicating construction underway will be erected where applicable.

14. Construction of the gas well pad and/or access road shall come to a halt during inclement weather to prevent soil damage or destruction.

15. **A BUREAU OF INDIAN AFFAIRS TIMBER CUTTING PERMIT, FORM 5-5331 MUST BE OBTAINED PRIOR TO CUTTING TREES. THIS PERMIT CAN BE OBTAINED FROM THE BUREAU OF INDIAN AFFAIRS (970) 563-4571.**

    a. The cleared area is to be kept to the minimum necessary for construction and maintenance.

    b. Chainsaws shall be used to cut trees. Bulldozers or other heavy equipment shall not be used to clear areas.

    c. All sound woody material, from piñon pine, juniper, and gambel oak, which is at least three (3) inches in diameter and two (2) feet in length will be salvaged during clearing activities. Unless otherwise stated in the Site Specific Stipulations, all wood material will be cut into eighteen (18) inch lengths, limbed, and hauled to the Tribal wood yard located north of the Custom Farm Shop, Monday through Friday, between the hours of 8:00 A.M. and 4:30 P.M., except on holidays. All wood shall be hauled prior to completion of construction. Load tickets must accompany every load hauled to the wood yard.

    d. Debris (slash) from forest products, which includes limbs, brush, and wood products which do not meet the minimum size, will be chipped with a wood chipper and scattered around the location at a depth not to exceed 3 inches and shall be scattered within seven (7) days after completion of construction.

    e. Stumps shall be cut as low as practical to avoid waste. The mean height of any stump shall not exceed one half its diameter, and in no case shall it exceed six (6) inches on the uphill side. Stumps which are grubbed during construction shall be scattered within the right-of-way within seven days after completion of construction.

    f. The wood volume has been determined to be X cords and X posts.

16. The access road will be constructed on the flagline location previously approved.

17. The reserve and water pits will be lined with sufficient reinforced liner to prevent leakage.

18. The reserve and water pits shall be fenced on three sides prior to the arrival of the drilling rig. The fourth side will be fenced immediately after the rig leaves the location. The fence shall be 4-wire barbed wire with "H" braces. Wire spacing from the ground shall be 12", 12", 10", and 8", with the top wire 42" from the ground. This fence shall be maintained until the pits are reclaimed, then removed.

19. The reserve pits will be allowed fifteen (15) months for evaporation. The 15-month period shall begin on the spud date. Any fluids remaining after fifteen (15) months shall be disposed of in a manner consistent with Federal Regulations. The pits will then be filled with dirt material, leveled, and reclaimed.

20. Reserve pits with torn liners shall immediately be reclaimed.

21. Neither burn pits nor blow pits shall used for storage or disposal of fluids.

22. The reserve pit shall have a minimum of four (4) feet of freeboard at all times. Freeboard shall be measured from the top of the pit liner to the surface of the water in the reserve pit.

23. If a well is abandoned or suspended, all pits must be immediately fenced until they are backfilled. No pits shall be left open for longer than fifteen (15) months.

24. Water, mud, and drilling fluids will not be transferred to other gas well locations or reserve pits without prior approval. Compliance checks will be made by the BLM, Southern Ute Department of Energy Office and/or BIA Realty personnel.

25. All topsoil will be stockpiled neatly for reclamation purposes.

26. Topsoil will not be piled against trees or deposited in natural drainageways.

27. All fences and gates that are torn down or removed will be repaired or rebuilt within seven (7) days after the drilling rig leaves the location.

28. Culverts will be installed in areas where needed or required.

29. Culverts or cattleguards will not be removed unless authorized by the Tribe.

30. Trash pits will be wired in and trash disposed of at an approved landfill within seven (7) days after the gas well has been completed.

31. No trash shall be disposed of in the reserve pit.

32. Trash shall not be burned.

33. All materials, trash, junk, debris, etc., not required for production shall be removed from the well site within seven (7) days after the completion rig leaves the location.

34. Misters on blooie lines shall be used when drilling with air or gas. Operators shall be responsible for cleaning dust off vegetation if required by the Energy Office. Contact the Energy Office at (970) 563-5550 for authorization of cleaning procedures. Additional surface damage compensation and reclamation may be required.

35. Upon completion of the gas well pad and access road, disturbed areas will be recontoured and revegetated. Unless otherwise specified, seed varieties and drilled seeding rates shall be as below. For broadcast seeding, double the rates specified.

SEED MIXES:

AG FIELD MIX	
Manchar Smooth Brome	8 lbs/per acre PLS
Orchardgrass	2 lbs/acre PLS
Timothy	3 lbs/acre PLS
Annual Sterile Ryegrass or Sterile Triticale	4-8 lbs/acre PLS

MIX # 1, The Pine River valley to Highway 550;

Western Wheatgrass	7 LBS/PLS per acre
Antelope Bitter Brush	1 LBS/PLS per acre
Smooth Brome	4 LBS/PLS per acre
Intermediate Wheatgrass	3 LBS/PLS per acre
Annual Sterile Ryegrass or Sterile Triticale	12 LBS/PLS per acre

MIX # 2, West of Hwy 550 to Hwy 140;

Crested Wheatgrass	2 LBS/PLS per acre
Indian Rice Grass	2 LBS/PLS per acre
Blue Grama Grass	2 LBS/PLS per acre
Galleta Grass	2 LBS/PLS per acre
Sand Drop Seed	1 LBS/PLS per acre
Fourwing Saltbush	1 LBS/PLS per acre
Western Wheatgrass	4 LBS/PLS per acre
Pubescent Wheatgrass	2 LBS/PLS per acre
Annual Ryegrass Or Annual Barley	12 LBS/PLA per acre

For Broadcast rates double the above rates.

First seeding shall be done within six (6) months of completion of well pad and access road. Periodic checks will be made by Tribal personnel of seeding success. If within one year of seeding no visible stand or only a partial stand is observed, additional seeding shall be required.

30. No fluids (i.e., diesel, motor oil, water, etc.) will be disposed of on the Southern Ute Indian Reservation, except as otherwise specifically authorized.

31. Access roads and well pads will be maintained in accordance with generally accepted standards for repair, orderliness, neatness, sanitation, and safety.

32. All personnel, vehicles, and equipment will be confined to the access roads and gas well pads.

33. Ample notification shall be given to the Tribe at (970) 563-5550 when construction will hamper ingress and egress to Tribal land.

34. All spills, fires, accidents or any other unusual occurrence shall be promptly reported to the Southern Ute Energy Resources Department at (970) 563-5550 and BIA Realty Office at (970) 563-4514.

35. Construction, drilling, and production of the proposed gas well will be monitored by BLM, Tribal and/or BIA representatives.

36. Special conditions will be issued whenever conditions warrant requirements outside the General Well Site Conditions of Approval.

37. All production equipment shall be muffled.

38. All equipment shall be painted an environmental green color within seven (7) days of completion of construction.

39. Operator shall give the Southern Ute Department of Energy Office advance notice by email etrahan@sudoe.us and telephone (970) 563-5563 at least 48 hours before construction is to begin.

40. Adequate weed control will be maintained on the wellpad and access road at all times during the life of the project until final reclamation of the wellsite and access road is achieved.

41. On Fruitland formation cavitation procedures, any off location vegetation that gets "dusted" by coalfines needs to be washed off with cold water within 48 hours of cavitation completion. The Operator will contact the BIA and BLM immediately so that the washing process can be monitored by them.

TRIBAL SITE SPECIFIC MITIGATIONS/STIPULATIONS:

SEE RANGE REPORT

AGREE TO COMPLY WITH TERMS AND CONDITIONS:

OPERATOR

BY: _____ **DATE:** _____

SIGNED: _____ **DATE:** **March 11, 2013**
Energy Land Manager

CONCURRED: _____ **DATE:** _____
BIA Superintendent

REVISED 11/07/11

SOUTHERN UTE INDIAN TRIBE

GENERAL PIPELINE RIGHT-OF-WAY STIPULATIONS

COMPANY: Operator DATE: March 11, 2013

LINE NAME: Project Pipeline/Access

LOCATION: Section(s) XX, T XX N, R X W, N.M.P.M.

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Boldface and/or underlined text denotes site specific stipulations.

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General Stipulations

These Stipulations shall govern the development of the above named project. In instances, where definite procedures are not outlined in these Site Specific Stipulations, the General Stipulations shall apply. If the operator has questions regarding these or any stipulations they should contact SUIT DOE at etrahan@sudoe.us, dolquin@sudoe.us, ksiesser@sudoe.us; or Southern Ute Range Division at qwesterman@southern-ute.nsn.gov.

1. A preliminary onsite review of the pipeline right-of-way by Tribal, BIA and archaeological representatives is required.

2. Construction will conform to the requirements as described on the Right-Of-Way Application. A copy of these stipulations shall be kept on location at all times.

3. A preliminary survey plat shall be submitted to the Energy Office at P.O. Box 1500, Ignacio, Colorado 81137 at least five (5) days prior to the onsite inspection, and an "as built" survey plat shall be submitted to the Energy Office within 30 days following completion of construction.

4. The company shall notify Southern Ute Energy Landman, Ed Trahan at 970-563-5563 (office) or 970-759-4412 (cell) or by email etrahan@sudoe.us and Range Technician, Gus Westerman at 970-563-4780 EXT. 3515 (office) or 970-749-8840 (cell) or by email at ***qwesterman@southern-ute.nsn.gov*** 5 business days prior to construction of project.

5. Proper Crossing Permits shall be obtained from the Southern Ute Indian Tribe prior to entering Tribal Lands.

6. Surface damage compensation and/or right-of-way grant of permission assessment will be paid to the Southern Ute Indian Tribe at a rate determined by the Southern Ute Department of Energy as stated in the Tribal Council Policy regarding right-of-way and surface damage compensation for oil and gas facilities. All assessments shall be paid prior to construction.

7. Special stipulations will be issued whenever conditions warrant requirements outside the General Pipeline Right-Of-Way Stipulations.

8. All activity shall be confined to the areas surveyed for cultural resources. If subterranean cultural resources are encountered, all land-altering activities shall be halted, and the following shall be notified immediately:

Southern Ute Department of Energy - (970) 563-5550
BIA Area Archaeologist - (505) 563-3407
BIA Southern Ute Agency - (970) 563-4514

All people who are in the area will be informed by the operator that they are subject to prosecution for disturbing archaeological sites or picking up artifacts.

9. The centerline of the pipeline shall be restaked prior to construction. The edges of the right-of-way shall be staked in 100 foot intervals prior to construction.

10. Ample notification shall be given to the Southern Ute Department of Energy at (970) 563-5550 when construction will hamper ingress and egress to Tribal lands.

11. The company shall use Best Management Practices (BMP's) which eliminate or minimize adverse impacts to the environment, public health and the Tribes natural resources.

12. Restroom facilities shall be provided on the jobsite during construction.

13. Warning signs and reflectors indicating construction underway will be erected where applicable.

14. Construction of the pipeline shall come to a halt during inclement weather to prevent soil damage or destruction.

15. All personnel, vehicles, and construction equipment will be confined to the right-of-way.

16. Construction of new permanent access roads will not be permitted.

17. The pipeline shall be laid at a sufficient depth below the bed of any ravine, canyon or waterway it crosses to prevent exposure in heavy runoff periods.

18. Blading of pipeline routes located on gentle topography need only to have brush and surface irregularities removed and smoothed, leaving most of the underlying layer of vegetation undisturbed. Graders are recommended for clearing these routes, because blade depths can be more easily controlled.

19. **A BUREAU OF INDIAN AFFAIRS TIMBER CUTTING PERMIT, FORM 5-5331 MUST BE OBTAINED PRIOR TO CUTTING TREES. THIS PERMIT CAN BE OBTAINED FROM THE BUREAU OF INDIAN AFFAIRS (970) 563-4571.**

    a. The cleared area is to be kept to the minimum necessary for construction and maintenance.

    b. Chainsaws shall be used to cut trees. Bulldozers or other heavy equipment shall not be used to clear areas.

    c. All sound woody material, from piñon pine, juniper, and gambel oak, which is at least three (3) inches in diameter and two (2) feet in length will be salvaged during clearing activities. Unless otherwise stated in the Site Specific Stipulations, all wood material will be cut into eighteen (18) inch lengths, limbed, and hauled to the Tribal wood yard located north of the Custom Farm Shop, Monday through Friday, between the hours of 8:00 A.M. and 4:30 P.M., except on holidays. All wood shall be hauled prior to completion of construction. Load tickets must accompany every load hauled to the wood yard.

    d. Debris (slash) from forest products, which includes limbs, brush, and wood products which do not meet the minimum size, will be chipped with a wood chipper and scattered around the location at a depth not to exceed 3 inches and shall be scattered within seven (7) days after completion of construction.

    e. Stumps shall be cut as low as practical to avoid waste. The mean height of any stump shall not exceed one half its diameter, and in no case shall it exceed six (6) inches on the uphill side. Stumps which are grubbed during construction shall be scattered within the right-of-way within seven days after completion of construction.

    f. The wood volume has been determined to be __x__ cords and __x__ posts.

20. Topsoil material shall be stockpiled to the side of the routes where cuts and fills or other surface disturbance occur during pipeline construction. Topsoil shall not be mixed or covered with subsurface material.

21. If TUA's are approved for this project:
    - Use in the Temporary Use Area (TUA) shall not harvest trees or cause ground disturbance beyond turning, parking, or storing equipment;
    - This area will be reclaimed including reseeding when construction is final;
    - The perimeter of the TUA'S shall be marked as surveyed; and
    - Work in the TUA's shall cease during inclement weather that causes equipment to rut the surface.

22. Excavated material shall be stored within the permitted area.

23. Cuts and fills on pipelines should be made only where necessary. Reclaimed cut and fill slopes should normally be no steeper than 3:1 and should be graded to blend with the adjacent terrain.

24. Rock which is brought to the surface during construction will normally be buried on site. The amount of surface rock will not be greater than the pre-disturbance condition of the site.

25. After backfilling of the ditch, final leveling will be done and the proper crown constructed to allow for settling of the trench. These trenches should be maintained in order to correct settlement and to prevent erosion.

26. All road crossings shall be reconstructed to allow smooth travel and shall be compacted to avoid excessive settling and have adequate crowning to prevent storm water from pooling on the roadway.

27. Pipeline routes should be recontoured to conform to the adjacent terrain, water barred, and reseeded.

28. Frequency of water bar spacing will be dependent on the slope of the land as shown below:

percent of slope	**spacing interval in feet**
0 to 5	N/A
6 to 10	200 (only on slopes longer than 500 feet)
10 plus	50

Water bars will be started and finished in vegetation and constructed at grades of 2% or less. Water bars should be repaired as necessary.

29. The Southern Ute Tribal seeding mixture recommendation is as follows:

SEED MIXES:

AG FIELD MIX	
Manchar Smooth Brome	8 lbs/per acre PLS
Orchardgrass	2 lbs/acre PLS
Timothy	3 lbs/acre PLS
Annual Sterile Ryegrass	
or Sterile Triticale	4-8 lbs/acre PLS

MIX # 1, The Pine River valley to Highway 550;

Western Wheatgrass	7 LBS/PLS per acre
Antelope Bitter Brush	1 LBS/PLS per acre
Smooth Brome	4 LBS/PLS per acre

Intermediate Wheatgrass	3 LBS/PLS per acre
Annual Sterile Ryegrass or Sterile Triticale	12 LBS/PLS per acre

MIX # 2, West of Hwy 550 to Hwy 140;

Crested Wheatgrass	2 LBS/PLS per acre
Indian Rice Grass	2 LBS/PLS per acre
Blue Grama Grass	2 LBS/PLS per acre
Galleta Grass	2 LBS/PLS per acre
Sand Drop Seed	1 LBS/PLS per acre
Fourwing Saltbush	1 LBS/PLS per acre
Western Wheatgrass	4 LBS/PLS per acre
Pubescent Wheatgrass	2 LBS/PLS per acre
Annual Ryegrass Or Annual Barley	12 LBS/PLA per acre

For Broadcast rates double the above rates.

First seeding shall be done within six (6) months of completion of construction. Routine checks will be made of the seeded areas. If, within one year, no visible strands are observed, reseeding will be required.

30. All existing fences removed for construction purposes will be repaired or rebuilt, unless otherwise stipulated.

31. All existing ditches/drainages shall be rerouted or restored to pre-construction conditions unless otherwise addressed in the Site Specific Stipulations.

32. The centerline of the pipeline shall be permanently staked with pipeline location stakes. The company name and telephone number shall be placed on each stake.

33. All trash or litter on the right-of-way will be disposed of at an approved landfill when construction operations have been completed.

34. No fluids (i.e., diesel, motor oil, crankcase oil, etc.) will be disposed of on the Southern Ute Indian Reservation. Discharge permits (e.g., NPDES) shall be obtained for hydrostatic water disposal.

35. All fuels, lubricants, cleaning agents, drilling mud or other chemicals shall be stored in catchments to prevent surface contamination. Drilling mud and or other fluids shall not be discharged on the surface.

36. Pipeline rights-of-way and related facilities shall be kept in a neat and well maintained condition.

37. Periodic inspections of the right-of-way by representatives of the Southern Ute Indian Tribe and the Bureau of Indian Affairs will be done once construction has been completed.

38. Operator shall be responsible for upkeep and maintenance of the right-of-way on an "as needed" basis.

TRIBAL SITE SPECIFIC MITIGATIONS/STIPULATIONS:

SEE RANGE REPORT STIPULATIONS

AGREE TO COMPLY WITH TERMS AND CONDITIONS:

OPERATOR

BY: _____ **DATE:** _____

SIGNED: _____ **DATE:** **March 11, 2013**
Energy Land Manager

CONCURRED: _____ **DATE:** _____
BIA Superintendent

REVISED 11/07/11

EXHIBIT "A"

LA PLATA COUNTY
PIPELINE/FACILITY NOTIFICATION FORM

Intended to comply with taxation compact between the Southern Ute Tribe and La Plata County.

Send to: La Plata County – Tax Assessor
Craig Larson
Post Office Box 3339
Durango, Colorado 81302

1. Company Name: ____
   Contact Person Name: _____
   Address: _____
   Phone Number: _____

2. Facility Name: _____

3. Legal description of location: _ Sec. __ Twn. _ Range

4. Site plan (for facility) attached _____

5. Estimated cost of pipeline or facility or both _

6. Estimated date of commencement ___
   Estimated date of completion _____

Position/title of person completing form _____

Name _____ Signature _____ Date _____

cc: Southern Ute Indian Tribe
Department of Energy – Land Division
Post Office Box 1500
Ignacio, Colorado 81137

SOUTHERN UTE INDIAN TRIBE

GENERAL ACCESS ROAD RIGHT-OF-WAY STIPULATIONS

COMPANY: OPERATOR DATE: March 11, 2013

LINE NAME: PROJECT NAME

LOCATION: Section(s) XX , T XX N, R XX W, N.M.P.M.

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Boldface and underlined text denotes site specific stipulations.

****

General Stipulations

These Stipulations shall govern the development of the above named project. In instances, where definite procedures are not outlined in these Site Specific Stipulations, the General Stipulations shall apply. If the operator has questions regarding these or any stipulations they should contact SUIT DOE at etrahan@sudoe.us, dolquin@sudoe.us, ksiesser@sudoe.us; or Southern Ute Range Division at gwesterman@southern-ute.nsn.gov.

1. A preliminary onsite review of the pipeline right-of-way by Tribal, BIA and archaeological representatives is required.

2. Construction will conform to the requirements as described on the Right-Of-Way Application. A copy of these stipulations shall be kept on location at all times.

3. A preliminary survey plat shall be submitted to the Energy Office at P.O. Box 1500, Ignacio, Colorado 81137 at least five (5) days prior to the onsite inspection, and an "as built" survey plat shall be submitted to the Energy Office within 30 days following completion of construction.

4. Surface damage compensation and/or right-of-way grant of permission assessment will be paid to the Southern Ute Indian Tribe at a rate determined by the Southern Ute Energy Department as stated in the Tribal Council Policy regarding right-of-way and surface damage compensation for oil and gas facilities. All assessments shall be paid prior to construction.

5. Special stipulations will be issued whenever conditions warrant requirements outside the General Access Road Right-Of-Way Stipulations.

6. All activity shall be confined to the areas surveyed for cultural resources. If subterranean cultural resources are encountered, all land-altering activities shall be halted, and the following shall be notified immediately:

Southern Ute Energy Resources - (970) 563-5550 BIA Area Archaeologist - (505) 563-3407 BIA Southern Ute Agency - (970) 563-4514

All people who are in the area will be informed by the operator that they are subject to prosecution for disturbing archaeological sites or picking up artifacts.

7. **The centerline of the access road shall be restaked prior to construction. The edges of the right-of-way shall be staked in 100 foot intervals prior to construction.**

8. Ample notification shall be given to the Tribe at (970) 563-5550 when construction will hamper ingress and egress to Tribal lands.

9. Warning signs and reflectors indicating construction underway will be erected where applicable.

10. Construction of the access road shall come to a halt during inclement weather to prevent soil damage or destruction.

11. All personnel, vehicles, and construction equipment will be confined to the right-of-way.

12. **A BUREAU OF INDIAN AFFAIRS TIMBER CUTTING PERMIT, FORM 5-5331 MUST BE OBTAINED PRIOR TO CUTTING TREES. THIS PERMIT CAN BE OBTAINED FROM THE BUREAU OF INDIAN AFFAIRS (970) 563-4571.**

    a. The cleared area is to be kept to the minimum necessary for construction and maintenance.

    b. Chainsaws shall be used to cut trees. Bulldozers or other heavy equipment shall not be used to clear areas.

    c. All sound woody material, including deadwood, from piñon pine, juniper, and gambel oak, which is at least three (3) inches in diameter and two (2) feet in length will be salvaged during clearing activities. All wood material will be cut into eighteen (18) inch lengths, limbed, and hauled to the Tribal wood yard located north of the Custom Farm Shop, Monday through Friday, between the hours of 8:00 A.M. and 4:30 P.M., except on holidays. All wood shall be hauled prior to completion of construction. Load tickets must accompany every load hauled to the wood yard.

    d. Debris (slash) from forest products, which includes limbs, brush, and wood products which do not meet the minimum size, will be chipped with a wood chipper and scattered around the location within seven (7) days after completion of construction.

    e. Stumps shall be cut as low as practical to avoid waste. The mean height of any stump shall not exceed one half its diameter, and in no case shall it exceed fourteen (14) inches on the uphill side. Stumps which are grubbed during construction shall be scattered at least 50 feet from the right-of-way within seven days after completion of construction.

    f. The wood volume has been determined to be __X__ cords and __X__ posts.

13. Cuts and fills on pipelines should be made only where necessary. Cut and fill slopes should normally be no steeper than 3:1 and should be graded to blend with the adjacent terrain.

14. Rock which is brought to the surface during construction will normally be buried on site. The amount of surface rock will not be greater than the pre-disturbance condition of the site.

15. All road crossings shall be compacted to avoid excessive settling.

16. All existing fences removed for construction purposes will be repaired or rebuilt.

17. All existing ditches shall be rerouted or restored to pre-construction conditions.

18. All trash or litter on the right-of-way will be disposed of at an approved landfill when construction operations have been completed.

19. No fluids (i.e., diesel, motor oil, crankcase oil, etc.) will be disposed of on the Southern Ute Indian Reservation. Discharge permits (e.g., NPDES) shall be obtained for hydrostatic water disposal.

20. Pumping stations should be kept in a neat and well maintained condition.

21. A final inspection of the right-of-way by representatives of the Southern Ute Indian Tribe and the Bureau of Indian Affairs will be done once construction has been completed.

22. Operator shall give the Southern Ute Energy Resource Office (970.563.5550) at least 48 hours advance notice before construction is to begin and also email said notice to ***etrahan@sudoe.us***.

23. Operator shall be responsible for upkeep and maintenance of the right-of-way on an "as needed" basis.

TRIBAL SITE SPECIFIC MITIGATIONS/STIPULATIONS:

SEE RANGE REPORT

AGREE TO COMPLY WITH TERMS AND CONDITIONS:

OPERATOR

BY: _____ **DATE:** _____

SIGNED: _____ **DATE:** **March 11, 2013**
Energy Land Manager

CONCURRED: _____ **DATE:** _____
BIA Superintendent

SOUTHERN UTE INDIAN TRIBE Revised.cst.doc

GENERAL COMPRESSOR STATION STIPULATIONS

COMPANY: Operator DATE: March 11, 2013

FACILITY NAME: PROJECT NAME

LOCATION: Section(s) XX, T XX N, R XX W, N.M.P.M., La Plata County, Colorado

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Boldface and/or underlined text denotes site specific stipulations.

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General Stipulations

These Stipulations shall govern the development of the above named project. In instances, where definite procedures are not outlined in these Site Specific Stipulations, the General Stipulations shall apply. If the operator has questions regarding these or any stipulations they should contact SUIT DOE at etrahan@sudoe.us, dolguin@sudoe.us, ksiesser@sudoe.us; or Southern Ute Range Division at gwesterman@southern-ute.nsn.gov.

1. A preliminary onsite review of Compressor Station sites by Tribal, BIA, BLM and Archaeological representatives is required.

2. The company shall notify Southern Ute Energy Landman, Ed Trahan at 970-563-5563 (office) or 970-759-4412 (cell) or by email etrahan@sudoe.us and Range Technician, Gus Westerman at 970-563-4780 EXT. 3515 (office) or 970-749-8840 (cell) or by email at gwesterman@southern-ute.nsn.gov 5 business days prior to construction of project.

3. Proper Crossing Permits shall be obtained from the Southern Ute Indian Tribe prior to entering Tribal Lands.

4. Surface damage compensation and/or right-of-way grant of permission assessment will be paid to the Southern Ute Indian Tribe at a rate determined by the Southern Ute Department of Energy as stated in the Tribal Council Policy regarding right-of-way and surface damage compensation for oil and gas facilities. All assessments shall be paid prior to construction.

5. All land-altering activity will require permission by the Energy Department. A copy of these stipulations shall be kept on location at all times.

6. All activity shall be confined to the areas surveyed for cultural resources. If subterranean cultural resources are encountered, all land-altering activities shall be halted and the following shall be notified immediately:

Southern Ute Energy Department - (970) 563-5563 BIA Area Archaeologist - (505) 563-3407 BIA Southern Ute Agency - (970) 563-4514

All people who are in the area will be informed by the operator that they are subject to prosecution for disturbing archaeological sites or picking up artifacts.

7. The Compressor Station shall be properly identified with a readable sign, which shall include the following information:

Company name
Facility name
Legal description
Lease number

8. Construction of the Compressor Station shall come to a halt during inclement weather to prevent soil damage or destruction.

9. The company shall use Best Management Practices (BMP's) which eliminate or minimize adverse impacts to the environment, public health and the Tribes natural resources.

10. Restroom facilities shall be provided on the jobsite during construction.

11. Warning signs and reflectors indicating construction underway will be erected where applicable.

12. All equipment shall be muffled.

13. The compressor station will be contained within a sound mitigated building.

14. Operator will be required to install sufficient equipment, including, but not limited to hospital grade mufflers and sound walls in order to reduce noise to levels deemed adequate by the Tribal Energy Department.

15. A 9-gauge chain link fence with at least three strands of barbed wire along the top of the fence will be installed along the perimeter of the compressor station right-of-way.

16. No fencing shall be placed across existing roads.

17. No fluids (i.e., diesel, motor oil, water, etc.) will be disposed of on the Southern Ute Indian Reservation, except as otherwise specifically authorized.

18. Any fluids discharged from the compressor shall be held in a fiberglass pit. Said pit shall be enclosed in a woven wire enclosure. The pit shall have a minimum of two (2) feet of freeboard at all times. Excess fluids shall be disposed of in a manner consistent with Federal regulations.

19. **A BUREAU OF INDIAN AFFAIRS TIMBER CUTTING PERMIT, FORM 5-5331 MUST BE OBTAINED PRIOR TO CUTTING TREES. THIS PERMIT CAN BE OBTAINED FROM THE BUREAU OF INDIAN AFFAIRS (970) 563-4571.**

    a. The cleared area is to be kept to the minimum necessary for construction and maintenance.

    b. Chainsaws shall be used to cut trees. Bulldozers or other heavy equipment shall not be used to clear areas.

    c. All sound woody material, from piñon pine, juniper, and gambel oak, which is at least three (3) inches in diameter and two (2) feet in length will be salvaged during clearing activities. Unless otherwise stated in the Site Specific Stipulations, all wood material will be cut into eighteen (18) inch lengths, limbed, and hauled to the Tribal wood yard located north of the Custom Farm Shop, Monday through Friday, between the hours of 8:00 A.M. and 4:30 P.M., except on holidays. All wood shall be hauled prior to completion of construction. Load tickets must accompany every load hauled to the wood yard.

d. Debris (slash) from forest products, which includes limbs, brush, and wood products which do not meet the minimum size, will be chipped with a wood chipper and scattered around the location at a depth not to exceed 3 inches and shall be scattered within seven (7) days after completion of construction.

e. Stumps shall be cut as low as practical to avoid waste. The mean height of any stump shall not exceed one half its diameter, and in no case shall it exceed six (6) inches on the uphill side. Stumps which are grubbed during construction shall be scattered within the right-of-way within seven days after completion of construction.

f. The wood volume has been determined to be X cords and X posts.

10. All equipment and buildings shall be painted an environmental green color within seven (7) days of completion of construction.

11. All topsoil will be stockpiled neatly for reclamation purposes.

12. Topsoil will not be piled against trees or deposited in natural drainageways.

13. A 16-foot heavy duty cattle guard, eight (8) feet in width and with six (6) inch spacing between bars, will be installed at the entrance of the yard. A livestock tight gate may be substitute for a cattle guard. The cattle guard shall be installed within seven (7) days after completion of construction.

14. Culverts will be installed in areas were needed or required.

15. Culverts or cattle guards will not be removed unless authorized by the Tribe.

16. All materials, trash, junk, debris, etc., not required for operation shall be removed from the site within seven (7) days after the completion of construction.

17. Trash shall not be burned.

18. Upon completion of construction and unless specified otherwise, disturbed areas not within the fenced area shall be revegetated with the following low growing grass mixture. Seeding rates stated are a drilled rate. For broadcast seeding, double the rate.

SEED MIXES:

AG FIELD MIX

Manchar Smooth Brome	8 lbs/per acre PLS
Orchardgrass	2 lbs/acre PLS
Timothy	3 lbs/acre PLS
Annual Sterile Ryegrass or Sterile Triticale	4-8 lbs/acre PLS

MIX # 1, The Pine River valley to Highway 550;

Western Wheatgrass	7 LBS/PLS per acre

Antelope Bitter Brush	1 LBS/PLS per acre
Smooth Brome	4 LBS/PLS per acre
Intermediate Wheatgrass	3 LBS/PLS per acre
Annual Sterile Ryegrass or Sterile Triticale	12 LBS/PLS per acre

MIX # 2, West of Hwy 550 to Hwy 140;

Crested Wheatgrass	2 LBS/PLS per acre
Indian Rice Grass	2 LBS/PLS per acre
Blue Grama Grass	2 LBS/PLS per acre
Galleta Grass	2 LBS/PLS per acre
Sand Drop Seed	1 LBS/PLS per acre
Fourwing Saltbush	1 LBS/PLS per acre
Western Wheatgrass	4 LBS/PLS per acre
Pubescent Wheatgrass	2 LBS/PLS per acre
Annual Ryegrass Or Annual Barley	12 LBS/PLA per acre

First seeding shall be done within six (6) months of completion of construction. Periodic checks by Tribal personnel will be made of the seeded area. If within one year no seeding success or only partial success is observed, additional seeding will be required.

19. The Compressor Station site will be maintained in accordance with generally accepted standards for repair, orderliness, neatness, sanitation and safety.

20. All vehicles, equipment and personnel will be confined to the access roads and parking areas.

21. Ample notification shall be given to the Tribe at (970) 563-5550 when construction will hamper ingress and egress to Tribal land.

22. All spills, fires, accidents or any other unusual occurrences shall be promptly reported to the Southern Ute Natural Resources/Southern Ute Energy Department at (970) 563-5550 and BIA Realty Office at (970) 563-4514.

23. BLM, Tribal and/or BIA representatives will monitor construction and operation of the compressor site.

24. Special and/or additional stipulations will be issued whenever conditions warrant requirements outside the General Compressor Station Stipulations.

25. Operator shall give the Southern Ute Energy Department advance notice at least 48 hours before construction is to begin.

TRIBAL SITE SPECIFIC MITIGATIONS/STIPULATIONS:

SEE RANGE REPORT

AGREE TO COMPLY WITH TERMS AND CONDITIONS:

OPERATOR

BY: _____ **DATE:** _____

SIGNED: _____ **DATE:** **March 11, 2013**
Energy Land Manager

CONCURRED: _____ **DATE:** _____
BIA Superintendent

Appendix F – Stormwater Recommendations for Operations on Tribal Lands within the Southern Ute Indian Reservation

STORM WATER RECOMMENDATIONS FOR OPERATIONS ON TRIBAL LANDS WITHIN THE SOUTHERN UTE INDIAN RESERVATION

Southern Ute Indian Tribe Water Quality Program requests that any oil & gas exploration and production (E&P) companies submit the Notice of Intent (NOI) form and a Storm Water Pollution Prevention Plan (SWPPP) when proposing any ground disturbing activities of one (1) acre or greater.

Oil & gas construction operations on Tribal lands are currently required to install proper BMPs and control sedimentation and erosion according to the BIA and Tribal right-of-way agreements. These recommendations will aid the operator, BIA, and the Tribe with documenting the storm water controls that are being implemented.

The SWPPP will include the following:

Identification of Potential Sources of Pollution: All potential sources of pollution which may reasonably be expected to affect the quality of storm water discharges associated with construction activity from the site must be identified; and the practices to be used to reduce the pollutants in storm water discharges associated with construction activity at the facility must be described. The SWPPP must ensure the practices are selected, installed, implemented and maintained in accordance with good engineering practices.

At a minimum, each of the following shall be evaluated for the potential for contributing pollutants to runoff:

- Vehicle and equipment maintenance and fueling areas
- Concrete truck/equipment washing
- Areas for unloading/loading materials
- Above-ground tanks of liquid storage
- On-site waste management areas (waste piles, liquid wastes, dumpsters, etc)
- Management
- Outside storage areas for chemicals and building materials
- Sanitation areas (port-a-potties)

Site Narrative (should be included): a site narrative must describe the phases of construction and the implementation and maintenance of BMPs for each phase as well as BMP removal once 70% vegetative groundcover has been established. The site narrative must describe the re-vegetation efforts that will be performed including seedbed preparation, seeding methods and seed mixtures and straw mulching and crimping. The Southern Ute Tribe strongly encourages native grass, shrub and forest species be utilized for re-vegetation purposes.

Site Map (should be included): The map must provide all information noted on the Notice of Intent form

- construction site boundaries;
- all areas of ground surface disturbance;
- areas of cut and fill;

- areas used for storage of building materials, equipment, soil, or waste ;
- location of major structural and non-structural BMPs identified in the SWMP;
- location(s) where storm water discharges offsite
- location of any springs,
- locations of all potential receiving waters. **Receiving waters include ditches, ephemeral and intermittent streams, arroyos, creeks, rivers, lakes, and wetlands as well as tributaries to these waters.**

Soil Type: Please indicate the predominant soil type in the area of the project.

Site Photos: Color photos of the site prior to ground disturbing activities will be used to determine when 70% re-vegetation has been achieved.

Drainage Patterns: This submittal should describe the natural drainages and any new drainages that will be anticipated after site grading.

Pollution Prevention Team list: Included in this list will be the names of the team members, their contact numbers, and responsibilities.

Materials Handling and Spill Prevention: The SWPPP shall clearly describe and locate all practices implemented at the site to minimize impacts from procedures or potential pollutant sources that could contribute pollutants to runoff. Areas or procedures where potential spills can occur shall have spill prevention and response procedures identified in the SWPPP.

THE SOUTHERN UTE INDIAN TRIBE RESERVES THE RIGHT TO REVIEW AND INSPECT THE FOLLOWING:

Best Management Practices (BMP): Prior to project construction, installation of BMPs must be completed and detailed in the SWPP. The selection of BMP installation is up to the O&G exploration company and or its contractors. An inspection report will include the following:

Photographic Documentation: In addition to initial photos, O&G E&P will maintain photo points and photographic records of on-going progress of revegetation to be included in any required or requested monitoring reports. The photographic documentation will be submitted for finale stabilization and termination determinations.

Inspection and Maintenance: A schedule of routine BMP inspections and inspection reports should be kept on site and completed every 30 days or following a greater than 0.5 inch rain event. The inspection report should be signed by the project manager. Inspection of the site will continue until 70% revegetation is attained for the project site as detailed above.

Upon termination, O&G E&P operator will submit copies of all inspection reports and photo documentation of site re-vegetation. The Southern Ute Indian Tribe will review the submitted records and will issue a Notice of Termination.

If there are any questions please contact the Southern Ute Indian Tribe's Water Quality Program at (970) 563-0135.

Southern Ute Indian Tribe
OIL & GAS STORM WATER

NOTICE OF INTENT (NOI)

Southern Ute Indian Tribe requests that any oil and gas companies submit the following information when proposing any ground disturbing activities of **one (1) acre or greater**.

Project Name:_____ **Location Legal Description:**_____

Company:_____ **Project Contact Person:**_____

Office Phone #:_____ **Cell Phone #:**_____

Total Disturbance Area:_____**acres** **Predominate Soil Type:**_____

Purpose of Project:_____

_____

_____

_____

Required Documents and Plans:

1. **Site Map** □ Included □ Not Included – Reason:_____

A detailed and legible site map must be submitted that includes the following:

- Detailed footprint of the site and the anticipated size of the project area including any infrastructure(s).
- All drainages, outfalls, and receiving waters (receiving waters include ephemeral and intermittent streams, arroyos, creeks, tributaries and the primary water sources).
- Location and type of all BMPs that will be installed.
- Topography of site and surrounding area.
- Location of all exposed significant materials and high-risk waste-generating areas and activities associated with the project - i.e. fueling stations, washing & maintenance area (including concrete washout areas), above ground storage tanks, industrial waste management areas, outside storage for chemicals, secondary containment areas, sanitation areas, etc.
- Mud control locations (ingress/egress areas).

2. **Site Photos** □ Included □ Not included – Reason:_____

Companies will submit color photos of proposed site prior to ground disturbing activity. The photographs will be used to determine when 70% of pre-existing re-vegetation has been achieved.

The Southern Ute Indian Tribe requests the right to review and inspect all BMPS and monitoring reports until 70% revegetation has been achieved and a Notice of Termination has been issued.

Appendix G – Air Quality Impact Analysis

Air Quality Modeling and Impact Analysis for the North Carracas Plan of Development Environmental Assessment on the Southern Ute Indian Reservation

Prepared for:
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Safety and Environmental Compliance
Management Group
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Durango, CO 81301

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March, 2013
06-30048

ENVIRON

CONTENTS

APPENDICES

TABLES

FIGURES

1.0 EXECUTIVE SUMMARY

The Southern Ute Indian Tribe (SUIT) is proposing to develop natural gas assets in the North Carracas area of the Reservation in southwestern Colorado. The proposed facilities, to be located on Tribal Trust and private (fee) lands within Archuleta County, includes 48 Fruitland Coal Bed Methane (CBM) wells on 18 well pads (16 new pads and 2 existing pads), one saltwater disposal well, associated roads and pipelines and a new compressor facility.

Based on a review of the Proposed Action and consultations between SECMG, the BLM, the U.S. Forest Service, and the U.S. Environmental Protection Agency (EPA), BLM requested an ambient air quality impact analysis (AQIA) to ensure National Environmental Policy Act (NEPA) adequacy in consideration of the Proposed Action with respect to potential impacts on attainment of the National Ambient Air Quality Standards (NAAQS) for criteria pollutants, air quality-related values in nearby Class I areas (Weminuche and Mesa Verde) and human exposures to hazardous air pollutants (HAPs).

An AQIA was conducted in response to BLM's request using models and procedures consistent with Federal Land Manger and EPA guidance. The modeling approach was laid out in a Modeling Protocol document which underwent agency review prior to finalization of the AQIA. Two emission scenarios were developed and analyzed: a "maximum day" scenario consisting of the combination of construction and operational source activities which produce the highest daily total emissions of all pollutants and a "maximum annual average" scenario under which the annual full production phase emissions are combined with the maximum annual development phase emissions. Model results based on the "maximum day" emissions scenario were used for the short-term NAAQS and HAPs analyses and the plume visual impact analysis; model results for the maximum annual average scenario were used for the annual average NAAQS and HAPs analyses and the acid deposition analysis.

Cumulative air quality impacts of the Proposed Action were estimated by considering the combined impacts of the Proposed Action, existing sources and potential impacts from reasonably foreseeable future development (RFFD) sources. Existing source impacts were represented by background pollutant concentrations measured at nearby ambient air monitoring sites. A review of RFFD sources within the cumulative impact area of the Proposed Action identified several oil and gas development plans including the Northern San Juan Basin Coal Bed Methane project, the Southern Ute Indian Reservation 160-acre spacing project and the Southern Ute Indian Reservation 80-Acre Infill project. A comprehensive cumulative impacts analysis based on a photochemical modeling application encompassing these and other existing and RFFD sources in the Four Corners region was prepared as part of the Programmatic Environmental Assessment (PEA) for the 80-Acre Infill project. On a regional level, the combined impacts of projects included in the PEA cumulative analysis, which included plans for over 1,700 new oil and gas wells in the Northern San Juan Basin, can be reasonably assumed to overwhelm any changes to cumulative impacts resulting from the 48 wells to be developed under the Proposed Action. Therefore, the cumulative impacts analysis from the PEA is used here to qualitatively evaluate the potential cumulative impacts of the Proposed Action.

Results of the AQIA show that emissions of criteria pollutants from the Proposed Action, when combined with measured background air quality levels, are not estimated to cause or contribute to any NAAQS violations. Exposures to HAP emissions from the Proposed Action are calculated to be below EPA dose-response screening levels. The summed incremental cancer risk due to chronic exposures to benzene and formaldehyde is calculated to be less than 10 in a million. The plume visual impact from the Proposed Action is estimated not to exceed established screening level criteria. Acid deposition impacts from the Proposed Action on sensitive lakes in the Weminuche Class I area are calculated to be below acceptable limits for acid neutralizing capacity established by the U.S. Forest Service (no sensitive lakes have been identified within the Mesa Verde Class I area). Maximum total sulfur deposition within the Weminuche and Mesa Verde Class I areas from the Proposed Action is estimated to be below the 0.005 kg/ha/year Deposition Analysis Threshold (DAT) established by the Federal Land Managers Working Group. Maximum total nitrogen deposition from the Proposed Action is calculated to be no more than 0.069 kg/ha/year, which exceeds the nitrogen DAT (0.005 kg/ha/year). However, qualitative evaluations of cumulative incremental impacts based on the 80-Acre Infill PEA as described above indicate that cumulative impacts associated with the Proposed Action, including acid deposition impacts, are estimated to be below established thresholds.

2.0 INTRODUCTION

The Southern Ute Indian Tribe (SUIT) is proposing to develop natural gas assets in the North Carracas area of the Reservation. The proposed facilities would be located on Tribal Trust and private (fee) lands within Archuleta County, Colorado. The Proposed Action is outlined in the document titled "Summary of Proposed Action, Southern Ute Indian Tribe North Carracas Oil and Gas Plan of Development" and the "Proposed Action Map" dated January 30, 2012 as provided to the U.S. Bureau of Land Management (BLM) by the Southern Ute Growth Fund's Safety & Environmental Compliance Management Group (SECMG). A summary of the proposed action is provided in Appendix A. The Proposed Action includes 48 Fruitland Coal Bed Methane (CBM) wells on 18 well pads (16 new pads and 2 existing pads), one saltwater disposal well, associated roads and pipelines and a new compressor facility. This proposed project is located in the southeast corner of the Southern Ute Indian Reservation.

Based on the Proposed Action and consultations between SECMG, the BLM, the U.S. Forest Service, and the U.S. Environmental Protection Agency (EPA), BLM has requested an ambient air quality impact analysis (AQIA) be conducted to ensure National Environmental Policy Act (NEPA) adequacy in consideration of the Proposed Action with respect to:

- The National Ambient Air Quality Standards (NAAQS) for nitrogen dioxide (NO_2), sulfur dioxide (SO_2), carbon monoxide (CO), and particulate matter (PM_{10} and $PM_{2.5}$);
- Air quality related values (AQRV), including visibility, acid deposition and acid neutralizing capacity of sensitive lakes in nearby Class I Areas; and
- Acute and chronic dose-response values for benzene, toluene, ethylbenzene, xylenes (BTEX), n-hexane, and formaldehyde.

This Technical Support Document presents a description of the data sources, analysis methods and results of the AQIA. A review of emission sources and emission inventory preparation methods for the Proposed Action is provided in Section 2. Section 3 describes the data sources and methods used for the AQIA and Section 4 presents results of the AQIA.

3.0 EMISSION SOURCES

The Proposed Action would be located within the exterior boundaries of the Southern Ute Indian Reservation (SUIR) and would include construction of 16 new well pads, drilling of 48 natural gas wells, a salt water disposal (SWD) facility and a natural gas compressor station located approximately 6 miles north of Carracas, CO. Figure 2.1 (General Location Map) shows the approximate proposed locations of the compressor station, SWD facility and new and existing well pads. Criteria pollutant (CO, SO_2, NOx, VOC [including hazardous air pollutants], PM_{10}, $PM_{2.5}$) emissions from all combustion sources and construction and unpaved road dust emissions were estimated and modeled for each emissions source. Greenhouse gas (CO_2, CH_4, N_2O) emissions from combustion and fugitive sources were also estimated for reporting purposes. Emission source characteristics are described in the following subsections; a detailed description of the emissions inventory for the Proposed Action is provided in Appendix B.

3.1 Development Emissions

Emissions associated with the development phase of the project include 1) fugitive dust from construction of the well pads, pipelines and roadways, 2) fugitive dust from haul road traffic, drill rig and supply traffic, and well completion traffic, 3) tailpipe emissions from haul trucks and off-road construction equipment, 4) drill rig engine emissions, and 5) well completion emissions, including hydraulic fracturing pumps (fracking pumps). Fracking is expected to be required for 8 wells in the eastern-most portion of the project area where vertical or s-shaped drilling techniques are to be employed as per the Project Description (Appendix A). Green completion procedures with no flaring will be used for all wells. A detailed listing of development phase emission sources is provided in Table 2.1.

Construction/road dust and tailpipe emissions are expected to occur throughout the project area, predominantly at the well pad locations and on the roadways and pipelines connecting them. In order to simulate these emissions, well pad locations were set up as idealized 3-acre, 4-acre and 6-acre volume sources based on the maximum expected disturbance per pad as listed in the Project Description (see Appendix A). Typical 6-acre and 4-acre layouts for the compressor and SWD facilities are shown in Figures 2.2 and 2.3, respectively. A typical layout for a 3 acre production well pad is illustrated in Figure 2.4. Construction fugitive dust emissions were divided among the well pads and roads, based on the acreage of each idealized pad and the length of the road using procedures developed by the Haul Roads Working Group (Fox, 2012). On- and off-road construction tailpipe emissions were modeled along the access roads. A maximum of two drill rigs would operate within the project boundaries at any one time. For the “maximum annual average” emissions scenario (see Section 2.3) used to model annual average concentrations, the total annual emissions from the rigs were divided among eight (8) pad locations (based on the maximum proposed annual drilling schedule). Drill rig and fracking engine emissions were modeled as point sources at each well pad. For the “maximum day” emissions scenario used to model peak short-term (1-, 3-, 8- and 24-hour average) concentrations (see Section 2.3), two drill rigs were modeled as operating on two well pads while fracking engines were modeled as operating on two other pads and a third pad was undergoing construction (see Appendix B).

Table 2.1. Development phase emission sources.

Sources	NOx	SO2	CO	VOC	PM10	PM2.5
Construction and Road Dust	-	-	-		x	x
On-Road Vehicle Tailpipe emissions	x	x	x	x	x	x
Off-Road Construction Equipment Tailpipe emissions	x	x	x	x	x	x
Drill Rigs	x	x	x	x	x	x
Completion/Fracking Engines	x	x	x	x	x	x

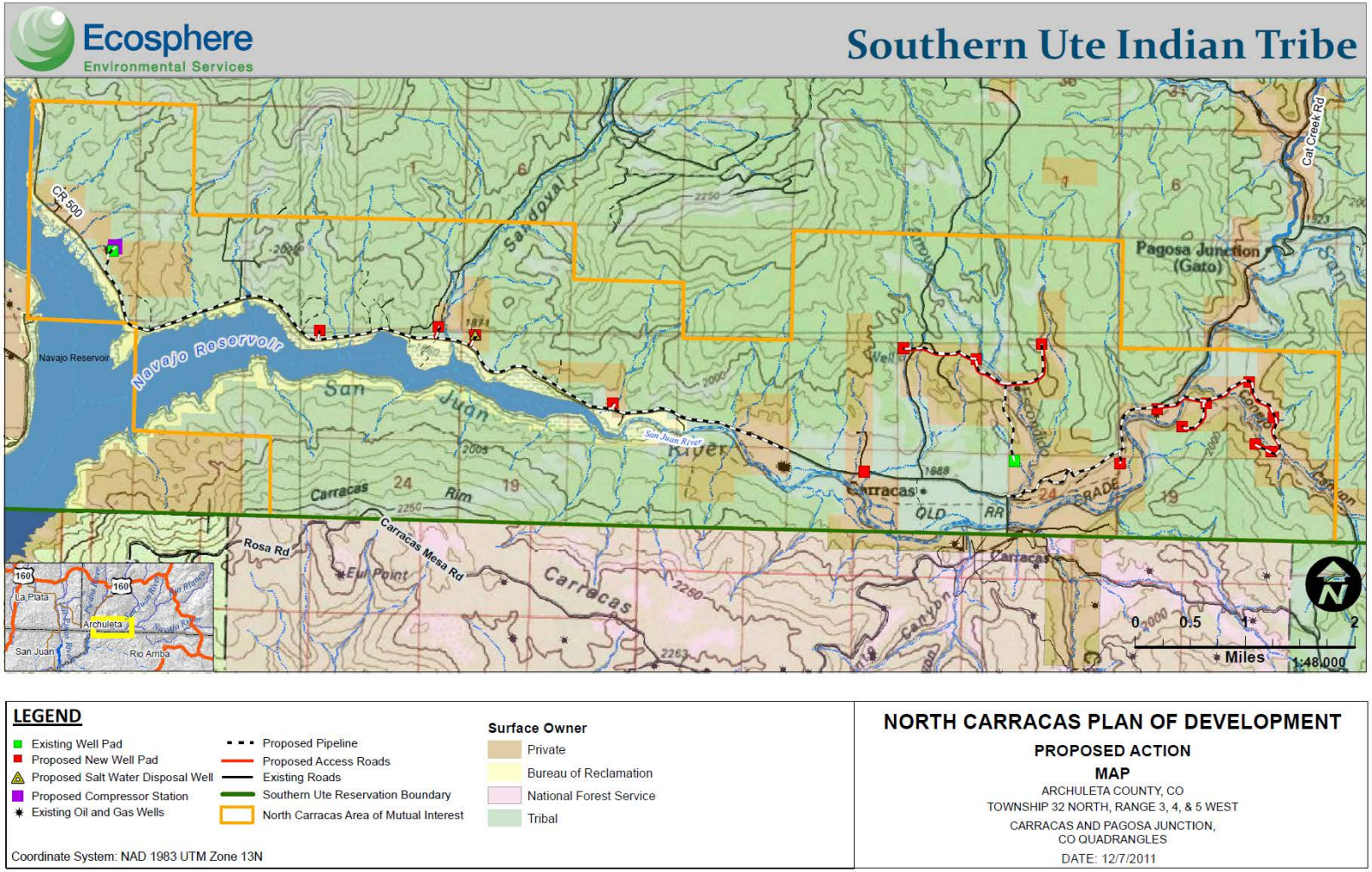

Figure 2.1. Project location map.

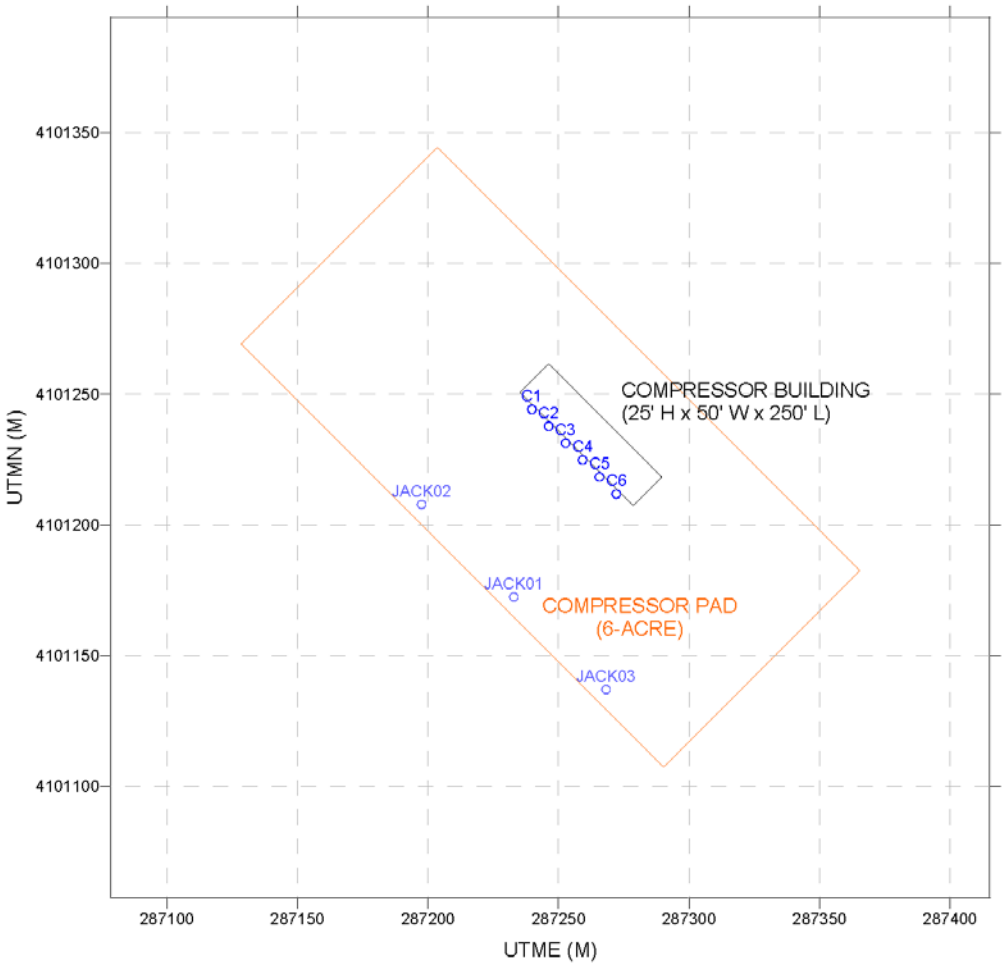

Figure 2.2. Compressor station pad layout.

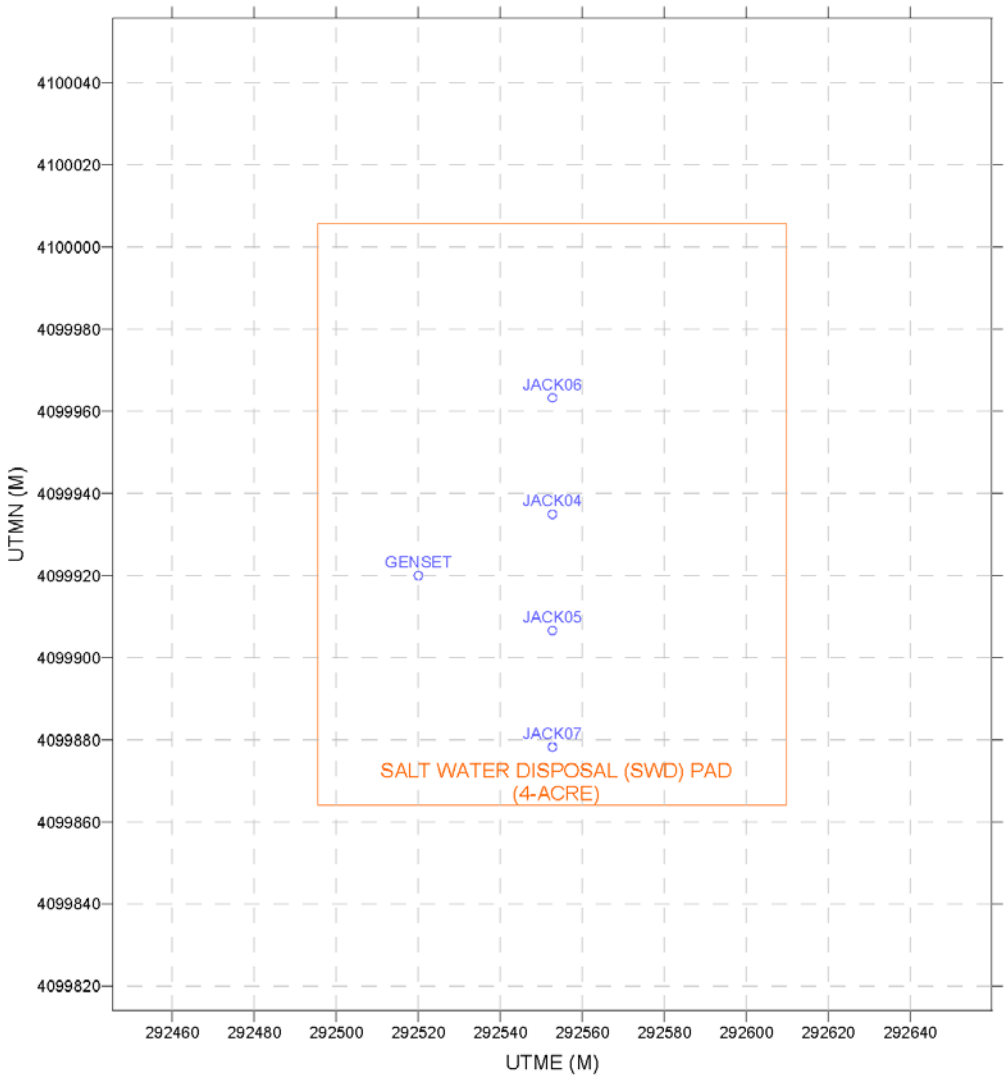

Figure 2.3. SWD pad layout.

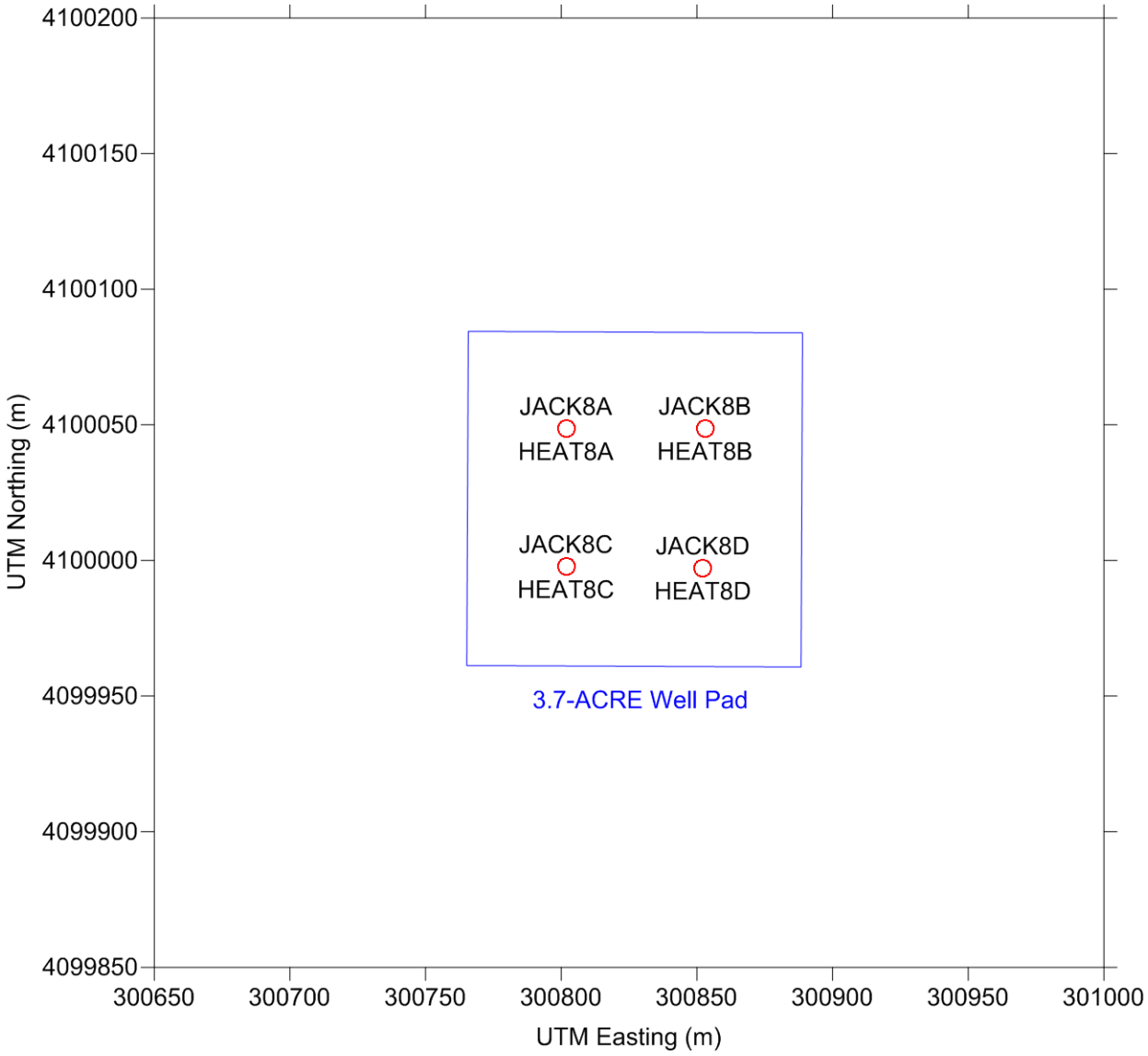

Figure 2.4. Well pad layout.

3.2 Production Phase Emissions

Emissions associated with the production phase of the project include emissions from the pumpjack engines and separator and water tank heaters located at each of the 48 new wellheads, generator engine for the salt water disposal (SWD) well, and a group of six compressor engines expected to be installed at a single compressor station. A list of production phase emission sources is provided in Table 2.2.

Table 2.2. Production phase emission sources.

Sources	NOx	SO2	CO	VOC	PM10	PM2.5
Compressors	x	x	x	x	x	x
Salt Water Disposal Well Injection Pump	x	x	x	x	x	x
Heaters	x	x	x	x	x	x
Pump Jacks	x	x	x	x	x	x

Emissions from each of the sources in Table 2.2 were modeled as individual discrete point sources using stack parameters appropriate for each source type based on available data and engineering judgment. Pad layouts for the compressor station and salt water disposal well are as shown in Figures 2.2 and 2.3, respectively. A representative well pad layout as shown in Figure 2.4 was used to locate emission sources on each of the 18 well pads.

3.3 Emission Scenarios

For dispersion modeling purposes, a "maximum day" emissions scenario was developed as described in Appendix B. This scenario represents the time period during project development when the combined emissions from all sources (construction, drilling, completion and partial production) are expected to be at a maximum. Emissions under the "maximum day" scenario are summarized in Table 2.3. These "maximum day" emissions were conservatively assumed to occur evenly throughout each day of the five-year dispersion model run. Dispersion model results based on the "maximum day" emissions scenario were used for the short-term NAAQS analysis described in Section 4.1, the short-term hazardous air pollutants (HAP) exposure analysis described in Section 4.2, and the plume visual impact analysis described in Section 4.3.2.

Table 2.3. Maximum Day scenario emissions.

Source	Emissions (lb/day)					
	CO	NOx	PM10	PM2.5	SO2	VOC
Development Phase						
Well Pad and ROW Construction Emissions (1 pad constructing)	11.9	25.6	99.0	45.7	1.9	3.2
Rig-up, Drill and Rig-Down Emissions (2 wells drilling)	110.5	368.7	243.1	33.0	0.4	30.9
Completion (fracking) and Testing (2 wells)	49.5	122.4	355.7	42.1	3.2	8.9
Total Development Phase	**171.9**	**516.7**	**697.8**	**120.7**	**5.6**	**43.0**
Operational Phase						
Compressor Station – Six units with two control elements.	60.3	177.2	0.1	0.1	0.7	85.1
Salt water disposal well generator assuming 1,700 hrs annual operation	2.6	18.1	0.4	0.4	0.0	0.2
pump jacks	23.7	103.5	1.4	1.4	0.0	0.4
Separator and water tank heaters	3.6	8.6	0.7	0.7	0.1	0.5
Total Operational Phase	**90.2**	**307.3**	**2.6**	**2.6**	**0.8**	**86.1**
TOTAL PROJECT – MAXIMUM DAILY	**262.2**	**824.0**	**700.4**	**123.2**	**6.4**	**129.2**

Similarly, emissions corresponding to a "maximum annual average" scenario as described in Appendix B were developed by adding the annual full production phase emissions to the maximum annual development phase emissions. Maximum annual average scenario emissions are summarized in Table 2.4. This scenario assumes maximum development of 19 wells on 8 well pads will occur in any one year. Total annual emissions from the "maximum annual average" scenario were conservatively modeled as occurring evenly through each year of the five year modeling period. Model predictions based on the maximum annual emissions scenario were used for the annual average NAAQS analysis (Section 4.1), the long-term HAP exposure calculations (Section 4.2) and the acid deposition and acid neutralizing capacity analyses (Sections 4.3.3 and 4.3.4).

Table 2.4. Maximum Annual Average scenario emissions.

Source	Emissions (tons per year)					
	CO	NOx	PM10	PM2.5	SO2	VOC
Development Phase						
Well Pad and ROW Construction Emissions	**0.28**	**0.40**	**6.88**	**2.61**	**0.02**	**0.05**
Rig-up, Drill and Rig-Down Emissions	**12.21**	**43.33**	**17.78**	**2.80**	**0.05**	**3.60**
Completion (fracking) and Testing	**2.33**	**5.27**	**35.05**	**3.80**	**0.13**	**0.42**
Total Development Phase	**14.82**	**49.00**	**59.71**	**9.20**	**0.20**	**4.07**
Operational Phase						
Compressor Station – Six units with two control elements.	12.57	36.96	0.02	0.02	0.14	17.74
Salt water disposal well generator assuming 1,700 hrs annual operation	0.55	3.77	0.09	0.09	0.01	0.03
pump jacks	4.94	21.59	0.28	0.28	0.00	0.08
Separator and water tank heaters	0.76	1.78	0.14	0.14	0.01	0.10
Total Operational Phase	**18.82**	**64.10**	**0.54**	**0.54**	**0.17**	**17.96**
TOTAL PROJECT – MAXIMUM YEAR	**33.64**	**113.11**	**60.25**	**9.74**	**0.37**	**22.03**

4.0 AIR QUALITY MODELING

An Air Quality Impact Analysis (AQIA) was conducted to estimate project impacts relative to the National Ambient Air Quality Standards (NAAQS analysis), to estimate project impacts on air quality related values (AQRVs) in nearby protected (Class I) areas, and to evaluate ambient air impacts with respect to acute and chronic dose-response values for hazardous air pollutants (HAPs). The AQIA was conducted using generally accepted methods and procedures as described in federal guidance documents, including the FLAG Phase I report (FLAG, 2010) and EPA's Air Quality Modeling Guidelines (40 CFR Appendix W).

4.1 Model Selection

Emission sources associated with the proposed project all have relatively low release heights with limited initial plume rise. Thus, maximum concentrations of criteria pollutants and HAPs from project sources occur either at or very close to the "fenceline" separating the project area from publically accessible locations. EPA's preferred guideline model for these types of sources is the AERMOD Gaussian Plume dispersion model[1]. AERMOD is appropriate for determining near-field ambient impacts in both simple and complex terrain from multiple sources subject to building downwash effects.

4.2 Emission Sources

Emission sources were modeled as described in Section 2 using emission totals developed as described in Appendix B. Source parameters (Tables 3.1 and 3.2) were selected based on available information and engineering judgment. Emissions from all sources except for fugitive dust sources and on-road truck and off-road well pad construction equipment used during the development phase were modeled as point sources. Unpaved road dust and haul truck emissions were modeled as a series of volume sources arranged along the access road network.

Table 3.1. AERMOD point source parameters.

Source	Stack Height (m)	Temperature (K)	Exit Velocity (m/s)	Stack Diameter (m)
Drill Rig	6.1	695.37	71.7	0.1
Completion Rig	6.1	695.37	71.7	0.1
Fracking Engine	6.1	695.37	71.7	0.1
Compressor Station Unit	10.67	806.48	59.03	0.305
Pump Jack	2.56	977.59	20.71	0.064
Salt Water Disposal Well Generator	3.05	998.15	107.75	0.102
Separator/Water Tank Heater	8.72	571	5.55	0.49

[1] http://www.epa.gov/scram001/dispersion_prefrec.htm

Table 3.2. AERMOD volume source parameters.

Source	Release Height (m)	Sigma y (m)	Sigma z (m)
Well pad	2.55	51.16	2.37
Road Segment	2.55	37.21	2.37

Modeled emission rates for each source type under the maximum day and maximum annual average emission scenarios were calculated from the emission inventory data provided in Appendix B and are listed in Tables 3.3 and 3.4, respectively.

Example AERMOD input parameter files for the NOx maximum day emissions scenario are provided in Appendix C (for the construction source run) and Appendix D (for the operational sources run).

Table 3.3(a). AERMOD emission rates (g/s) for maximum day scenario: criteria pollutants.

Source Type	CO	NOx	PM10	PM2.5	SO2	VOC
Compressor Station Unit	6.03E-02	1.77E-01	9.06E-05	9.06E-05	6.93E-04	8.51E-02
Pump Jack	2.96E-04	1.29E-02	1.69E-04	1.69E-04	2.28E-06	6.47E-04
Salt Water Disposal Unit	1.57E-02	1.09E-01	2.61E-03	2.61E-03	1.62E-04	9.14E-04
Separator / Water Tank Heater	4.55E-04	1.07E-03	8.65E-05	8.65E-05	6.83E-06	6.26E-05
Fracking Engine	1.04E-01	3.01E-01	1.83E-02	1.75E-02	8.33E-03	2.08E-02
Drill Rig	2.44E-01	9.59E-01	2.55E-02	2.48E-02	1.14E-03	7.75E-02
Fugitive Dust (well pad)	0.00E+00	0.00E+00	1.86E-02	1.86E-02	0.00E+00	0.00E+00
Highest Traveled Road Segment	1.02E-03	9.56E-04	1.67E-02	1.75E-03	5.14E-05	1.45E-04

Table 3.3(b). AERMOD emission rates (g/s) for maximum day scenario: hazardous air pollutants.

Source Type	Formaldehyde	n-Hexane	Benzene	Toluene	Ethyl-benzene	Xylenes
Compressor Station Unit	3.74E-02	1.30E-03	5.17E-04	4.79E-04	4.66E-05	2.16E-04
Pump Jack	3.65E-04	--[a]	2.81E-05	9.94E-06	4.42E-07	3.47E-06
Salt Water Disposal Unit	5.63E-03	0.00E+00	4.34E-04	1.53E-04	6.81E-06	5.35E-05
Separator / Water Tank Heater	8.53E-08	2.05E-05	2.39E-08	3.87E-08	--[a]	--[a]
Fracking Engine	1.77E-03	0.00E+00	2.18E-04	3.16E-04	3.73E-05	2.51E-04
Drill Rig	1.17E-02	1.27E-04	1.59E-03	1.16E-03	2.46E-04	8.32E-04
Highest Traveled Road Segment*	9.01E-06	4.86E-07	2.95E-06	6.70E-06	9.40E-07	4.12E-06

[a]Emissions not modeled due to lack of available emission factor.

Table 3.4(a). AERMOD emission rates (g/s) for maximum annual average scenario: criteria pollutants.

Source Type	CO	NOx	PM10	PM2.5	SO2	VOC
Compressor Station Unit	6.03E-02	1.77E-01	9.06E-05	9.06E-05	6.93E-04	8.51E-02
Pump Jack	2.96E-04	1.29E-02	1.69E-04	1.69E-04	2.28E-06	6.47E-04
Salt Water Disposal Unit	1.57E-02	1.09E-01	2.61E-03	2.61E-03	1.62E-04	9.14E-04
Separator / Water Tank Heater	4.55E-04	1.07E-03	8.65E-05	8.65E-05	6.83E-06	6.26E-05
Road Dust	1.35E-04	7.57E-05	3.00E-03	3.06E-04	1.39E-06	1.31E-05
Construction Related Emissions	4.42E-02	1.71E-01	1.27E-02	1.25E-02	6.32E-04	1.38E-02

Table 3.4(b). AERMOD emission rates (g/s) for maximum annual average scenario: hazardous air pollutants.

Source Type	Formaldehyde	n-Hexane	Benzene	Toluene	Ethyl-benzene	Xylenes
Compressor Station Unit	3.74E-02	1.30E-03	5.17E-04	4.79E-04	4.66E-05	2.16E-04
Pump Jack	3.65E-04	--[a]	2.81E-05	9.94E-06	4.42E-07	3.47E-06
Salt Water Disposal Unit	5.63E-03	--[a]	4.34E-04	1.53E-04	6.81E-06	5.35E-05
Separator / Water Tank Heater	8.53E-08	2.05E-05	2.39E-08	3.87E-08	--[a]	--[a]
Road Dust	5.68E-07	8.09E-08	3.75E-07	9.43E-07	1.36E-07	5.51E-07
Construction Related Emissions	1.99E-03	2.05E-05	2.68E-04	2.06E-04	4.18E-05	1.48E-04

[a]Emissions not modeled due to lack of available emission factor.

4.3 AERMOD Options

Ambient air concentrations were predicted using AERMOD (Version 12060). The regulatory default option (DFAULT) was used, except for the NO_2 model runs as described below. The DFAULT option specifies use of stack-tip downwash and elevated terrain effects. Building downwash effects were simulated for the compressor station engines using data provided by USEPA's Building Profile Input Program for PRIME (BPIPPRM). BPIPPRM was used to compute Good Engineering Practice (GEP) stack heights for each emission source, and then to compute direction-specific building dimensions for each non-GEP stack modeled. These dimensions were then used by the AERMOD model to simulate downwash effects for the compressor engine stacks.

Primary criteria pollutants (CO, primary PM, SO_2) were modeled as inert species. For NO_2, the three tier analysis approach recommended by EPA (Fox, 2010, 2011) was employed. Modeling based on the Tier 1 screening assumption of 100% conversion of NO emissions to NO_2 and the Tier 2 screening assumption of a 80% NO_2/NOx ambient ratio were determined to be too conservative. Consequently, conversion of NO to NO_2 was estimated via the recommended Tier 3 methodology

using the Plume Volume Molar Ratio Method (PVMRM) method as implemented in AERMOD. The PVMRM approach requires input of hourly ozone concentrations which were obtained for the 2007-2011 modeling period from the Tribe's Ignacio air monitor (AQS Site ID: 08-067-7001). Missing ozone data (approximately 2% of all modeled hours) were filled in using linear interpolation. In-stack NO_2/NOx ratios were set to 0.1 for all internal combustion diesel engines and natural gas engines represented in the emission inventory, consistent with the value used in other recent oil and gas project EIRs (e.g., BLM, 2012).[2]

4.4 Receptors

Arrays of model receptor sites were placed at off-site locations in the vicinity of the project area to provide an accurate estimate of maximum near-source impacts. Additional receptors were placed in nearby Class I areas for the AQRV analysis as described below. For the near-source analysis, receptors were placed 25 m apart along the fenceline/ambient air boundary located at a distance of 100 meters from each well pad and the compressor station as per BLM recommendations. A Cartesian grid of receptors at 25 m spacing was also placed surrounding the fenceline receptors, out to a radial distance of 250 m. Additional gridded receptors with 100 m spacing were then placed at radial distances between 250 and 2,500 m. Model results were reviewed to confirm that the maximum predicted concentrations all fall within the 2.5 km zone. The resulting receptor grids are illustrated in Figure 3.1.

For determination of Class I area AQRVs, receptors as specified by the US Forest Service within the Weminuche Wilderness Class I area were included up to a maximum distance of 50 km from the proposed project. Additional receptors for the Weminuche Class I area were placed at 500 m intervals along portions of the 50 km radius arc that spans the boundaries of the Weminuche Class I area. Impacts within Weminuche beyond 50 km from the project can be reasonably assumed to have lower predicted concentrations. Although the Mesa Verde Class I area is located more than 50 km from the project area, a conservative estimate of potential impacts in Mesa Verde was obtained by placing receptors at 500 m intervals along a 50 km radius arc spanning the angles between the proposed project and the projected width of the Mesa Verde Class I area. The resulting receptor arcs to be used in the AQRVs analysis are illustrated in Figure 3.2.

Receptor elevations were obtained from the USGS National Elevation Dataset (NED) data for the area. The 1/3 Arc-Second NED data consist of an array of elevations (with 10-meter spacing) referenced horizontally by latitude and longitude. The NED data were processed with the AERMAP terrain processor, and each receptor in the grid was assigned Universal Transverse Mercator (UTM) coordinates and a corresponding elevation by the program (given the southwest corner of each grid, the horizontal spacing of the grids, and the number of grid points in each cardinal direction).

[2] Data on in-stack NO_2/NOx ratios contained in the NO_2/NOx In-Stack Ratio (ISR) Database recently released by EPA (http://www.epa.gov/ttn/scram/no2_isr_database.htm) indicate that a value of 0.1 is conservative for internal combustion engines; the central average value for engines of size similar to those used in the proposed project is 0.068 (diesel) and 0.08 (natural gas).

AERMAP was used to determine the terrain height and location that has the greatest influence on dispersion for each individual receptor, and assign a hill scale height for each receptor location. These hill scale heights were then inserted into the AERMOD input control file with the receptor data for the model runs. The NED data extend at least 1 km beyond any receptor to ensure that all significant terrain elevations (i.e., all terrain that is at or above a 10% slope from each and every receptor) were included in the modeling domain.

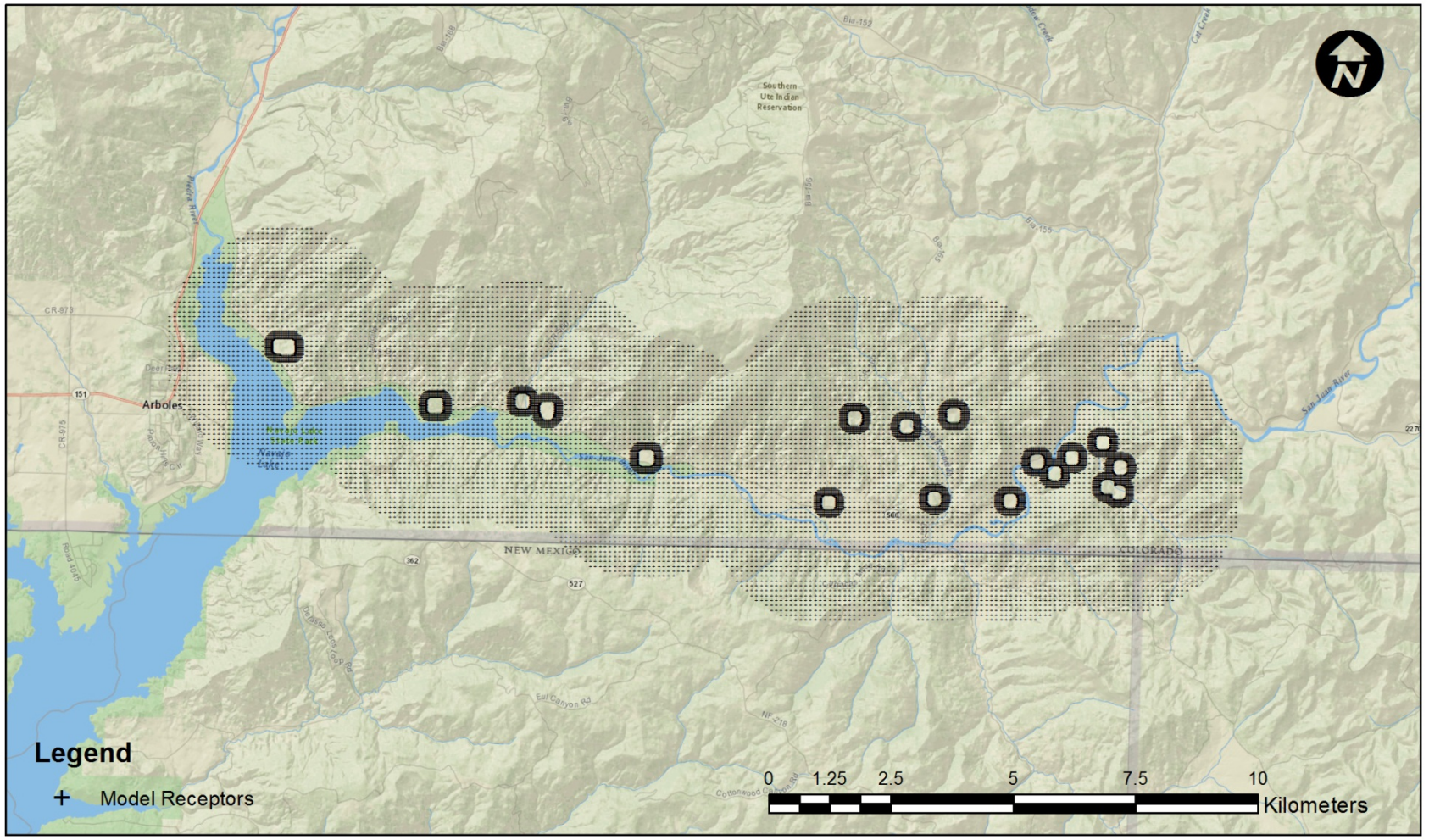

Figure 3.1. Modeling receptors – NAAQS analysis.

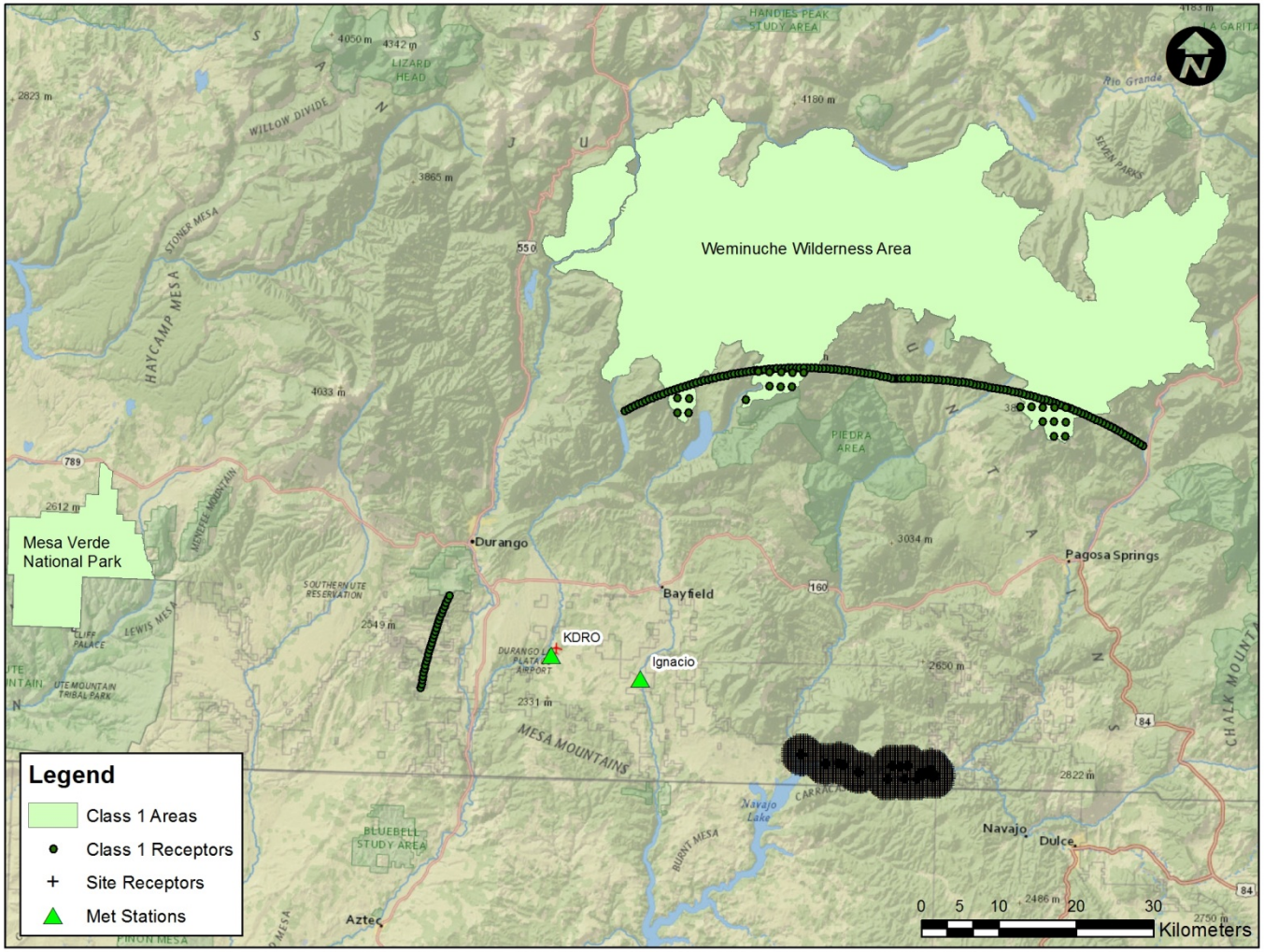

Figure 3.2. Modeling receptors – Class I AQRV analysis and locations of KDRO and Ignacio meteorological data sites.

4.5 Meteorology

Five years (2007-2011) of surface meteorological data were obtained from the Ignacio, CO air quality monitoring site for use in the AERMOD analysis (see Figure 3.2). These data are representative of the North Carracas project area given the close proximity (within 25 miles) of the Ignacio site to the Proposed Action and its similar altitude and intermontane topography. Missing data from the Ignacio site were filled in using data obtained from the National Weather Service KDRO monitoring site located at the Durango - La Plata County airport as shown in Figure 3.2. Upper air data were obtained from the twice daily soundings made at Grand Junction, CO. Grand Junction data are more representative of southwestern Colorado than are data from the only other nearby upper air site (Albuquerque).

Data from the Ignacio site were used in the AERMET ONSITE input pathway, while the KDRO data were used in the SURFACE pathway. This arrangement takes advantage of AERMET's built-in substitution feature, whereby missing data from the ONSITE station are substituted from the SURFACE station. It does not, however, imply that the Ignacio MET tower is within the boundaries of the project area, so Ignacio is not truly "on-site" data. Surface data used in the modeling include wind speed/direction, solar radiation, precipitation, relative humidity, and temperature.

Surface characteristics for albedo, Bowen ratio, and surface roughness length were calculated using EPA's AERSURFACE program. This tool uses information about the area surrounding a meteorological station; including land cover types, snow cover, and precipitation, to obtain realistic and reproducible surface characteristic values for input into AERMET. Snow cover and precipitation statistics were collected from the Western Regional Climate Center (http://www.wrcc.dri.edu/Climsum.html, accessed August 2012). Land cover types surrounding the meteorological station were determined using the USGS 1992 National Land Cover Data (NLCD) map for Colorado.

4.6 Background Air Quality

Data collected at nearby air quality monitoring stations were used to establish background criteria pollutant air quality levels for the proposed development area, as shown in Table 3.5. The Southern Ute Indian Tribe collects high quality, representative air quality data from several monitoring stations within the analysis area. The data from these monitors, along with data quality assurance and quality control information, is submitted to and available from the US EPA's Air Quality System (AQS). The Tribal monitoring stations, combined with several other reference monitoring stations near the project, are a good representation of background air quality. These background concentrations represent the impacts of existing sources in the project area and were added to modeled impacts from the proposed action to determine cumulative impacts.

Conservative estimates of background concentrations of all HAPs except n-hexane and formaldehyde were obtained from monitoring data collected over a two month period in 2009

at the Sunnyside Elementary School in Durango, CO as part of the EPA school air toxics study.[3] These HAP measurements are the closest available to the Proposed Action but HAP levels at the school are likely higher than actual background HAP concentrations in the vicinity of the Proposed Action as the Sunnyside School is located in an area with significantly more human activity, including vehicle traffic. Thus, the Sunnyside HAP data are used here only as a conservative estimate of actual background HAP levels and are not intended to be representative of HAP baseline levels. N-hexane and formaldehyde data were not collected as part of the Sunnyside study. Background values for these two HAPs were therefore obtained from the Garfield County (Colorado) Air Toxics Study (CDPHE, 2010). Garfield County is similar to La Plata and Archuleta counties in that it is a largely rural area with several small towns and a significant amount of natural gas production. Background HAP concentrations are provided in Table 4.3.

The NO_2 1-hour background concentration design value listed in Table 3.5 is the 3-year (2009 – 2011) average of the annual 98th percentile daily maximum 1-hour concentrations determined using the Ignacio, CO monitoring station. Adding this peak monitored value to the modeled NO_2 design value is extremely conservative in that it assumes that the maximum background concentration at the exact time and location of the modeled NO_2 design value happens to be as high as one of the highest hourly concentrations observed at Ignacio. We therefore used the potentially less conservative approach for background NO_2 described in EPA's recent clarifications of the NO_2 modeling guidance (Fox, 2011). Under this approach, seasonal diurnal NO_2 profiles derived from the hourly monitoring data are used to represent the background NO_2 concentration by season and hour of day as shown in Figure 3-3. The cumulative NO_2 impact from the Proposed Action for every modeled hour is then calculated as the sum of the modeled NO_2 concentration and the background NO_2 for the corresponding hour of day and season as shown in Figure 3-3. The modeled cumulative NO_2 design value, i.e., the average annual 98th percentile daily maximum 1-hour value) is then determined from the resulting five year time series of cumulative hourly NO_2 impacts.

Table 3.5. Background concentrations.

Pollutant	Averaging Time	Selected Value	Concentration	Monitoring Station or Reference (years)
NO_2	Annual	Annual mean	5.34 ppb (10.04 µg/m^3)	Ignacio S Ute (2009-2011)
NO_2	1-hour	3-yr average of 98th percentile daily maximum	38 ppb (71.44 µg/m^3)[a]	Ignacio S Ute (2009-2011)
SO_2	3-hour	Highest 3-hour average over 3 years	8 ppb (20.9 µg/m^3)	Bloomfield AIRS ID 35-045-0009 (2009 – 2011)
SO_2	1-hour	3-yr average of 99th percentile daily maximum	6 ppb (15.2 µg/m^3)	Bloomfield AIRS ID 35-045-0009 (2009 – 2011)
PM_{10}	24-hour	4th highest value in 3 years	20.8 µg/m^3	Farmington AIRS ID 35-045-0019 (2009 – 2011)
$PM_{2.5}$	Annual	Annual mean	4.2 µg/m^3	Ignacio S Ute (2009-2011)

[3] http://www.epa.gov/schoolair/SunnysideE.html

Pollutant	Averaging Time	Selected Value	Concentration	Monitoring Station or Reference (years)
$PM_{2.5}$	24-hour	3-yr average of 98th percentile daily mean	9 µg/m³	Ignacio S Ute (2009-2011)
CO	8-hour	Max	0.7 ppm (801.5 µg/m3)	Ignacio S Ute (2009-2011)
CO	1-hour	2nd Max	1.3 ppm (1488.5 µg/m³)	Ignacio S Ute (2009-2011)

[a] Seasonal average diurnal profiles used for modeling background contribution to predicted 1-hour NO2 design value as per Fox (2011).

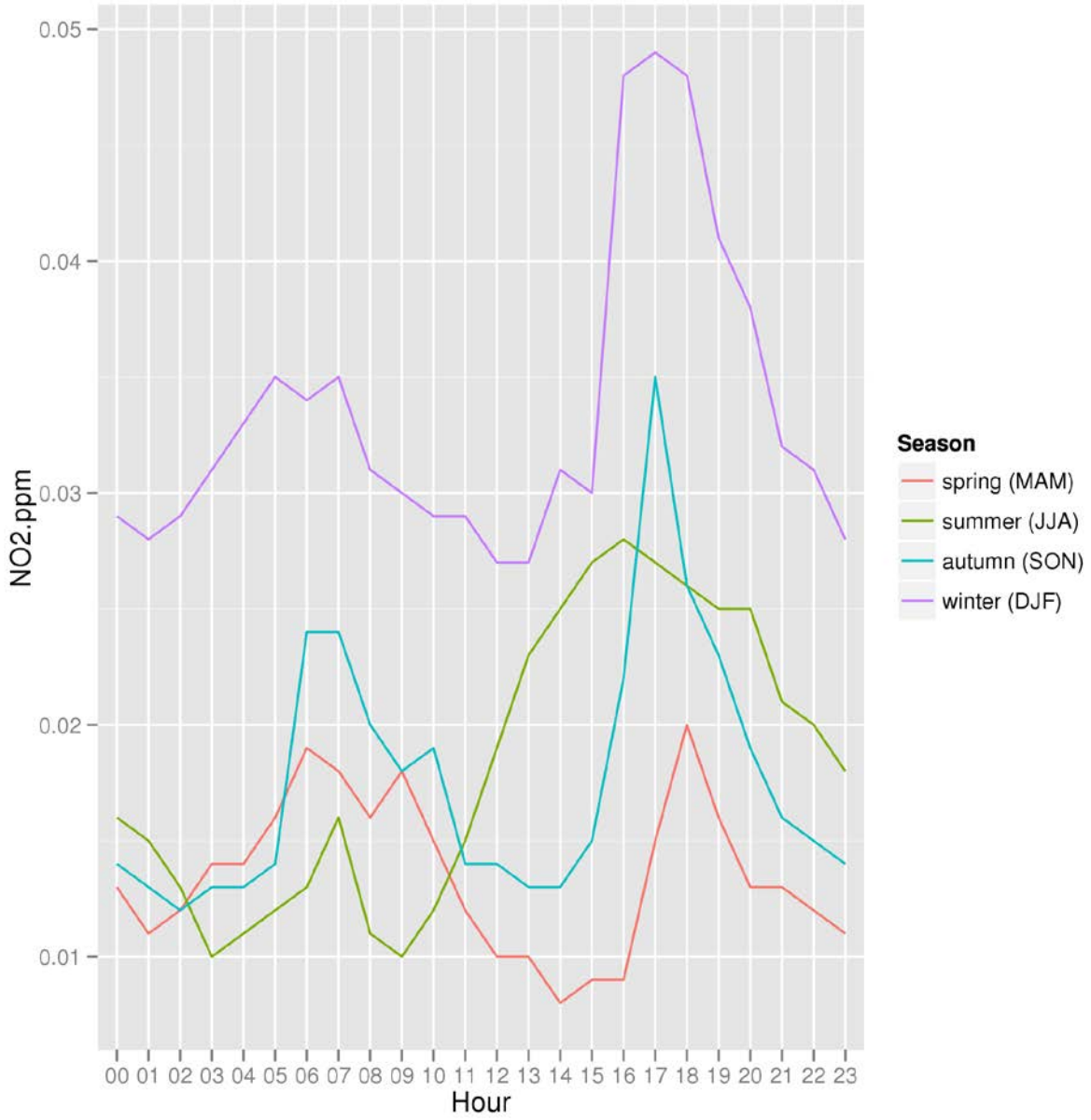

Figure 3.3. Seasonal hourly NO_2 background profiles from Ignacio, CO (2009-2011 data).

4.7 Cumulative Sources

Cumulative source emissions are defined with respect to a NEPA analysis as:

Cumulative source emissions = Existing emissions + project emissions + reasonably foreseeable future development (RFFD) sources emissions.

The project emissions are those estimated in the emission inventory for the Proposed Action as presented in Section 2 of this document.

A review of existing and RFFD sources, including future modifications to existing sources, within the vicinity of the Proposed Action was conducted by Ecosphere. Ecophere's review was based on information available from government agencies including NEPA documents, land use and natural resource management plans and private organizations. Based on this review and discussions with BLM, it was determined that existing source impacts applicable to the near-field analysis of maximum criteria and hazardous pollutant (NAAQS and HAPs) and plume visibility impacts from the Proposed Action are adequately represented by the observed background air quality conditions described in Section 3.6. RFFD sources identified by Ecosphere applicable to the cumulative air quality impact analysis are listed in Table 3.6.

Table 3.6. Reasonably foreseeable development (RFFD) sources applicable to the cumulative air quality impact analysis.

RFFD Source	Type	Description
Southern San Juan Basin ROD	Oil and Gas	Potential for 9,220 new wells
Northern San Juan Basin ROD	Oil and Gas	Potential for 522 new wells
Southern Ute Indian Reservation 2002 EIS	Oil and Gas	Potential for 433 new wells
Southern Ute Indian Reservation 80-Acre Infill	Oil and Gas	Potential for 770 new wells
Four Corners and San Juan Power Plant Emission Controls	Electric Power Generation	Emission reductions at existing power plants required by federal regulations
Miscellaneous Land Management Developments and Activities	Land Management	Mechanical and prescribed fire fuel reduction; urban and residential developments

Additional potential RFFD sources identified in Ecosphere's review included the Gothic Shale Gas Play as analyzed in the 2011 San Juan Public Lands Center Supplemental EIS, the 2008 Carson National Forest (CNF) Jicarilla Ranger District (Carson National Forest, NM) oil and gas development ROD, and some miscellaneous urban/residential developments and land management (fuel reduction) activities. However, these sources are either outside of the cumulative impacts analysis zone for the Proposed Action, are not far enough along in the planning process to allow for adequate characterization of their potential emissions, or are not

expected to result in significant additional cumulative impacts due to their projected size and/or scope and are therefore not further considered here.

RFFD sources in the vicinity of the Proposed Action identified above which potentially contributeto mid- or far-field criteria pollutant concentrations and AQRV impacts (regional haze and acid deposition) were included in the quantitative cumulative AQRV impacts analysis conducted for the Programmatic Environmental Assessment (PEA) completed for the 80-Acre Infill project (PEA, 2009). The PEA results were based on a complete photochemical modeling study of the Four Corners region.

Although the Proposed Action was not included as a RFFD source in the PEA, the proposed project analyzed in the PEA (i.e., the 80-acre "Full Infill" scenario) consisted of as many as 770 new CBM wells to be located in an area just west of the Proposed Action as illustrated by the projected distribution of new wells in Figure 3.4. This figure assumes that the maximum number of wells will be developed and includes the expected scenario that just under 75% of the infill wells will be located on existing well pads. Thus, the cumulative analysis included in the PEA was based on a proposed project with a much larger number of CBM wells and associated facilities than the 48 wells to be completed under the Proposed Action. As shown in Figure 3.4, with respect to the Mesa Verde and Weminuche Class I areas, the 80-Acre Infill project wells are located approximately within the same general area as the Proposed Action and many of the 80-Acre Infill wells are closer to these Class I areas than are the Proposed Action sources. In addition, the RFFD included in the PEA along with the 80-Acre Infill sources together represent over 1,700 potential new wells in the Northern San Juan Basin. Any changes to the combined impacts of these new developments arising from the very small (48 well) Proposed Action can reasonably be considered to be minor.

Information supplied by the Southern Ute Indian Tribe's Department of Energy (DOE) indicates that 51 infill wells have been drilled during the first 3 years of the infill project. For at least the near future, it is reasonable to assume the pace of future infill well development will continue at the current average rate of 51/3 = 17 new wells per year. Annual emission estimates prepared for the PEA indicate that SUIT lands oil and gas engine NOx emissions (not including the Proposed Action) have been declining from the 2005 baseline and will continue to decline until about 2018 when they will start increasing, reaching a local peak of 3,500 tpy NOx in 2020 (which is still below the 5,000 tpy NOx value for 2005). As shown in Section 2.3, annual NOx emissions from the Proposed Action during the operational phase are estimated to be 64 tpy. The development phase of the Proposed Action is likely to have been completed before the 2020 SUIT NOx emissions peak occurs. Thus, the Proposed Action emissions represent just a 1.8% (equal to 64/3500) increase in NOx over the total SUIT 2018 infill scenario emissions. In addition, the number of infill wells developed during the Proposed Action's five year development period (which corresponds to the period of maximum emissions from the Proposed Action as described in Section 2.3), is 51 +5*17 = 136 new wells which, when combined with the 48 wells in the Proposed Action makes a total of 184 wells. This is just 24% of the 770 wells analyzed in the PEA. As a result, emissions from the Proposed Action, both

during the development phase and the operational phase, are minimal with respect to emissions analyzed in the PEA under the full infill scenario.

Air quality impacts were analyzed in the PEA using a gridded photochemical model (CAMx) run on three nested domains: 1) a 36 km resolution domain covering the lower 48 states, 2) a 12 km resolution domain covering all of the western U.S. and 3) a 4 km domain covering the greater Four Corners region. Cumulative impacts from the 80-Acre Infill project were analyzed over the 4 km domain, a map of which is provided in Figure 3.5. Three emission scenarios were modeled with CAMx:

- a 2005 base case scenario,
- a 2018 "no action" scenario including emission changes from existing sources and emissions from new (RFFD) sources occuring between 2005 and 2018,
- and a 2018 "full infill" scenario which is the same as the 2018 "no action" scenario but with emissions from the 80-Acre Infill project included.

Model results from these scenarios were used to calculate project incremental impacts (2018 "full infill" scenario impacts minus 2018 "no action" impacts) and cumulative incremental impacts (2018 "full infill"impacts minus 2005 base case impacts). For the reasons noted above, project incremental impacts analyzed in the PEA provide conservative estimates of mid- and far-field project impacts expected to result from the much smaller Proposed Action. In addition, cumulative impacts analyzed in the PEA can reasonably be assumed to be comparable to cumulative impacts associated with the Proposed Action given the much larger size of the project and cumulative sources included in the PEA. Discussions of project and cumulative impacts as estimated in the PEA for the NAAQS impacts analysis and AQRV impacts analyses are presented below in sections 4.1 and 4.3, respectively.

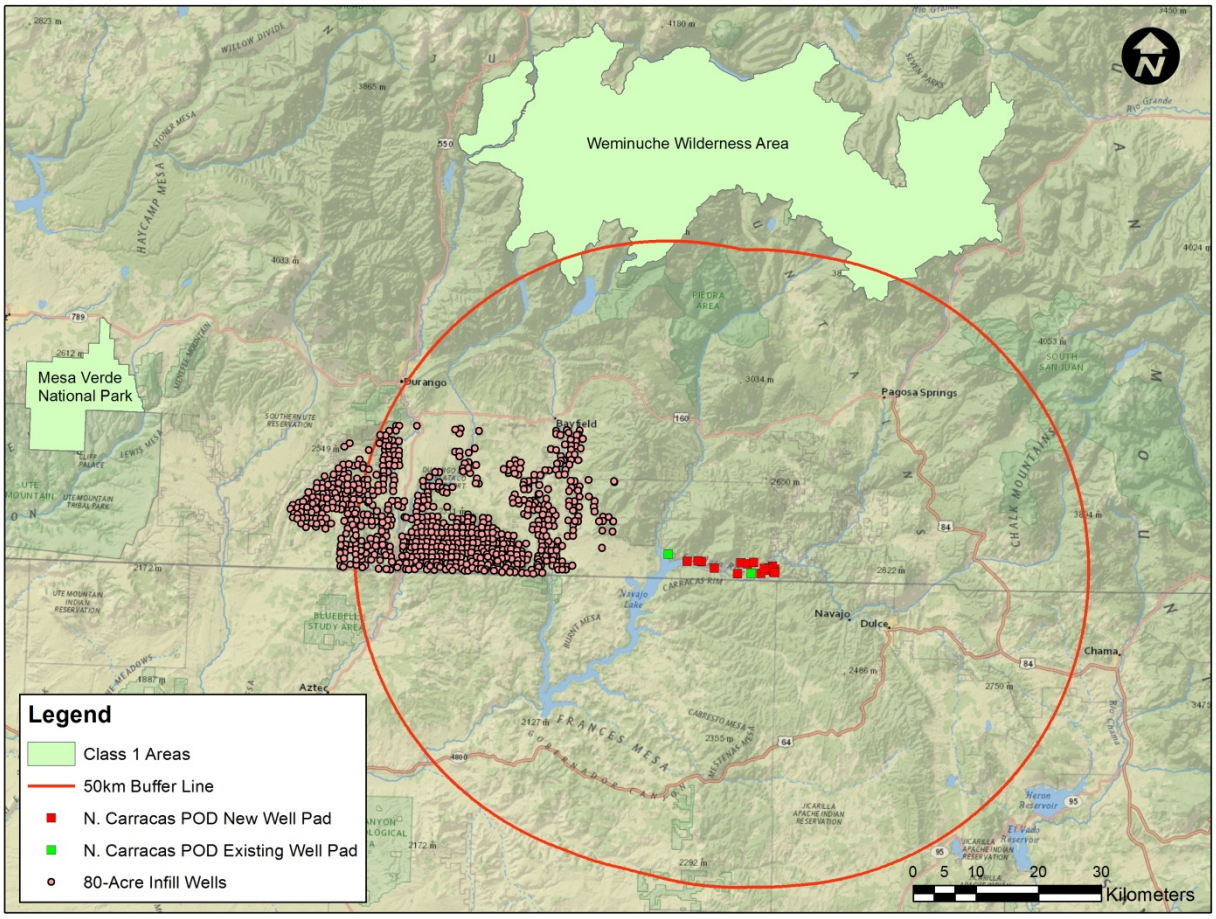

Figure 3.4. Locations of existing well pads included in the 80-Acre Infill PEA relative to the Proposed Action (N. Carracas POD) well pads; almost 75% of the 80-Acre Infill project CBM wells are projected to be drilled on existing well pads.

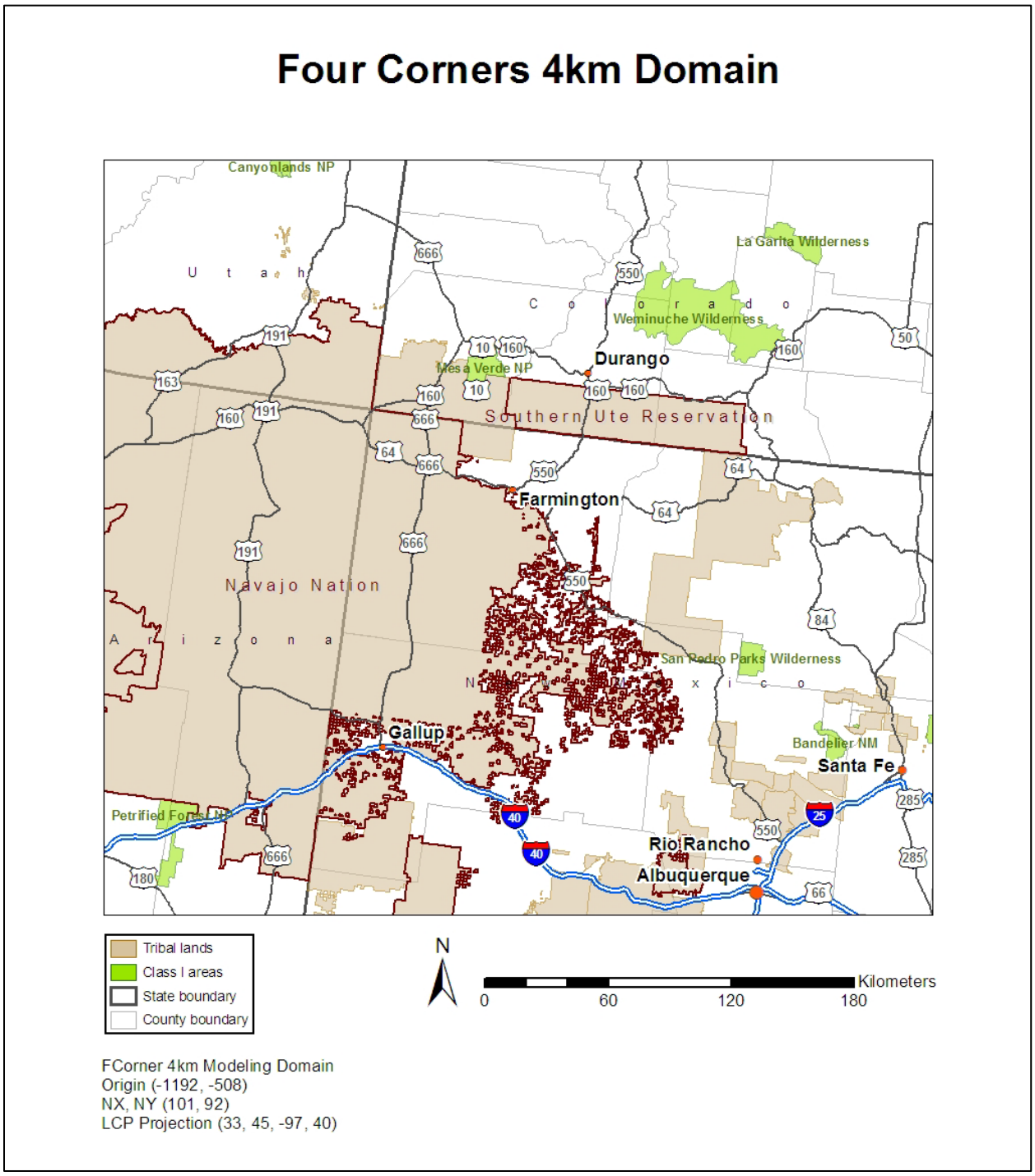

Figure 3.5. Map covering the extent of the PEA 4 km modeling domain.

4.8 Analysis of AQRV Impacts

Impacts from the Proposed Action on Air Quality Related Values (AQRVs) in nearby Class I areas were analyzed according to methodologies recommended by BLM and procedures presented in the Federal Land Managers' *Air Quality Related Values Work Group (FLAG) Phase I Report—Revised (2010)*, and other associated documents.[4] The AQRV analysis was focused on acid deposition and visibility impacts. AERMOD was used to obtain conservative estimates of acid precursor species (NOx and SO_2) concentrations within the near-field analysis zone within which the Gaussian plume model assumptions of steady state conditions and a horizontally uniform wind field can be expected to approximately hold. This near-field analysis zone is generally limited to 50 km, consistent with EPA's *Modeling Guidelines* (40 CFR Appendix W). As shown in Figure 3.2, the 50-km zone around the Proposed Action includes the southern portion of the Weminuche Class I area. Although the Mesa Verde Class I area is located approximately 85 km from the Proposed Action, receptors were placed along a 50 km arc in the direction of Mesa Verde as shown in Figure 3.2 to provide a conservative estimate of potential project impacts at Mesa Verde. Concentrations beyond 50 km can reasonably be expected to be lower than those within 50 km; so AERMOD predictions of NOx and SO_2 concentrations, and the acid deposition fluxes derived from these concentrations at the Class I receptors and 50 km arc shown in Figure 3.2, represent upper bound impact estimates from the Proposed Action. Procedures for calculating acid deposition impacts from AERMOD results are presented in Section 4.

Coherent plume visibility impacts of the Proposed Action were estimated at a screening level using the VISCREEN model in accordance with FLM guidance (FLM, 2010). VISCREEN modeling procedures and results are presented in Section 4.

Cumulative AQRV impacts for regional haze and acid deposition cannot be reasonably estimated using the AERMOD dispersion model since AERMOD cannot simulate the nonlinear chemistry involved in secondary particulate matter formation. As noted in Section 3.7, however, a qualitative assessment of cumulative AQRV impacts can be obtained by referencing the cumulative incremental analyses provided in the 80-Acre Infill PEA. This qualitative assessment is presented below in Section 4.3.

[4] In a memorandum dated March 8, 2012 from Rick Rymerson (BLM) to Sarah Kelly (SECMG), Mr. Rymerson indicated that "BLM would like to see the AQRVs analyzed and quantified using current BLM methodologies" and that "…additional required quantitative analyses can be performed for ANC, N and S deposition, and visibility" based on modeled AERMOD impacts. Section 4.3 presents methodologies based on this approach.

5.0 RESULTS

5.1 NAAQS Impacts

AERMOD was run with five years of meteorological data as described in Section 3 with the emission inputs described in Section 2. Results were analyzed to determine if the Proposed Action is expected to cause or contribute to any violations of the National Ambient Air Quality Standards (NAAQS) as listed in Table 4.1. The "maximum daily" emissions scenario was used to evaluate impacts relative to the short-term (1, 3, 8 and 24-hour) NAAQS and the "maximum annual" emissions scenario was used to evaluate impacts relative to the annual NAAQS. Model results for each NAAQS pollutant were processed according to the form of the NAAQS following EPA guidance procedures (40 CFR Appendix W, Fox 2010, 2011). The resulting modeled design values were then added to the background concentrations from Table 3.1 and the sum compared to the level of the applicable NAAQS. Results are summarized in Table 4.1. No exceedances are predicted for any of the NAAQS. The maximum cumulative (project impact plus background) 1-hour NO_2 concentration of 149.8 µg/m³ is 79.7% of the 188 µg/m³ NAAQS. The maximum cumulative 24-hour PM_{10} impact is 81% of the PM_{10} NAAQS. Maximum cumulative impacts for all other pollutants are much smaller percentages of their respective NAAQS.

Table 4.1. Cumulative NAAQS impacts.

Pollutant	Averaging Time	Modeled Design Value (µg/m³)	Background Conc. (µg/m3)	Total (µg/m3)	NAAQS (µg/m3)	NAAQS Exceeded?
NO_2	Annual	46.8	10.0	56.8	100	No
	1-hour	--[a]	var[a]	149.8	188	No
SO_2	3-hour	10.2	20.9	31.1	1300	No
	1-hour	9.5	18.3	27.8	196	No
CO	8-hour	91.3	801.5	892.8	10,000	No
	1-hour	164.3	1488.5	1652.8	40,000	No
$PM_{2.5}$	Annual	0.9	4.2	5.1	12[b]	No
	24-hour	13.2	9	22.2	35	No
PM_{10}	24-hour	101.0	20.8	121.8	150	No

[a]Seasonal average diurnal profiles used for modeling background contribution to predicted total (modeled impact plus background) 1-hour NO_2 design value as per Fox (2011).

[b]As promulgated by EPA on 14 December 2012.

Cumulative NAAQS pollutant impacts summarized in Table 4.1 do not include potential contributions from RFFD sources. However, RFFD sources identified in Section 3.7, which are located on the order of 10,000 m or more from the Proposed Action sources, are not expected to contribute significantly to the maximum total impacts listed in Table 4.1 as these maximum impacts occur at locations approximately 100 m from the Proposed Action sources and are thus dominated by emissions from those sources.

Future NAAQS pollutant concentrations in the Four Corners region, taking RFFD sources into account, were modeled as part of the 80-Acre Infill PEA as described in Section 3.7. PEA

modeling results showed that maximum cumulative impacts under the full 80-Acre Infill scenario were estimated not to result in any NAAQS violations for CO, annual average NO_2 and annual average $PM_{2.5}$. The PEA did not include an analysis of the 24-hour PM2.5 NAAQS or of the 1-hour NO_2 NAAQS (which was promulgated after completion of the PEA). However, the results in Table 4.1 suggest that RFFD sources would have to substantially increase background NO_2 and $PM_{2.5}$ levels in the Proposed Action development area to produce any NAAQS violations. With regard to SO_2, impacts shown in Table 4.1 are very small relative to the levels of the NAAQS, and RFFD sources are not expected to increase background SO_2 in the vicinity of the project as demonstrated by the 2018 full infill scenario modeling results presented in the PEA. With regard to PM_{10}, current background levels shown in Table 4.1 are low relative to the NAAQS, and RFFD sources are not expected to contribute significantly to regional PM_{10} increases as demonstrated by the 2018 full infill scenario modeling results presented in the PEA.

5.1.1 Ozone Impacts

Given the technical difficulties and uncertainties involved in estimating the impact on ambient ozone levels of a relatively small project such as the Proposed Action, a modeling analysis for ozone was not conducted. However, cumulative impacts of the 80-Acre Infill project on ambient ozone levels were analyzed in the PEA as described in Section 3.7. Results of CAMx model simulations for the 2005 "base case", 2018 "no action" and 2018 "full infill" scenarios were processed for the PEA using EPA guideline procedures (EPA, 2007) to calculate the predicted 8-hour ozone design values under each scenario. Modeled design values were calculated at each ozone monitoring site within the 4 km modeling domain (Fig. 3.5) using EPA's MATS methodology (Abt, 2008); modeled design values were also calculated in each 4 x 4 km model grid cell. Results showed that:

- Ozone design values are predicted to be below the level of the NAAQS at all locations under all three scenarios,
- Ozone design values are predicted to be lower under both 2018 scenarios as compared to the 2005 base case at all monitoring sites except at Bloomfield where it remained unchanged,
- Ozone design values are predicted to remain unchanged under the 2018 full infill scenario as compared to the 2018 no action scenario at all monitoring sites except for an increase of 1 ppb (from 63 ppb to 64 ppb) at Bondad and an increase of 1 ppb (from 71 ppb to 72 ppb) at Mesa Verde.

It is reasonable to assume that the incremental project impact of the Proposed Action on ozone design values will be less than those predicted for the much larger 80-Acre Infill project. In addition, cumulative impacts for the Proposed Action are likely to be substantially the same as determined in the PEA for the reasons presented in Section 3.7. Thus, the incremental and cumulative impacts of the Proposed Action are not projected to cause or contribute to violations of the 8-hour ozone NAAQS.

5.2 HAPs Analysis

An analysis of potential health risks from direct emissions of Hazardous Air Pollutants (HAPs) from the Proposed Action were evaluated by comparing maximum modeled 1-hour HAP concentrations (corresponding to the "maximum day" emissions scenario) and annual average HAP concentrations (corresponding to the "maximum year" emissions scenario) to the acute and chronic dose-response screening values recommended by EPA.[5] Acute dose-response values for screening purposes are taken as the California EPA Reference Exposure Levels (RELs) as listed in *EPA Table 2. Acute Dose-Response Values for Screening Risk Assessments (12/19/2011)*. Chronic dose-response values (i.e., non-cancer chronic inhalation reference concentrations [RfC] and unit risk factors for carcinogenic compounds) are taken from *EPA Table 1. Chronic Dose-Response Values for Screening Risk Assessments (4/27/2010)* and are listed in Table 4.2. Results of the HAPs impact analysis are summarized in Table 4.3. Predicted incremental HAP impacts from the Proposed Action are all less than the corresponding dose-response screening values. Cumulative HAP impacts (equal to the incremental impact plus background concentration) are also all less than the screening values.

Table 4.2. Acute and chronic dose-response screening values.

Pollutant	Acute: 1-hour REL (ug/m^3)	Chronic: Annual Rfc (ug/m^3)	Unit Risk Factor $(\mu g/m^3)^{-1}$
Benzene	1,300	30	7.8×10^{-6}
Ethylbenzene	350,000	1,000	
n-Hexane	390,000	700	
Toluene	37,000	5,000	
Xylenes	22,000	100	
Formaldehyde	55	9.8	1.3×10^{-5}

Table 4.3. HAPs analysis results: non-cancer.

	Avg. Time	Maximum Modeled Conc. (ug/m3)	Background Conc. (ug/m3)	Total Con. (ug/m3)	Dose-Response Screening Value Exceeded?
Benzene	1-hour	0.98871	0.45	1.43871	No
	Annual	0.02286	0.45	0.47286	No
Ethylbenzene	1-hour	0.1534	0.08	0.2334	No
	Annual	0.0021	0.08	0.0821	No
n-Hexane	1-hour	1.46539	7.32[a]	8.78539	No
	Annual	0.04978	7.32[a]	7.36978	No
Toluene	1-hour	0.72817	0.51	1.23817	No
	Annual	0.02063	0.51	0.53063	No
Xylenes	1-hour	0.51991	0.25	0.76991	No
	Annual	0.00957	0.25	0.25957	No
Formaldehyde	1-hour	41.62998	2.12[a]	43.74998	No
	Annual	1.45341	2.12[a]	3.57341	No

[a] From Garfield Co. air toxics study (CDPHE, 2010); equals the maximum exposure point concentration over the four monitoring sites evaluated.

[5] http://www.epa.gov/ttn/atw/toxsource/summary.html

Potential incremental cancer risks to the most likely exposed (MLE) and maximum exposed individual (MEI) due to benzene and formaldehyde emissions from the Proposed Action were calculated using the same methods and assumptions used to estimate formaldehyde exposure risks in the Programmatic Environmental Assessment (PEA) for the Southern Ute 80-Acre Infill Project (PEA, 2009). Maximum annual average concentrations were multiplied by the applicable Unit risk Factor as listed in Table 4.2 and by the appropriate Exposure Factor based on the MEI and MLE exposure scenarios used in the 80-Acre Infill PEA. Resulting incremental risks are provided in Table 4.4. Maximum incremental cancer risks from exposure to benzene emissions are less than 1 in a million; risks from formaldehyde exposures are between 1 and 10 in a million. The sum of the benzene and formaldehyde exposure risks is 5.45 per million for the MEI and 1.79 per million for the MLE. These values are within the 1 to 100 in a million (10^{-6} to 10^{-4}) range of generally acceptable risks based on the Superfund National Oil and Hazardous Substances Pollution Contingency Plan (USEPA 1990). It should be noted that the additive effects of exposures to multiple chemicals are not fully understood and may or may not be accurately represented by a simple sum of risks from each individual chemical.

Table 4.4. Maximum predicted incremental cancer risks associated with project emissions of benzene and formaldehyde.

	Exposure Scenario	Exposure Factor	Unit Risk Factor	Max. Concentration (µg/m³)	Risk
Benzene	MEI	0.286	7.8×10^{-6}	0.02286	5.10×10^{-8}
	MLE	0.0939	7.8×10^{-6}	0.02286	1.67×10^{-8}
Formaldehyde	MEI	0.286	1.3×10^{-5}	1.45341	5.40×10^{-6}
	MLE	0.0939	1.3×10^{-5}	1.45341	1.77×10^{-6}

5.3 AQRV Analysis

Impacts from the Proposed Action on Air Quality Related Values (AQRVs) in nearby Class I areas were analyzed according to methodologies recommended by BLM and procedures presented in the Federal Land Managers' *Air Quality Related Values Work Group (FLAG) Phase I Report—Revised (2010)*, and other associated documents.[6] AQRV analysis methods and results for visibility impacts, sulfur (S) and nitrogen (N) deposition, and acid neutralizing capacity (ANC) in the Class I areas of concern are described in the following sections.

5.3.1 Class I Area Selection

BLM has identified Mesa Verde National Park (Mesa Verde) and the Weminuche Wilderness (Weminuche) as Class I areas of concern with respect to the Proposed Action. Mesa Verde is a Class I area under the jurisdiction of the National Park Service (NPS), while Weminuche is a Class I area under the jurisdiction of the US Forest Service (USFS). Mesa Verde is located approximately 85 kilometers from the Proposed Action, while the southern boundary of Weminuche is approximately 43 kilometers away, as shown in Figure 4.1.

[6] In a memorandum dated March 8, 2012 from Rick Rymerson (BLM) to Sarah Kelly (SECMG), Mr. Rymerson indicated that "BLM would like to see the AQRVs analyzed and quantified using current BLM methodologies" and that "…additional required quantitative analyses can be performed for ANC, N and S deposition, and visibility" based on modeled AERMOD impacts. Section 4.3 presents methodologies based on this approach.

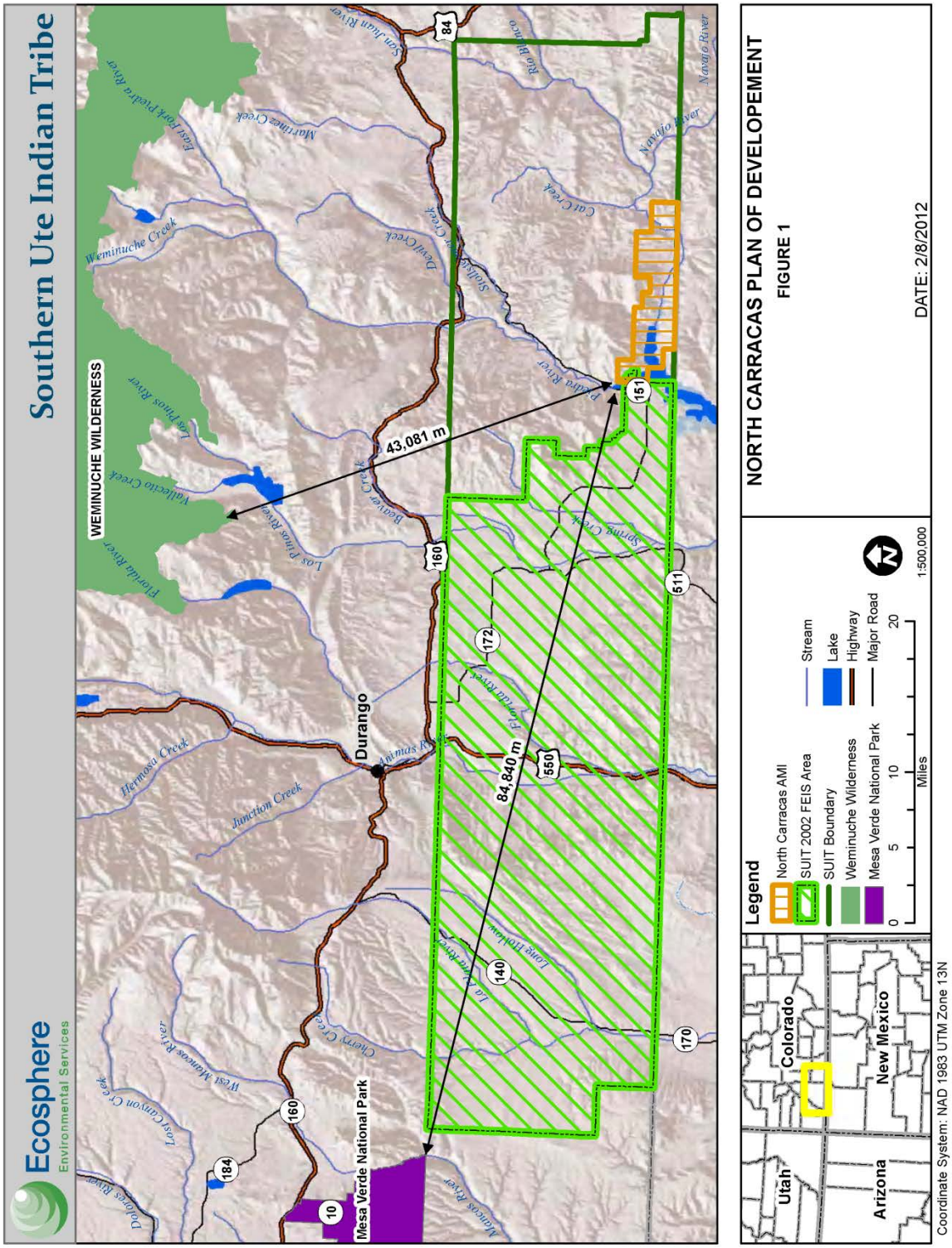

Figure 4.1. Class I areas and proposed action.

5.3.1.1 Visibility Analysis

For sources located within 50 km of a Class I area, FLAG (2010) recommends that potential plume impacts be modeled using the screening model VISCREEN to determine maximum hourly values of the color difference index (ΔE) and the absolute value of the contrast (|C|) based on plume concentrations of fine primary particulates and NO_2 and the relative positions of the observer, target, plume and sun. A Level-1 screening analysis was conducted using VISCREEN to provide a conservative upper-bound estimate of plume visual impacts in Weminuche.[7] The Level-1 screening assumes worst-case meteorological conditions and viewing parameters (i.e., F stability, 1 m/s wind speed persisting for 12 hours with a wind direction transporting the plume directly adjacent to the observer). VISCREEN does not simulate overlapping plumes, so the virtual point source approach (Turner, 1970) was used to simulate total emissions from the Proposed Action under the "maximum day" scenario. This approach has been used in prior plume visibility analyses for oil and gas developments (BLM, 2009). Based on the spacing of well pads within the Proposed Action (17 km), a virtual point source was defined at an upwind distance of 200 km from the project area based on the horizontal plume standard deviation as a function of distance under F stability as specified in Turner (1970).

The following data were used for the Level-1 analysis:

- Maximum 24-hour emissions of NO_2 and PM_{10} from all combustion sources under the "maximum day" emissions scenario.
- The maximum monthly average natural visual range provided for Weminuche in Table 10 of the FLAG (2010) document (281 km).
- Source/observer distance of 243 km.
- Source/nearest Class I distance of 243 km (see Figure 3.5).
- Source/furthest Class I distance of 282 km (within 22.5 degree sector of source/nearest Class I distance).
- Plume/source observer angle of 11.25 degrees.
- Background ozone concentration of 0.08 ppm

Results of the VISCREEN run (see Appendix D) showed a maximum ΔE value of 0.329 and a maximum |C| value of 0.006 inside the Class I area and a maximum ΔE of 1.28 and a maximum |C| of 0.015 outside the Class I area. All of these values are less than the screening values of 2.0 and 0.05 recommended by FLAG (2010).

AERMOD and plume visibility models (VISCREEN and PLUVUE II) are not suitable for estimating regional haze impacts of the proposed project within the Weminuche or Mesa Verde Class I areas because these models are not capable of simulating formation of secondary particulate matter or dispersion at distances beyond 50 km from the source. However, results of a detailed photochemical modeling analysis of Class I area regional haze impacts associated with the

[7] A plume visual impact analysis for Mesa Verde is not appropriate in this case as Mesa Verde is located more than 50 km from the Proposed Action (see Figure 4.1). In any case, impacts in Mesa Verde would be lower than those in Weminuche due to the greater distance of Mesa Verde (85 km) from the Proposed Action as compared to Weminuche (43 km).

adjacent and much larger 80-Acre Infill Project (PEA, 2009; see Section 3.7) found that maximum day project incremental visibility reductions due to emissions from the proposed 80-acre infill development were predicted to be 0.1 dV at Weminuche and 0.3 dV at Mesa Verde. For reasons noted in Section 3.7, project incremental impacts from the Proposed Action can be expected to be less than these values and thus less than the 0.5 dV lower impact threshold recommended by FLAG (2010). Cumulative incremental visibility impacts were also estimated in the PEA. The maximum cumulative incremental visibility impact in Weminuche was estimated to be 0.7 dV while the 8th highest day (corresponding to the 98th percentile dV change) was 0.1 dV. At Mesa Verde, the maximum value was 0.2 dV and the 8th highest value was less than 0.05 dV. Cumulative impacts for the Proposed Action are likely to be substantially the same as determined in the PEA for the reasons presented in Section 3.7.

5.3.2 Deposition Analysis

Sulfur (S) and nitrogen (N) deposition were estimated according to the methodology outlined in Screening Methodology for Calculating ANC Change to High Elevation Lakes (USFS, 2000). Total deposition of S and N were estimated based on the maximum modeled annual average SO_2 and NO_2 impacts within the Weminuche Class I area and along the 50 km arc of receptors in the direction of Mesa Verde (see Fig. 3.2) under the "maximum annual" emissions scenario. Modeled NO_2 impacts were conservatively evaluated assuming all NOx is emitted as NO_2.

Deposition fluxes were calculated according to the following equation:

$$D = (X)(V_d)(R)(DEP)(F_c)$$

where:

D = sulfur or nitrogen deposition flux (kg/ha/yr)
X = pollutant concentration ($\mu g/m^3$)
V_d = deposition velocity of 0.005 m/sec for SO_2 or 0.05 m/sec for HNO_3
R = Ratio of molecular weights of elements to convert from SO_2 to S and NO_2 to N
(14/46 = .3 for NO_2; 32/64 = .5 for SO_2; Molecular weight of H=1, N=14, O=16, S=32)
DEP = total deposition to dry deposition ratio (assume this equals 2.0)
F_c = units conversion of $\mu g/m^3$ x m/sec to kg/ha/yr (315.4)

Results of the acid deposition analysis are summarized in Table 4.5. Predicted S deposition from the Proposed Action is less than the Deposition Analysis Threshold (DAT) for the western U.S. (0.005 kg/ha/yr) as specified in Federal Land Managers' Interagency Guidance for Nitrogen and Sulfur Deposition Analyses (NPS, 2011), while the predicted N deposition exceeds the DAT. As pointed out in the FLM guidance (NPS, 2011), an exceedance of the DAT does not necessarily mean that acid deposition impacts from the project are significant.

Table 4.5. Deposition analysis results.

	N	S
Weminuche		
Max. Annual Avg. Conc. (µg/m^3)	0.00521	0.00002
Deposition Flux (kg/ha/yr)	0.050	0.00003
Mesa Verde[a]		
Max. Annual Avg. Conc. (µg/m^3)	0.00714	0.00002
Deposition Flux (kg/ha/yr)	0.069	0.00003
Deposition Analysis Threshold (DAT) (kg/ha/yr)	0.005	0.005

[a]As estimated along an arc of receptors located at least 35 km closer to the Proposed Action sources than is Mesa Verde (see Fig. 3.2).

Deposition estimates obtained above based on AERMOD predictions of maximum annual average NOx and SO_2 concentrations are likely to be conservative due to the simplifying assumption that all emitted N and S is deposited at the location of maximum concentration.

A more refined deposition analysis based on detailed photochemical modeling of acid deposition impacts associated with the adjacent and larger 80-Acre Infill Project was conducted for the PEA as described in Section 3.7. Project incremental impacts were estimated in the PEA at sensitive lakes in the Weminuche Class I area. The maximum project incremental annual total N deposition was estimated to be 0.00843 kg/ha/yr while the incremental annual total S deposition was estimated to be slightly negative at all locations (due to nonlinear chemical interactions included in the PEA photochemical model) but with maximum absolute value less than 0.00004 kg/ha/yr.[8] For reasons noted in Section 3.7, incremental deposition from the Proposed Action sources is likely to be less than indicated by these more refined estimates for the 80-Acre Infill project. This conservative but more refined N deposition value (0.008 kg/ha/yr) is closer to the DAT (0.005 kg/ha/yr) than the AERMOD estimate of 0.050 kg/ha/yr shown in Table 4.5.

Estimates of cumulative incremental acid deposition impacts from the 80-Acre Infill project were also prepared for the PEA. These estimates took into account the 80-Acre Infill development project, existing and RFFD sources, together with projected emission changes at existing sources. Results of this analysis showed relatively large cumulative reductions in acid deposition in the Weminuche Class I area relative to the 2005 baseline level. Simply adding the above estimated N and S deposition increases estimated for the Proposed Action to the cumulative deposition increments modeled for the Weminuche Class I area in the PEA results in net estimated *decreases* in acid deposition.

5.3.3 ANC Analysis

An acid neutralizing capacity (ANC) analysis was performed according to the methodology outlined in Screening Methodology for Calculating ANC Change to High Elevation Lakes (USFS 2000). This analysis shows how additions of sulfate and/or nitrate deposition from the

[8] These deposition estimates are not specifically listed in the PEA document (PEA, 2009) but were used to derive the changes in acid neutralizing capacity results that are presented in the PEA.

Proposed Action may cause a change in the ANC of sensitive lakes from a monitored baseline according to the following equation:

$$\% \text{ ANC change} = [H_{dep}/ANC(o)] \times 100$$

where:

ANC(o) = baseline ANC = W x P x (1-Et) x A x (10,000m^2/ha) x (eq/10^6 ueq) x (10^3 liters/m^3)
A = baseline lake sample alkalinity (lowest 10%) in µeq/l
H_{dep} = acid deposition = [H(s) + H(n)] x W x 10,000m^2/ha
H_s = sulfur deposition in eq/m^2/yr = D_s (kg/ha/yr) x (ha/10,000m^2) x (1000g/kg) x (eq/16g S)
H_n = nitrogen deposition in eq/m^2/yr = D_n (kg/ha/yr) x ha/10,000m^2) x (1000g/kg) x (eq/14g N)
W = watershed area in ha
P = average annual precipitation in meters
Et = fraction of the annual precipitation lost to evaporation and transpiration (assume Et = .33)
D_s = sulfur deposition in kg/ha/yr from all sulfur species
D_n = nitrogen deposition in kg/ha/yr from all nitrogen species

Sulfur and nitrogen deposition (D_s and D_n in the above equation) were calculated according to the procedures described in Section 4.3.3 for the Weminuche Class I area; the maximum deposition fluxes are listed in Table 4.5. These maximum deposition fluxes were taken as conservative estimates of the deposition fluxes at each sensitive lake included in the analysis as listed in Table 4.6. The National Park Service has not identified any sensitive lakes within Mesa Verde National Park. Resulting changes in ANC at each lake are listed in Table 4.6 and compared to acceptable limits established by the USFS for the Weminuche Wilderness Area[9]:

- For lakes with baseline alkalinity greater than 25 µeq/l: a 10% change.
- For lakes with baseline alkalinity less than 25 µeq/l: a 1 µeq/l reduction in ANC.

Predicted changes in ANC are less than the acceptable threshold limits at each lake.

[9] http://www.fs.fed.us/air/technical/class_1/wilds.php?recordID=84

Table 4.6. ANC analysis for Weminuche wilderness lakes.

Lake[a]	Watershed Area (ha)	Baseline Alkalinity (µeq/l)	Precipitation (meters)	Predicted ANC Reduction (µeq/l)	Predicted ANC Reduction (%)	Limit of Acceptable Change[b]
BIG ELDORADO LAKE	115.26	20.39	1.143	0.467	N/A	1 µeq/l
LOWER SUNLIGHT LAKE	97.89	85.04	1.143	0.467	0.55	10%
UPPER GRIZZLY LAKE	30.62	29.88	1.143	0.467	1.56	10%
UPPER SUNLIGHT LAKE	79.58	28	1.143	0.467	1.67	10%

[a] Lakes to be analyzed and data provided per 4/2/2012 email from Kelly Palmer (BLM) to Sarah Kelly (SECMG).

[b] Limit of Acceptable Change is a 10% ANC reduction for lakes with baseline alkalinity greater than or equal to 25 µeq/l; and a 1 µeq/l loss in ANC for lakes with baseline alkalinity less than 25 µeq/l (http://www.fs.fed.us/air/technical/class_1/wilds.php?recordID=84).

By way of comparison, we note that results of a detailed photochemical modeling analysis of changes in ANC at the lakes listed in Table 4.6 expected to result from the adjacent and larger 80-Acre Infill Project (PEA, 2009) also found that that proposed development would not cause any project incremental ANC impacts exceeding the applicable threshold values.

As noted in Section 4.3.3, cumulative incremental ANC impacts taking into account RFFD sources along with the 80-Acre Infill sources were also estimated for the 80-Acre Infill PEA (PEA, 2009). Results of this analysis showed that ANC is expected to *increase* at sensitive lakes in Weminuche relative to the 2005 baseline due to cumulative incremental *decreases* in acid deposition. Simply adding N and S deposition increases estimated for the Proposed Action to the cumulative deposition increments modeled for the Weminuche Class I area in the PEA results in net estimated decreases in acid deposition and thus increases in ANC.

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APPENDIX A

Project Description

1.1 Alternative B—Proposed Action

The SUIT proposes to develop the oil and gas resource in the North Carracas area of the Reservation. The proposed POD would include 48 Fruitland CBM wells located on 18 well pads, one salt water disposal well, associated roads and pipelines, and a compressor facility. To minimize surface disturbance, (1) two existing pads would be utilized, (2) multiple wells would be drilled from individual well pads, and (3) existing corridors would be used to the greatest extent practicable for flow lines and access roads. Three drilling techniques would be used to optimize resource recovery—horizontal, vertical, and vertical s-shaped wells. The development is proposed to occur over an estimated 4 to 5 year period.

The stipulations of the North Carracas AMI lease prohibit drilling wells on Tribal Trust lands; therefore, wells associated with the proposed action would be located on fee lands accessing Federal minerals held in trust for the Tribe. Flow lines and access roads would be constructed on fee lands to the maximum extent practicable; however, impacts to Tribal Trust lands would occur. Tribal surface use for flow lines and roads would be subject to the issuance of the Tribe's consent to the location of such surface facilities, as is permissible under the lease terms and conditions.

In the future, APDs would be prepared as specified by BLM for the drilling program. Each well pad would be subject to additional site-specific environmental and cultural analysis at the time of the APD submittal, as determined by the BLM and BIA. ROW grants would be prepared as specified by the BIA and SUIT. The pipeline and/or access roads would also be subject to site-specific environmental and cultural analysis at the time of the grant submittal.

The Proposed Actions are shown on Map 2 in Appendix A. The Proposed Action components as shown on Map 2 have been identified based on land status, access, spacing, and reservoir characteristics. The exact well pad locations are expected to be in the same general locations but would be adjusted based on future site-specific environmental and cultural analyses.

Well pad size would vary based on the number of wells drilled from the pad. Short-term disturbance would range from approximately 3 to 6.25 acres per pad. Following interim reclamation, long-term disturbance associated with the well pads would range from approximately 1 to 3.65 acres per pad. Two existing well pads would be utilized as co-locations (twinned locations), thereby overlapping existing disturbance. Table 2-1 lists the general well pad location, number of wells per pad, and short and long term disturbance. Total short-term disturbance from new well pad construction and expansion of existing pads would be approximately 65.75 acres. Total long term disturbance would be approximately 35.45 acres.

Table 2-1. Well pad location, number of wells, and disturbance acreage for the proposed North Carracas Plan of Development.

Quarter	Section	Township and Range	New or Existing Pad	Number of Wells	Short-Term Disturbance (acres)	Long-Term Disturbance (acres)
NE	9	32 North, 5 West	Existing	3	6.25	3.65
NE	14	32 North, 5 West	New	6	5.75	3.4

SE	12	32 North, 5 West	New	4	3.75	2.5
NW	18	32 North, 4 West	New	4	3.75	2.5
SW	17	32 North, 4 West	New	6	5.75	3.4
NE	22	32 North, 4 West	New	1	3	1
NW	14	32 North, 4 West	New	4	3.75	2.5
NE	14	32 North, 4 West	New	3	3	2
NW	24	32 North, 4 West	Existing	1	3	2
SW	12	32 North, 4 West	New	4	3.75	2.5
NW	19	32 North, 3 West	New	1	3	1
SW	18	32 North, 3 West	New	2	3	1.5
NE	18	32 North, 3 West	New	1	3	1
SE	18	32 North, 3 West	New	2	3	1.5
NW	17	32 North, 3 West	New	1	3	1
SW	17	32 North, 3 West	New	2	3	1.5
NE	17	32 North, 3 West	New	2	3	1.5
SE	17	32 North, 3 West	New	1	3	1
			Totals	**48**	**65.75**	**35.45**

Activities associated with the Proposed Action Alternative would include well pad construction, drilling, stimulation and completion of the proposed natural gas wells, and the installation of any surface equipment necessary for natural gas production. At each well pad, construction crews would remove vegetation from the proposed location and the pad would be leveled and contoured. Existing pads would be expanded. Cuts and fills would vary between the proposed pads based on specific location characteristics. Excavated materials from the cuts would be used on the fill portion of the location to level the pad. Clearing and leveling is needed to provide a level surface for rig and equipment access, and drilling. There would be no reserve pit, blow pit; or flare stack.

Natural gas well drilling facility assembly would occur on the well pad after site clearing and leveling. Drilling equipment located on each drilling pad would include the drilling rig and associated equipment (e.g., blowout preventer, separator, etc.), pipe storage, one 400 barrel flow line tank, pumps, generators, a forklift, four to five housing trailers, three additional 400 barrel storage tanks, and mud pallets.

Multiple wells on individual pads would be spaced to emphasize safe operation and maintenance, optimize rig movement, minimize surface disturbance, and to allow for simultaneous completion operations. After drilling, the pad design would also allow for uninterrupted operation of an artificial lift

pump while a workover (if needed) is proceeding on an adjacent well. A workover is the process of performing major maintenance or remedial treatments on an oil or gas well.

Drilling and Completion

Closed-loop systems would be utilized for all wells. The drilling mud would be water-based. Closed-loop systems employ a suite of solids control equipment to minimize drilling fluid dilution. This results in a "dry" location where a reserve pit is not required, used fluids are recycled, and solid wastes can be land farmed, hauled off, or injected downhole. After the majority of the water is removed from the cuttings with the shaker and centrifuge, the cuttings would be stored in a bermed and lined "drying pit" and allowed to dry further. Cuttings would be transported to the Bondad Landfill—an approved disposal facility. Total cuttings volume from a "typical" wellbore, not including any kind of excess, would be about 2,710 cubic yards. Cuttings transport bins would be 20 cubic yard containers, but would only transport 12 cubic yards at a time for weight reasons. The total number of cutting haul loads per well would be approximately 10 to account for any residual liquid.

The majority of wells would be horizontally drilled. A 9 5/8 inch surface casing would be set to no less than 400 feet total vertical depth. The 8 ¾ inch intermediate well bore would then be drilled with a curve being built and landed in the target coal at an inclination of approximately 88 degrees. A 7 inch intermediate casing would then be run, set to depth, and cemented to the surface. A 6 ¼ inch production lateral would then be drilled to the total depth and a pre-perforated liner with no less than 8 shots per foot would then be run to provide wellbore integrity over the life of the well. The completion technique is illustrated in Figure 2-1.

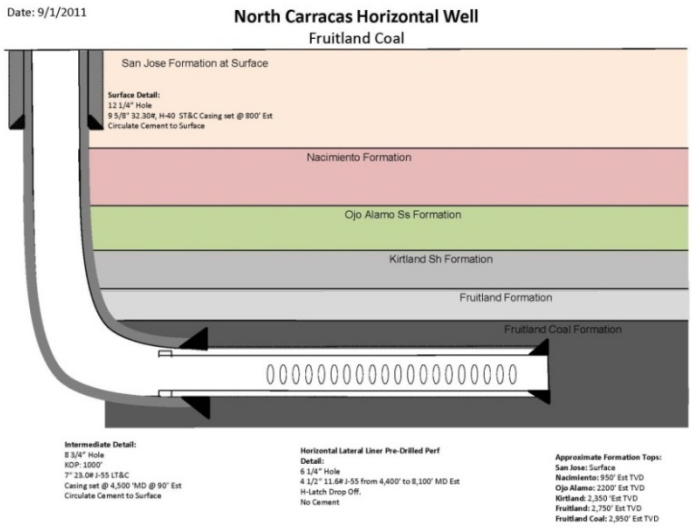


Figure 2-1. North Carracas Plan of Development horizontal well drilling completion technique.

A total of nine vertical or deviated s-shaped wells would be drilled under the proposed POD. Figure 2-2 shows the completion techniques for a typical vertical or deviated s-shaped well.

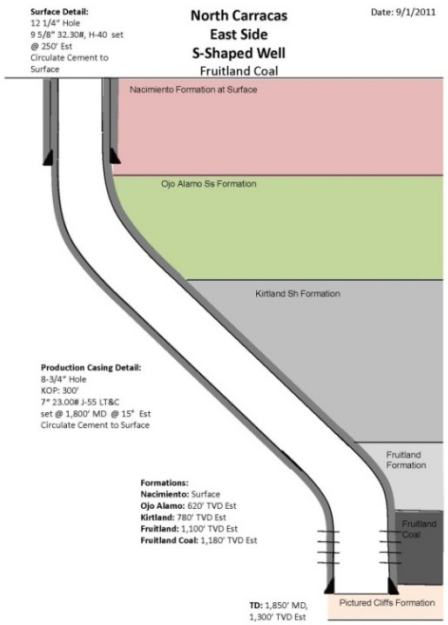


Figure 2-2. North Carracas Plan of Development deviated s-shaped well drilling completion technique.

Wells are often treated during completion to improve resource recovery by increasing the rate and volume of hydrocarbons moving from the natural gas and/or oil reservoir into the wellbore. These processes are known as well-stimulation treatments and include hydraulic fracturing, acidizing, and other mechanical and chemical treatments, often used in combination.

Hydraulic fracturing (fracking) is a process used to maximize the extraction of underground resources by allowing oil or natural gas to move more freely from the rock pores to production wells that bring the oil or gas to the surface. Fluids, commonly made up of water and chemical additives, are pumped into a geologic formation at high pressure during hydraulic fracturing. When the pressure exceeds the rock strength, the fluids open or enlarge fractures that can extend several hundred feet away from the well. After the fractures are created, a propping agent is pumped into the fractures to keep them from closing when the pumping pressure is released. After fracturing is completed, most of the injected fracturing fluid returns to the wellbore (USEPA 2004).

Hydraulic fracturing is a 60-year old process that is now being used more commonly as a result of advanced technology. Groundwater is protected during the fracturing process by a combination of the casing and cement that is installed when the well is drilled and by the depth of the rock between the fracture zone and any fresh-water bearing zones or aquifers (USDOE 2009). General casing specifications for horizontal and vertical and/or deviated s-shaped wells are provided in Figures 2-2.1 and 2-2.2.

Hydraulic fracturing is not proposed for any horizontal wells for the North Carracas development. Vertical completion techniques may be utilized on the eastern portion of the study area due to specific geologic conditions. It is anticipated that wells utilizing vertical completion techniques would require hydraulic fracturing. If needed, a Halliburton Delta 140 fracturing fluid (or similar fluid) would be used. The specific components of the fluid are determined at the time of completion. The applicant would comply with the regulations in COGCC Order 1R-114 which requires disclosure of hydraulic fracturing fluid chemical components.

Each vertical or deviated s-shaped well would require approximately 60,000 gallons for fracturing. If needed, approximately 100,000 gallons of water would be used to stimulate the salt water disposal well. Water for hydraulic fracturing would be obtained under existing water rights or from commercial sources.

Green completion technology would be used. Green completions take place during the flowback stage of the completion. The flowback involves removing the water necessary to stimulate the well. During this flowback, natural gas is produced with the water. What makes the well completion "green," or environmentally friendly, is that the gas is separated from the water and placed in a pipeline instead of being released to the atmosphere.

Pipelines

A pipeline gathering system would be constructed to transport both gas and produced water from the proposed wells. Red Cedar Gathering Company has been designated as the primary recipient of produced gas from the North Carracas AMI. Pipelines would be located adjacent to existing or proposed disturbance to the maximum extent practicable. All pipelines would be constructed within 40-foot wide ROWs. The Middle pipeline would be a subsurface 20-inch outside diameter welded steel line. The Middle pipeline would be approximately 7.1 miles in length. A pipeline would also be constructed beneath the San Juan River in the eastern portion of the study area. This pipeline would be 8 to 12-inch outside diameter and approximately 3.9 miles in length. Shorter pipelines from the proposed wells would connect to the Middle and East gathering lines. These pipelines would be 8 to 12-inch outside diameter welded steel lines. The total disturbance associated with the pipeline gathering system would be approximately 71.5 acres.

Access

Archuleta County Road (CR) 500 (aka Trujillo Road) bisects the North Carracas study area from west to east and is the primary access. Access to the North Carracas area would also be south from New Mexico using Forest Service Road 218 and the North Carracas Road.

Under the proposed action, approximately 4.5 miles of access roads would be constructed. Proposed well pad access roads would spur from CR 500 and constructed within the same ROW as the proposed pipelines to the maximum extent practicable in order to minimize surface disturbance.

A bridge would be constructed over the San Juan River to access the proposed wells pads in the easternmost portion of the study area. Access to the bridge and wells would be acquired from a private land owner. The bridge design would be similar to the bridge constructed over the river to connect Carracas to CR 500. The bridge would be constructed with steel risers into competent bed rock within the river, and steel beams across to support. Surface would be an all-weather maintainable finish. Bridge

design and construction would comply with all Colorado Department of Transportation (CDOT) regulations and USACE permitting requirements.

Production

Pumping units would be used for artificial lift at each well. Pumping units would have natural gas-powered engines. The North Carracas POD would include the drilling of a salt water disposal well located adjacent to proposed disturbance in the NW ¼ of Section 18, Range 4 West, Township 32 North. Produced water would be transported via subsurface polyethylene pipe to the proposed salt water disposal well facility. The water pipelines would be constructed concurrently with the gas pipelines and laid within the same trench, resulting in no additional surface disturbance. Water pipelines would be 6-inch outside diameter and constructed of fiberspar or comparable material. The produced water would be injected into the target formations; Bluff Sandstone and/or Entrada Sandstone. These formations are located at approximately 8,000 to 9,000 feet below ground surface in the project area. The salt water disposal well would be completed using techniques protective of fresh-water bearing zones. The salt water disposal well would not be a commercial disposal site.

Compressor Station

A compressor station would be constructed adjacent to an existing well pad in the NE ¼ of Section 9, Range 5 West, Township 32 North. This facility would disturb a total of approximately 4 acres. Approximately 8,200 horsepower (hp) is projected to compress gas produced from the proposed development. To achieve sufficient hp, six 1,380 hp engines with oxidation catalysts would be installed. No well head compression is anticipated.

Total Disturbance

Table 2-2 summarizes the estimated total disturbance associated with the North Carracas POD. The total estimated disturbance per land status is shown in Table 2-3.

Table 2-2. Total estimated surface disturbance associated with the proposed North Carracas Plan of Development.

	Short-term Disturbance (acres)	Long-term Disturbance (acres)
Well Pads	65.75	35.45
Salt Water Disposal Well	1.50	1.50
Pipelines/Roads	71.52	35.76
Compressor Station	4.0	4.0
Totals	**142.77**	**76.71**

Table 2-3. Total estimated disturbance associated with the proposed North Carracas Plan of Development per land status.

	Short-Term Disturbance Tribal Trust	Short-Term Disturbance Private	Long-Term Disturbance Tribal Trust	Long-Term Disturbance Private

	(acres)	(acres)	(acres)	(acres)
Well Pads		65.75		35.45
Salt Water Disposal Well		1.50		1.50
Pipelines/Roads	5.24	66.28	2.62	33.14
Compressor Station		4.0		4.0
Totals [(1)]	**5.15**	**137.53**	**2.62**	**74.09**

[(1)] Acreage estimates may be marginally more or less than those described in Table 2-2 due to GIS polygon analysis.

Reclamation

The proposed well pads would be partially reclaimed following drilling and completion operations. A portion of the pad not required for production equipment and vehicular access would be recontoured and reclaimed. Reclamation would typically consist of respreading topsoil, preparing the seedbed, seeding, and mulching and crimping with certified weed free straw or native hay mulch. Depending on the number of wells per pad, approximately 1 to 2.6 acres for production facilities on each well pad would remain in use for production and vehicle access. These areas would not be reclaimed until final abandonment of the wells. Production equipment that would remain on site would include the wellheads, production unit, separators, and meter runs. Ancillary equipment could also be installed at the well pad site, such as a Christmas tree (i.e., valves, spools, and fittings on the well head), storage tank(s), dehydrator, and separator.

The majority of proposed pipelines would parallel and overlap existing roads. Approximately 4.5 miles of pipeline ROW would parallel proposed new roads. Therefore, approximately half of the proposed pipeline ROWs would be reclaimed following construction, with the other half remaining for access. On Tribal Trust lands, access roads would be reclaimed at final abandonment per BIA stipulations.

Design Features

Design features (best management practices [BMPs]) are an integral part of the Proposed Action Alternative. The environmental effects are analyzed assuming that design features are in place and are successful. For the Proposed Actions, standard and project-specific design features have been derived from the Programmatic Environmental Assessment for 80-Acre Infill Oil and Gas Development on the Southern Ute Indian Reservation (USDI 2009) and the Southern Ute North Carracas Energy Development: Guidance and Protocol to Reduce Wildlife Impacts (SUIT 2010).

SUIT DNR, SUIT DOE, BLM, and BIA may perform inspections of facilities within the exterior SUIT boundary to assess compliance with mitigation and may take additional, legally authorized enforcement actions to assure compliance.

Design features for the proposed action include but are not limited to:

Air Quality

Roads would be surfaced or dust inhibitors would be used (e.g., surfacing materials, non-saline dust suppressants, water, etc.) as appropriate, on roads and well locations constructed on soils

susceptible to wind erosion, to reduce the amount of fugitive dust generated by traffic or other activities.

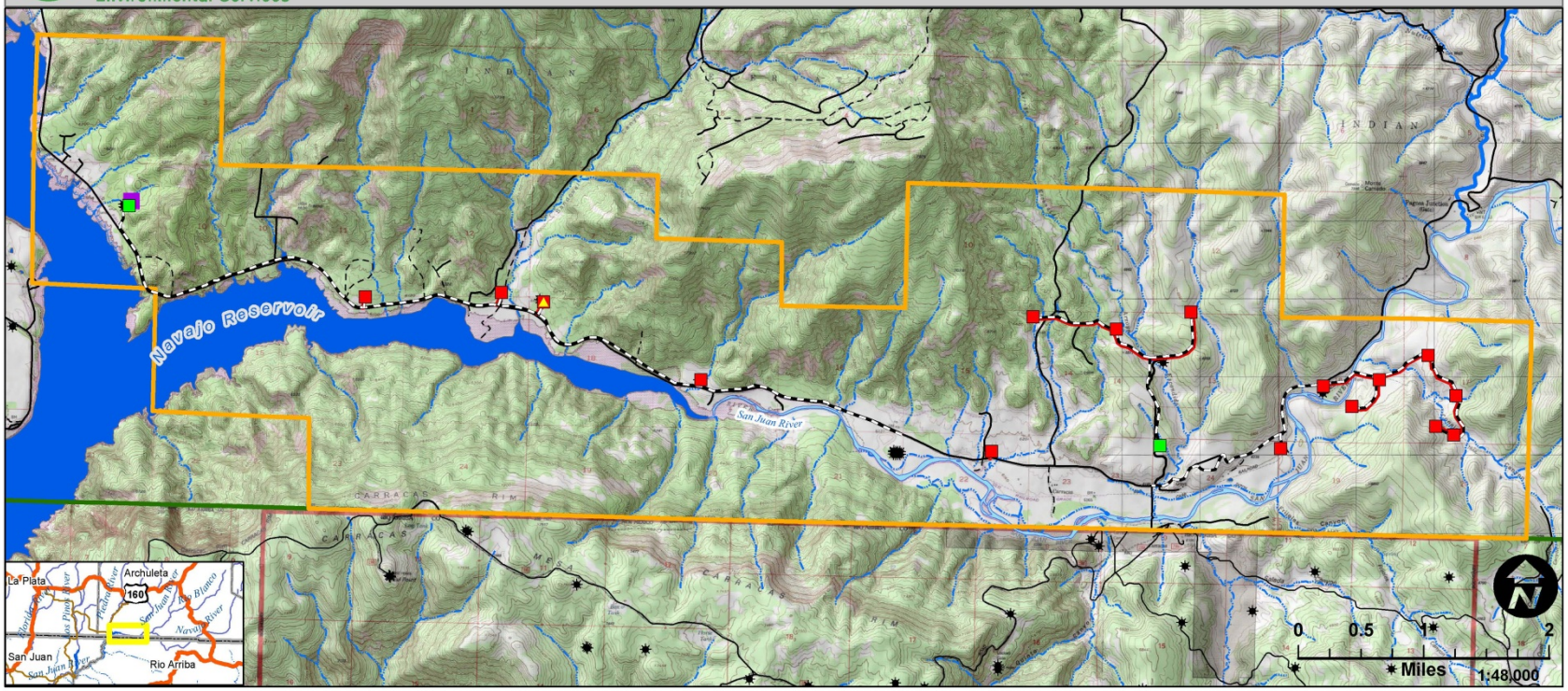
Speed limits would be enforced to the extent practicable on roads in and adjacent to the project area, to further reduce fugitive dust.

All new and replacement internal combustion gas field engines must meet, at minimum, recently promulgated (January 18, 2008, 73 Federal Register 3568) New Source Performance Standards (40 CFR 60, Subpart JJJJ). Additionally, all new and replacement internal combustion gas field engines greater than or equal to 500 design-rate hp (or site de-rated hp values, as long as manufacturer de-ration values and emission factors are supplied and current demonstration compliant with appropriate emission rate requirement) must not emit more than 1 gram of NO_x (nitrogen oxides) per horsepower-hour upon issuance of the Decision document, as opposed to being delayed under the NSPS.

All prime mover diesel drilling rig engines (not work overs or recompletion rigs) will meet Tier 2 (or better) emission standards.

Ecosphere
Environmental Services

Southern Ute Indian Tribe



LEGEND

- Existing Well Pad
- Proposed New Well Pad
- Proposed Salt Water Disposal Well
- Proposed Compressor Station
- Existing Oil and Gas Wells
- Proposed Pipeline
- Proposed Access Roads
- Existing Roads
- Southern Ute Reservation Boundary
- North Carracas Area of Mutual Interest

Coordinate System: NAD 1983 UTM Zone 13N

NORTH CARRACAS PLAN OF DEVELOPMENT

PROPOSED ACTION

MAP

ARCHULETA COUNTY, CO

TOWNSHIP 32 NORTH, RANGE 3, 4, & 5 WEST

CARRACAS AND PAGOSA JUNCTION, CO QUADRANGLES

DATE: 6/14/2012

APPENDIX B

Emission Inventory

North Carracas Plan of Development
Emission Inventory

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Safety & Environmental Compliance
Management Group
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November 26, 2012
06- 30048A

ENVIRON

CONTENTS

APPENDICES

TABLES

SUMMARY

This emission inventory (EI) is based on equipment and activities as projected on July 27, 2012 for the North Carracas Plan of Development (POD). The project will be built to be compliant with all applicable Clean Air Act (CAA) programs. Estimated emissions for the project once it is fully built out and operational are presented in Table 1.

Table 1. Estimated Total Project Emissions during Full Production, in tons per year (tpy.)

Source	NOx	CO	NMHC /VOC	SO2	PM2.5	PM10
Compressor Station – Six units with two control elements.	36.96	12.57	17.74	0.14	0.02	0.02
Salt water disposal well generator assuming 1,700 hrs annual operation	3.77	0.55	0.03	0.01	0.09	0.09
Pump jacks	21.59	4.94	0.08	0.00	0.28	0.28
Separator and water tank heaters	1.78	0.76	0.10	0.01	0.14	0.14
Project total	64.10	18.82	19.96	0.17	0.54	0.54

A set of six hazardous air pollutants (HAPs) were analyzed for this inventory. Concentrations of benzene, toluene, ethylbenzene, and xylenes (BTEX) in natural gas from coal bed methane wells in the Northern San Juan Basin are typically so low as to be non-detectable but detectable quantities are sometimes found with results varying across the reservation and often from sample to sample within a single well. A recent analysis of the gas at Red Cedar Gathering Company's Sambrito Compressor Station's inlet (see Appendix A) is representative of gas expected to be produced by the North Carracas project. The Sambrito Compressor Station collects gas from the reservation's east side (where the North Carracas project would be located). As shown in Appendix A, BTEX components were not detected in the gas at Sambrito. Other gas samples, collected from Red Cedar's Ponderosa and Spring Creek compressor stations, both located on the reservation's east side, either show low (just above detection limits) or non-detectable levels of BTEX. The gas at the compressor stations, collected prior to dehydration, is a composite of raw gas from the wells they gather from. Together these samples provide an accurate reflection of typical raw gas composition in this area of the reservation and the analysis results show that BTEX concentrations are negligible. Therefore, only combustion sources contribute HAP emissions to the North Carracas inventory.

To conservatively estimate HAPs emitted by this project, EPA emission factors for natural gas combustion were used to estimate HAPs emissions from the production phase of this project. No dehydrators are planned to be installed, so they are not of concern as HAPs emitters for this project. Estimated HAPs emissions are presented in Table 2.

Table 2. Estimated Total Project HAPs Emissions During Full Production.

Source	Formaldehyde tpy	n-Hexane tpy[a]	Benzene tpy	Toluene tpy	Ethyl-benzene tpy	Xylenes tpy
Compressor Station – Six units with two control elements.	7.8055	0.2720	0.1078	0.1000	0.0097	0.0451
Salt water disposal well generator assuming 1,700 hrs annual operation	0.1957	No EF	0.0151	0.0053	0.0002	0.0019
Pump jacks	0.6094	No EF	0.0470	0.0166	0.0007	0.0058
Separator and water tank heaters	0.00	0.03	0.00	0.00	No EF	No EF
Project total according to this EI	8.61	0.31	0.17	0.12	0.01	0.05

[a]EPA's diesel internal combustion engine speciation profile (SPECIATE4, Profile 4674) was used for all diesel engines; this profile includes zero n-hexane emissions. EPA AP-42 emission factors for 4-stroke, rich-burn, natural gas-fired reciprocating engines (AP-42, Table 3.2-3) was used to estimate HAP emissions from pump jacks and the salt water disposal well generator; no emission factor for n-hexane is included in this table.

Development of the project is planned to occur over five years. The maximum activity for well pad construction is projected to be 8 well pads in one year. The maximum activity for drilling is projected to be 19 wells in one year. Although maximum activity for these two phases of development are not planned to occur in the same year, these two scenarios were used to develop a worst case emission inventory for the project development phase. In addition, the estimate below assumes half of pipeline and road construction will take place within this same year. Total emissions for this maximum activity year are presented in Table 3. Estimated HAPs emissions from the drill rig engines are presented in Table 4.

Source	Emissions (TPY)					
	CO	NOx	PM10	PM2.5	SO2	VOC
Well Pad and ROW Construction Emissions						
Dust: Well pad construction			0.15	0.15		
Dust: Pipeline and resource road construction			1.95	1.95		
Dust: Haul road traffic			4.74	0.47		
Haul truck tailpipe emissions	0.16	0.10	0.01	0.01	0.00	0.01
Heavy Equipment tailpipe emissions	0.12	0.29	0.03	0.03	0.02	0.04
Total Well Pad and ROW Construction Emissions	0.28	0.40	6.88	2.61	0.02	0.05
Rig-up, Drill and Rig-Down Emissions						
Dust: Drill truck and supply traffic			16.61	1.66		
Haul truck tailpipe emissions	1.26	0.24	0.02	0.01	0.00	0.10
Diesel drilling engine	10.94	43.09	1.15	1.12	0.05	3.51
Total Rig-up, Drill and Rig-Down Emissions	12.21	43.33	17.78	2.80	0.05	3.60
Completion and Testing						
Dust: Well completion traffic			26.86	2.69		

Haul truck tailpipe emissions: Completion	0.87	0.56	0.05	0.04	0.00	0.08
Dust: Fracing traffic			7.86	0.79		
Haul truck tailpipe emissions: Fracing	0.11	0.22	0.02	0.02	0.00	0.01
Completion rig engines	0.93	3.17	0.18	0.18	0.09	0.23
Fracing pump engines	0.42	1.32	0.08	0.08	0.04	0.09
No flaring, green completions						
Total Completion and Testing Emissions	**2.33**	**5.27**	**35.05**	**3.80**	**0.13**	**0.42**
Total maximum activity analysis year	**14.82**	**49.00**	**59.71**	**9.20**	**0.20**	**4.07**

Table 3. Estimated Total Construction, Drilling and Completion Emissions for a Projected Maximum Activity Year, in tpy.

Table 4. Estimated Total Construction, Drilling and Completion HAPs Emissions for a Projected Maximum Activity Year, in tpy.

Source	Emissions (TPY)					
	Formaldehyde	n-Hexane[a]	Benzene	Toluene	Ethyl-benzene	Xylenes
Well Pad and ROW Construction Emissions						
Haul truck tailpipe emissions	0.0006	0.0001	0.0004	0.0011	0.0002	0.0006
Heavy Equipment tailpipe emissions	0.0031		0.0004	0.0006	0.0001	0.0004
Total Well Pad and ROW Construction Emissions	0.0037	0.0001	0.0008	0.0016	0.0002	0.0011
Rig-up, Drill and Rig-Down Emissions						
Haul truck tailpipe emissions	0.0027	0.0008	0.0035	0.0096	0.0014	0.0054
Diesel drilling engine	0.5250	0.0057	0.0713	0.0523	0.0110	0.0374
Total Rig-up, Drill and Rig-Down Emissions	0.5277	0.0065	0.0749	0.0619	0.0124	0.0428
Completion and Testing						
Haul truck tailpipe emissions: Completion	0.0033	0.0005	0.0024	0.0059	0.0009	0.0035
Haul truck tailpipe emissions: Fracing	0.0009	0.0001	0.0003	0.0005	0.0001	0.0003
Completion rig engines	0.0195		0.0024	0.0035	0.0004	0.0028
Fracing engines	0.0079		0.0010	0.0014	0.0002	0.0011
No flaring, green completions						
Total Completion and Testing Emissions	**0.0316**	**0.0006**	**0.0060**	**0.0113**	**0.0015**	**0.0077**
Total maximum activity analysis year	**0.5630**	**0.0072**	**0.0817**	**0.0748**	**0.0142**	**0.0516**

[a]EPA's diesel internal combustion engine speciation profile (SPECIATE4, Profile 4674) was used for all diesel engines; this profile includes zero n-hexane emissions. EPA AP-42 emission factors for 4-stroke, rich-burn, natural gas-fired reciprocating engines (AP-42, Table 3.2-3) was used to estimate HAP emissions from pump jacks and the salt water disposal well generator; no emission factor for n-hexane is included in this table.

Greenhouse gases (GHGs) were inventoried for the fully built project in production. GHG emissions for the planned development are presented in Table 5.

Table 5. North Carracas Annual Greenhouse Gas Estimated Emissions Under Full Production.

Equipment	CO2e per equipment, metric tpy	N. Carracas Equipment Inventory	N. Carracas CO2e emissions, metric tpy
Separators	21	48	1,009
Heaters	9.98	68	679
Wellhead	6.37	48	306
Meter piping	8.92	48	428
Pump jack engine	239.88	48	11,514
Salt Water Disposal Generator	244.87	1	245
Compressor station emissions			35,041
Low bleed pneumatic devices	4.46	48	214
Project total GHG emissions			49,436

The total annual CO2e emissions for this project exceed EPA's GHG Reporting Rule (40 CFR 98) Subpart W facility reporting threshold of 25,000 metric tons CO2e per year. However, if the project is found to be part of an existing sub-basin as defined by Subpart W of the GHG Reporting Rule, these emissions may be reported to EPA as an addition to that sub-basin. The compressor station would be required to report under Subpart C of the GHG Reporting Rule.
Emission Inventory - Production

Compressor Station

The estimate below for the compressor station was provided to Southern Ute Growth Fund (SUGF) by Energen.

Assumptions:

- Six Caterpillar G3516B Compressor Engines
- Emission factors for NOx, CO, formaldehyde (HCHO) and VOC from Engine Technical Data from Caterpillar's Ref.Data Set DM8800-04-001
- Oxydation Catalyst Reduction: Per Manufacturer
- Elevation - 6500 feet Assumed continuous operation – 8760 hrs/year.
- Two O2 catalysts to meet New Source Performance Standards (NSPS)

Derate for Elevation: Name Plate HP – 1380 Derate from Data Sheet for 6500 feet at 70 degrees - 92.5% Horsepower for Calculations: 1380 x 0.925 = 1277 HP

Emissions Estimate:

Table 6. Compressor Emission Estimates: NOx, CO and VOC.

CONTROLLED - TWO ELEMENTS Assuming 93% reduction of CO, 50% of VOC				
	g/hp-hr	O2 Catalyst	One UnitTPY	Six UnitsTPY
NOx	0.5	None	6.2	37.0
CO	2.43	0.93	2.1	12.6
VOC	0.48	0.5	3.0	17.7

HCHO	0.44	0.76	1.3	7.8

Emissions for PM10, PM2.5, SO2 and HAPs were estimated using emission factors from EPA's AP-42, Compilation of Air Pollutant Emission Factors, Chapter 3.2 Stationary Internal Combustion Engines, Natural Gas-Fired Reciprocating Engines, Table 3.2-2.

Table 7. Compressor Emission Estimates: PM10, PM2.5, SO2 and HAPS.

	Value	Units		
Fuel consumption	7301	Btu/bhp-hr	From Caterpillar engine spec sheet.	
	1277	bhp		
Hours operating	8760	hours		
Annual Fuel consumption	81672782520	Btu's		
	81672.78252	MMBtu		
	Pollutant	lb/MMBtu	one unit tpy	six units tpy
	PM10	0.0000771	0.003	0.02
	PM2.5	0.0000771	0.003	0.02
	SO2	0.00059	0.024	0.14
	n-Hexane	0.00111	0.0453	0.272
	Benzene	0.00044	0.0180	0.108
	Toluene	0.000408	0.0167	0.1000
	Ethylbenzene	0.0000397	0.00162	0.00973
	Xylene	0.000184	0.00751	0.0451

Greenhouse Gases

Emission factor from Engine Technical Data from Caterpillar's Ref. Data Set DM8800-04-001.

Table 8. Compressor Emissions Estimates: GHGs.

			One Unit	Six Units
	g/hp-hr	Controls	TPY	TPY
CO2	474	None	5,839	35,036

Salt Water Disposal Well Generator

Assumptions:

- One generator to supply electricity to the electric well pump.
- Assumed a Cummins GTA855, 286 hp.
- Emission factors from Cummins Engine Performance data sheet, revised February 24, 2005, for a GTA855.
- Assumed hours of operation = 1,700 hrs/year. (Maximum annual hours for salt water disposal engines reported in the (NMED, 2006) report's survey of producers for this source type.)

Derate for Elevation: Derated engine for 6,500 feet at 70 degrees = 92.5%. (286 hp)(0.925) = 265 hp.

Emissions Estimate:

Table 9. Salt Water Disposal Well Emissions: NOx, CO and VOC Salt water disposal well Cummins generator.

	NOx	CO	VOC
EF, g/hp-hr	7.6	1.14	0.064
Annual emissions from salt water injection, tons/yr	19.4	2.8	0.2
Likely actual emissions, assuming hours of operation of 1,700 hrs (NMED, 2006.)	3.77	0.55	0.03

Emissions for PM10, PM2.5 and SO2 and HAPs were estimated using emission factors from EPA's AP-42, C*ompilation of Air Pollutant Emission Factors,* Chapter 3.2 Stationary Internal Combustion Engines, Natural Gas-Fired Reciprocating Engines, Table 3.2-3.

Table 10. Salt Water Disposal Well Emissions: PM10, PM2.5, SO2 and HAPs.

From Cummins specifications sheet - Fuel consumption = 8224 Btu/bhp-hr			
	Value	units	
Fuel consumption	8224	Btu/bhp-hr	
Bhp	265	bhp	
Hours operating	8760	hours	
	Pollutant	lb/MMBtu	One unit tpy
	PM10	0.0095	0.09
	PM2.5	0.0095	0.09
	SO2	0.00059	0.006
	n-Hexane	No EF	NA
	Formaldehyde	0.0205	0.196
	Benzene	0.00158	0.0151
	Toluene	0.000558	0.00533
	Ethylbenzene	0.0000248	0.000237
	Xylene	0.000195	0.00186

Wells

Pump Jack Emissions

As of July 27, 2012, it is projected 48 wells will be drilled as a result of this project.

Assumptions:

- Pumping units will be installed at 48 wells as a result of this project. Energen indicated Arrow C96's may be used. The NOx, CO and THC emissions below were calculated using the emission factors for the Arrow C96 engine obtained from Southern San Juan Basin field survey responses (NMED, 2006.) Emission factors in the NMED report are based on actual field survey responses

from operators referencing manufacturer specifications for engines as they are actually configured for use in the field. An engine deterioration factor from the NONROAD model was also applied to better account for increases in emissions with engine age. Thus, the NMED emission factors represent a realistic estimate of actual in-use emission factors. An average engine load factor of 71% was applied in the NMED study when calculating emission rates. However, to maintain a higher degree of conservatism for the North Carracas inventory, we assume constant year-round operation of the pump jack engines at 100% load. NOx emissions from these engines meet the NOx NSPS Subpart JJJJ limit for engines manufactured after 2011 of 6 g/hp-hr.

- Assumed continuous operation = 8,760 hrs/year.

Derate for Elevation: Used the (NMED, 2006) site derated horsepower for 5,500 feet of 16.4 hp for the Arrow C96 engines.

Emissions Estimate:

Table 11. Well Pump Jack Emissions: NOx, CO, Total Hydrocarbons (THC), and SO2.

Wells				
48 wells, each equipped with a pump jack engine.				
	NOx	CO	THC	SO2
EF, g/hp-hr	2.84	0.65	0.01	0.0005
Annual emissions, tons/yr, per well	0.45	0.10	0.002	0.00
Annual emissions from 48 wells, tons/year	21.59	4.94	0.08	0.00

Emissions for PM10, PM2.5 and HAPs were estimated using emission factors from EPA's AP-42, Compilation of Air Pollutant Emission Factors, Chapter 3.2 Stationary Internal Combustion Engines, Natural Gas-Fired Reciprocating Engines, Table 3.2-3.

Table 12. Well Pump Jack Emissions: HAPs and PM.

Parameter	Value		
Arrow engine site-rated hp	16.4		
Arrow engine bsfc, btu/hp-hr	8622		
Red Willow Fruitland coal HHV, Btu/scf	923		
Arrow Engine hourly fuel consumption, scf/hr	153.20		
Annual fuel consumption, per well, MMBtu/yr	1238.67		
Species	**EF, lbs/MMscf**	**Emissions, tpy, per well**	**48 wells**
PM10	0.0095	3.9E-03	0.28
PM2.5	0.0095	3.9E-03	0.28
n-Hexane	No EF	NA	NA
Formaldehyde	0.0205	1.27E-02	0.61
Benzene	0.00158	9.79E-04	0.0470
Toluene	0.000558	3.46E-04	0.017
Ethylbenzene	0.0000248	1.54E-05	0.0007
Xylenes	0.000195	1.21E-04	0.0058

Other Well Head Equipment

Separators

Each well will have a separator, but some separators will share a heater. The current estimate is 28 heaters (250,000 Btu/hr) will be needed for separators.

Dehydrators

No dehydrators are planned to be installed under this plan of development.

Water Tanks

A total of 32 produced water tanks are planned to be located at various well locations. Each tank will have a 125,000 Btu/hr heater. The salt water disposal facility is planned to have 8 water tanks, each with a 125,000 Btu/hr heater.

Assumptions

- Emission factors were obtained from AP-42, Section 1.4, Tables 1.4-1 and 1.4-2. Factors for Residential Furnaces were used because their ratings (<0.3 MMBtu/hr) most closely match those of the heaters.
- Used AP-42 assumption that sulfur content of natural gas is 2,000 grains/106 scf.
- VOC emissions were not estimated for separators or burners because coal bed methane does not have a significant reactive volatile component. (Programmatic Environmental Assessment for 80 Acre Infill Oil and Gas Development on the Southern Ute Indian Reservation (SUIT PEA, 2009) Volume II, Table A-7.) However, to conservatively estimate HAPs for this project, EPA AP-42 emission factors for natural gas combustion were used to estimate HAPs emissions from combustion.
- Fruitland coal bed methane (CBM) value of 923 Btu/scf was used to convert emission factors. This value was obtained from Red Willow Production Company to represent local CBM gas.
- All heaters operate approximately 4 months per year (2920 hrs/year.)

Table 13. Separator and Water Tank Heater Emissions: NOx, CO, PM and SO2.

Separator and Water Tank Heaters				
Separators equipped with 0.25 MMBtu/hr heaters				
Water tanks equipped with 0.125 MMBtu/hr heaters				
	NOx	**CO**	**PM***	**SO2**
EF, lbs/MMBtu	0.102	0.043	0.0082	0.0007
Annual emissions from separator heaters, tons/year	1.04	0.44	0.08	0.01
Annual emissions from water tank heaters, tons/year	0.74	0.32	0.06	0.0005
Annual emissions from all heaters, tons/year	**1.78**	**0.76**	**0.14**	**0.01**

*PM represents PM10 and PM2.5

Table 14. Separator and Water Tank Heater Emissions: HAPs.

Separator and Water Tank Heaters				
Separators equipped with 0.25 MMBtu/hr heaters				
Water tanks equipped with 0.125 MMBtu/hr heaters				
	Formaldehyde	**n-Hexane**	**Benzene**	**Toluene**
EF, lbs/MMBtu	8.13E-06	1.95E-03	2.28E-06	3.68E-06
Annual emissions from separator heaters, tons/year	8.30E-05	1.99E-02	2.33E-05	3.76E-05
Annual emissions from water tank heaters, tons/year	5.93E-05	1.42E-02	1.66E-05	2.69E-05
Annual emissions from all heaters, tons/year	**1.42E-04**	**3.42E-02**	**3.99E-05**	**6.45E-05**

EMISSION INVENTORY – CONSTRUCTION AND DEVELOPMENT

Construction

Dust generated by well pad construction

Assumptions:

- Acres disturbed = 50.5 for well pads, 4 acres for compressor station and 1.5 acres for salt water disposal facility. Project total = 56 acres. Assumed half of this would occur in a worst case year = 28 acres.
- Emission factor from the Western Regional Air Partnership's (WRAP) Fugitive Dust Handbook (WRAP, 2006) Chapter 3 – Construction and Demolition.
- Construction takes 3 days for one 2 acre well pad. Well pads will vary in size depending on how many wells are located on them; 2 acres is used here as a median value. Construction will take place sequentially, so each well pad will be disturbed by construction for 3 days. The day/month ratio used is 0.1.
- 50% control by watering during activity.

Emissions = (Acres disturbed)(0.11 tons PM10/acre per month)(day/month ratio)(control)
(28 acres) (0.11 tons PM10/acre per month)(0.1)(0.5) = 0.15 tons PM10

Dust Generated by Resource Road and Pipeline Construction

Assumptions:

- Acres disturbed = 70.8 for pipeline, with resource roads constructed on the pipeline right of way. Assumed half of this would occur in a worst case year = 35.4 acres.
- Emission factor from the Western Regional Air Partnership's (WRAP) Fugitive Dust Handbook (WRAP, 2006) Chapter 3 – Construction and Demolition.
- Construction will take approximately one month.
- 50% control by watering during activity.

Emissions = (Acres disturbed)(0.11 tons PM10/acre per month)(day/month ratio)(control)
(35.4 acres) (0.11 tons PM10/acre per month)(1)(0.5) = 1.95 tons PM10

Dust Generated by Unpaved Haul Road Traffic

Emission factor calculated as follows as per (EPA AP-42, 2006)

Assumptions:

- 50% control by watering roads during activity.
- Per well traffic estimates taken from (SUIT, 2009.)

Table 15. Parameters used to calculate unpaved road emission factor.

Emission Factor-Industrial Unpaved Roads		
AP-42 (EPA, Nov 06) Section 13.2.2 emission factor for industrial roads since many HDDV trucks are included in VMT.		
Parameter	Value	Source
k, PM10	1.5	AP-42 Table 13.2.2-2
k, PM2.5	0.15	AP-42 Table 13.2.2-2
s, silt content	5.1	AP-42 Table 13.2.2-1 modified by silt content for the state of CO = 1.5% obtained from 2002 NEI documentation for nonpoint sources
Parameter	Value	Source
Speed	25	Traffic average
Parameter	Value	Source
Weight, tons	14.33	Weighted average of project vehicles
p, # of days with at least 0.1 inch of precipitation/year	90	Figure 13.2.2-1 in AP-42 13.2.2.
EF, PM10 lbs/VMT	1.06	
EF, PM2.5 lbs/VMT	0.11	

Table 16. Vehicle Miles Traveled (VMT) Estimate.

Truck	Activity	Avg weight, tons	RTs per pad	Avg speed	Total miles per well pad assuming 20 mi RT	% of total miles	# of wellpads	Project VMT
Semi	heavy equipment hauler	37	5	20	100	0.04	8	800
Haul	Gravel haul	24	48	20	960	0.43	8	7680
Haul	Fuel truck	24	3	20	60	0.03	8	480
Pickup	Equipment/Operator crew	3.5	56	30	1120	0.50	8	8960
				Total miles	2240	1.00	8	17920

Emissions = (EF)(VMT)(control efficiency)/2000 = tpy

PM10 = (1.06 PM10 lbs/VMT)(17920 VMT)(50%)/2000 = 4.74 tpy PM10

PM2.5 = (0.11 PM2.5 lbs/VMT)(17920 VMT)(50%)/2000 = 0.47 tpy PM2.5

Haul Truck Tailpipe Emissions

Assumptions:

- Emission factors from MOVES2010a, nationwide scale model runs, for combination unit short haul trucks (haul trucks) and light duty commercial trucks (pickups) with county default inputs.
- Total miles travelled by haul trucks and pickups is equal to 17,920 miles.
- 50% of travel in pickups = 8,960 miles ; 50% of travel in HDDV trucks = 8,960 miles

Table 17. Haul Truck Tailpipe Emissions: VOC, CO, NOx.

VOC		CO		NOx	
Pickup Efs (grams/miles)	1.05	Pickup Efs (grams/miles)	13.88	Pickup Efs (grams/miles)	1.50
HDDV Efs (grams/miles)	0.44	HDDV Efs (grams/miles)	2.23	HDDV Efs (grams/miles)	9.07
HDDV Emissions, g	3,983	HDDV Emissions, g	19,986	HDDV Emissions, g	81,311
Pickup Emissions, g	9,435	Pickup Emissions, g	124,347	Pickup Emissions, g	13,456
Emissions, lbs	29.58	Emissions, lbs	318.19	Emissions, lbs	208.92
Emissions from 8 well pads, tons	0.01	Emissions from 8 well pads, tons	0.16	Emissions from 8 well pads, tons	0.10

Table 18. Haul Truck Tailpipe Emissions: PM10 PM2.5 and SO2.

PM10		PM2.5		SO2	
Pickup Efs (grams/miles)	0.07	Pickup Efs (grams/miles)	0.06	Pickup Efs (grams/miles)	0.01
HDDV Efs (grams/miles)	0.81	HDDV Efs (grams/miles)	0.77	HDDV Efs (grams/miles)	0.01
HDDV Emissions, g	7,253	HDDV Emissions, g	6,925	HDDV Emissions, g	126
Pickup Emissions, g	620	Pickup Emissions, g	538	Pickup Emissions, g	74
Emissions, lbs	17.36	Emissions, lbs	16.45	Emissions, lbs	0.44
Emissions from 8 well pads, tons	0.01	Emissions from 8 well pads, tons	0.01	Emissions from 8 well pads, tons	<0.01

Heavy Equipment Tailpipe Exhaust Emissions

Used emission factors from (SUIT, 2009) which include a dozer, grader and backhoe, each operating 8 hours a day for 3 days on each well pad. Emission factors represent all heavy equipment emissions per well.

Table 19. Heavy Equipment Tailpipe Exhaust Emissions.

Pollutant	Emission factor, lbs/well pad	Emissions for 8 well pads, tons
PM10 and PM2.5	7.37	0.029
SO2	5.84	0.023
NOx	72.87	0.29
CO	29.82	0.12
VOC	9.14	0.037

Rig-up, Drilling, and Rig-Down – 19 wells

Dust: Drill Truck and Supply Traffic

The emission factors used were calculated as described in the Construction - Dust Generated by Unpaved Haul Road Traffic section above. The emission factors vary because the weighted average of the project vehicles varies by activity.

Assumptions:

- 50% control by watering roads during activity.
- Per well traffic estimates taken from (SUIT, 2009.)

Table 20. Vehicle Miles Traveled (VMT) Estimate.

Truck	Semi	Haul	Pickup	Total miles
Activity	Rig Transport	Fuel, mud and logging trucks	Equipment/ Operator crew	
Avg weight, tons	30	24	3.5	
RTs per pad	13	15	213	
Average speed	20	20	30	
Total miles per well assuming 20 mi RT	260	300	4260	4820
Percent of total miles	0.05	0.06	0.88	1.00
# of wells	19	19	19	19
Project VMT	4940	5700	80940	91580

Emissions = (EF)(VMT)(control efficiency)/2000 = tpy

PM10 = (0.73 PM10 lbs/VMT)(91,580 VMT)(50%)/2000 = 16.61 tpy PM10

PM2.5 = (0.07 PM2.5 lbs/VMT)(91,580 VMT)(50%)/2000 = 1.66 tpy PM2.5

Haul Truck Tailpipe Emissions

Assumptions:

- Emission factors from MOVES2010a, nationwide scale model runs, for combination unit short haul trucks (haul trucks) and light duty commercial trucks (pickups) with county default inputs.
- A total mile travelled by haul trucks is equal to 91,580 miles.
- 88% of travel for pickups =80,940 miles ; 12% of travel for haul trucks = 10,640 miles

Table 21. Haul Truck Tailpipe Emissions: VOC, CO, NOx.

VOC		CO		NOx	
Pickup Efs (grams/miles)	1.05	Pickup Efs (grams/miles)	13.88	Pickup Efs (grams/miles)	1.50
HDDV Efs (grams/miles)	0.44	HDDV Efs (grams/miles)	2.23	HDDV Efs (grams/miles)	9.07
HDDV Emissions, g	4,730	HDDV Emissions, g	23,734	HDDV Emissions, g	96,557
Pickup Emissions, g	85,229	Pickup Emissions, g	1,123,284	Pickup Emissions, g	121,557
Emissions, lbs	198.32	Emissions, lbs	2528.70	Emissions, lbs	480.85
Emissions from 19 well pads, tons	0.10	Emissions from 19 wells, tons	1.26	Emissions from 19 wells, tons	0.24

Table 22. Haul Truck Tailpipe Emissions: PM10 PM2.5 and SO2.

PM10		PM2.5		SO2	
Pickup Efs (grams/miles)	0.07	Pickup Efs (grams/miles)	0.06	Pickup Efs (grams/miles)	0.01
HDDV Efs (grams/miles)	0.81	HDDV Efs (grams/miles)	0.77	HDDV Efs (grams/miles)	0.01
HDDV Emissions, g	8,612	HDDV Emissions, g	8,223	HDDV Emissions, g	150
Pickup Emissions, g	5,605	Pickup Emissions, g	4,856	Pickup Emissions, g	670
Emissions, lbs	31.34	Emissions, lbs	28.83	Emissions, lbs	1.81
Emissions from 19 wells, tons	0.02	Emissions from 19 wells, tons	0.01	Emissions from 19 well pads, tons	<0.01

Diesel Drilling Engine

Assumptions:

- Used emission factors from (TCEQ, 2009)
- Average hours to drill a 9,000 ft, horizontal Fruitland coal bed methane (CBM) well estimated by Energen =596 hrs. Although some wells drilled under the North Carracas POD will be vertically drilled in an s-shape, will be approximately half as deep and take half the time to drill, all wells are estimated to be horizontal to provide a conservative estimate of drilling emissions.

The (TCEQ, 2009) study developed emission factors for drilling based on a survey of drilling companies. Through the survey, detailed information was collected on engine profiles and overall average loads for all the engines included in each model rig category, well type (vertical, directional or horizontal) and well depth. US EPA's NONROAD model was used to develop criteria pollutant emission factors for each rig type for each year of the inventory. Use of the NONROAD model allowed for expected reductions in emissions over time due to the phasing in of EPA's emissions standards for nonroad diesel engines. The following emission factors for this inventory were taken from the 2013 column of Table F.3 Emission Factors for Directional/Horizontal Wells of (TCEQ, 2009).

EPA Engine Tier Standards were not used in this analysis because a typical drill rig comprises several engines (draw works, mud pumps and generator engines). It is difficult to obtain data in advance on exactly what make, model and year engines will comprise a given drill rig. The exact drill rigs to be used on North Carracas were not known at the time of this analysis. The TCEQ study developed drill rig engine emission profiles based on type and depth of wells together

with characterizations of drill rigs obtained from a survey of drilling rig contractors. The types of wells included in the TCEQ study (vertical, with different classes for less than and greater than 7,000 ft well depth, horizontal and directional) are similar to those to be drilled as part of this action. At North Carracas, the vertical s-shaped wells are expected to be approximately 3,250 ft deep and horizontal wells are expected to be approximately 9,000 ft deep. The average measured depth for the horizontal and directional wells in the TCEQ study was 11,000 feet, which provides a similar and conservative match to the projected well depths for North Carracas.

Table 23. Diesel Drilling Rig Criteria Pollutant Emissions.

	CO	NOx	PM10	PM2.5	SO2	VOC
EF, tons/1,000 ft drilled	0.064	0.252	0.00675	0.00655	0.0003	0.0205
Emissions per 9,000 ft well, tons	0.58	2.27	0.061	0.059	0.0027	0.18
Emissions for 19 wells (max year)	10.94	43.09	1.15	1.12	0.051	3.51

Table 24. Diesel Drilling Rig HAPs Emissions.

	Formaldehyde	Benzene	Xylenes	Ethylbenzene	Toluene	n-Hexane
EF, tons/1,000 ft drilled	0.00307	0.000417	0.0002187	6.46E-05	0.00031	3.3E-05
Emissions per 9,000 ft well, tons	0.028	0.004	0.002	0.001	0.003	0.000
Emissions for 19 wells (max year)	0.53	0.071	0.037	0.011	0.052	0.006

Completion, Testing and Fracturing – 19 wells

Dust: Well Completion and Testing Traffic

The emission factors used were calculated as described in the Construction - Dust Generated by Unpaved Haul Road Traffic section above. The emission factors vary because the weighted average of the project vehicles varies by activity.

Assumptions:

- 50% control by watering roads during activity.
- Per well traffic estimates taken from (SUIT, 2009.)

Table 25. Vehicle Miles Traveled (VMT) Estimate.

Truck	Semi	Haul	Pickup	Total miles
Activity	Casing, cement, etc haulers	Cementer, completion equip., tubing, etc	Equipment/ Operator crew	
Avg weight, tons	37	24	3.5	
RTs per pad	45	81	129	
Average speed	20	20	30	
Total miles per well assuming 10 mi RT	900	1620	2580	5100
Percent of total miles	0.18	0.32	0.51	1.00
# of wells	19	19	19	19
Project VMT	17100	30780	49020	96900

Emissions = (EF)(VMT)(control efficiency)/2000 = tpy

PM10 = (1.11 PM10 lbs/VMT)(96,900 VMT)(50%)/2000 = 26.86 tpy PM10

PM2.5 = (0.11 PM2.5 lbs/VMT)(96,900 VMT)(50%)/2000 = 2.69 tpy PM2.5

Haul Truck Tailpipe Emissions: Well Completion and Testing Traffic

Assumptions:

- Emission factors from MOVES2010a, nationwide scale model runs, for combination unit short haul trucks (haul trucks) and light duty commercial trucks (pickups) with county default inputs.
- A total miles travelled by haul trucks is equal to 96,900 miles.
- 51% of travel for pickups =49,020 miles; 49% of travel for haul trucks = 47,880 miles.

Table 26. Haul Truck Tailpipe Emissions: VOC, CO, NOx.

VOC		CO		NOx	
Pickup Efs (grams/miles)	1.05	Pickup Efs (grams/miles)	13.88	Pickup Efs (grams/miles)	1.50
HDDV Efs (grams/miles)	0.44	HDDV Efs (grams/miles)	2.23	HDDV Efs (grams/miles)	9.07
HDDV Emissions, g	21,283	HDDV Emissions, g	106,802	HDDV Emissions, g	434,507
Pickup Emissions, g	51,618	Pickup Emissions, g	680,299	Pickup Emissions, g	73,619
Emissions, lbs	160.72	Emissions, lbs	1735.23	Emissions, lbs	1120.21
Emissions from 19 wells, tons	0.08	Emissions from 19 wells, tons	0.87	Emissions from 19 wells, tons	0.56

Table 27. Haul Truck Tailpipe Emissions: PM10 PM2.5 and SO2.

PM10		PM2.5		SO2	
Pickup Efs (grams/miles)	0.07	Pickup Efs (grams/miles)	0.06	Pickup Efs (grams/miles)	0.01
HDDV Efs (grams/miles)	0.81	HDDV Efs (grams/miles)	0.77	HDDV Efs (grams/miles)	0.01
HDDV Emissions, g	38,756	HDDV Emissions, g	37,004	HDDV Emissions, g	676
Pickup Emissions, g	3,394	Pickup Emissions, g	2,941	Pickup Emissions, g	406
Emissions, lbs	92.92	Emissions, lbs	88.06	Emissions, lbs	2.38
Emissions from 19 wells, tons	0.05	Emissions from 19 wells, tons	0.04	Emissions from 19 wells, tons	<0.01

Dust: Fracturing Traffic

The emission factors used are the same as described in the Construction - Dust Generated by Unpaved Haul Road Traffic section above. Any difference in the emission factors is due to the change in the weighted average of project vehicles for this phase of work.

Assumptions:

- 50% control by watering roads during activity.
- Per well traffic estimates for fracturing operations obtained from Energen.

Table 28. Vehicle Miles Traveled (VMT) Estimate.

Truck	Semi	Haul	Pickup	Total miles
Activity		Cementer, completion equip., tubing, etc	Equipment/ Operator crew	
Avg weight, tons	37	24	3.5	
RTs per pad	0	56	10	
Average speed	20	20	30	
Total miles per well assuming 20 mi RT	0	1120	200	1320
Percent of total miles	0.0	0.85	0.15	1.00
# of wells	19	19	19	19
Project VMT	0	21280	3800	25080

Emissions = (EF)(VMT)(control efficiency)/2000 = tpy

PM10 = (1.25 PM10 lbs/VMT)(25,080 VMT)(50%)/2000 = 7.86 tpy PM10

PM2.5 = (0.13 PM2.5 lbs/VMT)(25,080 VMT)(50%)/2000 = 0.79 tpy PM2.5

Haul Truck Tailpipe Emissions: Fracturing Traffic

Assumptions:

- Emission factors from MOVES2010a, nationwide scale model runs, for combination unit short haul trucks (haul trucks) and light duty commercial trucks (pickups) with county default inputs.
- A total mile travelled by haul trucks is equal to 25,080 miles.
- 15% of travel for pickups =3,800 miles; 85% of travel for haul trucks = 21,280 miles.

Table 29. Haul Truck Tailpipe Emissions: VOC, CO, NOx.

VOC		CO		NOx	
Pickup Efs (grams/miles)	1.05	Pickup Efs (grams/miles)	13.88	Pickup Efs (grams/miles)	1.50
HDDV Efs (grams/miles)	0.44	HDDV Efs (grams/miles)	2.23	HDDV Efs (grams/miles)	9.07
HDDV Emissions, g	9,459	HDDV Emissions, g	47,467	HDDV Emissions, g	193,114
Pickup Emissions, g	4,001	Pickup Emissions, g	52,736	Pickup Emissions, g	5,707
Emissions, lbs	29.68	Emissions, lbs	220.91	Emissions, lbs	438.32
Emissions from 19 wells, tons	0.01	Emissions from 19 wells, tons	0.11	Emissions from 19 wells, tons	0.22

Table 30. Haul Truck Tailpipe Emissions: PM10 PM2.5 and SO2.

PM10		PM2.5		SO2	
Pickup Efs (grams/miles)	0.07	Pickup Efs (grams/miles)	0.06	Pickup Efs (grams/miles)	0.01
HDDV Efs (grams/miles)	0.81	HDDV Efs (grams/miles)	0.77	HDDV Efs (grams/miles)	0.01
HDDV Emissions, g	17,225	HDDV Emissions, g	16,446	HDDV Emissions, g	300
Pickup Emissions, g	263	Pickup Emissions, g	228	Pickup Emissions, g	31
Emissions, lbs	38.55	Emissions, lbs	36.76	Emissions, lbs	0.73
Emissions from 19 wells, tons	0.02	Emissions from 19 wells, tons	0.02	Emissions from 19 wells, tons	<0.01

Fracturing and Completion Engines

Assumptions:

- Used emission factors from the BLM's Farmington Field Office's air emissions calculator template Excel spreadsheet. The source for these EFs given within the spreadsheet is EPA NONROAD 2008a, for Year 2018, accounting for a mixture of Tier 1-3 engines.
- According to Energen, a total of 41,423 hp-hrs are needed from fracking engines to frac each well. This includes the engines and operating hours shown below.
- As per "Indirect Emissions of Carbon Dioxide from Marcellus Shale Gas Development, A Technical Report from the Agriculture, Energy, & Environment Program at Cornell University" June 2011, R.L Santoro, R.H. Howarth, A.R. Ingraffea, the air package engines are assumed to run at 100% load; average load factors for the other engines are from Table 6.6, TCEQ Drilling Rig Emission Inventory for the State of Texas, 2009.

Activity	Equipment Type	Capacity (hp)	# of Units per well	Avg Load factor	# hours operating per well
Fracturing	Air package	600	1	1	36
Fracturing	Rig engine	475	1	0.43	72
Fracturing	Mud pump	425	1	0.43	28
Completion	Rig engine	475	1	0.43	168
Completion	mud pump	425	1	0.43	42

Table 31. Fracturing Engines Emissions: NOx, PM10, PM2.5, SO2, CO and VOCs.

	Fracturing Engine Emissions, lb per well	Completion Engine Emissions, lb per well	Completion Engine Emissions, tons for 19 wells	Fracturing Engine Emissions, tons for 8 wells
NOx	329.67	334.18	3.17	1.32
PM10	19.65	19.44	0.18	0.0786
SO2	9.13	9.26	0.09	0.0365
CO	105.85	98.12	0.93	0.423
VOCs	23.27	24.07	0.23	0.0931
PM2.5	19.18	19.44	0.18	0.0767

Flaring and Venting

Wells completed as part of this project will not be flared. However, they will be vented. VOC emissions were not estimated for venting because coal bed methane does not have a significant reactive volatile component. (*Programmatic Environmental Assessment for 80 Acre Infill Oil and Gas Development on the Southern Ute Indian Reservation* (SUIT PEA, 2009) Volume II, Table A-7.) All of the wells planned for this project will produce coal bed methane.

EMISSION INVENTORY - GREENHOUSE GAS

The per-equipment CO2e annual emission rates for a typical Fruitland Coal well were obtained from SUGF's Red Willow Production Company's 2011 GHG inventory. Emission estimation methodologies and emission factors were obtained from the Mandatory Greenhouse Gas Reporting Rule, 40 CFR 98.233. The emission rates include vented and combustion CO2 emissions, vented and uncombusted methane emissions and combustion N2O emissions.

Table 32. Projected Greenhouse Gas Emissions.

Equipment	CH4 Emissions, metric tpy	CO2 Emissions, metric tpy	N20 Emissions, metric tpy	CO2e per equipment type, metric tpy[b]	N. Carracas Equipment Inventory	N. Carracas CO2e emissions, metric tpy
Separators	0.99	0.24	NA	21.03	48	1009
Heaters	0.47	0.11	NA	9.98	68	679
Wellhead	0.3	0.07	NA	6.37	48	306
Meter piping	0.42	0.1	NA	8.92	48	428
Pumpjack Engine	0.41	231.08	0.0006	239.88	48	11514
Salt Water Disposal Generator	0.02	243.83	0.002	244.87	1	245
Compressor Station Emissions[a]	0.09	35036	0.009	35040.68	1	35041
Low Bleed Pneumatic Devices	0.21	0.05	NA	4.46	48	214
Project Total GHG emissions						49436

a CO2 emissions calculated using manufacturer's emission factor. CH4 and N2O calculated as per 40 CFR 98.33(c).
b CH4 and N2O are multiplied by their global warming potentials, 21 and 310 respectively, to obtain CO2e (CO2 equivalent) emissions.

Note that under 98.233(z)(4), internal fuel combustion sources less than or equal to 130 hp do not need to report combustion emissions or include those emissions for threshold determination under the GHG Reporting Rule. Therefore, pumpjack engines are excluded from reporting GHGs.

Emissions Scenario: Maximum Annual Average

A maximum annual average emissions scenario was defined based on conservative estimates of the maximum amount of combined well pad construction, drilling and completion/fracking emissions in addition to production phase emissions expected to occur in a single year. As described above, this scenario includes construction of 8 well pads and drilling and completion of 19 wells and fracing of 8 wells in one year. Although maximum activity for these two phases of project development are not planned to occur in the same year, these two scenarios were used to develop a worst case emission inventory for the development phase. In addition, the maximum annual emissions scenario assumes half of pipeline and road construction will take place within this same year. Also included in the maximum annual scenario are production phase emissions from 42 wells along with the compressor station and salt water disposal well (at full operation). Total emissions for this maximum emissions year are presented in Table 33 (criteria pollutants) and Table 34 (HAPS).

Table 33. Maximum Annual Emissions Scenario (tpy).

Source	Emissions (TPY)					
	CO	NOx	PM10	PM2.5	SO2	VOC
Dust: Well pad construction			0.15	0.15		
Dust: Pipeline and resource road construction			1.95	1.95		
Dust: Haul road traffic			4.74	0.47		
Haul truck tailpipe emissions	0.16	0.10	0.01	0.01	0.00	0.01
Heavy Equipment tailpipe emissions	0.12	0.29	0.03	0.03	0.02	0.04
Total Well Pad and ROW Construction Emissions	**0.28**	**0.40**	**6.88**	**2.61**	**0.02**	**0.05**
Dust: Drill truck and supply traffic			16.61	1.66		
Haul truck tailpipe emissions	1.26	0.24	0.02	0.01	0.00	0.10
Diesel drilling engine	10.94	43.09	1.15	1.12	0.05	3.51
Total Rig-up, Drill and Rig-Down Emissions	**12.21**	**43.33**	**17.78**	**2.80**	**0.05**	**3.60**
Dust: Well completion traffic			26.86	2.69		
Haul truck tailpipe emissions: Completion	0.87	0.56	0.05	0.04	0.00	0.08
Dust: Fracing traffic			7.86	0.79		
Haul truck tailpipe emissions: Fracing	0.11	0.22	0.02	0.02	0.00	0.01
Completion rig engines	0.93	3.17	0.18	0.18	0.09	0.23
Fracing pump engines	0.42	1.32	0.08	0.08	0.04	0.09
No flaring, green completions						
Total Completion and Testing Emissions	**2.33**	**5.27**	**35.05**	**3.80**	**0.13**	**0.42**
Total Development Phase	**14.82**	**49.00**	**59.71**	**9.20**	**0.20**	**4.07**
Compressor Station – Six units with two control elements.	12.57	36.96	0.02	0.02	0.14	17.74
Salt water disposal well generator assuming 1,700 hrs annual operation	0.55	3.77	0.09	0.09	0.01	0.03
Pump jacks	4.94	21.59	0.28	0.28	0.00	0.08
Separator and water tank heaters	0.76	1.78	0.14	0.14	0.01	0.10
Total Operational Phase	**18.82**	**64.10**	**0.54**	**0.54**	**0.17**	**17.96**
TOTAL PROJECT – MAXIMUM YEAR	**33.64**	**113.11**	**60.25**	**9.74**	**0.37**	**22.03**

Table 34. Maximum Annual HAPs Emissions Scenario (tpy).

Source	Emissions (TPY)					
	Formaldehyde	n-Hexanea	Benzene	Toluene	Ethyl-benzene	Xylenes
Well Pad and ROW Construction Emissions						
Haul truck tailpipe emissions	0.0006	0.0001	0.0004	0.0011	0.0002	0.0006
Heavy Equipment tailpipe emissions	0.0031	-	0.0004	0.0006	0.0001	0.0004
Total Well Pad and ROW Construction Emissions	0.0037	0.0001	0.0008	0.0016	0.0002	0.0011
Rig-up, Drill and Rig-Down Emissions						
Haul truck tailpipe emissions	0.0027	0.0008	0.0035	0.0096	0.0014	0.0054
Diesel drilling engine	0.5250	0.0057	0.0713	0.0523	0.0110	0.0374
Total Rig-up, Drill and Rig-Down Emissions	0.5277	0.0065	0.0749	0.0619	0.0124	0.0428
Completion and Testing						
Haul truck tailpipe emissions: Completion	0.0033	0.0005	0.0024	0.0059	0.0009	0.0035
Haul truck tailpipe emissions: Fracing	0.0009	0.0001	0.0003	0.0005	0.0001	0.0003
Completion rig engines	0.0195		0.0024	0.0035	0.0004	0.0028
Fracing engines	0.0079		0.0010	0.0014	0.0002	0.0011
No flaring, green completions						
Total Completion and Testing Emissions	0.0316	0.0006	0.0060	0.0113	0.0015	0.0077
Total Development Phase	0.5630	0.0072	0.0817	0.0748	0.0142	0.0516
Compressor Station – Six units with two control elements.	7.8055	0.2720	0.1078	0.1000	0.0097	0.0451
Salt water disposal well generator assuming 1,700 hrs annual operation	0.1957	No EF	0.0151	0.0053	0.0002	0.0019
Pump jacks	0.6094	No EF	0.0470	0.0166	0.0007	0.0058
Separator and water tank heaters	0.0001	0.0342	0.0000	0.0001	No EF	No EF
Total Operational Phase	8.6107	0.3061	0.1699	0.1219	0.0107	0.0527
TOTAL PROJECT – MAXIMUM YEAR	9.1737	0.3133	0.2516	0.1968	0.0249	0.1043

[a]EPA's diesel internal combustion engine speciation profile (SPECIATE4, Profile 4674) was used for all diesel engines; this profile includes zero n-hexane emissions. EPA AP-42 emission factors for 4-stroke, rich-burn, natural gas-fired reciprocating engines (AP-42, Table 3.2-3) was used to estimate HAP emissions from pump jacks and the salt water disposal well generator; no emission factor for n-hexane is included in this table.

EMISSIONS SCENARIO: MAXIMUM DAY

A Maximum Day Emissions scenario was defined as the day during the project development phase when the combined emissions from all sources (construction, drilling, completion and partial production) are expected to be at a maximum. During the day of maximum daily emissions, two drill rigs are assumed to be operating, one well pad is undergoing construction, two wells are undergoing fracturing, and 42 wells are in production. Table 35 and 36 show criteria pollutant and HAP emissions, respectively, for the maximum day emissions scenario. Note that it is conservatively assumed that daily truck traffic associated with both completion and fracking activities are included in the Maximum Day scenario although only the fracking engines are operating under this scenario.

Table 35. Maximum Daily Emissions Scenario Criteria Pollutant Emissions (lb/day).

Source	Emissions (lb/day)					
	CO	NOx	PM10	PM2.5	SO2	VOC
Well Pad and ROW Construction Emissions (1 pad constructing)						
Dust: Well pad construction			12.8333	12.8333		
Dust: Pipeline and resource road construction			24.3375	24.3375		
Dust: Haul road traffic			59.22	5.92		
HDDV tailpipe emissions	0.2754	1.1204	0.0999	0.0954	0.0017	0.0549
Pickup tailpipe emissions	1.7134	0.1854	0.0085	0.0074	0.0010	0.1300
Heavy Equipment tailpipe emissions	9.9400	24.2900	2.4567	2.4567	1.9467	3.0467
Total Well Pad and ROW Construction Emissions	**11.9287**	**25.5958**	**98.9569**	**45.6524**	**1.9494**	**3.2315**
Rig-up, Drill and Rig-Down Emissions (2 wells drilling)						
Dust: Drill truck and supply traffic			233.1732	23.3173		
HDDV tailpipe emissions	0.3672	1.4938	0.1332	0.1272	0.0023	0.0732
Pickup tailpipe emissions	17.3784	1.8806	0.0867	0.0751	0.0104	1.3186
Diesel drilling engine	92.7785	365.3154	9.7200	9.4320	0.4349	29.5200
Total Rig-up, Drill and Rig-Down Emissions	**110.5241**	**368.6899**	**243.1131**	**32.9517**	**0.4476**	**30.9118**
Completion (fracking) and Testing (2 wells)						
Dust: Well completion traffic			269.3055	26.9305		
HDDV tailpipe emissions: completion	1.1802	4.8016	0.4283	0.4089	0.0075	0.2352
Pickup tailpipe emissions: completion	7.5178	0.8135	0.0375	0.0325	0.0045	0.5704
Dust: Fracing traffic			78.7663	7.8766		
HDDV tailpipe emissions: fracing	0.5245	2.1341	0.1903	0.1817	0.0033	0.1045
Pickup tailpipe emissions: fracing	0.5828	0.0631	0.0029	0.0025	0.0003	0.0442
Fracing engines	39.6825	114.6032	6.9841	6.6667	3.1746	7.9365
No flaring, green completions						
Total Completion and Testing Emissions	**49.4879**	**122.4155**	**355.7149**	**42.0995**	**3.1902**	**8.8909**
Total Development Phase	171.9407	516.7011	697.7850	120.7036	5.5872	43.0342
Compressor Station – Six units with two control elements.	60.2815	177.1942	0.0906	0.0906	0.6931	85.0532
Salt water disposal well generator assuming 1,700 hrs annual operation	2.6190	18.0950	0.4348	0.4348	0.0270	0.1524
pump jacks	23.6893	103.5040	1.3541	1.3541	0.0182	0.3645
Separator and water tank heaters	3.6403	8.5547	0.6917	0.6917	0.0546	0.5005
Total Operational Phase	**90.2301**	**307.3479**	**2.5711**	**2.5711**	**0.7929**	**86.0706**
TOTAL PROJECT – MAXIMUM DAILY	**262.242**	**824.0336**	**700.4**	**123.2**	**6.4**	**129.1892**

Table 36. Maximum Daily HAPs Emissions Scenario (lb/day).

Source	Emissions (lb/day)					
	Formaldehyde	n-Hexane[a]	Benzene	Toluene	Ethyl-benzene	Xylenes
Well Pad and ROW Construction Emissions						
HDDV tailpipe emissions	4.3E-03	7.1E-05	6.2E-04	3.4E-04	8.3E-05	4.4E-04
Pickup tailpipe emissions	3.2E-03	1.1E-03	4.8E-03	1.3E-02	1.9E-03	7.5E-03
Heavy Equipment tailpipe emissions	2.6E-01	0.0E+00	3.2E-02	4.6E-02	5.5E-03	3.7E-02
Total Well Pad and ROW Construction Emissions	2.7E-01	1.2E-03	3.7E-02	6.0E-02	7.4E-03	4.5E-02
Rig-up, Drill and Rig-Down Emissions						
HDDV tailpipe emissions	5.8E-03	9.4E-05	8.3E-04	4.5E-04	1.1E-04	5.9E-04
Pickup tailpipe emissions	3.2E-02	1.2E-02	4.9E-02	1.3E-01	1.9E-02	7.6E-02
Diesel drilling engine	4.5E+00	4.8E-02	6.0E-01	4.4E-01	9.4E-02	3.2E-01
Total Rig-up, Drill and Rig-Down Emissions	4.5E+00	6.0E-02	6.5E-01	5.8E-01	1.1E-01	3.9E-01
Completion (fracking) and Testing						
HDDV tailpipe emissions: completion	1.9E-02	3.0E-04	2.7E-03	1.4E-03	3.6E-04	1.9E-03
Pickup tailpipe emissions: completion	1.4E-02	5.0E-03	2.1E-02	5.8E-02	8.3E-03	3.3E-02
HDDV tailpipe emissions: fracing	8.3E-03	1.3E-04	1.2E-03	6.4E-04	1.6E-04	8.4E-04
Pickup tailpipe emissions: fracing	1.1E-03	3.9E-04	1.6E-03	4.5E-03	6.5E-04	2.5E-03
Fracing engines	6.8E-01	0.0E+00	8.3E-02	1.2E-01	1.4E-02	9.6E-02
No flaring, green completions						
Total Completion and Testing Emissions	7.2E-01	5.8E-03	1.1E-01	1.8E-01	2.4E-02	1.3E-01
Total Development Phase	5.5E+00	6.7E-02	8.0E-01	8.2E-01	1.4E-01	5.7E-01
Compressor Station – Six units with two control elements.	3.7E+01	1.3E+00	5.2E-01	4.8E-01	4.7E-02	2.2E-01
Salt water disposal well generator assuming 1,700 hrs annual operation	9.4E-01		7.2E-02	2.6E-02	1.1E-03	8.9E-03
Pump jacks	2.9E+00		2.3E-01	8.0E-02	3.5E-03	2.8E-02
Separator and water tank heaters	6.8E-04	1.6E-01	1.9E-04	3.1E-04		
Total Operational Phase	**4.1E+01**	**1.5E+00**	**8.1E-01**	**5.8E-01**	**5.1E-02**	**2.5E-01**
TOTAL PROJECT – MAXIMUM DAILY	**4.7E+01**	**1.5E+00**	**1.6E+00**	**1.4E+00**	**2.0E-01**	**8.2E-01**

[a]EPA's diesel internal combustion engine speciation profile (SPECIATE4, Profile 4674) was used for all diesel engines; this profile includes zero n-hexane emissions. EPA AP-42 emission factors for 4-stroke, rich-burn, natural gas-fired reciprocating engines (AP-42, Table 3.2-3) was used to estimate HAP emissions from pump jacks and the salt water disposal well generator; no emission factor for n-hexane is included in this table.

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US EPA, Emissions Standards Reference Guide for Heavy-Duty and Nonroad Engines. September, 1997 EPA420-F-97-014.

US Forest Service, Air Quality Analysis Technical Support Document For San Juan Public Lands Center Land Management Plan And Environmental Impact Statement (Gothic Shale Environmental Impact Statement.) October 8, 2010.

Western Regional Air Partnership's (WRAP) Fugitive Dust Handbook, September 3, 2006, Chapter 3 – Construction and Demolition

APPENDIX A

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Analytical Laboratory

EXTENDED GAS ANALYSIS

Client:	Red Cedar	Project Name:	Sambrito
Sample ID.:	#5	Project #:	95031-0555
Laboratory Number:	57233	Date Reported:	02/28/11
Chain of Custody No.:	11158	Date Sampled:	02/16/11
Sample Matrix:	Gas	Date Received:	02/17/11
Cylinder Number:	5	Date Analyzed:	02/18/11

Parameter	Concentration Mole -%	Parameter	Concentration Mole-%
Hydrogen Sulfide	N.D. %	n-Hexane	N.D. %
Carbon Dioxide	3.5747 %	Cyclohexane	N.D. %
Nitrogen	0.0018 %	other C6s	N.D. %
Methane	96.4221 %	Heptanes	N.D. %
Ethane	0.0014 %	2,2,4-trimethylpentane	N.D. %
Propane	N.D. %	Methylcyclohexane	N.D. %
Iso-Butane	N.D. %	Benzene	N.D. %
N-Butane	N.D. %	Toluene	N.D. %
Iso-Pentane	N.D. %	Ethylbenzene	N.D. %
N-Pentane	N.D. %	p,m-Xylene	N.D. %
Cyclopentane	N.D. %	o-Xylene	N.D. %
		Octanes +	N.D. %

Relative Density	0.5689	Sample Temperature	89.1 °F
Compressibility Factor (Z)	0.9982	Sample Pressure	940 psig
Dry Heating Value	973.9 (BTU/CF)		

Parameter	Concentration	Mol-%
2,3-dimethylbutane	N.D.	%
3-methylpentane	N.D.	%
2,2-dimethylbutane	N.D.	%
2-methylpentane	N.D.	%
Cyclopentane	N.D.	%
n-hexane	N.D.	%
Methylcyclopentane	N.D.	%
Benzene	N.D.	%
Cyclohexane	N.D.	%
1,1-dimethylcyclopentane	N.D.	%
3-methylehexane	N.D.	%
trans-1,3-dimethylcyclopentane	N.D.	%
cis-1,3-dimethylcyclopentane	N.D.	%
3-ethylpentane	N.D.	%
trans-1,2-dimethylcyclopentane	N.D.	%

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Analytical Laboratory

EXTENDED GAS ANALYSIS

Client:	Red Cedar	Project Name:	Sambrito
Sample ID.:	#5	Project #:	95031-0555
Laboratory Number:	57233	Date Reported:	02/28/11
Chain of Custody No.:	11158	Date Sampled:	02/16/11
Sample Matrix:	Gas	Date Received:	02/17/11
Cylinder Number:	5	Date Analyzed:	02/18/11

Parameter	Concentration	Mol-%
n-heptane	N.D.	%
2,2,4-trimethylpentane	N.D.	%
cis-1,2-dimethylcyclopentane	N.D.	%
Methylcyclohexane	N.D.	%
Ethylcyclopentane	N.D.	%
Toluene	N.D.	%
2,5-dimethylhexane	N.D.	%
2,4-dimethylhexane	N.D.	%
1-cis-2-trans-4-trimethylcyclopentane	N.D.	%
3,3-dimethylhexane	N.D.	%
1-trans-2-cis-3-trimethylcyclopentane	N.D.	%
3-methylheptane	N.D.	%
n-octane	N.D.	%
Ethylbenzene	N.D.	%
m,p-xylene	N.D.	%
o-xylene	N.D.	%
n-nonane	N.D.	%
Isopropylbenzene	N.D.	%
1,3,5-trimethylbenzene	N.D.	%
1,2,4-trimethylbenzene	N.D.	%
n-propylbenzene	N.D.	%
t-butylbenzene	N.D.	%
Isobutylbenzene	N.D.	%
n-butylbenzene	N.D.	%
Hexanes +	**0.0000**	**%**
Total	**100.0000**	**%**

References: Gas Processors Association Standard 2286-95, ASTM Method D1945-03

Comments: **Extended Analysis Sample for Sambrito, inlet to dehy X-701 contactor.**
GLYCALC Compounds in BOLD FONT

Comments: Data normalized to a total of 100%

Analyst

Review

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APPENDIX C

AERMOD INPUT FILE: Construction Sources

Appendix C: AERMOD INPUT FILE: Construction Sources

```
CO STARTING
CO TITLEONE SUIT NCarracas - 0630048B
CO TITLETWO Pad Construction Emissions, 10pct NO2STK, site recs
CO MODELOPT CONC PVMRM
CO AVERTIME 1
CO POLLUTID NO2
CO RUNORNOT RUN
CO OZONEFIL ../ozone/2007_080677001_hrly_ozone.dat PPM (4I2.2,F8.3)
CO OZONEVAL 32 PPB
CO NO2STACK 0.10
CO NO2EQUIL 0.90
CO ERRORFIL nox.2007.st.errors
CO FINISHED

SO STARTING
SO ELEVUNIT METERS
**          Name  Type    X         Y     Elev
SO LOCATION FRACP1 POINT 300827.05 4100022.56 1987.201
SO LOCATION FRACP2 POINT 298801.24 4099961.36 1942.297
SO LOCATION DRILP1 POINT 301980.09 4098269.88 1892.79
SO LOCATION DRILP2 POINT 298267.94 4098236.47 1881.744
SO LOCATION CONST VOLUME 299862.312 4099794.299 1957.218
SO LOCATION VI_1 VOLUME 293644.28 4099392.1 1860.563
SO LOCATION VI_2 VOLUME 293579.46 4099438.9 1860.474
SO LOCATION VI_3 VOLUME 293508.82 4099476.45 1860.57
SO LOCATION VI_4 VOLUME 293438.19 4099514 1860.667
SO LOCATION VI_5 VOLUME 293369.7 4099555.33 1861.057
SO LOCATION VI_6 VOLUME 293309.21 4099607.2 1860.483
SO LOCATION VI_7 VOLUME 293245.41 4099654.68 1860.703
SO LOCATION VI_8 VOLUME 293169.54 4099675.97 1861.24
SO LOCATION VI_9 VOLUME 293089.77 4099676.76 1861.901
SO LOCATION VI_10 VOLUME 293014.04 4099651.91 1862.564
SO LOCATION VI_11 VOLUME 292940.1 4099621.37 1861.998
SO LOCATION VK_1 VOLUME 303701.76 4100538.15 1919.055
SO LOCATION VK_2 VOLUME 303658.53 4100470.89 1912.378
SO LOCATION VK_3 VOLUME 303610.53 4100406.88 1908.013
SO LOCATION VK_4 VOLUME 303540.58 4100368.73 1904.99
SO LOCATION VK_5 VOLUME 303466.24 4100339.65 1902.635
SO LOCATION VK_6 VOLUME 303392.2 4100310.83 1903.791
SO LOCATION VK_7 VOLUME 303338.44 4100253.72 1905.268
SO LOCATION VK_8 VOLUME 303310.19 4100179.16 1900.034
SO LOCATION VK_9 VOLUME 303300.99 4100099.69 1897.997
SO LOCATION VK_10 VOLUME 303291.78 4100020.22 1897.518
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SO SRCPARAM VG_74 9.55530E-04 2.55 37.2093 2.3721
SO SRCPARAM VG_75 9.55530E-04 2.55 37.2093 2.3721
SO SRCPARAM VG_76 9.55530E-04 2.55 37.2093 2.3721
SO SRCPARAM VG_77 9.55530E-04 2.55 37.2093 2.3721
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SO SRCPARAM VG_78 9.55530E-04 2.55 37.2093 2.3721
SO SRCPARAM VG_79 9.55530E-04 2.55 37.2093 2.3721
SO SRCPARAM VG_8 9.55530E-04 2.55 37.2093 2.3721
SO SRCPARAM VG_80 9.55530E-04 2.55 37.2093 2.3721
SO SRCPARAM VG_81 9.55530E-04 2.55 37.2093 2.3721
SO SRCPARAM VG_82 9.55530E-04 2.55 37.2093 2.3721
SO SRCPARAM VG_83 9.55530E-04 2.55 37.2093 2.3721
SO SRCPARAM VG_84 9.55530E-04 2.55 37.2093 2.3721
SO SRCPARAM VG_85 9.55530E-04 2.55 37.2093 2.3721
SO SRCPARAM VG_86 9.55530E-04 2.55 37.2093 2.3721
SO SRCPARAM VG_87 9.55530E-04 2.55 37.2093 2.3721
SO SRCPARAM VG_88 9.55530E-04 2.55 37.2093 2.3721
SO SRCPARAM VG_89 9.55530E-04 2.55 37.2093 2.3721
SO SRCPARAM VG_9 9.55530E-04 2.55 37.2093 2.3721
SO SRCPARAM VG_90 9.55530E-04 2.55 37.2093 2.3721
SO SRCPARAM VG_91 9.55530E-04 2.55 37.2093 2.3721
SO SRCPARAM VG_92 9.55530E-04 2.55 37.2093 2.3721
SO SRCPARAM VG_93 9.55530E-04 2.55 37.2093 2.3721
SO SRCPARAM VG_94 9.55530E-04 2.55 37.2093 2.3721
SO SRCPARAM VG_95 9.55530E-04 2.55 37.2093 2.3721
SO SRCPARAM VG_96 9.55530E-04 2.55 37.2093 2.3721
SO SRCPARAM VG_97 9.55530E-04 2.55 37.2093 2.3721
SO SRCPARAM VG_98 9.55530E-04 2.55 37.2093 2.3721
SO SRCPARAM VG_99 9.55530E-04 2.55 37.2093 2.3721

** Included BPIP output sections
SO INCLUDED incl/FRACP1.bpip
SO INCLUDED incl/FRACP2.bpip
SO INCLUDED incl/DRILP1.bpip
SO INCLUDED incl/DRILP2.bpip



** Source Groups
SO SRCGROUP ALL
SO SRCGROUP PAD8 FRACP1
SO SRCGROUP PAD7 FRACP2
SO SRCGROUP PAD13 DRILP1
SO SRCGROUP PAD12 DRILP2
SO SRCGROUP ROADS VA_1-VA_22 VB_1-VB_11 VC_1-VC_2 VD_1-VD_27 VE_1-VE_28
SO SRCGROUP ROADS VF_1-VF_54 VG_1-VG_129 VH_1-VH_13 VI_1-VI_11 VJ_1-VJ_4
SO SRCGROUP ROADS VK_1-VK_11 VL_1-VL_5 VM_1-VM_3

SO FINISHED

** Receptors
RE STARTING
RE ELEVUNIT METERS
RE INCLUDED ../aermap_hd_roads_B/fenceline.xy.rec
RE INCLUDED ../aermap_hd_roads_B/site_recs.xy.rec
RE FINISHED

** Meteorology
ME STARTING
```

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ME SURFFILE ../aermet/UTE1.2007.SFC
ME PROFFILE ../aermet/UTE1.2007.PFL
ME PROFBASE 1967.0 METERS
ME SURFDATA 7001 2007
ME UAIRDATA 23066 2007
ME FINISHED

NO ECHO

** Output files
OU STARTING
OU SUMMFILE nox.2007.st.summary
OU RECTABLE 1 8
OU MAXDCONT ALL 8 8 nox.2007.st.ALL.8th.1hr.maxdcont 10000
OU PLOTFILE 1 ALL 8 nox.2007.st.ALL.8th.1hr.plot
OU PLOTFILE 1 PAD8 8 nox.2007.st.PAD8.8th.1hr.plot
OU PLOTFILE 1 PAD7 8 nox.2007.st.PAD7.8th.1hr.plot
OU PLOTFILE 1 PAD13 8 nox.2007.st.PAD13.8th.1hr.plot
OU PLOTFILE 1 PAD12 8 nox.2007.st.PAD12.8th.1hr.plot
OU PLOTFILE 1 ROADS 8 nox.2007.st.ROADS.8th.1hr.plot
OU RECTABLE 1 1
OU PLOTFILE 1 ALL 1 nox.2007.st.ALL.1st.1hr.plot 10001
OU FINISHED
```

APPENDIX D

AERMOD INPUT FILE: Operation Sources

Appendix D: AERMOD INPUT FILE: Operation Sources

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CO STARTING
CO TITLEONE SUIT NCarracas - 0630048B
CO TITLETWO Full Operational Emissions, with 10pct NO2STK ratio
CO MODELOPT CONC PVMRM
CO AVERTIME 1
CO POLLUTID NO2
CO RUNORNOT RUN
CO OZONEFIL ../ozone/2007_080677001_hrly_ozone.dat PPM (4I2.2,F8.3)
CO OZONEVAL 32 PPB
CO NO2STACK 0.10
CO NO2EQUIL 0.90
CO ERRORFIL nox.2007.st.errors
CO FINISHED

SO STARTING
SO ELEVUNIT METERS
**          Name  Type    X         Y     Elev
SO LOCATION COMPR1 POINT 287069.55 4101410.3 1871.807
SO LOCATION COMPR2 POINT 287061.84 4101417.99 1870.963
SO LOCATION COMPR3 POINT 287054.13 4101425.67 1870.146
SO LOCATION COMPR4 POINT 287046.42 4101433.36 1869.487
SO LOCATION COMPR5 POINT 287038.71 4101441.04 1869.006
SO LOCATION COMPR6 POINT 287031 4101448.73 1868.593
SO LOCATION JACK11A POINT 300429.99 4098308.1 1927.701
SO LOCATION JACK14A POINT 302529.8 4099096.56 1902.339
SO LOCATION JACK14B POINT 302529.8 4099049.96 1898.283
SO LOCATION JACK15A POINT 302892.67 4098863.93 1937.019
SO LOCATION JACK15B POINT 302892.67 4098806.83 1943.05
SO LOCATION JACK1A POINT 287169.55 4101433.22 1878.275
SO LOCATION JACK1B POINT 287191.15 4101411.72 1879.349
SO LOCATION JACK1C POINT 287212.65 4101390.12 1879.811
SO LOCATION JACK4A POINT 290195.06 4100254.19 1874.424
SO LOCATION JACK4B POINT 290195.06 4100221.53 1872.923
SO LOCATION JACK4C POINT 290195.06 4100179.93 1870.517
SO LOCATION JACK4D POINT 290259.68 4100251.75 1874.951
SO LOCATION JACK4E POINT 290259.68 4100219.09 1873.389
SO LOCATION JACK4F POINT 290259.68 4100186.43 1871.71
SO LOCATION JACK5A POINT 292009 4100345.85 1871.17
SO LOCATION JACK5B POINT 292009 4100317.53 1868.521
SO LOCATION JACK5C POINT 292009 4100289.21 1866.457
SO LOCATION JACK5D POINT 292009 4100260.89 1865.586
SO LOCATION JACK6A POINT 292519.18 4100194.9 1876.219
SO LOCATION JACK6B POINT 292519.18 4100166.6 1874.405
SO LOCATION JACK6C POINT 292516.496 4100138.508 1873.323
SO LOCATION JACK6D POINT 292516.902 4100111.722 1872.711
SO LOCATION JACK9A POINT 294506.7 4099188.3 1870.793
SO LOCATION JACK9B POINT 294506.7 4099155.64 1869.825
SO LOCATION JACK9C POINT 294506.7 4099114.04 1868.391
SO LOCATION JACK9D POINT 294571.32 4099185.86 1872.843
SO LOCATION JACK9E POINT 294571.32 4099153.2 1870.7
SO LOCATION JACK9F POINT 294571.32 4099120.54 1869.274
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SO LOCATION JACK13A POINT 301980.09 4098269.88 1892.79
SO LOCATION JACK12A POINT 298270.47 4098235.39 1881.623
SO LOCATION JACK8A POINT 300801.888 4100048.537 1987.319
SO LOCATION JACK8B POINT 300853.155 4100048.627 1985.486
SO LOCATION JACK8C POINT 300801.888 4099997.673 1990.492
SO LOCATION JACK8D POINT 300852.298 4099997.152 1988.971
SO LOCATION JACK7A POINT 298776.713 4099986.343 1945.299
SO LOCATION JACK7B POINT 298826.591 4099985.756 1945.24
SO LOCATION JACK7C POINT 298772.722 4099932.496 1944.972
SO LOCATION JACK7D POINT 298827.705 4099935.003 1940.785
SO LOCATION JACK10A POINT 299858.67 4099821.5 1957.797
SO LOCATION JACK10B POINT 299858.67 4099792.92 1957.576
SO LOCATION JACK10C POINT 299858.67 4099764.4 1957.026
SO LOCATION JACK19A POINT 303973.694 4098584.294 1982.421
SO LOCATION JACK19B POINT 303973.694 4098527.194 1995.743
SO LOCATION JACK16A POINT 304202.91 4098446.61 1970.536
SO LOCATION JACK18A POINT 304231.431 4098979.981 1969.519
SO LOCATION JACK18B POINT 304230.482 4098927.341 1966.571
SO LOCATION JACK20A POINT 303873.83 4099462.66 1959
SO LOCATION JACK17A POINT 303245.7 4099149 1942.382
SO LOCATION SWD POINT 292519.1818 4100138.199 1873.446
SO LOCATION HEAT11A POINT 300429.99 4098308.1 1927.701
SO LOCATION HEAT14A POINT 302529.8 4099096.56 1902.339
SO LOCATION HEAT14B POINT 302529.8 4099049.96 1898.283
SO LOCATION HEAT15A POINT 302892.67 4098863.93 1937.019
SO LOCATION HEAT15B POINT 302892.67 4098806.83 1943.05
SO LOCATION HEAT1A POINT 287169.55 4101433.22 1878.275
SO LOCATION HEAT1B POINT 287191.15 4101411.72 1879.349
SO LOCATION HEAT1C POINT 287212.65 4101390.12 1879.811
SO LOCATION HEAT4A POINT 290195.06 4100254.19 1874.424
SO LOCATION HEAT4B POINT 290195.06 4100221.53 1872.923
SO LOCATION HEAT4C POINT 290195.06 4100179.93 1870.517
SO LOCATION HEAT4D POINT 290259.68 4100251.75 1874.951
SO LOCATION HEAT4E POINT 290259.68 4100219.09 1873.389
SO LOCATION HEAT4F POINT 290259.68 4100186.43 1871.71
SO LOCATION HEAT5A POINT 292009 4100345.85 1871.17
SO LOCATION HEAT5B POINT 292009 4100317.53 1868.521
SO LOCATION HEAT5C POINT 292009 4100289.21 1866.457
SO LOCATION HEAT5D POINT 292009 4100260.89 1865.586
SO LOCATION HEAT6A POINT 292519.18 4100194.9 1876.219
SO LOCATION HEAT6B POINT 292519.18 4100166.6 1874.405
SO LOCATION HEAT6C POINT 292516.496 4100138.508 1873.323
SO LOCATION HEAT6D POINT 292516.902 4100111.722 1872.711
SO LOCATION HEAT9A POINT 294506.7 4099188.3 1870.793
SO LOCATION HEAT9B POINT 294506.7 4099155.64 1869.825
SO LOCATION HEAT9C POINT 294506.7 4099114.04 1868.391
SO LOCATION HEAT9D POINT 294571.32 4099185.86 1872.843
SO LOCATION HEAT9E POINT 294571.32 4099153.2 1870.7
SO LOCATION HEAT9F POINT 294571.32 4099120.54 1869.274
SO LOCATION HEAT13A POINT 301980.09 4098269.88 1892.79
SO LOCATION HEAT12A POINT 298270.47 4098235.39 1881.623
SO LOCATION HEAT8A POINT 300801.888 4100048.537 1987.319
SO LOCATION HEAT8B POINT 300853.155 4100048.627 1985.486
SO LOCATION HEAT8C POINT 300801.888 4099997.673 1990.492
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SO LOCATION HEAT8D POINT 300852.298 4099997.152 1988.971
SO LOCATION HEAT7A POINT 298776.713 4099986.343 1945.299
SO LOCATION HEAT7B POINT 298826.591 4099985.756 1945.24
SO LOCATION HEAT7C POINT 298772.722 4099932.496 1944.972
SO LOCATION HEAT7D POINT 298827.705 4099935.003 1940.785
SO LOCATION HEAT10A POINT 299858.67 4099821.5 1957.797
SO LOCATION HEAT10B POINT 299858.67 4099792.92 1957.576
SO LOCATION HEAT10C POINT 299858.67 4099764.4 1957.026
SO LOCATION HEAT19A POINT 303973.694 4098584.294 1982.421
SO LOCATION HEAT19B POINT 303973.694 4098527.194 1995.743
SO LOCATION HEAT16A POINT 304202.91 4098446.61 1970.536
SO LOCATION HEAT18A POINT 304231.431 4098979.981 1969.519
SO LOCATION HEAT18B POINT 304230.482 4098927.341 1966.571
SO LOCATION HEAT20A POINT 303873.83 4099462.66 1959
SO LOCATION HEAT17A POINT 303245.7 4099149 1942.382

**          Name  Q(g/s)  Ht(m)  Temp(K)  Vel(m/s) Diam(m)
SO SRCPARAM COMPR1 1.77190E-01 10.67 806.48 59.03 0.305
SO SRCPARAM COMPR2 1.77190E-01 10.67 806.48 59.03 0.305
SO SRCPARAM COMPR3 1.77190E-01 10.67 806.48 59.03 0.305
SO SRCPARAM COMPR4 1.77190E-01 10.67 806.48 59.03 0.305
SO SRCPARAM COMPR5 1.77190E-01 10.67 806.48 59.03 0.305
SO SRCPARAM COMPR6 1.77190E-01 10.67 806.48 59.03 0.305
SO SRCPARAM JACK11A 2.73332E-02 2.56 977.59 20.71 0.064
SO SRCPARAM JACK14A 2.73332E-02 2.56 977.59 20.71 0.064
SO SRCPARAM JACK14B 2.73332E-02 2.56 977.59 20.71 0.064
SO SRCPARAM JACK15A 2.73332E-02 2.56 977.59 20.71 0.064
SO SRCPARAM JACK15B 2.73332E-02 2.56 977.59 20.71 0.064
SO SRCPARAM JACK1A 2.73332E-02 2.56 977.59 20.71 0.064
SO SRCPARAM JACK1B 2.73332E-02 2.56 977.59 20.71 0.064
SO SRCPARAM JACK1C 2.73332E-02 2.56 977.59 20.71 0.064
SO SRCPARAM JACK4A 2.73332E-02 2.56 977.59 20.71 0.064
SO SRCPARAM JACK4B 2.73332E-02 2.56 977.59 20.71 0.064
SO SRCPARAM JACK4C 2.73332E-02 2.56 977.59 20.71 0.064
SO SRCPARAM JACK4D 2.73332E-02 2.56 977.59 20.71 0.064
SO SRCPARAM JACK4E 2.73332E-02 2.56 977.59 20.71 0.064
SO SRCPARAM JACK4F 2.73332E-02 2.56 977.59 20.71 0.064
SO SRCPARAM JACK5A 2.73332E-02 2.56 977.59 20.71 0.064
SO SRCPARAM JACK5B 2.73332E-02 2.56 977.59 20.71 0.064
SO SRCPARAM JACK5C 2.73332E-02 2.56 977.59 20.71 0.064
SO SRCPARAM JACK5D 2.73332E-02 2.56 977.59 20.71 0.064
SO SRCPARAM JACK6A 2.73332E-02 2.56 977.59 20.71 0.064
SO SRCPARAM JACK6B 2.73332E-02 2.56 977.59 20.71 0.064
SO SRCPARAM JACK6C 2.73332E-02 2.56 977.59 20.71 0.064
SO SRCPARAM JACK6D 2.73332E-02 2.56 977.59 20.71 0.064
SO SRCPARAM JACK9A 2.73332E-02 2.56 977.59 20.71 0.064
SO SRCPARAM JACK9B 2.73332E-02 2.56 977.59 20.71 0.064
SO SRCPARAM JACK9C 2.73332E-02 2.56 977.59 20.71 0.064
SO SRCPARAM JACK9D 2.73332E-02 2.56 977.59 20.71 0.064
SO SRCPARAM JACK9E 2.73332E-02 2.56 977.59 20.71 0.064
SO SRCPARAM JACK9F 2.73332E-02 2.56 977.59 20.71 0.064
SO SRCPARAM JACK13A 2.73332E-02 2.56 977.59 20.71 0.064
SO SRCPARAM JACK12A 2.73332E-02 2.56 977.59 20.71 0.064
SO SRCPARAM JACK8A 2.73332E-02 2.56 977.59 20.71 0.064
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SO SRCPARAM JACK8B 2.73332E-02 2.56 977.59 20.71 0.064
SO SRCPARAM JACK8C 2.73332E-02 2.56 977.59 20.71 0.064
SO SRCPARAM JACK8D 2.73332E-02 2.56 977.59 20.71 0.064
SO SRCPARAM JACK7A 2.73332E-02 2.56 977.59 20.71 0.064
SO SRCPARAM JACK7B 2.73332E-02 2.56 977.59 20.71 0.064
SO SRCPARAM JACK7C 2.73332E-02 2.56 977.59 20.71 0.064
SO SRCPARAM JACK7D 2.73332E-02 2.56 977.59 20.71 0.064
SO SRCPARAM JACK10A 2.73332E-02 2.56 977.59 20.71 0.064
SO SRCPARAM JACK10B 2.73332E-02 2.56 977.59 20.71 0.064
SO SRCPARAM JACK10C 2.73332E-02 2.56 977.59 20.71 0.064
SO SRCPARAM JACK19A 2.73332E-02 2.56 977.59 20.71 0.064
SO SRCPARAM JACK19B 2.73332E-02 2.56 977.59 20.71 0.064
SO SRCPARAM JACK16A 2.73332E-02 2.56 977.59 20.71 0.064
SO SRCPARAM JACK18A 2.73332E-02 2.56 977.59 20.71 0.064
SO SRCPARAM JACK18B 2.73332E-02 2.56 977.59 20.71 0.064
SO SRCPARAM JACK20A 2.73332E-02 2.56 977.59 20.71 0.064
SO SRCPARAM JACK17A 2.73332E-02 2.56 977.59 20.71 0.064
SO SRCPARAM SWD 1.08567E-01 3.05 998.15 107.75 0.102
SO SRCPARAM HEAT11A 1.06932E-03 8.72 571 5.55 0.49
SO SRCPARAM HEAT14A 1.06932E-03 8.72 571 5.55 0.49
SO SRCPARAM HEAT14B 1.06932E-03 8.72 571 5.55 0.49
SO SRCPARAM HEAT15A 1.06932E-03 8.72 571 5.55 0.49
SO SRCPARAM HEAT15B 1.06932E-03 8.72 571 5.55 0.49
SO SRCPARAM HEAT1A 1.06932E-03 8.72 571 5.55 0.49
SO SRCPARAM HEAT1B 1.06932E-03 8.72 571 5.55 0.49
SO SRCPARAM HEAT1C 1.06932E-03 8.72 571 5.55 0.49
SO SRCPARAM HEAT4A 1.06932E-03 8.72 571 5.55 0.49
SO SRCPARAM HEAT4B 1.06932E-03 8.72 571 5.55 0.49
SO SRCPARAM HEAT4C 1.06932E-03 8.72 571 5.55 0.49
SO SRCPARAM HEAT4D 1.06932E-03 8.72 571 5.55 0.49
SO SRCPARAM HEAT4E 1.06932E-03 8.72 571 5.55 0.49
SO SRCPARAM HEAT4F 1.06932E-03 8.72 571 5.55 0.49
SO SRCPARAM HEAT5A 1.06932E-03 8.72 571 5.55 0.49
SO SRCPARAM HEAT5B 1.06932E-03 8.72 571 5.55 0.49
SO SRCPARAM HEAT5C 1.06932E-03 8.72 571 5.55 0.49
SO SRCPARAM HEAT5D 1.06932E-03 8.72 571 5.55 0.49
SO SRCPARAM HEAT6A 1.06932E-03 8.72 571 5.55 0.49
SO SRCPARAM HEAT6B 1.06932E-03 8.72 571 5.55 0.49
SO SRCPARAM HEAT6C 1.06932E-03 8.72 571 5.55 0.49
SO SRCPARAM HEAT6D 1.06932E-03 8.72 571 5.55 0.49
SO SRCPARAM HEAT9A 1.06932E-03 8.72 571 5.55 0.49
SO SRCPARAM HEAT9B 1.06932E-03 8.72 571 5.55 0.49
SO SRCPARAM HEAT9C 1.06932E-03 8.72 571 5.55 0.49
SO SRCPARAM HEAT9D 1.06932E-03 8.72 571 5.55 0.49
SO SRCPARAM HEAT9E 1.06932E-03 8.72 571 5.55 0.49
SO SRCPARAM HEAT9F 1.06932E-03 8.72 571 5.55 0.49
SO SRCPARAM HEAT13A 1.06932E-03 8.72 571 5.55 0.49
SO SRCPARAM HEAT12A 1.06932E-03 8.72 571 5.55 0.49
SO SRCPARAM HEAT8A 1.06932E-03 8.72 571 5.55 0.49
SO SRCPARAM HEAT8B 1.06932E-03 8.72 571 5.55 0.49
SO SRCPARAM HEAT8C 1.06932E-03 8.72 571 5.55 0.49
SO SRCPARAM HEAT8D 1.06932E-03 8.72 571 5.55 0.49
SO SRCPARAM HEAT7A 1.06932E-03 8.72 571 5.55 0.49
SO SRCPARAM HEAT7B 1.06932E-03 8.72 571 5.55 0.49
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SO SRCPARAM HEAT7C 1.06932E-03 8.72 571 5.55 0.49
SO SRCPARAM HEAT7D 1.06932E-03 8.72 571 5.55 0.49
SO SRCPARAM HEAT10A 1.06932E-03 8.72 571 5.55 0.49
SO SRCPARAM HEAT10B 1.06932E-03 8.72 571 5.55 0.49
SO SRCPARAM HEAT10C 1.06932E-03 8.72 571 5.55 0.49
SO SRCPARAM HEAT19A 1.06932E-03 8.72 571 5.55 0.49
SO SRCPARAM HEAT19B 1.06932E-03 8.72 571 5.55 0.49
SO SRCPARAM HEAT16A 1.06932E-03 8.72 571 5.55 0.49
SO SRCPARAM HEAT18A 1.06932E-03 8.72 571 5.55 0.49
SO SRCPARAM HEAT18B 1.06932E-03 8.72 571 5.55 0.49
SO SRCPARAM HEAT20A 1.06932E-03 8.72 571 5.55 0.49
SO SRCPARAM HEAT17A 1.06932E-03 8.72 571 5.55 0.49

** Included BPIP output sections
SO INCLUDED incl/COMPR1.bpip
SO INCLUDED incl/COMPR2.bpip
SO INCLUDED incl/COMPR3.bpip
SO INCLUDED incl/COMPR4.bpip
SO INCLUDED incl/COMPR5.bpip
SO INCLUDED incl/COMPR6.bpip
SO INCLUDED incl/JACK11A.bpip
SO INCLUDED incl/JACK14A.bpip
SO INCLUDED incl/JACK14B.bpip
SO INCLUDED incl/JACK15A.bpip
SO INCLUDED incl/JACK15B.bpip
SO INCLUDED incl/JACK1A.bpip
SO INCLUDED incl/JACK1B.bpip
SO INCLUDED incl/JACK1C.bpip
SO INCLUDED incl/JACK4A.bpip
SO INCLUDED incl/JACK4B.bpip
SO INCLUDED incl/JACK4C.bpip
SO INCLUDED incl/JACK4D.bpip
SO INCLUDED incl/JACK4E.bpip
SO INCLUDED incl/JACK4F.bpip
SO INCLUDED incl/JACK5A.bpip
SO INCLUDED incl/JACK5B.bpip
SO INCLUDED incl/JACK5C.bpip
SO INCLUDED incl/JACK5D.bpip
SO INCLUDED incl/JACK6A.bpip
SO INCLUDED incl/JACK6B.bpip
SO INCLUDED incl/JACK6C.bpip
SO INCLUDED incl/JACK6D.bpip
SO INCLUDED incl/JACK9A.bpip
SO INCLUDED incl/JACK9B.bpip
SO INCLUDED incl/JACK9C.bpip
SO INCLUDED incl/JACK9D.bpip
SO INCLUDED incl/JACK9E.bpip
SO INCLUDED incl/JACK9F.bpip
SO INCLUDED incl/JACK13A.bpip
SO INCLUDED incl/JACK12A.bpip
SO INCLUDED incl/JACK8A.bpip
SO INCLUDED incl/JACK8B.bpip
SO INCLUDED incl/JACK8C.bpip
SO INCLUDED incl/JACK8D.bpip
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SO INCLUDED incl/JACK7A.bpip
SO INCLUDED incl/JACK7B.bpip
SO INCLUDED incl/JACK7C.bpip
SO INCLUDED incl/JACK7D.bpip
SO INCLUDED incl/JACK10A.bpip
SO INCLUDED incl/JACK10B.bpip
SO INCLUDED incl/JACK10C.bpip
SO INCLUDED incl/JACK19A.bpip
SO INCLUDED incl/JACK19B.bpip
SO INCLUDED incl/JACK16A.bpip
SO INCLUDED incl/JACK18A.bpip
SO INCLUDED incl/JACK18B.bpip
SO INCLUDED incl/JACK20A.bpip
SO INCLUDED incl/JACK17A.bpip
SO INCLUDED incl/SWD.bpip
SO INCLUDED incl/HEAT11A.bpip
SO INCLUDED incl/HEAT14A.bpip
SO INCLUDED incl/HEAT14B.bpip
SO INCLUDED incl/HEAT15A.bpip
SO INCLUDED incl/HEAT15B.bpip
SO INCLUDED incl/HEAT1A.bpip
SO INCLUDED incl/HEAT1B.bpip
SO INCLUDED incl/HEAT1C.bpip
SO INCLUDED incl/HEAT4A.bpip
SO INCLUDED incl/HEAT4B.bpip
SO INCLUDED incl/HEAT4C.bpip
SO INCLUDED incl/HEAT4D.bpip
SO INCLUDED incl/HEAT4E.bpip
SO INCLUDED incl/HEAT4F.bpip
SO INCLUDED incl/HEAT5A.bpip
SO INCLUDED incl/HEAT5B.bpip
SO INCLUDED incl/HEAT5C.bpip
SO INCLUDED incl/HEAT5D.bpip
SO INCLUDED incl/HEAT6A.bpip
SO INCLUDED incl/HEAT6B.bpip
SO INCLUDED incl/HEAT6C.bpip
SO INCLUDED incl/HEAT6D.bpip
SO INCLUDED incl/HEAT9A.bpip
SO INCLUDED incl/HEAT9B.bpip
SO INCLUDED incl/HEAT9C.bpip
SO INCLUDED incl/HEAT9D.bpip
SO INCLUDED incl/HEAT9E.bpip
SO INCLUDED incl/HEAT9F.bpip
SO INCLUDED incl/HEAT13A.bpip
SO INCLUDED incl/HEAT12A.bpip
SO INCLUDED incl/HEAT8A.bpip
SO INCLUDED incl/HEAT8B.bpip
SO INCLUDED incl/HEAT8C.bpip
SO INCLUDED incl/HEAT8D.bpip
SO INCLUDED incl/HEAT7A.bpip
SO INCLUDED incl/HEAT7B.bpip
SO INCLUDED incl/HEAT7C.bpip
SO INCLUDED incl/HEAT7D.bpip
SO INCLUDED incl/HEAT10A.bpip
```

```
SO INCLUDED incl/HEAT10B.bpip
SO INCLUDED incl/HEAT10C.bpip
SO INCLUDED incl/HEAT19A.bpip
SO INCLUDED incl/HEAT19B.bpip
SO INCLUDED incl/HEAT16A.bpip
SO INCLUDED incl/HEAT18A.bpip
SO INCLUDED incl/HEAT18B.bpip
SO INCLUDED incl/HEAT20A.bpip
SO INCLUDED incl/HEAT17A.bpip



SO BACKGRND SEASHR 0.028 0.029 0.031 0.033 0.035 0.034 0.035 0.031 0.03
0.029
SO BACKGRND SEASHR 0.029 0.027 0.027 0.031 0.03 0.048 0.049 0.048 0.041
0.038
SO BACKGRND SEASHR 0.032 0.031 0.028 0.029 0.011 0.012 0.014 0.014 0.016
0.019
SO BACKGRND SEASHR 0.018 0.016 0.018 0.015 0.012 0.01 0.01 0.008 0.009
0.009
SO BACKGRND SEASHR 0.015 0.02 0.016 0.013 0.013 0.012 0.011 0.013 0.015
0.013
SO BACKGRND SEASHR 0.01 0.011 0.012 0.013 0.016 0.011 0.01 0.012 0.015
0.019
SO BACKGRND SEASHR 0.023 0.025 0.027 0.028 0.027 0.026 0.025 0.025 0.021
0.02
SO BACKGRND SEASHR 0.018 0.016 0.013 0.012 0.013 0.013 0.014 0.024 0.024
0.02
SO BACKGRND SEASHR 0.018 0.019 0.014 0.014 0.013 0.013 0.015 0.022 0.035
0.026
SO BACKGRND SEASHR 0.023 0.019 0.016 0.015 0.014 0.014
SO BACKUNIT PPM
** Source Groups
SO SRCGROUP ALL BACKGROUND
SO SRCGROUP PAD1 JACK1A JACK1B JACK1C HEAT1A HEAT1B HEAT1C
SO SRCGROUP PAD1C COMPR1 COMPR2 COMPR3 COMPR4 COMPR5 COMPR6
SO SRCGROUP PAD4 JACK4A JACK4B JACK4C JACK4D JACK4E JACK4F HEAT4A HEAT4B
HEAT4C HEAT4D HEAT4E HEAT4F
SO SRCGROUP PAD5 JACK5A JACK5B JACK5C JACK5D HEAT5A HEAT5B HEAT5C HEAT5D
SO SRCGROUP PAD6 JACK6A JACK6B JACK6C JACK6D HEAT6A HEAT6B HEAT6C HEAT6D
SO SRCGROUP PAD6SWD SWD
SO SRCGROUP PAD7 JACK7A JACK7B JACK7C JACK7D HEAT7A HEAT7B HEAT7C HEAT7D
SO SRCGROUP PAD8 JACK8A JACK8B JACK8C JACK8D HEAT8A HEAT8B HEAT8C HEAT8D
SO SRCGROUP PAD9 JACK9A JACK9B JACK9C JACK9D JACK9E JACK9F HEAT9A HEAT9B
HEAT9C HEAT9D HEAT9E HEAT9F
SO SRCGROUP PAD10 JACK10A JACK10B JACK10C HEAT10A HEAT10B HEAT10C
SO SRCGROUP PAD11 JACK11A HEAT11A
SO SRCGROUP PAD12 JACK12A HEAT12A
SO SRCGROUP PAD13 JACK13A HEAT13A
SO SRCGROUP PAD14 JACK14A JACK14B HEAT14A HEAT14B
SO SRCGROUP PAD15 JACK15A JACK15B HEAT15A HEAT15B
SO SRCGROUP PAD16 JACK16A HEAT16A
SO SRCGROUP PAD17 JACK17A HEAT17A
SO SRCGROUP PAD18 JACK18A JACK18B HEAT18A HEAT18B
```

```
SO SRCGROUP PAD19 JACK19A JACK19B HEAT19A HEAT19B
SO SRCGROUP PAD20 JACK20A HEAT20A
SO FINISHED

** Receptors
RE STARTING
RE ELEVUNIT METERS
RE INCLUDED ../aermap_hd_roads_B/fenceline.xy.rec
RE INCLUDED ../aermap_hd_roads_B/site_recs.xy.rec
RE FINISHED

** Meteorology
ME STARTING
ME SURFFILE ../aermet/UTE1.2007.SFC
ME PROFFILE ../aermet/UTE1.2007.PFL
ME PROFBASE 1967.0 METERS
ME SURFDATA 7001 2007
ME UAIRDATA 23066 2007
ME FINISHED

NO ECHO

** Output files
OU STARTING
OU SUMMFILE nox.2007.st.summary
OU RECTABLE 1 8
OU MAXDCONT ALL 8 8 nox.2007.st.ALL.8th.1hr.maxdcont 10000
OU PLOTFILE 1 ALL 8 nox.2007.st.ALL.8th.1hr.plot
OU PLOTFILE 1 PAD1 8 nox.2007.st.PAD1.8th.1hr.plot
OU PLOTFILE 1 PAD1C 8 nox.2007.st.PAD1C.8th.1hr.plot
OU PLOTFILE 1 PAD4 8 nox.2007.st.PAD4.8th.1hr.plot
OU PLOTFILE 1 PAD5 8 nox.2007.st.PAD5.8th.1hr.plot
OU PLOTFILE 1 PAD6 8 nox.2007.st.PAD6.8th.1hr.plot
OU PLOTFILE 1 PAD6SWD 8 nox.2007.st.PAD6SWD.8th.1hr.plot
OU PLOTFILE 1 PAD7 8 nox.2007.st.PAD7.8th.1hr.plot
OU PLOTFILE 1 PAD8 8 nox.2007.st.PAD8.8th.1hr.plot
OU PLOTFILE 1 PAD9 8 nox.2007.st.PAD9.8th.1hr.plot
OU PLOTFILE 1 PAD10 8 nox.2007.st.PAD10.8th.1hr.plot
OU PLOTFILE 1 PAD11 8 nox.2007.st.PAD11.8th.1hr.plot
OU PLOTFILE 1 PAD12 8 nox.2007.st.PAD12.8th.1hr.plot
OU PLOTFILE 1 PAD13 8 nox.2007.st.PAD13.8th.1hr.plot
OU PLOTFILE 1 PAD14 8 nox.2007.st.PAD14.8th.1hr.plot
OU PLOTFILE 1 PAD15 8 nox.2007.st.PAD15.8th.1hr.plot
OU PLOTFILE 1 PAD16 8 nox.2007.st.PAD16.8th.1hr.plot
OU PLOTFILE 1 PAD17 8 nox.2007.st.PAD17.8th.1hr.plot
OU PLOTFILE 1 PAD18 8 nox.2007.st.PAD18.8th.1hr.plot
OU PLOTFILE 1 PAD19 8 nox.2007.st.PAD19.8th.1hr.plot
OU PLOTFILE 1 PAD20 8 nox.2007.st.PAD20.8th.1hr.plot
OU RECTABLE 1 1
OU PLOTFILE 1 ALL 1 nox.2007.st.ALL.1st.1hr.plot 10001
OU FINISHED
```

ENVIRON

APPENDIX E

VISCREEN Model Output

Appendix E: VISCREEN Model Output

```
Visual Effects Screening Analysis for
                 Source: VPS
                 Class I Area: wem


              *** User-selected Screening Scenario Results ***
 Input Emissions for

    Particulates   700.40  LB /DAY
    NOx (as NO2)   824.00  LB /DAY
    Primary NO2       .00  LB /DAY
    Soot              .00  LB /DAY
    Primary SO4       .00  LB /DAY


              PARTICLE CHARACTERISTICS
              Density       Diameter
              =======       ========
 Primary Part.     2.5            6
 Soot              2.0            1
 Sulfate           1.5            4

              Transport Scenario Specifications:

     Background Ozone:                  .08 ppm
     Background Visual Range:        281.00 km
     Source-Observer Distance:       243.00 km
     Min. Source-Class I Distance:   243.00 km
     Max. Source-Class I Distance:   282.00 km
     Plume-Source-Observer Angle:     11.25 degrees
     Stability:   6
     Wind Speed:   1.00 m/s

                           R E S U L T S

 Asterisks (*) indicate plume impacts that exceed screening
criteria

          Maximum Visual Impacts INSIDE  Class I Area
           Screening Criteria ARE NOT Exceeded
                                    Delta E       Contrast
                                 ===========   ============
 Backgrnd Theta Azi Distance Alpha Crit  Plume   Crit  Plume
 ======== ===== === ======== ===== ====  =====   ====  =====
  SKY      10. 121.  282.0    47.  2.00   .329    .05   .006
  SKY     140. 121.  282.0    47.  2.00   .043    .05  -.001
  TERRAIN  10.  84.  243.0    84.  2.00   .221    .05   .002
  TERRAIN 140.  84.  243.0    84.  2.00   .021    .05   .000


          Maximum Visual Impacts OUTSIDE Class I Area
           Screening Criteria ARE NOT Exceeded
                                    Delta E       Contrast
                                 ===========   ============
```