AIR QUALITY TECHNICAL SUPPORT DOCUMENT, ATLANTIC RIM NATURAL GAS PROJECT AND THE SEMINOE ROAD GAS DEVELOPMENT PROJECT, WYOMING

Prepared for

Bureau of Land Management,
Rawlins Field Office
Rawlins, Wyoming

Prepared by

TRC Environmental Corporation
Laramie, Wyoming

October 2005

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LIST OF ACRONYMS AND ABBREVIATIONS

μeq/l	Microequivalents per liter
μg/m^3	Micrograms per cubic meter
ANC	Acid neutralizing capacity
AQD	Air Quality Division
AQRV	Air Quality Related Value
AQTSD	Air Quality Technical Support Document
ARPA	Atlantic Rim Project Area
ARS	Air Resource Specialists
BLM	Bureau of Land Management
BTEX	Benzene, toluene, ethyl benzene, and xylene
BTNF-MA	Bridger Teton National Forest Management Area
C.F.R.	*Code of Federal Regulations*
CAAQS	Colorado Ambient Air Quality Standards
CBM	Coalbed methane
CDPHE/APCD	Colorado Department of Public Health and Environment/Air Pollution Control Division
CO	Carbon monoxide
COGCC	Colorado Oil and Gas Conservation Commission
DATs	Deposition Analysis Thresholds
Dv	Deciview
EIS	Environmental Impact Statement
EPA	Environmental Protection Agency

LIST OF ACRONYMS AND ABBREVIATIONS (CONTINUED)

FLAG	Federal Land Managers' Air Quality Related Values Workgroup
FLM	Federal Land Managers
GLEES	Glacier Lakes Ecosystem Experiments Site
HAP	Hazardous air pollutant
HNO_3	Nitric acid
IDEQ	Idaho Division of Environment Quality
IDLH	Immediately Dangerous to Life or Health
IOGCC	Idaho Oil and Gas Conservation Commission
IWAQM	Interagency Workgroup on Air Quality Modeling
kg/ha/yr	Kilograms per hectare per year
LAC	Level of Acceptable Change
LOP	Life of Project
LULC	Land Use and Land Cover
MEI	Maximally Exposed Individual
MLE	Most Likely Exposure
MM5	Mesoscale Meteorological Model
MSUP	Master Surface Use Plan
N	Nitrogen
NAAQS	National Ambient Air Quality Standards
NEPA	*National Environmental Policy Act*
NIOSH	National Institute for Occupational Safety and Health
NO_2	Nitrogen dioxide
NO_3	Nitrate
NO_x	Oxides of nitrogen
NPS	National Park Service
NWS	National Weather Service
O_3	Ozone
PM_{10}	Particulate matter less than or equal to 10 microns in size
$PM_{2.5}$	Particulate matter less than or equal to 2.5 microns in size
Ppb	Parts per billion
Protocol	Air Quality Impact Assessment Protocol
PSD	Prevention of Significant Deterioration
QA/QC	Quality Assurance/Quality Control
REL	Reference exposure level
RfC	Reference Concentrations for Chronic Inhalation
RFD	Reasonably foreseeable development
RFFA	Reasonably foreseeable future actions
RMP	Resource Management Plan
ROW	Right of Way
S	Sulfur

LIST OF ACRONYMS AND ABBREVIATIONS (CONTINUED)

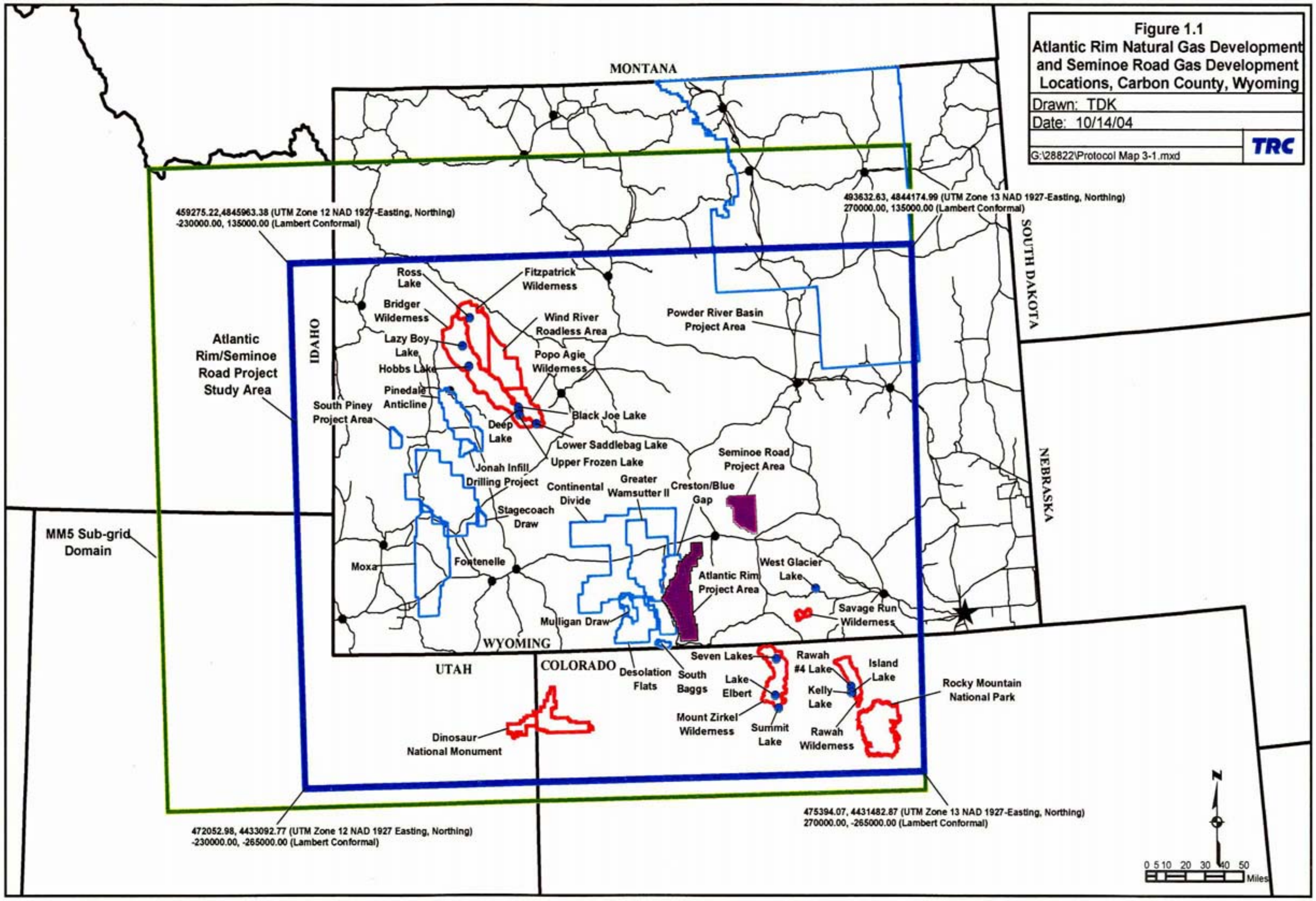
SO_2	Sulfur dioxide
SO_4	Sulfate
SRPA	Seminoe Road Project Area
SWWYTAF	Southwest Wyoming Technical Air Forum
TEG	Tri-ethylene glycol
TRC	TRC Environmental Corporation
UDEQ-AQD	Utah Department of Environmental Quality-Air Quality Division
UDNR-DOGM	Utah Department of Natural Resources-Division of Oil, Gas, and Mining
URF	Unit risk factor
USDA	U.S. Department of Agriculture
USGS	U.S. Geological Survey
VOC	Volatile organic compound
WAAQS	Wyoming Ambient Air Quality Standards
WAQSR	Wyoming Air Quality Standards and Regulations
WDEQ	Wyoming Department of Environmental Quality
WOGCC	Wyoming Oil and Gas Conservation Commission
WRAP	Western Regional Air Partnership

1.0 INTRODUCTION

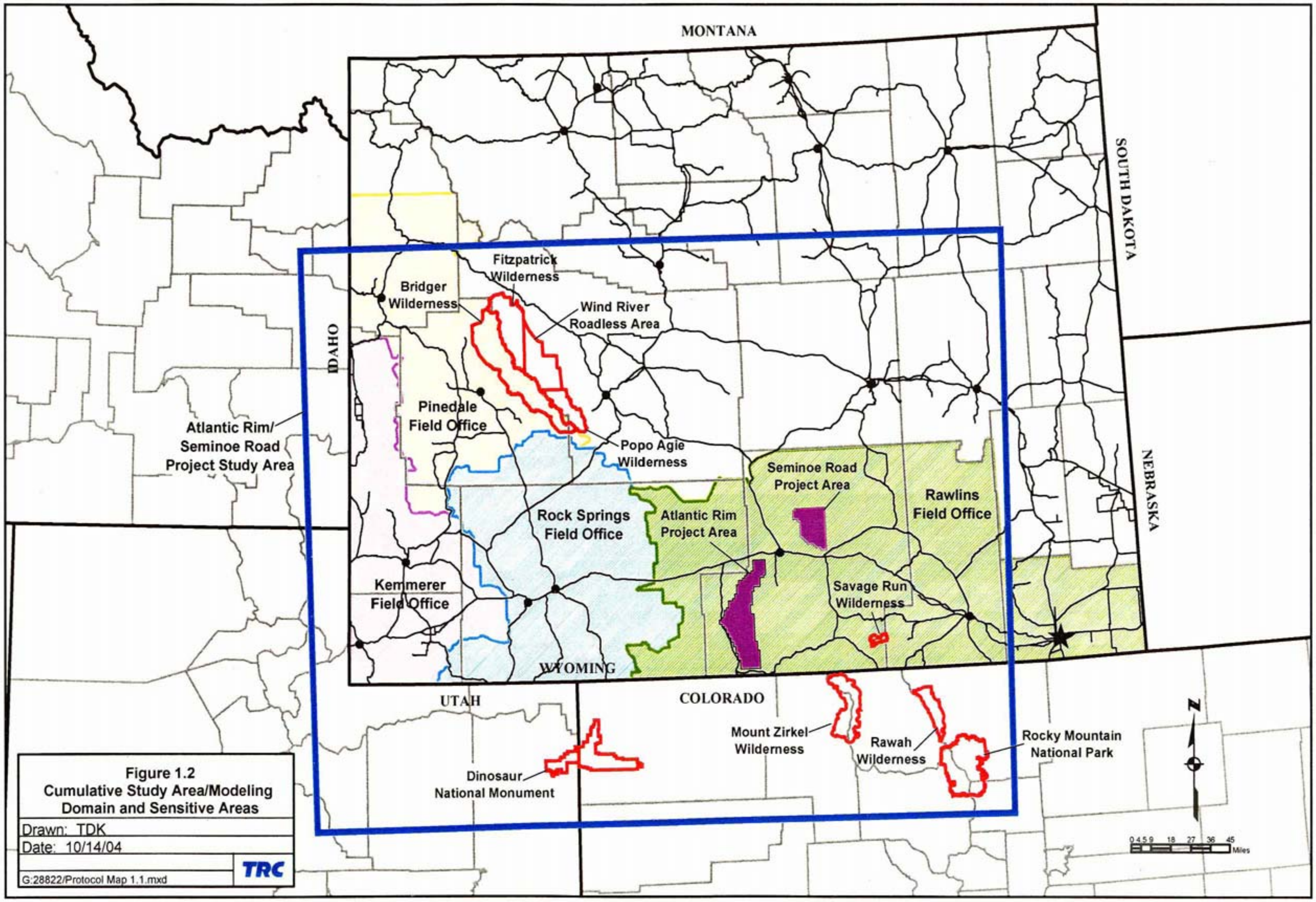
This Air Quality Technical Support Document (AQTSD) was prepared to summarize analyses performed to quantify potential air quality impacts from the proposed Atlantic Rim Natural Gas Project (Atlantic Rim Project) and the Seminoe Road Gas Development Project (Seminoe Road Project). The methodologies utilized in the analysis were originally defined in an air quality impact assessment protocol (Protocol) prepared by TRC Environmental Corporation (TRC) (2004) with input from the lead agency, U.S. Department of Interior Bureau of Land Management (BLM), and project stakeholders including the U.S. Environmental Protection Agency (EPA), National Park Service (NPS), U.S. Department of Agriculture Forest Service (USDA Forest Service), and Wyoming Department of Environmental Quality Air Quality Division (WDEQ-AQD). The AQTSD discusses those methodologies as necessary and summarizes the findings of the air emissions inventories and subsequent dispersion modeling analyses performed.

The Projects' location in south-central Wyoming required the examination of the Atlantic Rim Project, Seminoe Road Project, and cumulative source impacts in Wyoming, northwestern Colorado, and northeastern Utah, and southeastern Idaho within a defined study area, or modeling domain (Maps 1.1 and 1.2). The analysis area includes the area surrounding the proposed Project areas (ARPA and SRPA) and the federal Prevention of Significant Deterioration (PSD) Class I Bridger, Fitzpatrick, Mt. Zirkel, and Rawah Wilderness Areas and Rocky Mountain National Park, the Savage Run Wilderness Area (Federal Class II, Wyoming Class I), Dinosaur National Monument (Federal Class II, Colorado Class I SO_2 only), Popo Agie Wilderness Area (Federal Class II), and Wind River Roadless Area (Federal Class II). These areas were identified as sensitive areas of concern by project stakeholders during preliminary stakeholders meetings.

Impacts analyzed include those on air quality and air quality related values (AQRVs) resulting from air emissions from the 1) project sources within ARPA and SRPA, 2) non-project state-



Map 1.1 Atlantic Rim Natural Gas Development and Seminoe Road Gas Development Locations, Carbon County, Wyoming.



Map 1.2 Air Quality Study Area/Modeling Domain.

permitted and reasonably foreseeable future action (RFFA) sources within the study domain, and 3) non-project reasonably foreseeable development (RFD) within the study domain. Predicted pollutant concentrations were compared to applicable ambient air quality standards and PSD increments, and were used to assess potential impacts to AQRVs including visibility (regional haze) and acid deposition.

Project source emission inventories were performed in accordance with the Protocol and following WDEQ-AQD oil and gas inventory guidance. Non-project sources were inventoried as part of a cooperated effort between the BLM Wyoming State Office, the Atlantic Rim and Seminoe Road Project proponents, and the Jonah Infill Drilling Project proponents. These data were obtained for use in the Rawlins and Pinedale Resource Management Plan (RMP) revisions, the Atlantic Rim and Seminoe Road Project environmental impact statements (EIS) air quality analysis, and Jonah Infill Drilling Project EIS air quality analysis. This inventory is described in greater detail in Chapter 2.0 of this document.

The remainder of this document describes the Atlantic Rim Project and Seminoe Road Project in further detail, provides a description of the alternatives proposed and evaluated, and presents a list of tasks performed for the study. Chapter 2 specifically presents an overview of the emissions inventories. Descriptions of the near-field air quality impact assessment methodologies and impacts are provided in Chapter 3. Chapter 4 describes the analyses performed using the CALPUFF modeling system for assessment of direct Project and cumulative impacts at far field locations and within each Project area.

1.1 ATLANTIC RIM PROJECT DESCRIPTION

Anadarko E&P Company LP and other oil and gas companies (including Warren E&P, Inc., Double Eagle Petroleum, Julander Energy, and Merit Energy Company), collectively referred to as the Atlantic Rim Operators, propose to continue development of coalbed methane and natural gas resources located within the ARPA (Map 1.1). The proposed project area is generally located in Townships 13 through 20 North, and Ranges 89 through 92 West, Carbon County, Wyoming. The total project area encompasses approximately 310,335 acres, of which 199,558 acres are federal surface, 16,156 acres are State of Wyoming surface/mineral estate, and 94,621 acres are private surface.

The Proposed Action for this project involves the development of 2,000 new wells, including 1,800 coalbed methane wells and 200 natural gas wells, on 1,800 new surface locations. No alternatives besides the No Action Alternative are planned to be proposed at this time.

1.1.1 Well Development

Drilling operations are expected to last from approximately 6 to 10 years, with a life-of-project (LOP) of 20-30 years. Each drill site location would be approximately 200 feet by 200 feet in size, with surface disturbance at each wellsite approximately 1 acre. Temporary mud pits 15 feet by 35 feet would be constructed and reclaimed following completion operations. Drilling of the natural gas and coalbed methane wells, or water injection wells to be used in support of coalbed methane production operations, would utilize wither a conventional or truck-mounted drilling rig. Additional equipment and materials needed for drilling operations would be trucked to the wellsite. Each producing coalbed methane well would be drilled to a depth of 2,700 feet to 3,800 feet or deeper, depending upon the depth of the coal seam. Approximately 26 days would be required to develop each gas well (4 days to construct the well pad and access road, 2 days for rig-up, 10 days for drilling, 2-5 days for completion, 2 days for rig-down, and 3 days for pipeline construction). Methane gas may be flared or vented during the testing period at natural gas wells; no gas would be flared or vented at coalbed methane wells.

Drilling water injection wells would utilize gas well drilling equipment and personnel. The injection well depth is expected to range from 3,200 to 4,000 feet, and injection well drilling and completion is expected to require 7-14 days plus an additional 14 days to install surface equipment.

Non-productive gas wells would be reclaimed to the approximate landform existing prior to construction using techniques specified in the Master Surface Use Plan (MSUP). The ARPA is currently accessed by existing developed roads, and access to drill locations from the existing road network would be provided by new and upgraded roads when necessary. If drilling is productive, access roads to the wellsite would remain in place, and partial reclamation would be completed on segments of the well pad and access road right-of-way (ROW) no longer needed.

Gas-gathering pipeline systems (low pressure, from wellhead to central compressor station), produced water-gathering pipeline systems (low pressure, from wellhead to centralized conditioning facilities or injection facilities), and gas-delivery pipelines (high pressure, from compressor station to existing transmission pipelines) would be constructed in the ARPA. Reclamation of pipeline corridors would occur as soon as practical after pipeline construction was complete.

1.1.2 Well Operation

Coalbed methane wells would utilize electricity to power pumps required during well development and required to initiate and maintain production. Either natural gas- or propane-fired engines would be used to run generators on a temporary basis to power pumps at individual wells until electric distribution lines were installed. Atlantic Rim Operators may elect to use centrally located generation equipment at area compressor stations and an underground distribution system to provide necessary power to wellsites.

Natural gas wells would utilize natural gas-fired equipment at each wellsite. Several gas-fired heaters would operate intermittently to eliminate the freezing of separated liquids. A burner would also operate with the dehydrator to heat glycol solution. No electricity would be required at natural gas well locations. No wellsite compression would be utilized at natural gas wells.

1.1.3 Ancillary Facilities

Twelve compressor stations are planned for the ARPA. Each compressor station facility is expected to be constructed within a site area covering approximately 300 feet by 300 feet. About one-half of the compressor station site area will be affected by the construction, maintenance, and operation of the facility. The compressor station facility will be of all-weather construction, having a thick layer of gravel surfacing over the pad site. Topsoil will be removed and conserved for later reclamation activities. The compressor station will consist of an insulated header building containing a separator or a separator and allocation meters for each well. Additional equipment at each compressor station would include a tri-ethylene glycol (TEG) dehydration system, which would dry the gas to meet pipeline-quality specifications of the market pipeline. The water removed in the dehydration system will be pumped from the header building to an approved injection well.

Each compressor station will be sited to allow for the installation of one compressor initially, with the addition of up to two more compressors later in the life of the field. Each compressor would be driven by a natural gas engine that would be designed to meet all specifications established by the Wyoming Department of Environmental Quality, Air Quality Division (WDEQ-AQD).

1.2 ATLANTIC RIM ALTERNATIVES EVALUATED

The Proposed Action and the No Action Alternative were the only alternatives evaluated.

Modeling analyses were performed to quantify "near-field" pollutant concentrations, within and nearby the ARPA, from project related emissions sources for the Proposed Action. Near-field impacts are described in detail in Chapter 3.0.

Direct project and cumulative "far-field" modeling analyses were preformed for the Proposed Action and the No Action Alternative. These modeling scenarios assumed the maximum field emissions which could potentially occur concurrently (i.e., the final year of construction representing the maximum annual construction activity rate combined with nearly full-field production). Far-field impacts and their applicability to each alternative are described in greater detail in Chapter 4.0.

1.3 ATLANTIC RIM STUDY TASKS

The following tasks were performed for air quality and AQRVs impact assessment:

1. **Project Air Emissions Inventory.** Development of an air pollutant emissions inventory for the Atlantic Rim Project.
2. **Regional Air Emissions Inventory.** Development of an air pollutant emissions inventory for other regional sources not represented by background air quality measurements, including state-permitted sources, RFFA, and RFD.
3. **Project Near-Field Analysis.** Assessment of near-field air quality concentration impacts resulting from activities proposed within the ARPA.
4. **Far-Field Impact Analysis.** Assessment of air quality concentrations and AQRV impacts at far-field PSD Class I and sensitive PSD Class II areas resulting from Atlantic Rim Project and other regional sources inventoried under item 2 above.

1.4 SEMINOE ROAD PROJECT DESCRIPTION

Dudley & Associates, LLC (the project Proponent) notified the Bureau of Land Management (BLM) in September 2002 of its desire to continue to drill and develop coalbed methane natural gas wells and associated facilities at the Seminoe Road Pilot Plant Project Site. The project site is located in Carbon County, Wyoming just north of the Town of Sinclair in Townships 21, 22, 23, and 24 North, Ranges 84, 85, and 86 West, in Carbon County, Wyoming. The site is accessed via County Road 351, also known as the Seminoe Road. The SRPA is approximately 137,000 acres in size and involves a "checkerboard" mixture of mostly federal (49%) and private (49%), with some state land (1%). The BLM Rawlins Field Office manages the federal surface lands and the federal mineral estate. Dudley owns or controls oil and gas leasehold interests comprising approximately 80 percent of the ARPA.

The proposal includes drilling and developing up to 1,240 wells, on up to 785 well pad sites spaced at approximately 1 well pad site every 160 acres. Associated facilities include roads, gas and water collection pipelines, compressor stations, water disposal systems, and a power supply system. The total development, operation, and reclamation of the project is anticipated to occur over a period of between 30 and 40 years. The site will be developed in about 11 phases, with each phase requiring a separate environmental assessment.

1.4.1 Well Construction

The three main construction activities on the site which will cause disturbance include:

- Access roads,
- drill pads, and
- compressor sites.

Access will be needed to all drill sites and compressor sites. An effort will be made to utilize existing roads on site, however, these roads will also require upgrading. Approximately 2,195 acres will be disturbed by access roads. Initially, 2.2 acres will be disturbed for each drill pad. Once wells are completed, about 1.2 acres on each site will be reclaimed. There will be three compressor sites for the project, with each disturbing about 5 acres. Most water, gas, and utility lines will be buried within the access road disturbance corridor.

1.4.2 Well Development

Drilling will be conducted using conventional rotary drill rigs drilling vertical holes. Drilling and spacing unit of 160 acres (i.e. maximum of four wellsites per 640-acre section) is anticipated for the project area. The shallower Medicine Bow and Fox Hill coalbed methane extraction zones will be produced from separate wellbores; however, they will share a common wellsite with their

Mesaverde counterparts. With Medicine Bow and Fox Hill wellbores sharing a common well pad site with their Mesaverde counterparts, no additional land surface is planned to be disturbed in the course of the Medicine Bow and Fox Hill developments. It is estimated that 25% of the original total surface disturbance can be reclaimed as soon as practicable following drilling and well completion operations.

1.4.3 Ancillary Facilities

The initial analysis of gas produced from the pilot project wells in the Mesaverde coals indicates no need for nitrogen or CO_2 extraction facilities. Plans for construction of a compressor facility and a 20-mile long high-pressure pipeline were recently approved by the BLM (WY-030-EA2-229) to connect the pilot project wells to a sales transmission pipeline near Walcott, Wyoming. It is anticipated that two more compressor facilities/sites will be needed over the life of the project. In the event of field electrification, rights-of-way for utility lines will also be required.

1.4.4 Power Requirements

The Proposed Action includes electrification of the SRPA. It is anticipated that the lighting, pumps and compressors will utilize electricity from the existing power line which runs through the project site.

1.4.5 Reclamation

At the time of final reclamation, the following steps will occur as approved by the APDs for the project:

- decommissioning of facilities,
- removal of structures, facilities and roads,
- well abandonment and sealing,
- recontouring and regrading,
- soil replacement,

- mulching,
- permanent revegetation, and
- reclamation management and monitoring.

1.5 SEMINOE ROAD ALTERNATIVES EVALUATED

The Proposed Action, a non-electrification scenario, and the No Action Alternative were evaluated.

Modeling analyses were performed to quantify "near-field" pollutant concentrations, within and nearby the SRPA, from project related emissions sources for the worst-case scenario, which was the non-electrification scenario. Near-field impacts are described in detail in Chapter 3.0.

Direct project and cumulative "far-field" modeling analyses were preformed for the Proposed Action, the non-electrification, and the No Action Alternatives. These modeling scenarios assumed the maximum field emissions which could potentially occur concurrently (i.e., the final year of construction representing the maximum annual construction activity rate combined with nearly full-field production). Far-field impacts and their applicability to each alternative are described in greater detail in Chapter 4.0.

1.6 SEMINOE ROAD STUDY TASKS

The following tasks were performed for air quality and AQRVs impact assessment:

1. **Project Air Emissions Inventory.** Development of an air pollutant emissions inventory for the Seminoe Road Project.
2. **Regional Air Emissions Inventory.** Development of an air pollutant emissions inventory for other regional sources not represented by background air quality measurements, including state-permitted sources, RFFA, and RFD.
3. **Project Near-Field Analysis.** Assessment of near-field air quality concentration impacts resulting from activities proposed within the SRPA.

4. **Far-Field Impact Analysis.** Assessment of air quality concentrations and AQRV impacts at far-field PSD Class I and sensitive PSD Class II areas resulting from Seminoe Road Project and other regional sources inventoried under item 2 above.

2.0 EMISSIONS INVENTORY

2.1 ATLANTIC RIM PROJECT EMISSIONS

The Proposed Action includes the development of up to 2,000 gas wells spaced at approximately 1 well pad site every 160 acres. Ten percent (two hundred) of the wells would be traditional natural gas wells and the remaining 1,800 wells would be coal-bed methane wells.

Criteria pollutant and hazardous air pollutant (HAP) emissions were inventoried for construction and production activities and for ancillary facilities. Criteria pollutants include nitrogen oxides (NO_x), carbon monoxide (CO), sulfur dioxides (SO_2), volatile organic compounds (VOCs), and particulate matter. Particulate matter is further classified by its size; PM_{10} refers to particulate matter less than 10 microns in diameter, and $PM_{2.5}$ refers to particulate matter less than 2.5 microns in diameter. HAPs include n-hexane, BTEX (benzene, toluene, ethylbenzene, and xylene), and formaldehyde. All emission calculations were completed in accordance with WDEQ-AQD Oil and Gas Guidance, Environmental Protection Agency's (EPA's) AP-42, or other accepted engineering methods (see Appendix A, Air Quality Impact Assessment Protocol).

2.1.1 Construction Emissions

Construction activities would be a source of primarily criteria pollutants. Emissions would occur from well pad and resource road construction and traffic, rig moving/drilling and associated traffic, completion activities and traffic, pipeline installation and traffic, and wind erosion during construction activities. A timeline illustrating the duration of construction activities for a single well is provided in Figure 2.1.

Well pad and resource road emissions would include fugitive PM_{10} and $PM_{2.5}$ emissions from 1) construction activities and 2) traffic to and from the construction site. NO_X, CO, VOC, and $PM_{10}/PM_{2.5}$ emissions would occur from diesel combustion in haul trucks and heavy construction

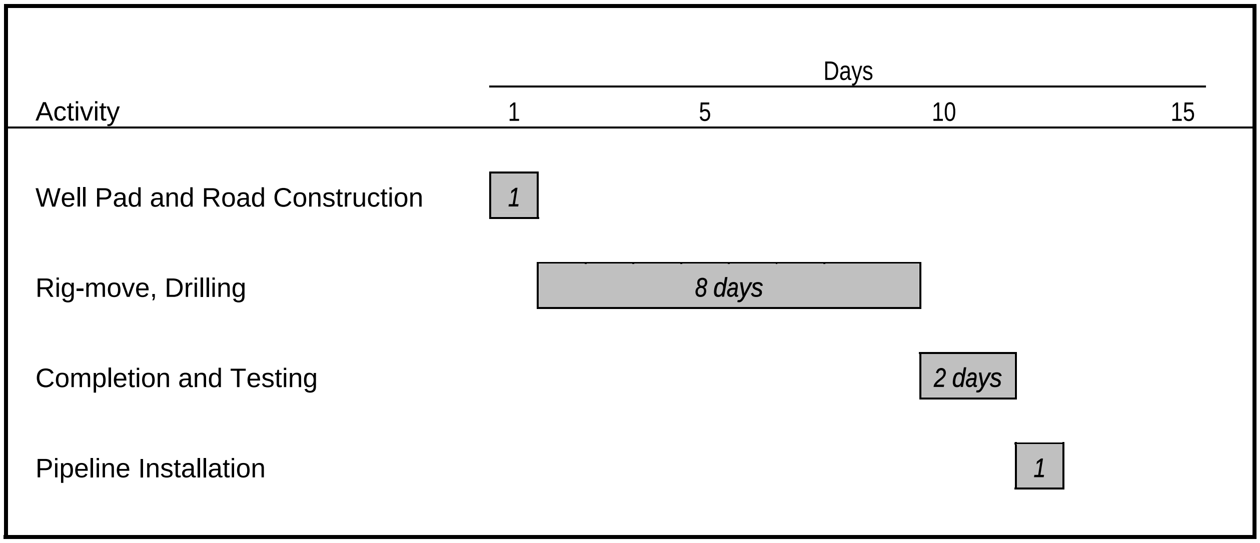


Figure 2.1 Approximate Single Well Development Timeline.

equipment. On unpaved roads within the Project Area, no water or chemical dust suppressant is proposed for fugitive dust control.

After the road and pad are prepared, rig moving/drilling would begin. Emissions would include fugitives from unpaved road travel to and from the drilling site, diesel haul truck tailpipes, and emissions from diesel drilling engines. Drilling engine emissions were calculated using manufacturer's emission data. Emissions from well completion and testing, which follow the drilling phase, would include fugitive PM_{10} and $PM_{2.5}$ emissions from unpaved road traffic and from diesel haul truck tailpipes.

Throughout the well construction process, particulate emissions occur from vehicle travel to and from wellsites on unpaved roads. Two roads access the field, 1) from Rawlins via County Road 605 and 2) from Baggs or Rawlins via Wyoming Highway 789. County Road 605 accesses the field from the north and Highway 789 accesses the field from the west. A shorter travel distance on unpaved roads results in lower pollutant emissions, and accessing the field via Wyoming Highway 789 results in a smaller number of vehicles miles traveled on unpaved roads.

No conventional natural gas wells have yet been drilled in the ARPA; therefore, no constituent analysis or data regarding flaring volumes are available. As a result, flared components and volumes developed for the Jonah Infill Project were utilized and are believed to represent a conservative estimate of future potential flaring operations at the 200 conventional natural gas wells proposed in the ARPA.

Pollutant emissions would also occur from pipeline installation activities, including general construction activities, travel on unpaved roads to and from the pipeline installation site, and diesel combustion from on-site construction equipment.

Fugitive dust (PM_{10} and $PM_{2.5}$) would occur during well pad construction, resource road construction, and pipeline installation due to wind erosion of disturbed areas. Wind erosion emissions were computed using methods described in EPA handbook AP-42 (EPA 1995). Rawlins 2002 meteorological data was used to quantify potential wind erosion events. Wind erosion emissions only occur for those periods when ambient wind speed exceeds a threshold value of 16.5 m/sec. Wind erosion emissions and output are shown in Appendix B1. See AP-42, Section 13.2.5, for further wind erosion calculation methodology.

A summary of construction emissions for a single wellsite is shown in Table 2.1. Construction emission calculations are provided in detail, showing all emission factors, input parameters, and assumptions, in Appendix B1. Calculations shown in Appendix B1 are available upon request.

2.1.2 Production Emissions

Traditional natural gas and coalbed methane well field production equipment and operations would be a source of criteria pollutants. Traditional natural gas wells would also be a source of HAPs; no HAPs would be emitted from the CBM wells. Pollutant emission sources during field production would include the following:

- travel via unpaved roads to and from wellsites within the field;
- diesel combustion emissions from haul trucks;

Table 2.1 Single Well Construction Emissions Summary.[1]

Pollutant	Well Pad and Access Road Construction		Rig Move and Drilling		Completion and Testing		Pipeline Construction		Total	
	lb/hr	tons/well	lb/hr	tons/well	lb/hr	tons/well	lb/hr	tons/well	lb/hr	tons/well
NO_x	2.96	0.025	20.79	0.998	4.61	0.055	1.69	0.008	30.04	1.086
CO	0.85	0.007	3.57	0.171	1.01	0.012	0.42	0.002	5.85	0.193
SO_2	0.31	0.003	2.21	0.106	0.30	0.004	0.19	0.001	3.02	0.113
PM_{10}	14.91	0.075	19.12	0.918	7.62	0.091	20.01	0.100	61.66	1.185
$PM_{2.5}$	3.71	0.019	4.90	0.235	1.43	0.017	4.07	0.020	14.12	0.292
VOC	0.30	4.865	0.60	0.029	0.38	0.005	0.13	0.001	1.40	4.899

[1] Traffic emissions based on travel to Jolly Rogers.

- separator heaters, TEG dehydration, condensate truck traffic, and condensate storage tank flashing (all associated with traditional natural gas wells);
- wind erosion of well pad disturbed area; and
- natural gas-fired reciprocating internal combustion compressor engines.

Fugitive PM_{10} and $PM_{2.5}$ emissions would occur from road travel and wind erosion from well pad disturbances. NO_X, CO, VOC, and $PM_{10}/PM_{2.5}$ emissions would occur from diesel combustion in haul trucks (condensate trucks) traveling in the field during production.

Twelve compressor stations are projected to be operational throughout the Atlantic Rim Project Area. The engines would be a source of NO_x, CO, VOCs, and formaldehyde. Each compressor station would have the following equipment: 1) two compressor engines, 1,206 horsepower (hp) CAT G3516TALE or similar engines; 2) two generator engines, 1,206 hp CAT G3516TA or similar engines; 3) one 10 MMSCFD glycol dehydration unit; and 4) one 400-bbl condensate storage tank. The dehydrator and condensate storage tanks would be a source of BTEX and n-hexane. The dehydrator heaters would be a source of NO_x and CO, and the dehydrator gas processing operations would be a source of VOC, BTEX, and n-hexane. Because 200 natural gas wells were included in the proposed action, emissions from the dehydrators operations were calculated using GRI-GLYCalc version 4.0. A gas analysis was developed for the calculations assuming 10% traditional natural gas and 90% CBM gas. Dehydrator emissions and the GRI-GLYCalc input and output are provided in Appendix B1. Calculations shown in Appendix B1 are available upon request.

Total production emissions of criteria pollutants and HAPs occurring from a single CBM well and a single natural gas well are presented in Table 2.2. Production emission calculations are provided in detail, showing all emission factors, input parameters, and assumptions, in Appendix B1. Calculations shown in Appendix B1 are available upon request.

Table 2.2 Single Well Production Emission Summary.

Well Configuration	Pollutant	Traffic Emissions Single Well (tpy)	Production Emissions Single Well (tpy)	Total Emissions Single Well (tpy)
CBM Well	NO_x	0.003	--	0.003
	CO	0.004	--	0.004
	SO_2	0.000	--	0.000
	PM_{10}	0.271	--	0.271
	$PM_{2.5}$	0.041	--	0.041
	VOC	0.002	--	0.002
	Benzene	--	--	0.000
	Toluene	--	--	0.000
	Ethylbenzene	--	--	0.000
	Xylene	--	--	0.000
	n-hexane	--	--	0.000
Traditional Gas Well	NO_x	0.003	0.219	0.222
	CO	0.004	0.046	0.050
	SO_2	0.000	0.000	0.000
	PM_{10}	0.590	0.010	0.600
	$PM_{2.5}$	0.089	0.010	0.099
	VOC	0.002	30.018	30.019
	Benzene	--	3.868	3.868
	Toluene	--	10.322	10.322
	Ethylbenzene	--	1.551	1.551
	Xylene	--	8.162	8.162
	n-hexane	--	3.865	3.865

[1] Traffic emissions based on travel to Jolly Rogers.

2.1.3 Total Field Emissions

Annual emissions in the ARPA under the Proposed Action are shown in Table 2.3. Emissions assume construction and production occurring simultaneously in the field and include one year of maximum construction emissions plus one year of production at maximum emission rates. Construction emissions were calculated based on the number of wells constructed per year and the type of well constructed. Production emissions were calculated based the total number of producing wells in the field. Total producing wells were equal to the difference in number of wells proposed and the number of well constructed per year.

2.2 SEMINOE ROAD PROJECT EMISSIONS

The Proposed Action for this project includes the development of 1,240 coal-bed methane wells on up to 785 well pad sites spaced at approximately 1 well pad site every 160 acres.

Table 2.3 Estimated Atlantic Rim Project Annual Emissions Summary - Construction and Production.

Alternative/ Pollutant	Wells Development Rate	Annual Construction Emissions (tpy)	Total Proposed Wells	Total Producing Wells	Annual Production Emissions[1] (tpy)	Total Annual Emissions (tpy)
Proposed Action						
NOx	100	627.29	2,000	1,900	47.59	674.88
SO_2		65.13			0.17	65.30
PM10		696.64			423.14	1,119.77
$PM_{2.5}$		182.61			64.90	247.51
VOC		163.13			5,706.30	5,869.44

[1] Assumes 10% the producing wells are traditional and 90% are CBM.

Criteria pollutant and HAP emissions were inventoried for construction and production activities and for ancillary facilities. Criteria pollutants include NO_x, CO, SO_2, VOCs, PM_{10}, and $PM_{2.5}$. All emission calculations were completed in accordance with WDEQ-AQD Oil and Gas Guidance, Environmental Protection Agency's (EPA's) AP-42, or other accepted engineering methods (See Appendix A, Air Quality Impact Assessment Protocol).

2.2.1 Construction Emissions

Construction activities would be a source of primarily criteria pollutants. Emissions would occur from well pad and resource road construction and traffic, rig moving/drilling and associated traffic, completion traffic, utility installation and traffic, and wind erosion during construction activities. A timeline illustrating the duration of construction activities for a single well is provided in Figure 2.2.

Well pad and resource road emissions would include fugitive PM_{10} and $PM_{2.5}$ emissions from 1) construction activities and 2) traffic to and from the construction site. NO_X, CO, VOC, and $PM_{10}/PM_{2.5}$ emissions would occur from diesel combustion in haul trucks and heavy construction equipment. Unpaved roads within the Project Area are proposed to be graveled, which reduces silt content of the roads and resultant emissions. No water or chemical dust suppressant is proposed on the graveled roads.

After the road and pad are prepared, rig moving/drilling would begin. Emissions would include those from unpaved road travel to and from the drilling site and from diesel drilling engines. Drilling engine emissions were calculated using manufacturer's emission data with engine requirements based on two depth ranges of wells drilled in the field. Emissions from the well completion phase, which follows the drilling phase, would include fugitive PM_{10} and $PM_{2.5}$ emissions from traffic and emissions from diesel haul truck tailpipe.

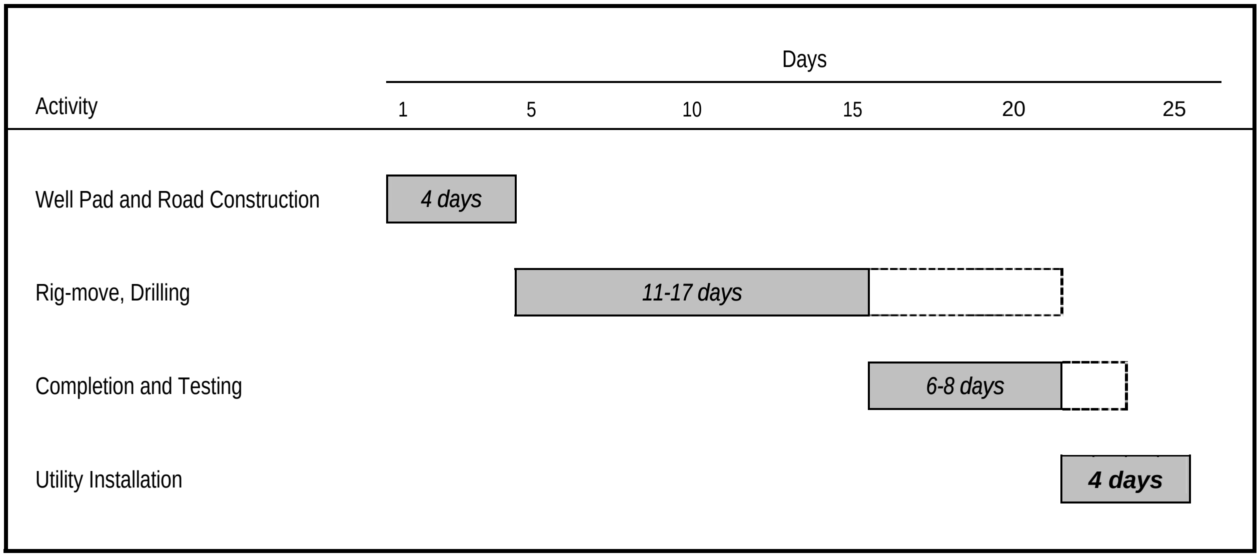


Figure 2.2 Approximate Single Well Development Timeline.

Pollutant emissions would also occur from utility installation activities, including general construction activities, travel on unpaved roads to and from the utility installation site, and diesel combustion from on-site construction equipment.

Fugitive dust (PM_{10} and $PM_{2.5}$) would occur during well pad construction, resource road construction, and utility installation due to wind erosion of disturbed areas. Wind erosion emissions were computed using methods described in EPA handbook AP-42 (EPA 1995). Rawlins 2002 meteorological data was used to quantify potential wind erosion events. Wind erosion emissions only occur for those periods when ambient wind speed exceeds a threshold value of 16.5 m/sec. Wind erosion emissions and output are shown in Appendix B2. See AP-42, Section 13.2.5, for further wind erosion calculation methodology.

A summary of construction emissions for a single wellsite are shown in Table 2.4. Construction emission calculations are provided in detail, showing all emission factors, input parameters, and assumptions, in Appendix B2. Calculations shown in Appendix B2 are available upon request.

2.2.2 Production Emissions

Coalbed methane well field production equipment and operations would be a source of criteria pollutants. Compressor engines would be a source of criteria pollutants and HAPs. All field production emissions were calculated for both the Proposed Action, which assumes that electric power will be supplied to the field in phases as the field is developed, and a nonelectrified scenario, which assumes no electric power will be available in the field over the LOP. Emissions from well equipment and compression equipment vary between these two scenarios.

Pollutant emission sources during field production would include the following:

- travel via collector and resource roads to and from wellsites within the field;
- diesel combustion emissions from haul trucks;
- wind erosion of well pad disturbed area;
- natural gas-fired reciprocating internal combustion compressor engines;
- natural gas-fired downhole pumps installed at each well outside of the field electrification boundary (under the Proposed Action); and
- natural gas-fired downhole pumps installed at each well, which remain for the life of the well (under the nonelectrified alternative).

Fugitive PM_{10} and $PM_{2.5}$ emissions would occur from road travel and wind erosion from well pad disturbances. NO_X, CO, VOC, and $PM_{10}/PM_{2.5}$ emissions would occur from diesel combustion in haul trucks traveling in the field during production.

There are three compressor stations projected to be operational throughout the Project Area. One compressor station is currently permitted under Wyoming Permit Number CT-2833. Emissions for the remaining two compressor stations were assumed to be identical to the permitted compressor station. Each compressor station would have the following equipment: 1) two compressor engines, 1,340 hp CAT Caterpillar 3516 LE or similar engines; and 2) one 20 MMSCFD glycol dehydration unit. Under the Proposed Action, one compressor station's

Table 2.4 Single Well Construction Emissions Summary.

	Well Pad and Access Road Construction		Rig Move and Drilling		Completion and Testing		Pipeline Construction		Total	
Pollutant	lb/hr	tons/well	lb/hr	tons/well	lb/hr	tons/well	lb/hr	tons/well	lb/hr	tons/well
NO_x	4.37	0.041	17.12	3.492	4.59	0.183	4.16	0.031	30.23	3.748
CO	1.20	0.011	2.94	0.600	0.99	0.040	1.55	0.010	6.69	0.661
SO_2	0.47	0.004	1.82	0.371	0.30	0.012	0.41	0.003	3.01	0.391
PM_{10}	29.79	0.592	3.34	0.582	2.24	0.071	7.48	0.145	42.85	1.388
$PM_{2.5}$	6.38	0.123	2.16	0.426	0.61	0.022	2.03	0.036	11.18	0.606
VOC	0.40	0.004	0.49	0.100	0.37	0.015	0.43	0.003	1.70	0.122

engines would be a source of NO_x, CO, VOCs, and formaldehyde, and the remaining two compressor stations would be electrified. The dehydrator would be a source of NO_x and CO. No significant HAPs would be emitted from the dehydrator.

Within the Project Area, the wells would be developed in a ring-like progression. Each year, the majority of the wells would be drilled within that year's development boundary. Under the Proposed Action, these wells would be electrified and would have no emissions from the downhole pumps installed at each well. However, each year there would be a small number of pilot wells drilled outside of the electrification boundary; these wells would not be electrified and would require natural gas-fired downhole pumps. Under the nonelectrified alternative, all wells would require natural gas-fired downhole pumps.

Total production emissions of criteria pollutants and HAPs occurring from a single electrified well and from a single non-electrified well are presented in Table 2.5. Production emission calculations are provided in detail, showing all emission factors, input parameters, and assumptions, in Appendix B2. Calculations shown in Appendix B2 are available upon request.

2.2.3 Total Field Emissions

Annual emissions in the SRPA under the Proposed Action and non-electrification alternative are shown in Table 2.6. Emissions assume construction and production occurring simultaneously in the field and include one year of maximum construction emissions plus one year of production at maximum emission rates. Construction emissions were calculated based on the number of wells constructed per year and the type of well constructed. Production emissions were calculated based the total number of producing wells in the field. Total producing wells were equal to the difference in number of wells proposed and the number of well constructed per year.

Table 2.5 Single Well Production Emissions Summary.

Well Configuration	Pollutant	Traffic Emissions Single Well (tpy)	Production Emissions Single Well (tpy)	Total Emissions Single Well (tpy)
Electrified Well	NO_x	0.0003	--	0.0003
	CO	0.0004	--	0.0004
	SO_2	0.0000	--	0.0000
	PM_{10}	0.2842	--	0.2842
	$PM_{2.5}$	0.0426	--	0.0426
	VOC	0.0003	--	0.0002
	Formaldehyde	--	--	0.0000
	Benzene	--	--	0.0000
	Toluene	--	--	0.0000
	Ethylbenzene	--	--	0.0000
	Xylene	--	--	0.0000
	n-hexane	--	--	0.0000
Non-Electrified Well	NO_x	0.0003	1.0000	1.0003
	CO	0.0004	2.9800	2.9804
	SO_2	0.0000	--	0.0000
	PM_{10}	0.2842	--	0.2842
	$PM_{2.5}$	0.0426	--	0.0426
	VOC	0.0002	1.0000	1.0002
	Formaldehyde	--	0.0500	0.0500
	Benzene	--	--	0.0000
	Toluene	--	--	0.0000
	Ethylbenzene	--	--	0.0000
	Xylene	--	--	0.0000
	n-hexane	--	--	0.0000

Table 2.6 Estimated Seminoe Road Project Annual Emissions Summary - Construction and Production.

Alternative/ Pollutant	Wells Developed	Annual Construction Emissions (tpy)	Total Proposed Wells	Total Producing Wells	Wells Outside Electrification Boundary	Annual Production Emissions[1] (tpy)	Total Annual Emissions (tpy)
Proposed Action[2]							
NO_x	129	309.39	1,240	71,111	9	9.35	318.74
SO_2		42.15				0.0098	42.16
PM_{10}		199.54				315.77	515.31
$PM_{2.5}$		73.75				47.27	121.02
VOC		20.87				9.17	30.05
Non-Electrified Case[3]							
NO_x	129	309.39	1,240	1,111	1,111	1,111.35	1,420.74
SO_2		42.15				0.0098	42.16
PM_{10}		199.54				315.77	515.31
$PM_{2.5}$		73.75				47.27	121.02
VOC		20.87				1,111.17	1,132.05

1 Production emissions are taken from an average of the 3 most active years, 2008-2010.
2 Includes emissions from wells outside electrification boundary in year 2009.
3 Includes down-hole pump emissions at all producing wells.

2.3 REGIONAL EMISSIONS INVENTORY

An emissions inventory of industrial sources within the Atlantic Rim/Seminoe Road cumulative modeling domain was prepared for use in the cumulative air quality analysis. The modeling domain included portions of Wyoming, Colorado, Utah, and Idaho (see Map 1.1). Industrial sources and oil and gas wells permitted within a defined time frame through state air quality regulatory agencies and state oil and gas permitting agencies were first researched. The subset of these sources which had begun operation as of the inventory end-date was classified as State-Permitted Sources, and those not yet in operation were classified as RFFA. Also included in the regional inventory were industrial sources proposed under NEPA in the State of Wyoming. The developed portions of these projects were assumed to be either included in monitored ambient background or included in the state-permitted source inventory. The undeveloped portions of projects proposed under NEPA were classified as RFD. In accordance with definitions agreed upon by BLM, EPA, WDEQ-AQD, and USDA Forest Service for use in EIS projects, RFD was defined as 1) the NEPA-authorized but not yet developed portions of Wyoming NEPA projects, or 2) not-yet-authorized NEPA projects for which air quality analyses were in progress and for which emissions had been quantified.

Figure 2.3 shows the regional inventory area with NEPA project areas, and a summary of the Regional Inventory is shown in Table 2.7. Values presented in Table 2.7 represent the change in emissions between the inventory start date (January 1, 2001) and the inventory end-date (March 31, 2004).

The inventory methodologies used to compile the regional source emissions inventory are provided in Appendix C and include a description of the data collected, the period of record for the data collected, inclusion and exclusion methodology, stack parameter processing methods, and the state-specific methodologies required due to significant differences in the content and completeness of data obtained from each state.

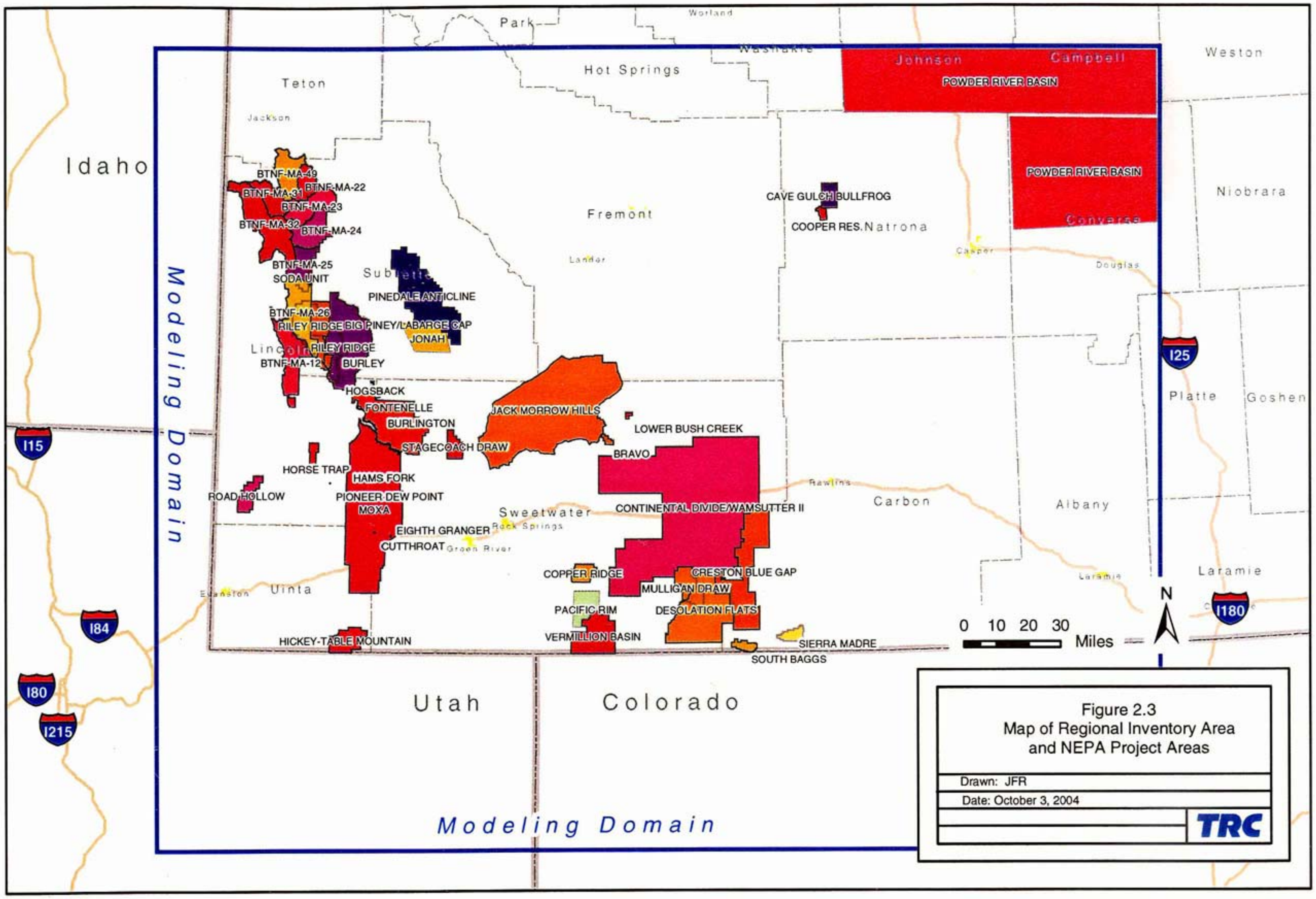


Figure 2.3 Regional Inventory Area and Included NEPA Project Areas.

Table 2.7 Regional Inventory Summary of Emissions Changes from January 1, 2001 to March 31, 2004.

Source/Category	Number of Included Sources	NO_x (tpy)	SO_2 (tpy)	PM_{10} (tpy)	$PM_{2.5}$ (tpy)
Colorado					
Excluded	353	--	--	--	--
RFD	0	--	--	--	--
RFFA	0	--	--	--	--
State Permitted	35	495.0	16.1	218.7	116.5
Idaho					
Excluded	53	--	--	--	--
RFD	0	--	--	--	--
RFFA	0	--	--	--	--
State Permitted	3	94.73	93.67	13.62	13.62
Utah					
Excluded	437	--	--	--	--
RFD	0	--	--	--	--
RFFA	0	--	--	--	--
State Permitted[1]	12	257.6	4.8	(283.6)	(283.6)
Wyoming					
Excluded	1369	--	--	--	--
RFD	44	6,224.2	55.5	48.1	48.1
RFFA	164	4,568.8	(1,394.3)	(833.6)	(330.0)
State Permitted[1]	91	2,020.72	3.6	36.6	20.4
Total					
Excluded	2,212	--	--	--	--
RFD	44	6,224.2	55.5	48.1	48.1
RFFA	164	4,568.8	(1,394.3)	(833.6)	(330.0)
State Permitted[1]	141	2,868.0	118.2	(14.8)	(133.1)

3.0 NEAR-FIELD MODELING ANALYSES

3.1 MODELING METHODOLOGY

A near-field ambient air quality impact analysis was performed to quantify the maximum criteria pollutant (PM_{10}, $PM_{2.5}$, CO, NO_2, SO_2, and ozone [O_3]) and HAP (benzene, toluene, ethylbenzene, xylene, n-hexane, and formaldehyde) impacts that could occur within and near the ARPA and SRPA. These impacts would result from emissions associated with construction and production activities, and are compared to applicable ambient air quality standards, and significance thresholds. All modeling analyses were performed in accordance with the Protocol presented in Appendix A with input from the BLM and members of the air quality stake holders' group, including the EPA, USDA Forest Service, and WDEQ-AQD.

The EPA's proposed guideline dispersion model, AERMOD (version 02222), was used to assess near-field impacts of criteria pollutants PM_{10}, $PM_{2.5}$, CO, NO_2 and SO_2, and to estimate short-term and long-term HAP impacts. This version of AERMOD utilizes the PRIME building downwash algorithms, which are the most current algorithms for modeling applications where aerodynamic building downwash is a concern. One year of Rawlins meteorology data was used with the AERMOD dispersion model to estimate these pollutant impacts. O_3 impacts were estimated from a screening methodology developed by Scheffe (1988) that utilizes NOx and VOC emissions ratios to calculate O_3 concentrations. For each pollutant, the magnitude and duration of emissions from each project phase (i.e., construction or production) emissions activity were examined to determine the maximum emissions scenario modeled.

3.2 METEOROLOGY DATA

One year of surface meteorological data, collected in Rawlins airport for the year of 2002, was used in the analysis. A wind rose for these data is presented in Figure 3.1.

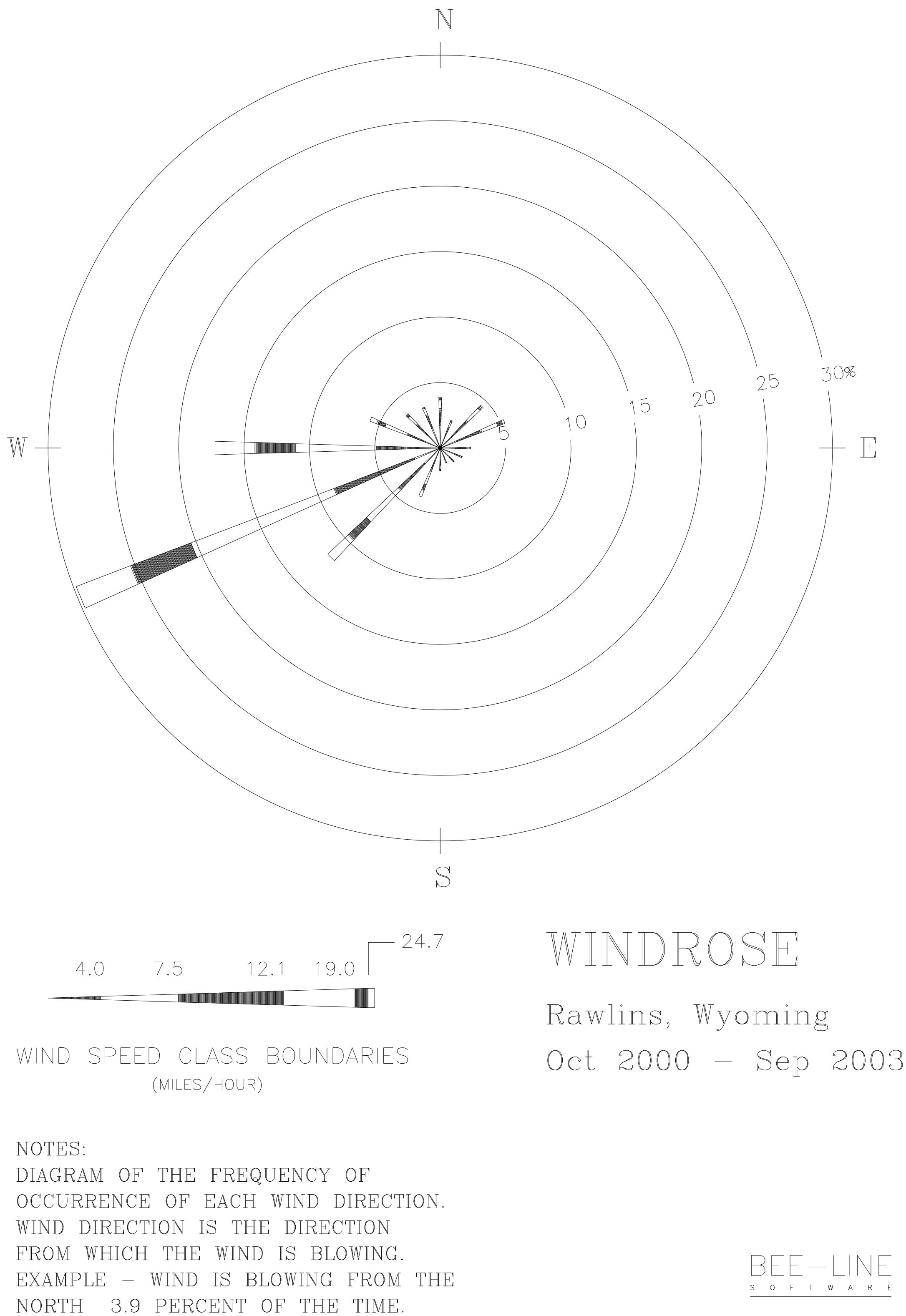


Figure 3.1 Wind Rose, Rawlins, Wyoming, 2000-2003.

The Rawlins surface meteorological data included the standard National Weather Service (NWS) hourly surface measurements of wind speed, wind direction, and temperature. These data were processed using the AERMET preprocessor to produce a dataset compatible with the AERMOD dispersion model. AERMET was used to combine the Rawlins surface measurements with twice daily sounding data from Riverton, Wyoming.

3.3 BACKGROUND POLLUTANT CONCENTRATIONS

Monitored background criteria pollutant concentration data deemed representative of the study area by stakeholders were added to concentrations modeled in the near-field analysis to establish total pollutant concentrations for comparison to ambient air quality standards. The most representative monitored regional background concentrations available for criteria pollutants are shown in Table 3.1.

3.4 ATLANTIC RIM CRITERIA AND HAP POLLUTANT IMPACT ASSESSMENT

The near-field criteria pollutant impact assessment was performed to estimate maximum potential impacts of PM_{10}, $PM_{2.5}$, NO_2, SO_2, CO, and O_3 from project emissions sources including wellsite and compressor station emissions. Maximum predicted concentrations in the vicinity of project emissions sources are compared with the WAAQS, NAAQS, and applicable PSD Class II increments shown in Table 3.2. This NEPA analysis compared potential air quality impacts from the proposed alternatives to applicable ambient air quality standards and PSD increments. The comparisons to the PSD Class I and II increments were intended to evaluate a threshold of concern for potential impacts and does not represent a regulatory PSD increment consumption comparison. Such a regulatory analysis is the responsibility of the state air quality agency (under EPA oversight) and would be conducted during permitting process.

In addition, emissions of Hazardous Air Pollutants (HAPs) including benzene, toluene, ethylbenzene, xylene (BTEX), n-hexane, and formaldehyde were also analyzed from project emission sources. The HAPs analysis is further discussed in Section 3.4.6.

Table 3.1 Near-Field Analysis Background Ambient Air Quality Concentrations ($\mu g/m^3$).

Pollutant	Averaging Period	Measured Background Concentration
Carbon monoxide (CO)[1]	1-hour	3,336
	8-hour	1,381
Nitrogen dioxide (NO_2)[2]	Annual	3.4
Ozone (O_3)[3]	1-hour	75.2
	8-hour	75.2
PM_{10}[4]	24-hour	33
	Annual	16
$PM_{2.5}$[4]	24-hour	13
	Annual	5
Sulfur dioxide (SO_2)[5]	3-hour	132
	24-hour	43
	Annual	9

1 Data collected by Amoco at Ryckman Creek for an 8-month period during 1978-1979, summarized in the Riley Ridge EIS (BLM 1983).
2 Data collected at Green River Basin Visibility Study site, Green River, Wyoming, during period January-December 2001 (Air Resource Specialists [ARS] 2002).
3 Data collected at Green River Basin Visibility Study site, Green River, Wyoming, during period June 10, 1998, through December 31, 2001 (ARS 2002).
4 Data collected by WDEQ-AQD at Emerson Building, Cheyenne, Wyoming, Year 2001, second highest concentrations are listed for short-term (24-hour) averages.
5 Data collected at LaBarge Study Area, Northwest Pipeline Craven Creek Site 1982-1983.

Table 3.2 Ambient Air Quality Standards and Class II PSD Increments (μg/m³).

Pollutant/ Averaging Time	Ambient Air Quality Standards		
	National	Wyoming	PSD Class II Increment
Carbon monoxide (CO)			
1-hour[1]	40,000	40,000	--
8-hour[1]	10,000	10,000	--
Nitrogen dioxide (NO_2)			
Annual[2]	100	100	25
Ozone (O_3)			
1-hour [1]	235	235	--
8-hour[3]	157	157	--
PM_{10}			
24-hour[1]	150	150	30
Annual[2]	50	50	17
$PM_{2.5}$			
24-hour[1,4]	65	65	NA
Annual [2,4]	15	15	NA
Sulfur dioxide (SO_2)			
3-hour[1]	1,300	1,300	512
24-hour[1]	365	260	91
Annual[2]	80	60	20

1 No more than one exceedance per year.
2 Annual arithmetic mean.
3 Average of annual fourth-highest daily maximum 8-hour average.
4 Standard not yet enforced in Wyoming per WAQSR Chapter 2 Section 2(b)(v).

Since $PM_{10}/PM_{2.5}$ emissions are greatest during the resource road/well pad construction phase of field development, construction emissions sources were modeled to determine compliance with the $PM_{10}/PM_{2.5}$ ambient air quality standards. SO_2 emissions are greatest from well drilling operations during construction and that phase development is modeled for SO_2. NO_x and CO emissions are greatest during well production; primarily from compressor stations; therefore, the NO_X and CO analysis was performed for the production phase.

O_3 impacts were estimated using the screening methodology developed by Scheffe (1988) which utilizes NO_x and VOC emissions ratios to calculate O_3 concentrations. NO_x and VOC emissions are greatest during production activities, and these emissions were used to estimate O_3 impacts.

3.4.1 $PM_{10}/PM_{2.5}$

Maximum localized $PM_{10}/PM_{2.5}$ impacts would result from well pad and road construction activities as well as wind erosion. A worst-case modeling scenario consisted of a well pad and a 2.0-mi resource road using the emissions estimates provided in Section 2.1.1. As illustrated in Figure 3.2, model receptors were placed beginning 200-m from the edge of the well pad and road at 50-m intervals along the first row and at 100-m intervals out to 1-km. Flat terrain was assumed. Volume sources were used to represent emissions from well pads and roads. Hourly emission rate adjustment factors were applied to limit construction emissions to daytime hours, and modeling was conducted March 1 through October 31 to reflect 8 months per year of construction operations. AERMOD was used to model each scenario 36 times, once at each of 36 10º wind direction rotations, to ensure that impacts from all directional layout configurations and meteorological conditions were assessed. Wind erosion emissions were modeled for all hours where the wind speed exceeded a threshold velocity. Source emissions and modeling parameters utilized in near-field modeling are provided Appendix D1. Modeling files available upon request.

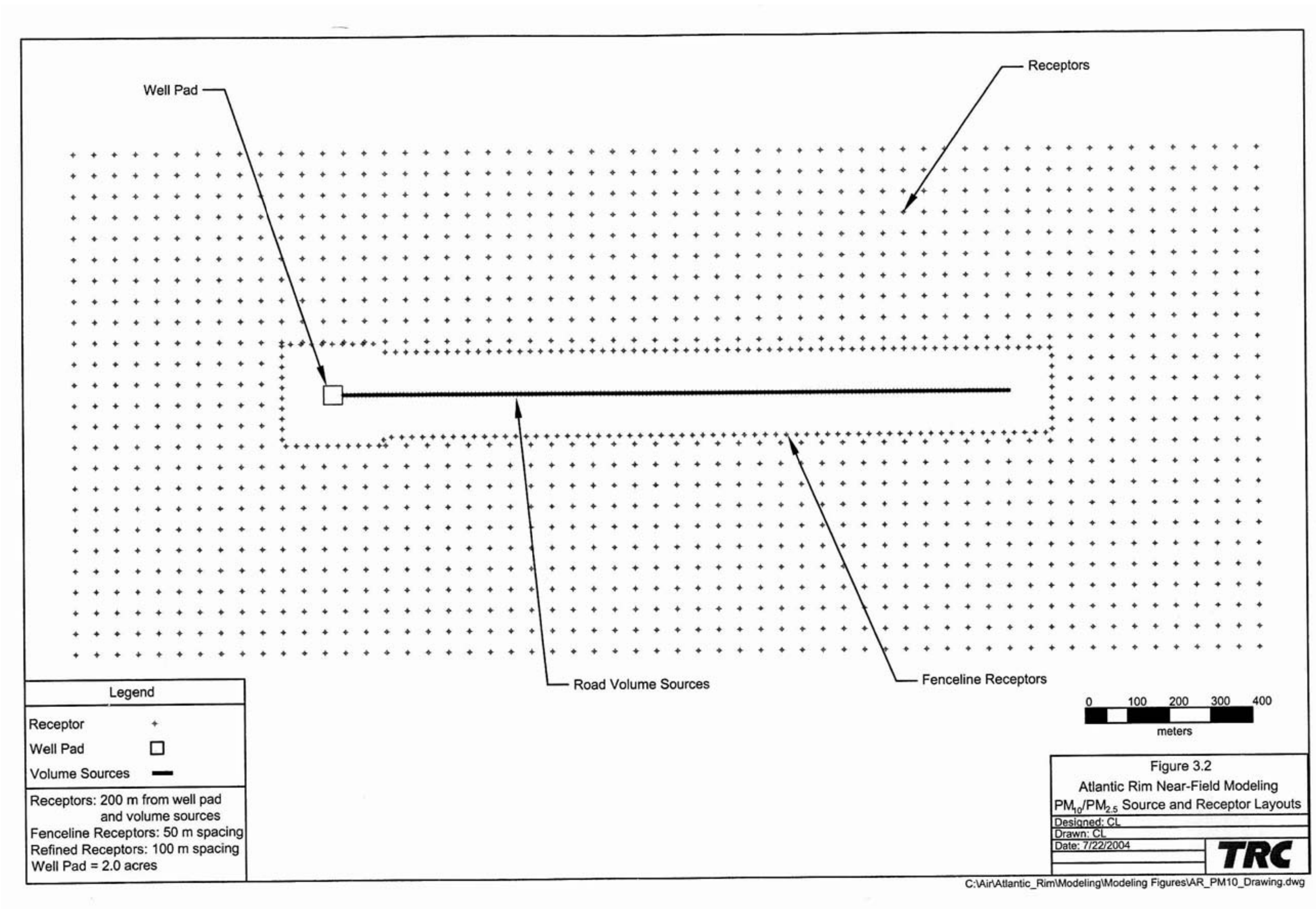


Figure 3.2 Atlantic Rim Near-field $PM_{10}/PM_{2.5}$ Source and Receptor Layouts.

Table 3.3 presents the maximum modeled $PM_{10}/PM_{2.5}$ concentrations for all well pad scenarios. When the maximum modeled concentration was added to representative background concentrations, it is demonstrated that PM_{10} and $PM_{2.5}$ concentrations comply with the WAAQS and NAAQS for PM_{10} and $PM_{2.5}$.

Emissions associated with temporary construction activities do not consume PSD Increment, therefore, impacts from temporary PM_{10} emissions from well pad and road construction are not compared to Class II PSD increments.

3.4.2 SO_2

Emissions from construction drilling operations would result in maximum SO_2 emissions of any development phase and were therefore analyzed in near-field modeling. The modeling scenario developed included a drill rig at the center of a pad, with model receptors beginning 200-m from the well pad at 50-m intervals along the first row and at 100-m intervals out to 1-km. Drill rigs were modeled as point sources. Source emissions and modeling parameters utilized in near-field modeling are provided Appendix D1. Modeling files available upon request. Figure 3.3 illustrates the modeling configuration used for drill rig SO_2 emissions.

Table 3.3 Maximum Modeled $PM_{10}/PM_{2.5}$ Concentrations, Atlantic Rim Project.

Pollutant	Averaging Time	Direct Modeled ($\mu g/m^3$)	Background ($\mu g/m^3$)	Total Predicted ($\mu g/m^3$)	WAAQS ($\mu g/m^3$)	NAAQS ($\mu g/m^3$)
PM_{10}	24-Hour	20.8	33	53.8	150	150
	Period	3.7	16	19.7	50	50
$PM_{2.5}$	24-Hour	7.0	13	20.0	65	65
	Period	1.0	6	5	15	15

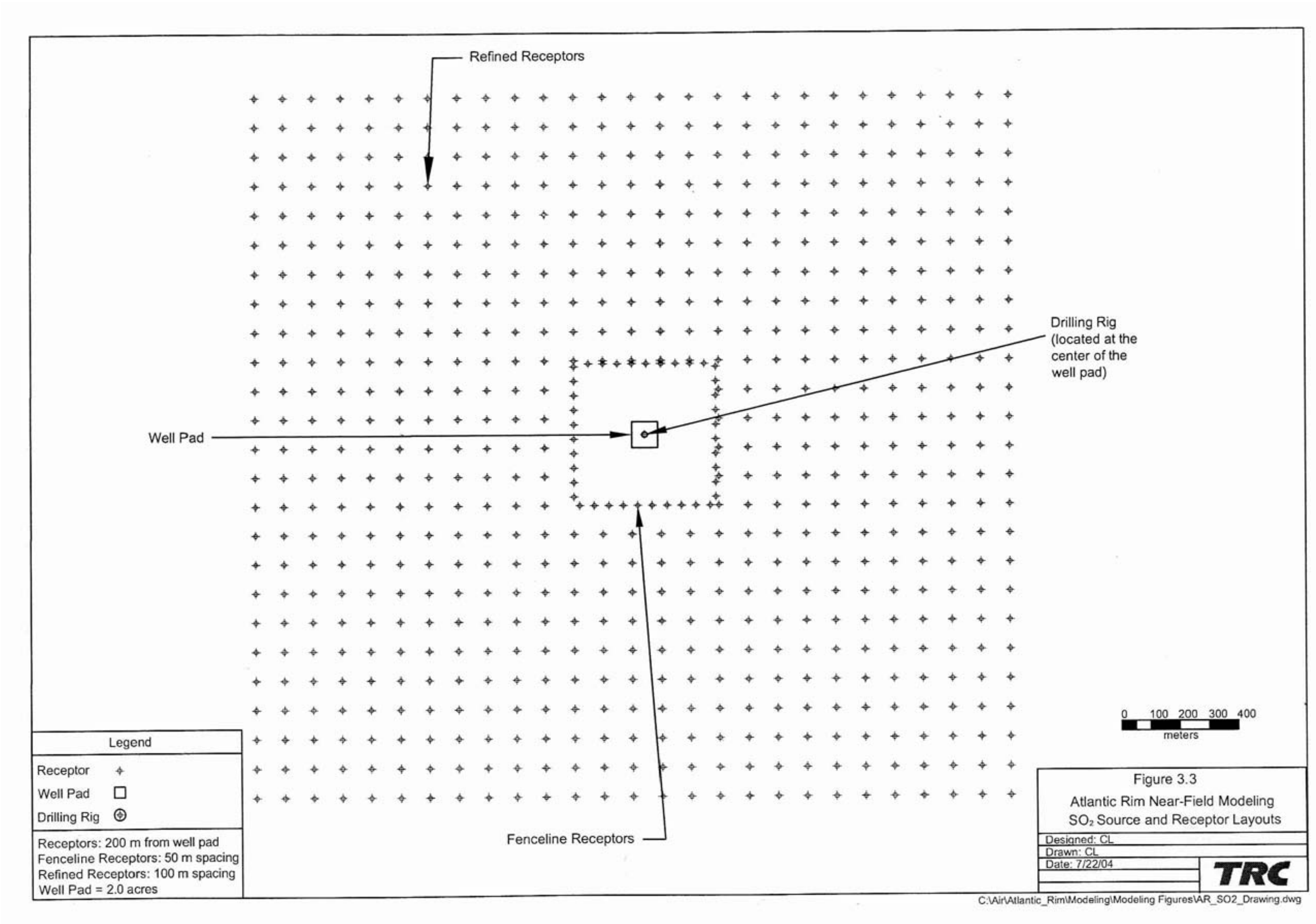


Figure 3.3 Atlantic Rim Near-field SO_2 Source and Receptor Layouts.

AERMOD was used to model drill rig SO_2 emissions. The maximum predicted concentrations are provided in Table 3.4. The modeled SO_2 impacts, when added to representative background concentrations, are below applicable standards.

Emissions associated with temporary construction activities do not consume PSD Increment; therefore, impacts from temporary SO_2 emissions from well drilling are not compared to Class II PSD increments.

3.4.3 NO_2

Production activities (wellsites and compressor stations) would result in maximum NO_X emissions of any development phase. An analysis was performed to quantify the maximum NO_2 impacts that could occur within and nearby the ARPA based on NO_X emissions from the proposed action. Well emissions would include those from haul trucks and from separator heaters at natural gas wells. Also, there are 12 compressor stations included as part of the proposed action and spread throughout the project area, which include Blue Sky, Brown Cow, Cow Creek, Doty Mountain, Jolly Rogers, Muddy Mountain, Red Rim, Sun Dog, and 4 additional planned but unpermitted compressor stations. Each permitted compressor station, with the exception of Cow Creek consists of 2 compressor engines, 2 generators, and 1 dehydrator. Cow Creek,

Table 3.4 Maximum Modeled SO_2 Concentrations, Atlantic Rim Project.

Pollutant	Averaging Time	Direct Modeled (µg/m^3)	Background (µg/m^3)	Total Predicted (µg/m^3)	WAAQS (µg/m^3)	NAAQS (µg/m^3)
SO_2	3-Hour	20.2	132	152.2	1,300	1,300
	24-Hour	9.7	43	52.7	260	365
	Annual	3.2	9	12.2	60	80

consists of 1 compressor engine, 2 generators, and 1 dehydrator. Unpermitted compressor stations were assumed equivalent to the most commonly permitted compressor station configuration.

NO_x emissions provided in Section 2.1.2 for haul trucks and separator heaters at traditional wells were modeled using 12, 1-km^2 area sources centered around each of the 12 compressor stations. Point sources were used for modeling the compressor station emissions and volume sources were used for modeling the dehydrator emissions. Refined receptor grids were placed around each of the 12 area sources, beginning 200-m from the compressor station at 50-m intervals along the fenceline and at 100-m intervals from the fenceline out to 1-km. The entire field was covered by receptors at 1-km intervals, extending to 2-km beyond the field boundary. Figure 3.4 illustrates the modeling configuration used for NO_x production emissions. Source emissions and modeling parameters utilized in near-field modeling are provided Appendix D1. Modeling files available upon request.

AERMAP was used to determine receptor height parameters from 30-m digitized elevation map (DEM) data. Aerodynamic building downwash parameters were considered for each compressor station.

The AERMOD model was used to predict maximum NO_x impacts for the modeled scenario. Maximum modeled concentrations occurred near Jolly Rogers compressor station, near the north end of the ARPA. Maximum modeled NO_2 concentrations were determined by multiplying maximum predicted NO_x concentrations by 0.75, in accordance with EPA's Tier 2 (*Federal Register*, Vol. 60, No. 153, Pg. 40,469, August 4, 1995). NO_x to NO_2 conversion method. Maximum predicted NO_2 concentrations are given in Table 3.5.

As shown in Table 3.5, direct modeled NO_2 concentrations are less than the PSD Class II Increment for NO_2. In addition, when these NO_X emissions are combined with representative background NO_2 concentrations, they are below the applicable WAAQS and NAAQS.

Figure 3.4 Atlantic Rim Near-field NO_x and CO Source and Receptor Layouts.

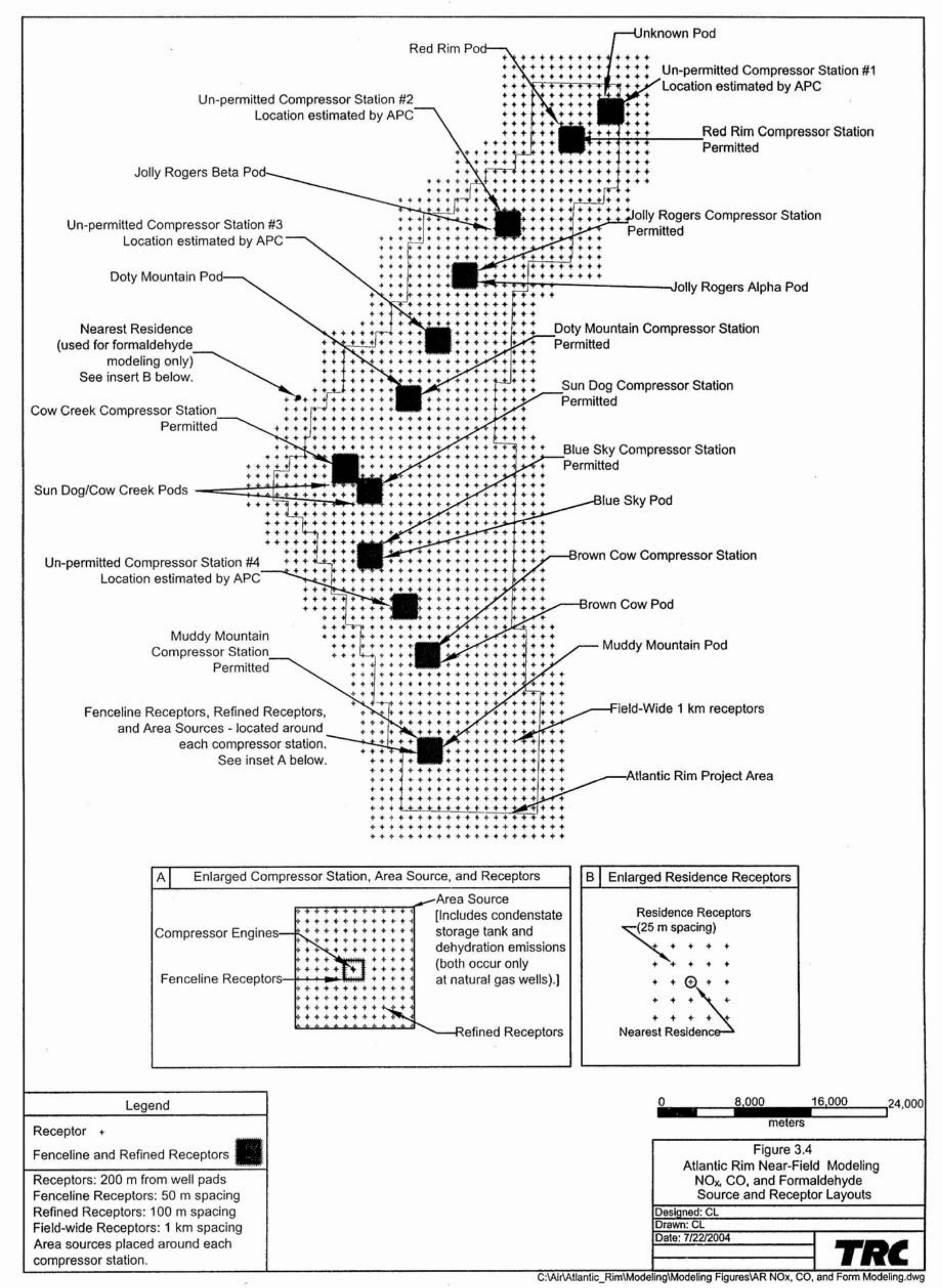


Table 3.5 Maximum Modeled Annual NO_2 Concentrations, Atlantic Rim Project.

Pollutant	Direct Modeled ($\mu g/m^3$)	PSD Class II Increment ($\mu g/m^3$)	Background ($\mu g/m^3$)	Total Predicted $\mu g/m^3$)	WAAQS ($\mu g/m^3$)	NAAQS ($\mu g/m^3$)
NO_2	11.5	25	3.4	14.9	100	100

Source emissions and modeling parameters utilized in near-field modeling are provided Appendix D1.

3.4.4 CO

Maximum CO emissions would occur from the same production activities (wellsites and compressor stations) that result in maximum NO_X emissions. The emission sources and receptors used to model NO_2 impacts were also used to determine maximum CO impacts (see Figure 3.4).

AERMOD was used to predict maximum CO impacts for the modeled scenario. Maximum predicted CO concentrations are given in Table 3.6. As indicated in Table 3.6, maximum CO modeled concentrations, when combined with representative background CO concentrations, are below the applicable WAAQS and NAAQS.

Source emissions and modeling parameters utilized in near-field modeling are provided in Appendix D1. Modeling files are available upon request.

3.4.5 Ozone (O_3)

O_3 is formed in the atmosphere as a result of photochemical reactions involving ambient concentrations of NO_2 and VOC. Because of the complex photochemical reactions necessary to

Table 3.6 Maximum Modeled CO Concentrations, Atlantic Rim Project.

Pollutant	Averaging Time	Direct Modeled ($\mu g/m^3$)	Background ($\mu g/m^3$)	Total Predicted $\mu g/m^3$)	WAAQS ($\mu g/m^3$)	NAAQS ($\mu g/m^3$)
CO	1-Hour	222.6	3,336	3,559	40,000	40,000
	8-Hour	85.9	1,381	1,467	10,000	10,000

form O_3, compliance with ambient air quality standards cannot be determined with conventional dispersion models. Instead, a nomograph developed from the Reactive Plume Model (Scheffe 1988) was used to predict maximum O_3 impacts. This screening methodology utilizes NO_x and VOC emissions ratios to estimate O_3 concentrations.

NO_x and VOC emissions are greatest during production activities and these emissions were used to estimate O_3 impacts. Emissions from a production area consisting of 17 conventional natural gas wells and the Jolly Rogers compressor station site were used. This scenario was selected because the Jolly Rogers station is largest compressor station and NO_x source of the 12 stations proposed within the ARPA, and 17 conventional gas wells was selected as representative of conventional wells near a single compressor station assuming conventional wells are equally distributed around each station. Emissions from the Jolly Rogers station were 58.3 tpy NOx and 75.6 tpy VOC, and emissions for 17 conventional gas wells were 0.5 tpy NO_x and 510.0 tpy VOC. The ratio of total VOC emissions to total NO_x emissions is 585.6 / 58.8 or 10.0. At this ratio, the estimated maximum potential 1-hour O_3 concentration is 0.012 parts per million (ppm) or 23.0 $\mu g/m^3$. Using EPA's recommended screening conversion factor of 0.7 to convert 1-hour concentrations to 8-hour values (EPA 1977), the predicted 8-hour O_3 concentration is 16.1 $\mu g/m^3$. Predicted maximum O_3 impacts are summarized in Table 3.7.

The maximum O_3 impacts shown in Table 3.7 represent the amount of O_3 that could potentially form within and nearby the ARPA as a result of the ratio of direct project emissions of NO_x and

Table 3.7 Maximum Modeled Ozone (O_3) Concentrations, Atlantic Rim Project.

Pollutant	Averaging Time	Direct Modeled ($\mu g/m^3$)	GRUBS Average 1-hour Background ($\mu g/m^3$)	Total Predicted ($\mu g/m^3$)	WAAQS ($\mu g/m^3$)	NAAQS ($\mu g/m^3$)
Ozone (O_3)	1-Hour	23.0	75.2	98.2	235	235
	8-Hour	16.1	75.2	91.3	157	157

VOC. Direct modeled concentrations shown in Table 3.7 were added to average hourly background O_3 conditions monitored as part of the Green River Basin Visibility Study (ARS 2002) during the period June 10, 1998, through December 31, 2001. This value, 75.2 $\mu g/m^3$, is slightly higher than the background O_3 concentration of 62.6 $\mu g/m^3$ inherent in the background O_3 condition used in the RPM model that was used to derive the Scheffe nomograph. The highest, 2nd highest O_3 concentration monitored over the period of record was originally proposed in the protocol. After further consideration, it was determined that pairing a screening modeled concentration with a maximum background concentration monitored over the period of record results in an overestimate of potential O_3 concentrations. O_3 formation is a complex atmospheric chemistry process that varies greatly due to meteorological conditions and the presence of ambient atmospheric concentrations of many chemical species. Adding NO_x and VOC emissions to the ambient air, where some amount of O_3 has already formed, is not necessarily an indication that the potential for O_3 formation has increased. In fact, it could decrease, since the ambient background conditions that caused O_3 formation have changed, and the new mixture of chemical species in the atmosphere may not be conducive to O_3 formation. In addition, the concentrations, shown in Table 3.7 are likely overestimates of the actual O_3 impacts that would occur, since the RPM nomograph used to derive these estimates was developed using meteorological conditions more conducive to forming O_3 than that found in south-western Wyoming.

3.4.6 HAPS

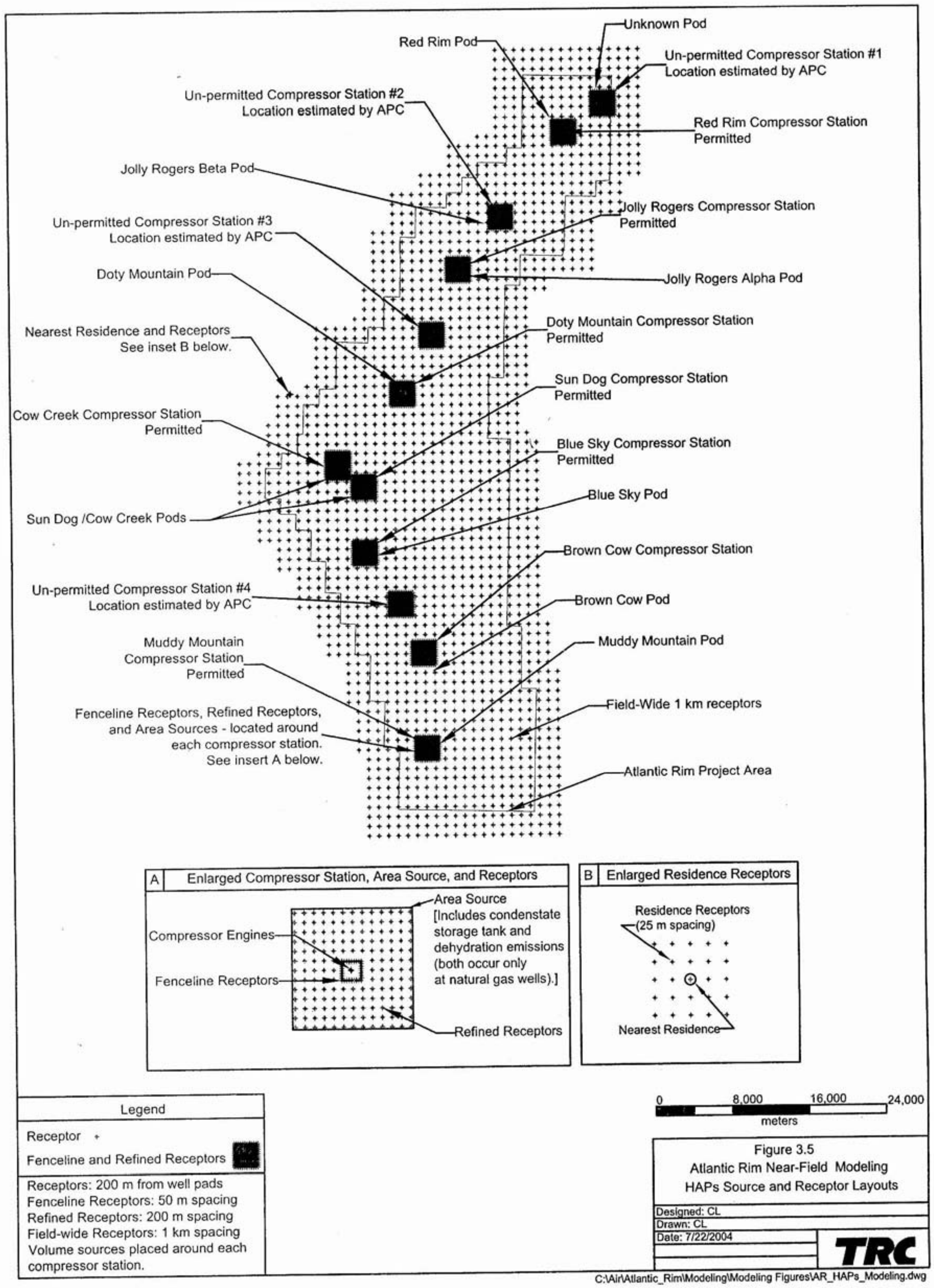
AERMOD was used to determine HAP impacts in the immediate vicinity of the ARPA emission sources for short-term (acute) exposure assessment and at the nearest residence to the ARPA for calculation of long-term risk. Sources of HAPs include gas dehydration and condensate storage tank emissions (benzene, toluene, ethylbenzene, xylene, and n-hexane), located only at the 200 natural gas wells, and formaldehyde emissions from the compressor stations. Because HAPs are emitted predominantly during the production phase, only HAP emissions from production were analyzed.

The modeling scenario developed for modeling short-term (1-hour) HAPs (benzene, toluene, ethylbenzene, xylene, and n-hexane) consisted of 12 volume sources, centered around each compressor station. HAPs emissions from gas dehydration and condensate storage tanks were included in the 12 volume sources. Refined receptors were placed at 50-m intervals on the fenceline and at 200-m intervals out to 1-km. Receptors were placed throughout the field at 1-km intervals, spanning to 2-km outside the field boundary. AERMAP was used to determine receptor height parameters from 30-m digitized elevation map (DEM) data. The source and receptor layouts utilized for the short-term HAP modeling are presented in Figure 3.5.

The long-term (annual) HAP modeling scenario developed was similar to the short-tem modeling scenario with the exception of the 1-km interval receptors. In place of the 1-km receptors, a receptor grid (5 x 5), at 25-m spacing, was placed around the nearest residence just west of the ARPA (see Figure 3.5).

Compressor station formaldehyde emissions were modeled in an analysis similar to what was performed for NO_2 and CO (see Sections 3.4.3 and 3.4.4). Formaldehyde emissions from the 12 proposed compressor stations were modeled. These emissions are provided in Appendix D1. Modeling files available upon request. The modeling parameters and receptor grids developed for the NO_x and CO impacts analyses were utilized for short-term formaldehyde. Long-term

Figure 3.5 Atlantic Rim Near-field HAPs Source and Receptor Layouts.



impacts are reported for the residential receptor locations used in the HAPs modeling. The source and receptor layout for modeling formaldehyde impacts is presented in Figure 3.4.

Reference Exposure Levels (RELs) are defined as concentrations at or below which no adverse health effects are expected. Since no RELs are available for ethylbenzene and n-hexane, the available Immediately Dangerous to Life or Health (IDLH) values were used. These REL and IDLH values are determined by the National Institute for Occupational Safety and Health (NIOSH) and were obtained from EPA's Air Toxics Database (EPA 2002). Modeled short-term HAP concentrations are compared to REL and IDLH values in Table 3.8. As shown in Table 3.8 the maximum predicted short-term HAP impacts within and near the ARPA would be below the REL or IDLH values.

Annual modeled HAP concentrations are compared to Reference Concentrations for Chronic Inhalation (RfCs). A RfC is defined by EPA as the daily inhalation concentration at which no long-term adverse health effects are expected. RfCs exist for both non-carcinogenic and carcinogenic effects on human health (EPA 2002). The maximum predicted annual HAP concentrations at the nearest residential area are compared to the corresponding non-carcinogenic RfC in Table 3.9. As shown in Table 3.9 the maximum predicted long-term HAP impacts at the nearest residence location would be below the RfCs.

Table 3.8 Maximum Modeled 1-Hour HAP Concentrations, Atlantic Rim Project.

HAP	Modeled Concentration ($\mu g/m^3$)	REL or IDLH ($\mu g/m^3$)
Benzene	926.0	1,300
Toluene	1,414.0	37,000
Ethylbenzene	154.0	35,000
Xylene	823.0	22,000
n-Hexane	3,832.0	39,000
Formaldehyde	11.0	94

Table 3.9 Maximum Modeled Annual HAP Concentrations, Atlantic Rim Project.

HAP	Modeled Concentration (μg/m³)	Non-Carcinogenic RfC (μg/m³)
Benzene	0.019	30
Toluene	0.029	400
Ethylbenzene	0.003	1,000
Xylene	0.017	430
n-Hexane	0.077	200
Formaldehyde	0.003	10

Long-term exposures to emissions of suspected carcinogens (benzene and formaldehyde) were evaluated based on estimates of the increased latent "cancer risk" over a 70-year lifetime. This analysis presents the potential incremental risk from these pollutants, and does not represent a total risk analysis. The cancer risks were calculated using the maximum predicted annual concentrations and EPA's Chronic Inhalation unit risk factors (URF) for carcinogenic constituents (EPA 2002). Estimated cancer risks were evaluated based on the "Superfund" National Oil and Hazardous Substances Pollution Contingency Plan (EPA 1990), where a cancer risk range of 1×10^{-6} to 1×10^{-4} is generally acceptable. Two estimates of cancer risk are presented: 1) a most likely exposure (MLE) scenario; and 2) a maximum exposed individual (MEI) scenario. The estimated cancer risks are adjusted to account for duration of exposure and time spent at home.

The adjustment for the MLE scenario is assumed to be 9 years, which corresponds to the mean duration that a family remains at a residence (EPA 1993). This duration corresponds to an adjustment factor of 9/70 = 0.13. The duration of exposure for the MEI scenario is assumed to be 50 years (i.e., the LOF), corresponding to an adjustment factor of 50/70 = 0.71. A second adjustment is made for time spent at home versus time spent elsewhere. For the MLE scenario, the at-home time fraction is 0.64 (EPA 1993), and it is assumed that during the rest of the day the individual would remain in an area where annual HAP concentrations would be one quarter as large as the maximum annual average concentration. Therefore, the MLE adjustment factor is

(0.13) x [(0.64 x 1.0) + (0.36 x 0.25)] = 0.0949. The MEI scenario assumes that the individual is at home 100% of the time, for a final adjustment factor of (0.71 x 1.0) = 0.71.

For each constituent, the cancer risk is computed by multiplying the maximum predicted annual concentration by the URF and by the overall exposure adjustment factor. The cancer risks for both constituents are then summed to provide an estimate of the total inhalation cancer risk.

The modeled long-term risk from benzene and formaldehyde are shown in Table 3.10.

Under the MLE scenario, the estimated cancer risk associated with the long-term exposure to benzene and formaldehyde is below 1 x 10^{-6}. Under the MEI analyses, the incremental risk for formaldehyde is less than 1 x 10^{-6}, and both the incremental risk for benzene and the combined incremental risk fall on the lower end of the cancer risk range of 1 x 10^{-6} to 1 x 10^{-4}. Total combined risk may not be appropriate.

Table 3.10 Long-term MLE and MEI Cancer Risk Analyses, Atlantic Rim Project.

Analysis	HAP Constituent	Modeled Concentration (μg/m^3)	Unit Risk Factor 1/ (μg/m^3)	Exposure Adjustment Factor	Cancer Risk
MLE	Benzene	0.019	7.8 x 10^{-6}	0.0949	1.39E-08
	Formaldehyde	0.0030	1.3 x 10^{-5}	0.0949	3.66E-09
Total Combined Risk					1.8 x 10^{-8}
MEI	Benzene	0.019	7.8 x 10^{-6}	0.71	1.04E-07
	Formaldehyde	0.0030	1.3 x 10^{-5}	0.71	2.74E-08
Total Combined Risk					1.3 x 10^{-7}

3.5 SEMINOE ROAD CRITERIA AND HAP POLLUTANT IMPACT ASSESSMENT

The near-field criteria pollutant impact assessment was performed to estimate maximum potential impacts of PM_{10}, $PM_{2.5}$, NO_2, SO_2, CO, and O_3 from project emissions sources including wellsite and compressor station emissions. Maximum predicted concentrations in the vicinity of project emissions sources are compared with the WAAQS, NAAQS, and applicable PSD Class II increments shown in Table 3.11. This NEPA analysis compared potential air quality impacts from the proposed alternatives to applicable ambient air quality standards and PSD increments. The comparisons to the PSD Class I and II increments were intended to evaluate a threshold of concern for potential impacts and does not represent a regulatory PSD increment consumption comparison. Such a regulatory analysis is the responsibility of the state air quality agency (under EPA oversight) and would be conducted during permitting process.

In addition, the emission the HAP formaldehyde was also analyzed from project emission sources. Due to the constituents that make up coalbed methane gas, no other HAPs were emitted from the project. The HAP analysis is further discussed in Section 3.5.6.

Since PM_{10}/$PM_{2.5}$ emissions are greatest during the resource road/well pad construction phase of field development, construction emissions sources were modeled to determine compliance with the PM_{10}/$PM_{2.5}$ ambient air quality standards. Similarly, SO_2 emissions are greatest from well drilling operations during construction and that phase of development is modeled. NO_x and CO emissions are greatest during well production; primarily from compressor stations; therefore, the NO_X and CO analysis was performed for the production phase.

O_3 impacts were estimated using the screening methodology developed by Scheffe (1988) which utilizes NO_x and VOC emissions ratios to calculate O_3 concentrations. NO_x and VOC emissions are greatest during production activities, and these emissions were used to estimate O_3 impacts.

Table 3.11 Ambient Air Quality Standards and Class II PSD Increments for Comparison to Near-Field Analysis Results (µg/m^3).

Pollutant/Averaging Time	Ambient Air Quality Standards		
	National	Wyoming	PSD Class II Increment
Carbon monoxide (CO)			
1-hour[1]	40,000	40,000	--
8-hour[1]	10,000	10,000	--
Nitrogen dioxide (NO_2)			
Annual[2]	100	100	25
Ozone (O_3)			
1-hour [1]	235	235	--
8-hour[3]	157	157	--
PM_{10}			
24-hour[1]	150	150	30
Annual[2]	50	50	17
$PM_{2.5}$			
24-hour[1,4]	65	65	NA
Annual [2,4]	15	15	NA
Sulfur dioxide (SO_2)			
3-hour[1]	1,300	1,300	512
24-hour[1]	365	260	91
Annual[2]	80	60	20

1 No more than one exceedance per year.
2 Annual arithmetic mean.
3 Average of annual fourth-highest daily maximum 8-hour average.
4 Standard not yet enforced in Wyoming per WAQSR Chapter 2 Section 2(b)(v).

3.5.1 PM_{10}/$PM_{2.5}$

Maximum localized PM_{10}/$PM_{2.5}$ impacts would result from well pad and road construction activities as well as wind erosion. A worst-case modeling scenario consisted of a well pad and a 2.0-mi resource road using the emissions estimates provided in Section 2.2.1. As illustrated in Figure 3.6 model receptors were placed beginning 200-m from the edge of the well pad and road at 50-m intervals along the first row and at 100-m intervals out to 1-km. Flat terrain was assumed. Volume sources were used to represent emissions from well pads and roads. Hourly emission rate adjustment factors were applied to limit construction emissions to daytime hours, and modeling was conducted March 1 through October 31 to reflect 8 months per year of construction operations. AERMOD was used to model each scenario 36 times, once at each of 36 10º wind direction rotations, to ensure that impacts from all directional layout configurations and meteorological conditions were assessed. Wind erosion emissions were modeled for all hours where the wind speed exceeded a threshold velocity. Source emissions and modeling parameters utilized in near-field modeling are provided Appendix D2. Modeling files available upon request.

Table 3.12 presents the maximum modeled PM_{10}/$PM_{2.5}$ concentrations, for all well pad scenarios. When the maximum modeled concentration was added to representative background concentrations, it is demonstrated that PM_{10} and $PM_{2.5}$ concentrations comply with the WAAQS and NAAQS for PM_{10} and $PM_{2.5}$.

Emissions associated with temporary construction activities do not consume PSD Increment, therefore, impacts for temporary PM_{10} emissions from well pad and road construction are not compared to Class II PSD increments excluded from increments.

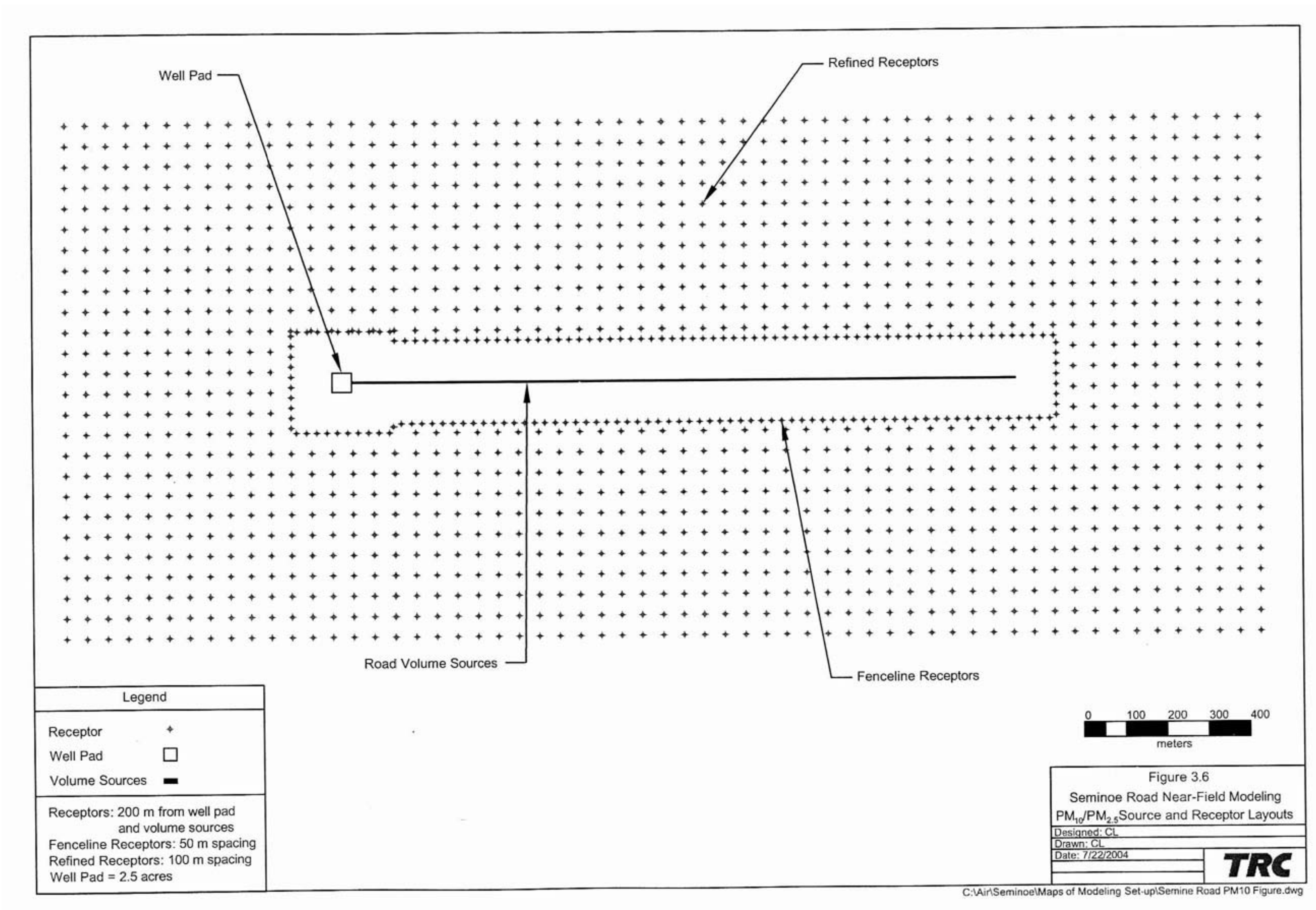


Figure 3.6 Seminoe Road Near-field $PM_{10}/PM_{2.5}$ Source and Receptor Layouts.

Table 3.12 Maximum Modeled $PM_{10}/PM_{2.5}$ Concentrations, Seminoe Road Project.

Pollutant	Averaging Time	Direct Modeled (μg/m^3)	Background (μg/m^3)	Total Predicted (μg/m^3)	WAAQS (μg/m^3)	NAAQS (μg/m^3)
PM_{10}	24-Hour	20.4	33	53.4	150	150
	Annual	3.5	16	19.5	50	50
$PM_{2.5}$	24-Hour	7.1	13	20.1	65	65
	Annual	1.0	5	6.0	15	15

were modeled as point sources. Source emissions and modeling parameters utilized in near-field modeling are provided Appendix D2. Modeling files available upon request. Figure 3.7 illustrates the modeling configuration used for drill rig SO_2 emissions.

AERMOD was used to model drill rig SO_2 emissions. The maximum predicted concentrations are provided in Table 3.13. The modeled SO_2 impacts, when added to representative background concentrations, below the applicable standards.

Emissions associated with temporary construction activities do not consume PSD Increment, therefore, impacts for temporary SO_2 emissions from well pad and road construction are not compared to Class II PSD increments excluded from increments.

3.5.3 NO_2

Non-electrified production activities (wellsites and compressor stations) would result in maximum NO_X emissions of any development phase. An analysis was performed to quantify the maximum NO_2 impacts that could occur within and nearby the SRPA based on NO_X non-electrified scenario. The non-electrified alternative was considered worst-case on a near-field basis because all wellsite pumps and all compressors would be gas-fired and was the only

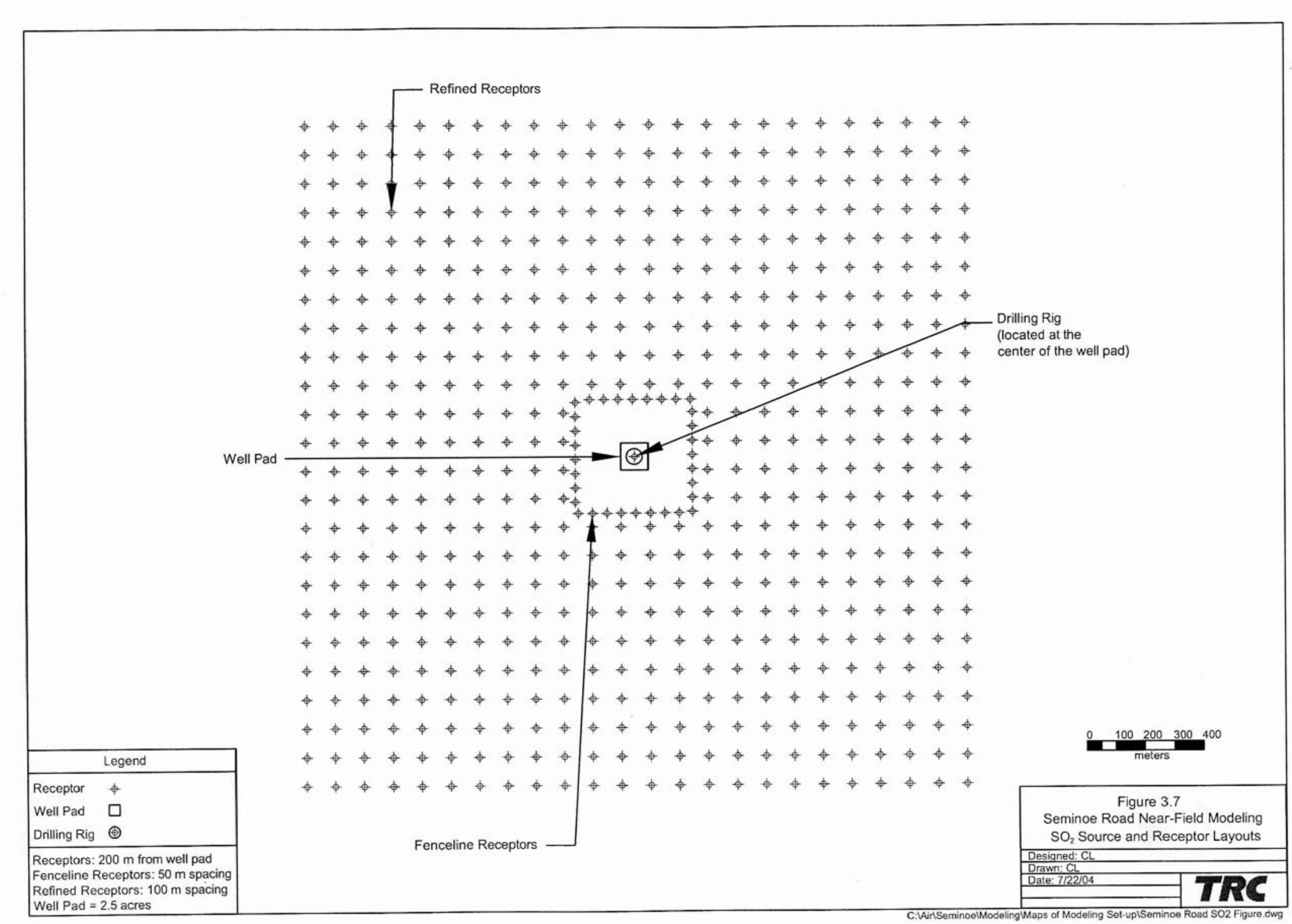


Figure 3.7 Seminoe Road Near-field SO_2 Source and Receptor Layouts.

Table 3.13 Maximum Modeled SO_2 Concentrations, Seminoe Road Project.

Pollutant	Averaging Time	Direct Modeled (μg/m^3)	Background (μg/m^3)	Total Predicted (μg/m^3)	WAAQS (μg/m^3)	NAAQS (μg/m^3)
SO_2	3-Hour	15.4	132	147.4	1,300	1,300
	24-Hour	7.6	43	50.6	260	365
	Annual	2.8	9	11.8	60	80

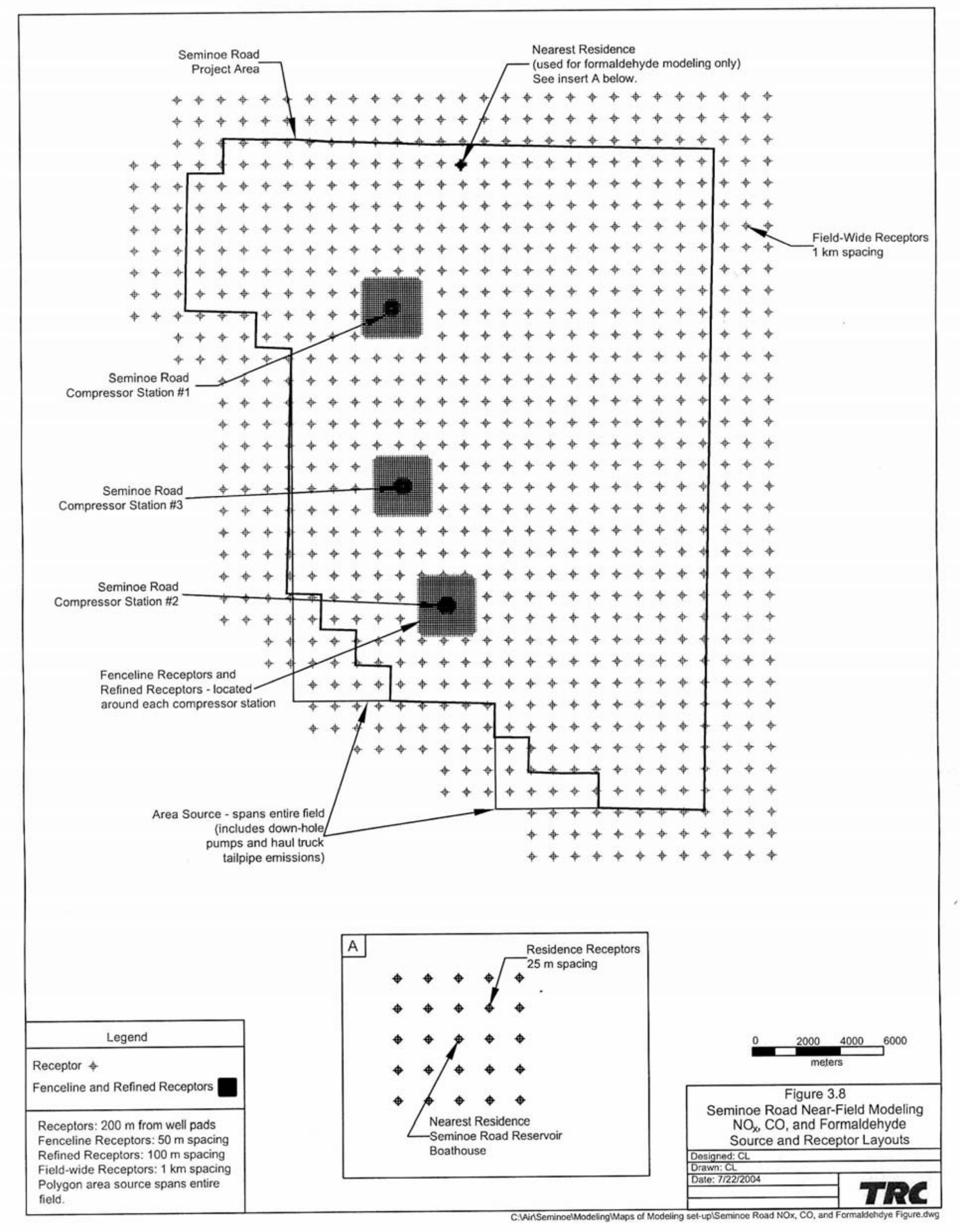
alternative analyzed in the near-field NO_X and CO modeling. Well emissions would include those from down-hole pumps and haul trucks. Also, there are 3 compressor stations included and spread throughout the project area, with each compressor station consisting of 2 compressor engines.

NO_x emissions provided in Section 2.2.2 for down-hole pumps and haul trucks were modeled using 1 area source polygon which spans the SRPA. Receptors were placed throughout the entire field at 1-km intervals, extending 2-km beyond the field boundary. Compressor station emissions were modeled as point sources. Refined receptor grids were placed around each of the 3 compressor stations, beginning 200-m from the compressor station at 50-m intervals along the fenceline and at 100-m intervals from the fenceline out to 1-km. Figure 3.8 illustrates the modeling configuration used for NO_x production emissions. Source emissions and modeling parameters utilized in near-field modeling are provided Appendix D2. Modeling files available upon request.

AERMAP was used to determine receptor height parameters from 30-m digitized elevation map (DEM) data. Aerodynamic building downwash parameters were considered for each compressor station.

The AERMOD model was used to predict maximum NO_x impacts for the modeled scenario. Maximum modeled concentrations occurred near Seminoe Road Compressor Station #3, near the

Figure 3.8 Seminoe Road Near-field NO_x, CO, and Formaldehyde Model Configuration.



middle of the SRPA. Maximum modeled NO_2 concentrations were determined by multiplying maximum predicted NO_x concentrations by 0.75, in accordance with EPA's Tier 2 (*Federal Register* Vol. 60, No. 153, Pg. 40,469, Aug. 9, 1995) NO_x to NO_2 conversion method. Maximum predicted NO_2 concentrations are given in Table 3.14.

As shown in Table 3.14, direct modeled NO_2 concentrations are less than the PSD Class II Increment for NO_2. In addition, when these NO_2 impacts are combined with representative background NO_2 concentrations, they are below the applicable WAAQS and NAAQS.

3.5.4 CO

Maximum CO emissions would occur from the same production activities (wellsites and compressor stations) that result in maximum NO_X emissions. The emission sources and receptors used to model NO_2 impacts were also used to determine maximum CO impacts (see Figure 3.8).

AERMOD was used to predict maximum CO impacts for the modeled scenario. Maximum predicted CO concentrations are given in Table 3.15. As indicated in Table 3.15, maximum CO modeled concentrations, when combined with representative background CO concentrations, are below the applicable WAAQS and NAAQS.

Source emissions and modeling parameters utilized in near-field modeling are provided Appendix D2. Modeling files available upon request.

Table 3.14 Maximum Modeled Annual NO_2 Concentrations, Seminoe Road Project.

Pollutant	Direct Modeled ($\mu g/m^3$)	PSD Class II Increment ($\mu g/m^3$)	Background ($\mu g/m^3$)	Total Predicted ($\mu g/m^3$)	WAAQS ($\mu g/m^3$)	NAAQS ($\mu g/m^3$)
NO_2	11.1	25	3.4	14.5	100	100

Table 3.15 Maximum Modeled CO Concentrations, Seminoe Road Project.

Pollutant	Averaging Time	Direct Modeled (µg/m^3)	Background (µg/m^3)	Total Predicted µg/m^3)	WAAQS (µg/m^3)	NAAQS (µg/m^3)
CO	1-Hour	101.7	3,336	3,438	40,000	40,000
	8-Hour	46.6	1,381	1,428	10,000	10,000

3.5.5 Ozone (O_3)

O_3 is formed in the atmosphere as a result of photochemical reactions involving ambient concentrations of NO_2 and VOC. Because of the complex photochemical reactions necessary to form O_3, compliance with ambient air quality standards cannot be determined with conventional dispersion models. Instead, a nomograph developed from the Reactive Plume Model (Scheffe 1988) was used to predict maximum O_3 impacts. This screening methodology utilizes NO_x and VOC emissions ratios to estimate O_3 concentrations.

NO_x and VOC emissions are greatest during production activities and these emissions were used to estimate O_3 impacts. Emissions from a patch consisting of 26 CBM gas wells and a compressor station site were used. This scenario was selected since it represents the maximum emissions from CBM wells anticipated outside of the electrification boundary combined with the emissions from a compressor station. The emissions from the compressor station were 38.6 tpy NO_x and 26.2 tpy VOC, and emissions for the 26 CBM wells were 26.0 tpy NO_x and 26.0 tpy VOC. The ratio of total VOC emissions to total NO_x emissions is 52.0 / 64.6 or 0.8. At this ratio, the estimated maximum potential 1-hour O_3 concentration is 0.011 parts per million (ppm) or 21.0 µg/m^3. Using EPA's recommended screening conversion factor of 0.7 to convert 1-hour concentrations to 8-hour values (EPA 1977), the predicted 8-hour O_3 concentration is 14.7 µg/m^3. Predicted maximum O_3 impacts are summarized in Table 3.16.

The maximum O_3 impacts shown in Table 3.16 represent the amount of O_3 that could potentially form within and nearby the SRPA, as a result of the ratio of direct project emissions of NO_x and

VOC. Direct modeled concentrations shown in Table 3.16 were added to average hourly background O_3 during the period June 10, 1998, through December 31, 2001. This value, 75.2 μg/m^3, is slightly higher than the background O_3 concentration of 62.6 μg/m^3 inherent in the background O_3 condition used in the RPM model that was used to derive the Scheffe nomograph. The highest, 2nd highest O_3 concentration monitored over the period of record was originally proposed in the protocol. After further consideration, it was determined that pairing a screening model concentration with a maximum background concentration monitored over the period of record results in an overestimate of the potential O_3 concentrations. O_3 formation is a complex atmospheric chemistry process that varies greatly due to meteorological conditions and the presence of ambient atmospheric concentrations of many chemical species. Adding NO_x and VOC emissions to the ambient air, where some amount of O_3 has already formed, is not necessarily an indication that the potential for O_3 formation has increased. In fact, it could decrease, since the ambient background conditions that caused O_3 formation have changed, and the new mixture of chemical species in the atmosphere may not be conducive to O_3 formation. Direct modeled concentrations, shown in Table 3.16 were added to background O_3 conditions that were used in the Reactive Plume Model to derive the nomographs. In addition, the concentrations, shown in Table 3.16 are likely overestimates of the actual O_3 impacts that would

Table 3.16 Maximum Modeled Ozone (O_3) Concentrations, Seminoe Road Project.

Pollutant	Averaging Time	Direct Modeled (μg/m^3)	GRUBS Average 1-Hour Background (μg/m^3)	Total Predicted (μg/m^3)	WAAQS (μg/m^3)	NAAQS (μg/m^3)
Ozone (O_3)	1-Hour	21.0	75.2	98.2	235	235
	8-Hour	14.7	75.2	91.3	157	157

occur, since the nomograph used to derive these estimates was developed using meteorological conditions more conducive to forming O_3 than that found in south-western Wyoming.

3.5.6 HAPS

AERMOD was used to determine HAP impacts in the immediate vicinity of the SRPA emission sources for short-term (acute) exposure assessment and at the nearest residence to the SRPA for calculation of long-term risk. Due to the constituents that make up coal bed methane gas, formaldehyde is the only HAP emitted. Sources of formaldehyde emissions include down-hole pumps, haul trucks, and compressor stations. Because formaldehyde is emitted predominantly from combustion equipment operating during the production phase, only formaldehyde emissions from production were analyzed.

Compressor station formaldehyde emissions were modeled in an analysis similar to what was performed for NO_2 and CO (see Sections 3.5.3 and 3.5.4). Formaldehyde emissions from the down-hole pumps, haul trucks, and 3 proposed compressor stations were modeled. These emissions are provided in Appendix D2. Modeling files available upon request. The modeling parameters and receptor grids developed for the NO_x and CO impacts analyses were utilized for short-term (1-hour) formaldehyde. A 5 x 5 receptor grid at 25-m spacing was placed around the nearest residential location, located just inside the northern boundary of the SRPA for modeling formaldehyde long-term (annual) impacts. The source and receptor layouts for modeling formaldehyde impacts are presented in Figure 3.8.

Reference Exposure Levels (RELs) are defined as concentrations at or below which no adverse health effects are expected. The REL values are determined by the National Institute for Occupational Safety and Health (NIOSH) and were obtained from EPA's Air Toxics Database (EPA 2002). The modeled short-term formaldehyde concentration is compared to the REL value in Table 3.17. As shown in Table 3.17 the maximum predicted short-term formaldehyde impact within and near the SRPA would be below the REL.

The annual modeled formaldehyde concentration is compared to the Reference Concentration for Chronic Inhalation (RfC). A RfC is defined by EPA as the daily inhalation concentration at which no long-term adverse health effects are expected. RfCs exist for both non-carcinogenic and carcinogenic effects on human health (EPA 2002). The maximum predicted annual formaldehyde concentration at the nearest residential area is compared to the corresponding non-carcinogenic RfC in Table 3.18. As shown in Table 3.18 the maximum predicted long-term formaldehyde impact at the nearest residence location would be below the RfC.

Long-term exposures to emissions of suspected carcinogen (formaldehyde) were evaluated based on estimates of the increased latent "cancer risk" over a 70-year lifetime. This analysis presents the potential incremental risk from this pollutant, and does not represent a total risk analysis. The cancer risk was calculated using the maximum predicted annual concentrations and EPA's Chronic Inhalation unit risk factor (URF) for carcinogenic constituents (EPA 2002). Estimated cancer risks were evaluated based on the "Superfund" National Oil and Hazardous Substances Pollution Contingency Plan (EPA 1990), where a cancer risk range of 1×10^{-6} to 1×10^{-4} is generally acceptable. Two estimates of cancer risk are presented: 1) a most likely exposure (MLE) scenario; and 2) a maximum exposed individual (MEI) scenario. The estimated cancer risks are adjusted to account for duration of exposure and time spent at home.

Table 3.17 Maximum Modeled 1-Hour HAP Concentrations, Seminoe Road Project.

HAP	Modeled Concentration ($\mu g/m^3$)	REL or IDLH ($\mu g/m^3$)
Formaldehyde	4.07	94

Table 3.18 Maximum Modeled Annual HAP Concentrations, Seminoe Road Project.

HAP	Modeled Concentration ($\mu g/m^3$)	Non-Carcinogenic RfC ($\mu g/m^3$)
Formaldehyde	0.027	9.8

The adjustment for the MLE scenario is assumed to be 9 years, which corresponds to the mean duration that a family remains at a residence (EPA 1993). This duration corresponds to an adjustment factor of 9/70 = 0.13. The duration of exposure for the MEI scenario is assumed to be 50 years (i.e., the LOF), corresponding to an adjustment factor of 50/70 = 0.71. A second adjustment is made for time spent at home versus time spent elsewhere. For the MLE scenario, the at-home time fraction is 0.64 (EPA 1993), and it is assumed that during the rest of the day the individual would remain in an area where annual HAP concentrations would be one quarter as large as the maximum annual average concentration. Therefore, the MLE adjustment factor is (0.13) x [(0.64 x 1.0) + (0.36 x 0.25)] = 0.0949. The MEI scenario assumes that the individual is at home 100% of the time, for a final adjustment factor of (0.71 x 1.0) = 0.71.

For each constituent, the cancer risk is computed by multiplying the maximum predicted annual concentration by the URF and by the overall exposure adjustment factor. The cancer risks for both constituents are then summed to provide an estimate of the total inhalation cancer risk.
The modeled long-term risk of formaldehyde is shown in Table 3.19.

Under the MLE scenario, the estimated cancer risk associated with the long-term exposure to formaldehyde is below 1×10^{-6}. Under the MEI analyses, the incremental risk for formaldehyde is less than 1×10^{-6}, and both the incremental risk and the combined incremental risk fall on the lower end of the cancer risk range of 1×10^{-6} to 1×10^{-4}.

Table 3.19 Long-term MLE and MEI Cancer Risk Analyses, Seminoe Road Project.

Analysis	HAP Constituent	Modeled Concentration (μg/m^3)	Unit Risk Factor 1/(μg/m^3)	Exposure Adjustment Factor	Cancer Risk
MLE	Formaldehyde	0.027	1.3×10^{-5}	0.0949	3.31E-08
MEI	Formaldehyde	0.027	1.3×10^{-5}	0.71	2.48E-07

4.0 FAR-FIELD ANALYSES

The purpose of the far-field analyses was to quantify potential air quality impacts on Class I and Class II areas from air pollutant emissions of NO_x, SO_2, PM_{10}, and $PM_{2.5}$ expected to result from the development of the Atlantic Rim and Seminoe Road projects. The analyses were performed using the EPA CALMET/CALPUFF modeling system to predict air quality impacts from Project and regional sources at far-field PSD Class I and sensitive Class II areas. The PSD Class I areas and sensitive Class II areas analyzed are shown on Map 1.2 and include:

- the Bridger Wilderness Area (Class I);
- the Fitzpatrick Wilderness Area (Class I);
- the Popo Agie Wilderness Area (Class II);
- the Wind River Roadless Area (Class II);
- the Mount Zirkel Wilderness Area (Class I);
- the Rawah Wilderness Area (Class I);
- the Savage Run Wilderness Area (Federal Class II, Wyoming Class I);
- Rocky Mountain National Park (Class I); and
- Dinosaur National Monument (Federal Class II, Colorado Class I).

Predicted pollutant concentrations at these sensitive areas were compared to applicable ambient air quality standards and PSD Class I and Class II increments, and were used to assess potential impacts to Air Quality Related Values (AQRVs)--visibility (regional haze) and acid deposition. In addition, analyses were performed for 14 lakes designated as acid sensitive located within the sensitive PSD Class I and Class II Wilderness Areas to assess potential lake acidification from acid deposition impacts (see Map 1.2). These lakes include:

- Deep Lake in the Bridger Wilderness Area;
- Black Joe Lake in the Bridger Wilderness Area;
- Hobbs Lake in the Bridger Wilderness Area;
- Upper Frozen Lake in the Bridger Wilderness Area;
- Lazy Boy Lake in the Bridger Wilderness Area;
- Ross Lake in the Fitzpatrick Wilderness Area;

- Lower Saddlebag Lake in the Popo Agie Wilderness Area;
- West Glacier Lake in the Glacier Lakes Ecosystem Experiments Site (GLEES);
- Lake Elbert in the Mount Zirkel Wilderness Area;
- Seven Lakes in the Mount Zirkel Wilderness Area;
- Summit Lake in the Mount Zirkel Wilderness Area;
- Island Lake in the Rawah Wilderness Area;
- Kelly Lake in the Rawah Wilderness Area; and
- Rawah Lake #4 in the Rawah Wilderness Area.

The far-field analysis was also used to estimate the cumulative impacts from direct project and regional source impacts at locations within each Project Area. Predicted pollutant impacts at in-field locations were compared to applicable ambient air quality standards. This analysis was performed to further support the compliance demonstrations provided in Section 3.4 for maximum near-field impacts

4.1 MODELING METHODOLOGY

The EPA-approved CALMET/CALPUFF modeling system (CALMET Version 5.53, Level 030709, and CALPUFF Version 5.711, Level 030625) was used for the modeling analyses. The CALMET meteorological model was used to develop wind fields for a year of meteorological data (1995) and the CALPUFF dispersion model combined these wind fields with Project-specific and regional emissions inventories of SO_2, NO_x, PM_{10}, and $PM_{2.5}$ to estimate ambient concentrations and AQRV impacts at in-field and far-field receptor locations. The study area is shown in Map 1.2.

The CALMET and CALPUFF models were utilized in this analysis generally following the methods described in the Impact Assessment Protocol (Appendix A) and the following guidance sources:

- *Guideline on Air Quality Models*, 40 *Code of Federal Regulations* (C.F.R.), Part 51, Appendix W;

- *Interagency Work Group on Air Quality Modeling (IWAQM) Phase 2 Summary Report and Recommendations for Modeling Long Range Transport Impacts*, EPA-454/R-98-019, Office of Air Quality Planning and Standards, December 1998 (IWAQM 1998); and
- *Federal Land Managers - Air Quality Related Values Workgroup (FLAG), Phase I Report*, December 2000 (FLAG 2000).

The CALMET wind fields developed for this analysis follow the CALMET methodologies established as part of the Southwest Wyoming Technical Air Forum (SWWYTAF) for southwest Wyoming, and were further enhanced through the use of additional meteorological datasets and an updated version of the CALMET model code.

4.2 PROJECT MODELING SCENARIOS

Atlantic Rim modeling scenario was developed for the Proposed Action, which includes a proposal for 2,000 new wells in the ARPA; of which up to 10 percent are conventional natural gas wells and the remainder are coalbed methane wells. Maximum field-wide emissions were determined and reflect the last year of field development, and include 1,700 wells in production and 300 wells under construction. The maximum emissions scenario conservatively assumes that both production emissions (producing wellsites and operational ancillary equipment including compressor stations) and construction emissions (drill rigs and associated traffic) occur simultaneously throughout the year. Compression was assumed to operate at 90% of fully permitted capacity, which Operators indicated was a reasonable assumption based on field operation expectations. The scenario analyzed assumes 10 drill rigs and 1 completion flare operating continuously throughout the year. Completion flaring operations (pit flares) were considered since up to 200 conventional natural gas wells are included as part of the Proposed Action and flaring may occur as part of the development of these wells. The maximum field-wide emissions scenarios for the Atlantic Rim Project are summarized in Table 4.1. The emissions used to develop these field-wide scenarios are described in Chapter 2.0.

Table 4.1 Maximum Emissions Scenario, Atlantic Rim Project

Project Phase/Constituent	Emissions (tons per year)
Production Wells[1]	
NO_x	4.6
SO_2	0.0
PM_{10}	0.2
$PM_{2.5}$	0.2
Production Traffic[2]	
NO_x	0.5
SO_2	0.01
PM_{10}	431.8
$PM_{2.5}$	64.8
Compression[3]	
NO_x	589.4
SO_2	0.0
PM_{10}	0.0
$PM_{2.5}$	0.0
Construction[4]	
NO_x	684.0
SO_2	58.2
PM_{10}	348.4
$PM_{2.5}$	105.6
Total	
NO_x	1278.5
SO_2	58.2
PM_{10}	780.4
$PM_{2.5}$	170.6

1 Includes emissions from 170 conventional gas well separator heaters.
2 Includes emissions from all traffic associated with 1700 wells in production.
3 Includes emissions from 12 compressor stations.
4 Includes emissions associated with 10 drill rigs; 4 under construction (rig-up/rig-down), 6 operating continuously; and 1 completion flare operating continuously.

Seminoe Road modeling scenarios were developed for the Proposed Action and the non-electrification scenario; both include the proposal for the development of up to 1,240 coalbed methane wells in the SRPA. The Proposed Action includes electrification of the SRPA. Within the Project Area, wells would be developed in a ring-like progression. Each year, the majority of the wells would be drilled within that year's development boundary. These wells would be electrified and would have no emissions from the downhole pumps installed at each well. There would be a small number of pilot wells drilled each year outside of the electrification boundary. These wells would not be electrified and would have emissions from the natural gas-fired downhole pumps. The Proposed Action scenario modeled includes 26 wells outside the electrification boundary and one non-electrified compressor station. The non-electrification scenario modeled assumes no wells or compressor stations would be electrified. For both the Proposed Action and non-electrification modeling scenarios, maximum field-wide emissions were determined and reflect the last year of field development, and include 1,040 wells in production and 200 wells under construction. The maximum emissions scenario conservatively assumes that both production emissions (producing wellsites and operational ancillary equipment including compressor stations) and construction emissions (drill rigs and associated traffic) occur simultaneously throughout the year. Compression was assumed to operate at 90% of fully permitted capacity, which Operators indicated was a reasonable assumption based on field operation expectations. The scenario analyzed assumes 6 drill rigs operating continuously. The maximum field-wide emissions for the Proposed Action and the non-electrification scenario are summarized in Table 4.2. The emissions used to develop these field-wide scenarios are described in Chapter 2.0.

4.3 METEOROLOGICAL MODEL INPUT AND OPTIONS

CALMET was used to develop wind fields for the study area shown in Map 1.2. Model domain extent was selected based on available refined mesoscale meteorological model (MM5) data from the SWWYTAF study and the locations of the PSD Class I and sensitive Class II Wilderness areas that were selected for air quality analyses.

Table 4.2 Maximum Emission Scenarios (tpy), Seminoe Road Project

Project Phase/Constituent	Proposed Action	Non-electrification Scenario
Production Well[1]		
NO_x	5.1	205.9
SO_2	0.0	0.0
PM_{10}	0.0	0.0
$PM_{2.5}$	0.0	0.0
Production Traffic[2]		
NO_x	0.3	0.3
SO_2	0.01	0.01
PM_{10}	295.6	295.6
$PM_{2.5}$	44.2	44.2
Compression[3]		
NO_x	34.7	104.2
SO_2	0.0	0.0
PM_{10}	0.0	0.0
$PM_{2.5}$	0.0	0.0
Construction[4]		
NO_x	300.1	300.1
SO_2	31.9	31.9
PM_{10}	70.7	70.7
$PM_{2.5}$	39.7	39.7
Total		
NO_x	340.2	610.5
SO_2	31.9	31.9
PM_{10}	366.3	366.3
$PM_{2.5}$	83.9	83.9

1 Includes emissions from wellsite down-hole water pump engines.
2 Includes emissions from all traffic associated with 1040 wells in production.
3 Includes emissions from the proposed compressor stations.
4 Includes emissions associated with 6 drill rigs; 2 under construction (rig-up/rig-down), 4 operating continuously.

The modeling domain was processed to a uniform horizontal grid using 4-km resolution, based on a Lambert Conformal Projection defined with a central longitude/latitude at (-108.55°/42.55°) and first and second latitude parallels at 30° and 60°. The modeling grid consisted of 125 x 100, 4-km grid cells, and covers the project area and all analyzed Class I and sensitive Class II areas. The total area of the modeling domain is 500 x 400 km. Ten vertical layers were used, with heights of 20, 40, 100, 140, 320, 580, 1,020, 1,480, 2,220, and 2,980 meters.

The CALMET analysis utilized the MM5 data, (which was processed at a 20-km horizontal grid spacing), data from 51 surface meteorological stations and 134 precipitation stations, and four upper air meteorological stations to supplement MM5 upper air estimates. USGS 1:250,000-Scale Land Use and Land Cover (LULC) data, and USGS 1-degree DEM data were used for land use and terrain data in the development of the CALMET wind fields. Listings of the surface and upper air meteorological stations, and the precipitation stations that were used in this analysis are provided in Appendix E. The CALMET model was run following control switch settings that were developed as part of SWWYTAF to develop the one-year (1995) wind field data set.

The modeling domain extended as far south and east as possible given the available refined MM5 data. The IWAQM guidance for CALMET/CALPUFF recommends that the horizontal domain of the model grid extend 50 to 80 km beyond the receptors and sources being modeled, for modeling potential recirculation wind flow effects. Because the southern and eastern portions of Rocky Mountain National Park are less than 50 km from the modeling grid boundary, the recirculation wind patterns may not be completely resolved by CALMET in those areas. However, because the direct wind flow patterns that could transport potential Project and regional source emissions to these areas are properly characterized in the modeling domain, the potential impacts from Project and regional sources in these areas would also be properly characterized.

4.4 DISPERSION MODEL INPUT AND OPTIONS

The CALPUFF model was used to model Project-specific and regional emissions of NO_x, SO_2, PM_{10}, and $PM_{2.5}$. CALPUFF was run using the IWAQM-recommended default control file switch settings for all parameters. Chemical transformations were modeled based on the MESOPUFF II chemistry mechanism for conversion of SO_2 to sulfate (SO_4) and NO_x to nitric acid (HNO_3) and nitrate (NO_3). Each of these pollutant species was included in the CALPUFF model runs. NO_x, HNO_3, and SO_2 were modeled with gaseous deposition, and SO_4, NO_3, PM_{10}, and $PM_{2.5}$ were modeled using particle deposition. The PM10 emissions input to CALPUFF included only the PM_{10} emissions greater than the $PM_{2.5}$ (i.e., modeled PM_{10} = PM_{10} emission rate – $PM_{2.5}$ emission rate). Total PM_{10} impacts were determined in the post-processing of modeled impacts, as discussed in Section 4.5.

4.4.1 Chemical Species

The CALPUFF chemistry algorithms require hourly estimates of background O_3 and ammonia concentrations for the conversion of SO_2 and NO/NO_2 to sulfates and nitrates, respectively. Background O_3 data, for the meteorology 1995 modeling year, were available for six stations within the modeling domain:

- Pinedale, Wyoming,
- Centennial, Wyoming,
- Yellowstone National Park, Wyoming,
- Craters of the Moon National Park, Idaho,
- Highland, Utah, and
- Mount Zirkel Visibility Study, Hayden, Colorado.

Hourly O_3 data from these stations was used in the CALPUFF modeling, with a default value of 44.7 parts per billion (ppb) (7 a.m.-7 p.m. mean) used for missing hours. A background ammonia concentration of 1.0 ppb was used as suggested in the IWAQM guidance for arid lands.

4.4.2 Model Receptors

CALPUFF model receptors, at which the concentration, deposition, and AQRV impacts were calculated, were placed along the boundaries of all Class I and other sensitive areas at 2-km spacing, and within the boundaries of these areas on a 4-km Cartesian grid. Discrete receptors were placed on a Cartesian grid at 4-km spacing within each Project Area. Individual receptor points were determined for each of the 14 acid-sensitive lakes. Receptor elevations for all sensitive Class I and Class II areas were determined from 1:250,000 scale USGS DEM data. Elevations for the sensitive lake receptors were derived from 7.5-minute USGS topographical maps. All model receptors utilized in the far-field analyses are shown in Figure 4.1.

4.4.3 Source Parameters

CALPUFF source parameters were determined for all Project and regional source emissions of NO_x, SO_2, PM_{10}, and $PM_{2.5}$. Project sources were input to CALPUFF using point sources to idealize compressor stations, drill rigs, pit flares, and down-hole well pump engines. Additionally, 4-km^2 area sources at 4-km spacing were placed throughout each Project Area to idealize vehicle traffic and wind erosion emissions, and for wellsite heaters (AR) and down-hole well pump emissions (SR). Compressor station emissions and modeled parameters are provided in Appendix D. The source and receptor layouts are shown in Figure 4.2 for Altantic Rim and in Figure 4.3 for Seminoe Road. Parameters used in modeling the drill rigs, pit flares, and wind erosion are given in Appendix B. Field-wide emissions scenarios for each analyzed Project alternative are summarized in Section 4.2.

Non-project regional emissions were input to CALPUFF using area sources to idealize non-compression RFD sources and county-wide wellsites, and point sources to idealize state-permitted sources, RFD compression sources, and RFFA. The source parameters used in modeling all state-permitted and RFFA sources are provided in Appendix C. Non-compression RFD emissions were modeled using area sources developed for each proposed field development

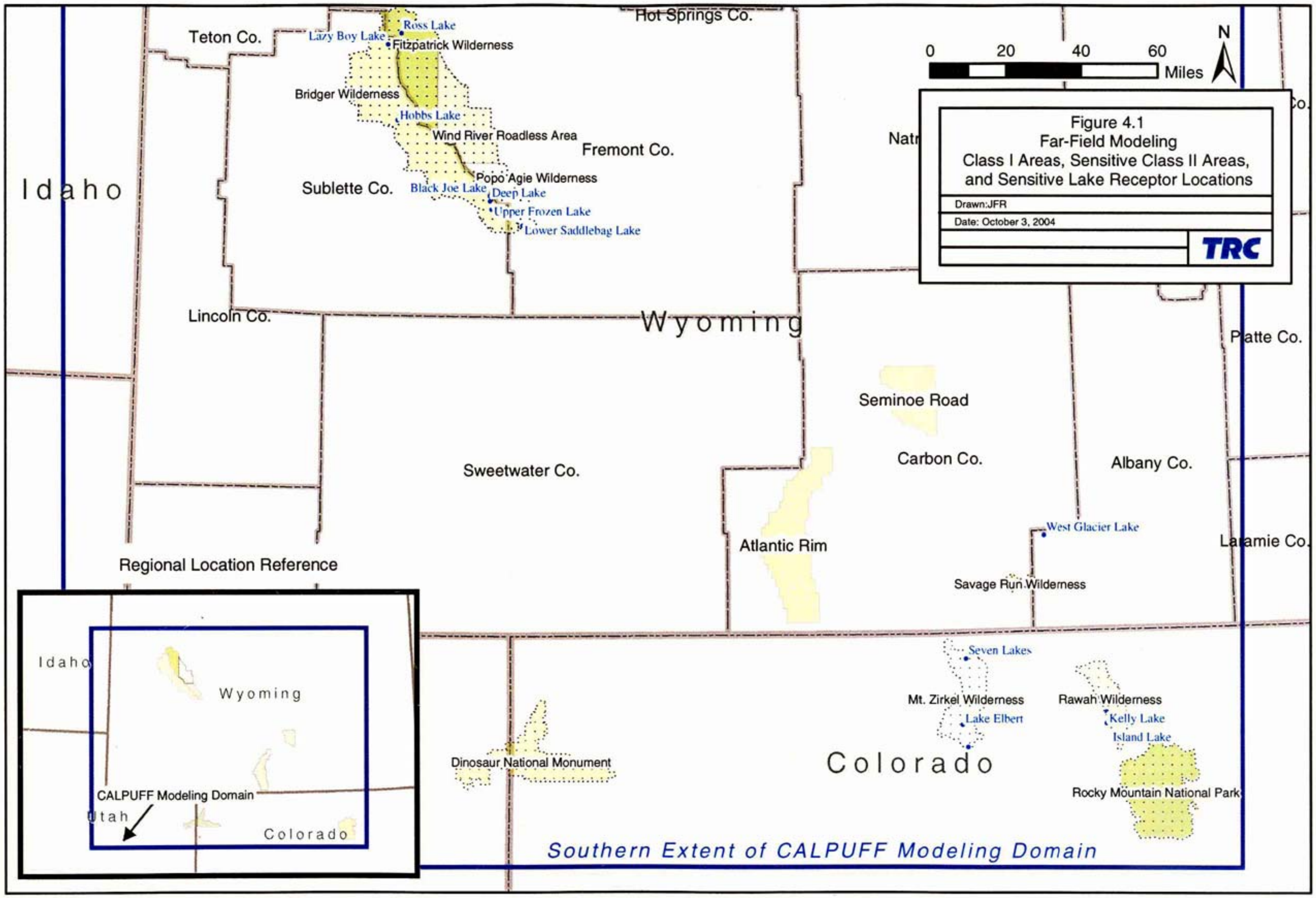


Figure 4.1 Far-field Modeling Receptor Locations.

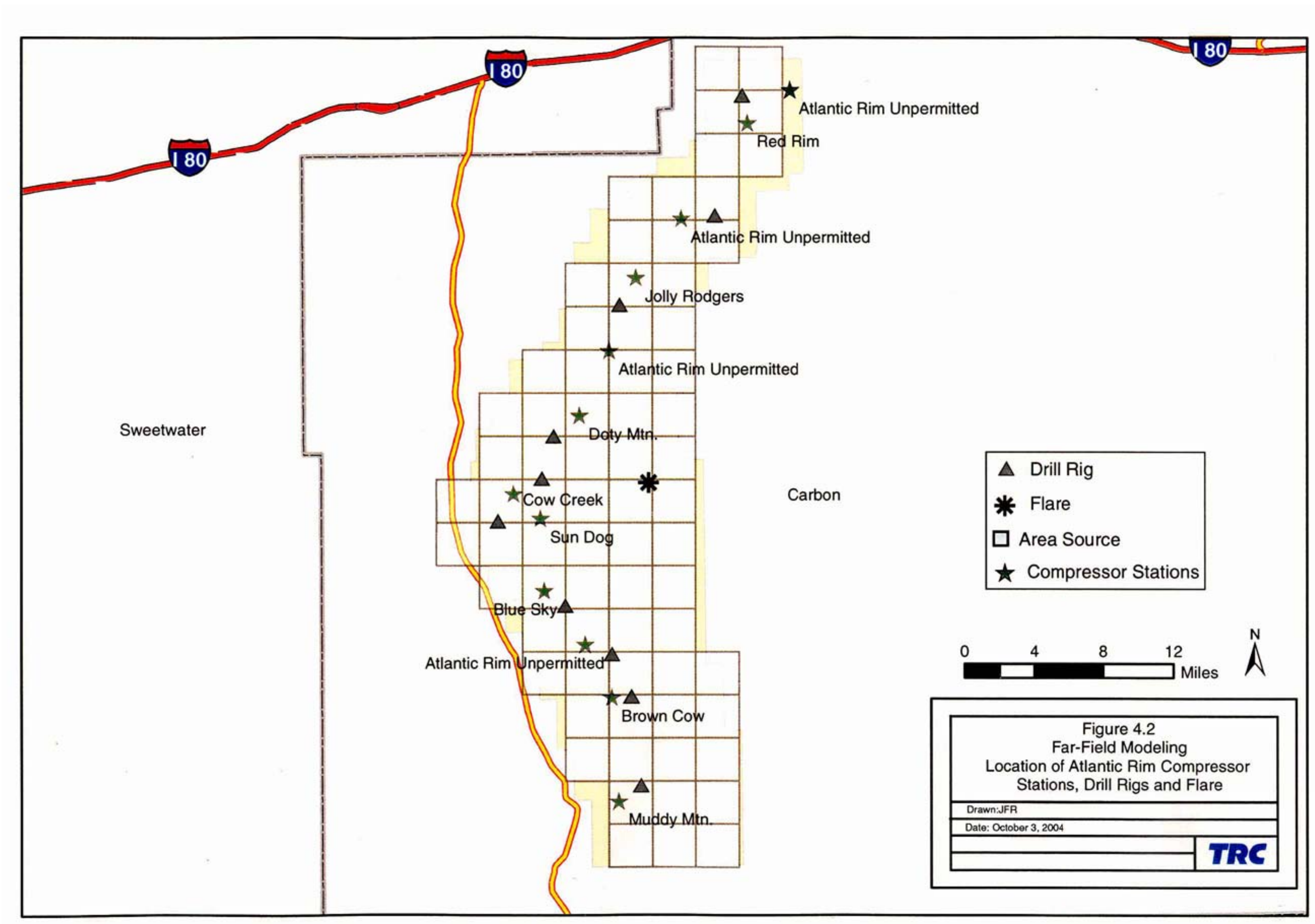


Figure 4.2 Far-field Modeling Receptor Locations.

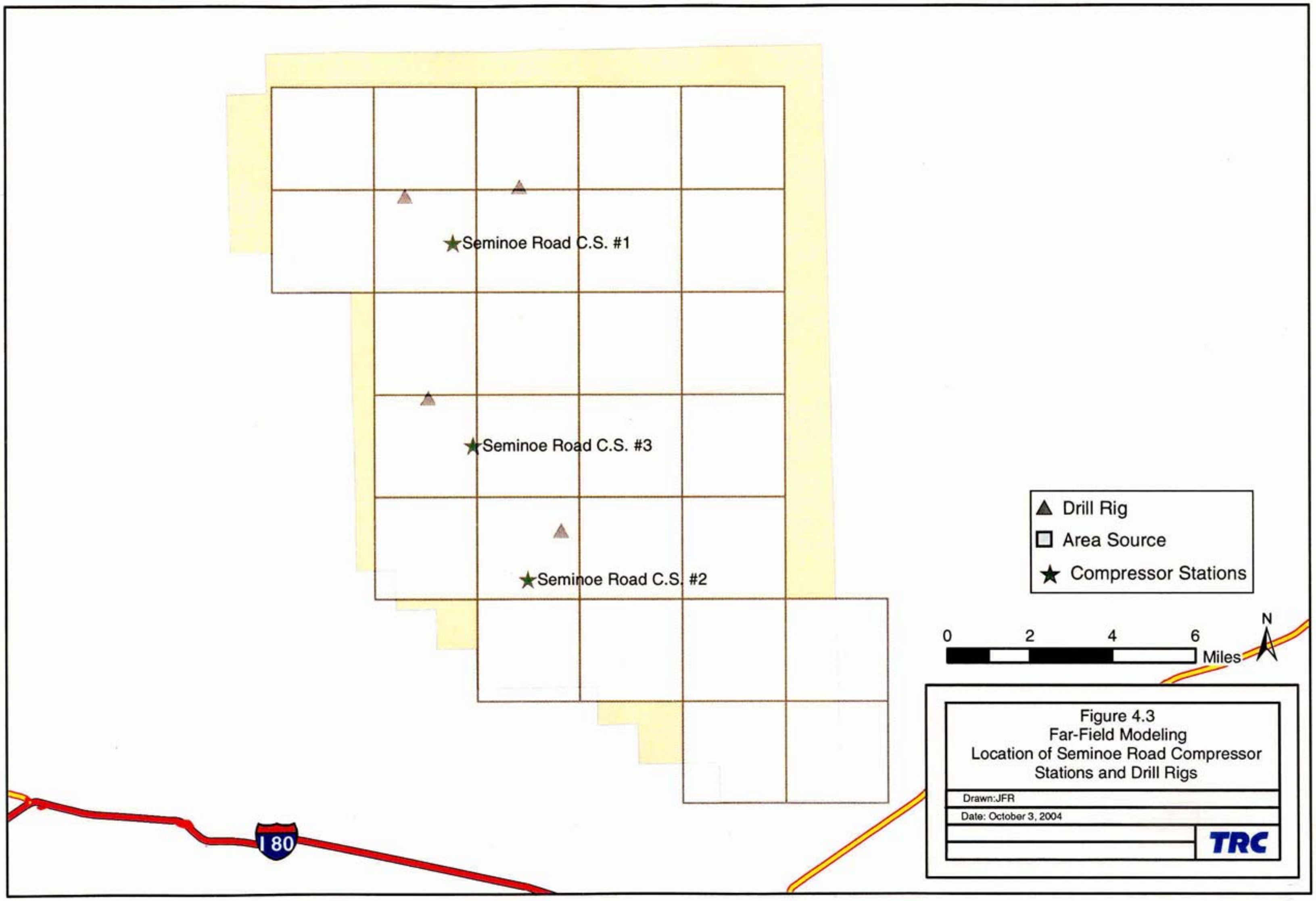


Figure 4.3 Far-field Modeling Compressor Locations.

as a "best fit" to the respective project area. The area sources developed for each RFD project are shown in Figure 4.4. County-wide well emissions were modeled using area sources that "best fit" the respective county area. The area sources used to model county-wide wellsite emissions are shown in Figure 4.5. Where applicable, seasonal emission-rate adjustment factors were applied to emissions from wellsite heaters to account for seasonal variations in heater use. Source elevations for all RFD and county-wide area sources were determined from 1:250,000 scale USGS DEM data.

4.5 BACKGROUND DATA

4.5.1 Criteria Pollutants

Ambient air concentration data collected at monitoring sites in the region provide a measure of the background conditions during the most recent available time period. Regional monitoring-based background values for criteria pollutants (PM_{10}, $PM_{2.5}$, NO_2, and SO_2) were collected at monitoring sites in Wyoming and northwestern Colorado, and are summarized in Table 4.3. These ambient air background concentrations are added to modeled pollutant concentrations (expressed in micrograms per cubic meter [$\mu g/m^3$]) to arrive at total ambient air quality impacts for comparison to the NAAQS and applicable WAAQS or CAAQS.

4.5.2 Visibility

Background visibility data representative of the study area are from IMPROVE monitoring sites located at the Bridger Wilderness and Mount Zirkel Wilderness Areas and at Rocky Mountain National Park (Table 4.4). Background visibility data are used in combination with modeled pollutant impacts to estimate change in visibility conditions (measured as change in light extinction). The IMPROVE background visibility data are provided as reconstructed aerosol total extinction data, based on the quarterly mean of the 20% cleanest days measured at each site for the historical monitoring period of record through December 2002.

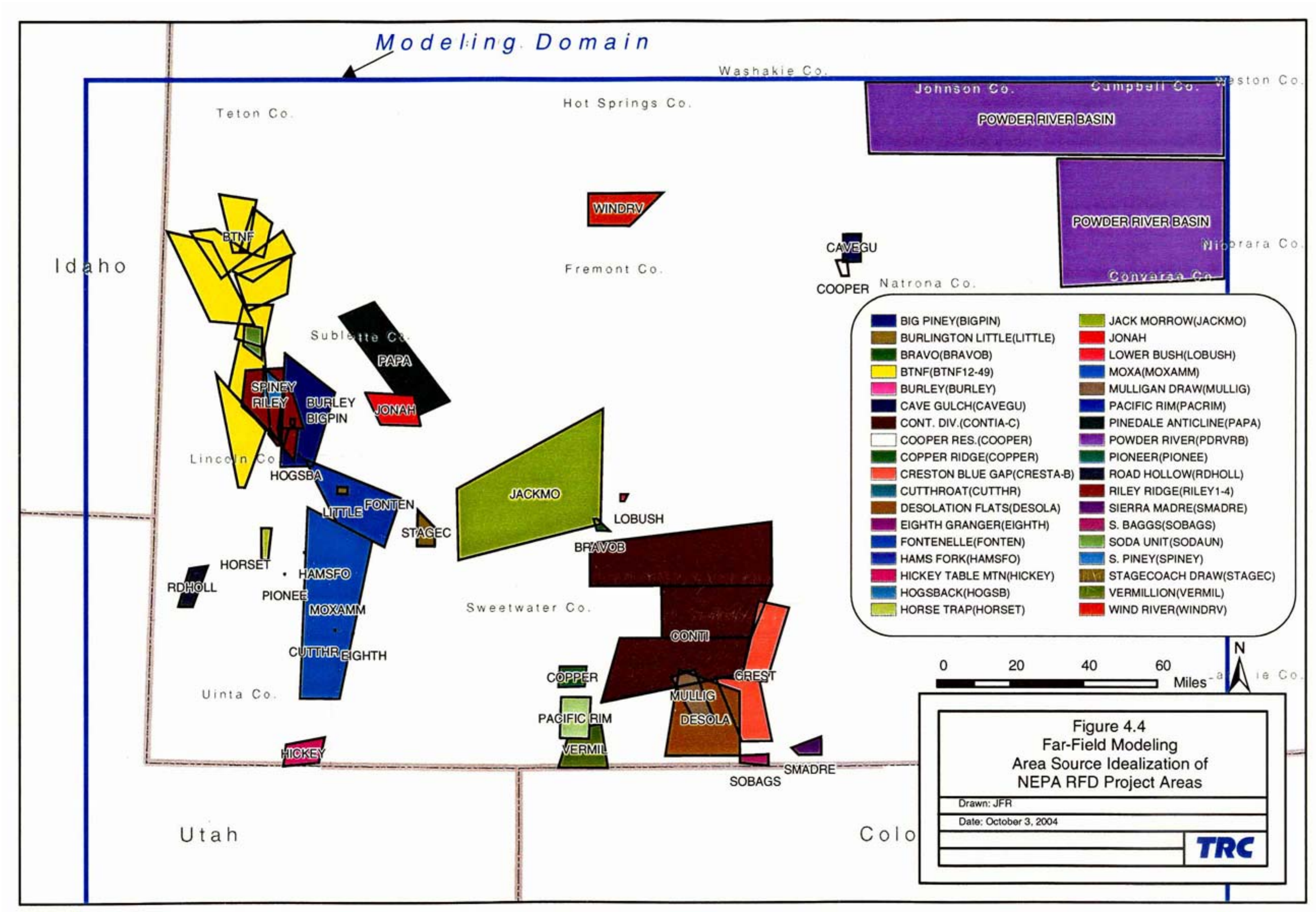


Figure 4.4 Far-field Modeling Project-specific Point and Area Source Locations.

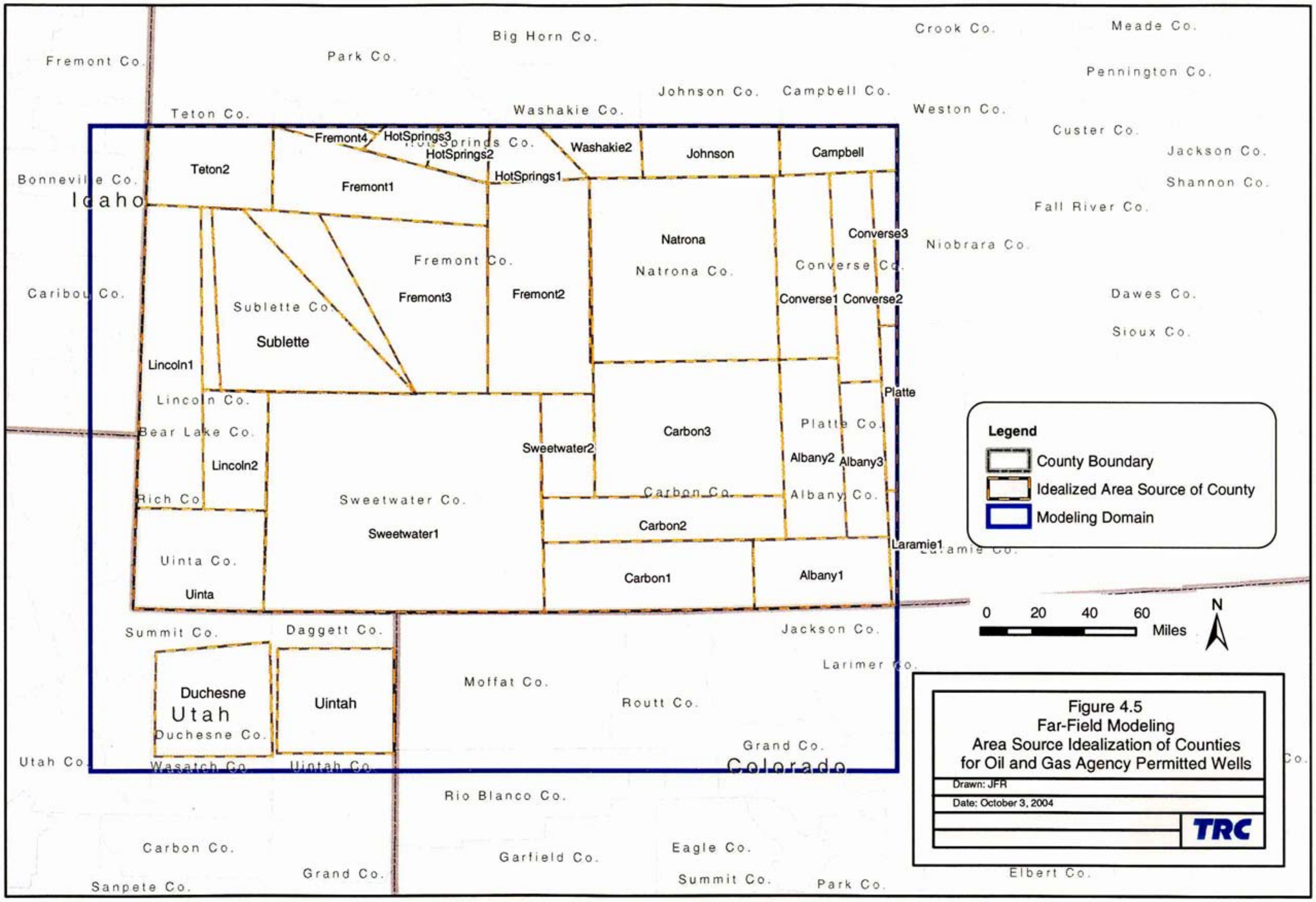


Figure 4.5 Far-field Modeling Idealization of NEPA Project Area Sources.

Table 4.3 Far-field Analysis Background Ambient Air Quality Concentrations (µg/m^3).

Pollutant	Averaging Period	Measured Background Concentration
NO_2[1]	Annual	3.4
PM_{10}[2]	24-hour	33
	Annual	16
$PM_{2.5}$[2]	24-hour	13
	Annual	5
SO_2[3]	3-hour	132
	24-hour	43
	Annual	9

[1] Data collected at Green River Basin Visibility Study site, Green River, Wyoming during period January-December 2001 (ARS 2002).
[2] Data collected by WDEQ-AQD at Emerson Building, Cheyenne, Wyoming, Year 2001.
[3] Data collected at LaBarge Study Area at the Northwest Pipeline Craven Creek Site 1982-1983.

Table 4.4 IMPROVE Background Aerosol Extinction Values.

IMPROVE Site	Quarter	Hygroscopic (Mm^{-1})	Non-Hygroscopic (Mm^{-1})	Monitoring Period
Bridger Wilderness Area	1	0.845	1.666	1989-2002
	2	1.730	3.800	1988-2002
	3	1.902	5.637	1988-2002
	4	0.915	2.035	1988-2002
Mount Zirkel Wilderness Area	1	1.269	2.591	1995-2002
	2	2.028	4.163	1995-2002
	3	2.358	5.151	1994-2002
	4	0.961	2.262	1994-2002
Rocky Mountain National Park	1	0.986	2.117	1991-2002
	2	2.457	5.261	1991-2002
	3	2.651	6.709	1991-2002
	4	0.790	2.720	1990-2002

4.5.3 Deposition

Background total sulfur (S) and nitrogen (N) deposition data (expressed in kilograms per hectare per year [kg/ha-yr]) collected at National Acid Deposition Program (NADP) National Trends Network (NTN) and Clean Air Status and Trends Netwok (CASTNET) stations monitoring locations near Pinedale and Centennial/Brooklyn Lake, Wyoming are provided in Table 4.5. These background S and N deposition data are added to modeled cumulative (Project alternative and regional sources) deposition impacts to estimate total S and N deposition impacts.

Table 4.5 Background N and S Deposition Values (kg/ha-yr).

Site Location	Nitrogen Deposition	Sulfur Deposition	Year of Monitoring
Pinedale	1.4	0.65	2003
Centennial/Brooklyn Lake	2.7	0.84	2002

4.5.4 Lake Chemistry

The most recent lake chemistry background ANC data were obtained for each sensitive lake included in the analysis. The 10th percentile lowest ANC values were calculated for each lake following procedures provided by the USDA Forest Service. These ANC values and the number of samples used in the calculation of the 10^{th} percentile lowest ANC values are provided in Table 4.6.

Table 4.6 Background ANC Values for Acid Sensitive Lakes.

Wilderness Area	Lake	Latitude (Deg-Min-Sec)	Longitude (Deg-Min-Sec)	10th Percentile Lowest ANC Value (µeq/l)	Number of Samples	Monitoring Period
Bridger	Black Joe	42º44'22"	109º10'16"	67.0	61	1984-2003
Bridger	Deep	42º43'10"	109º10'15"	59.9	58	1984-2003
Bridger	Hobbs	43º02'08"	109º40'20"	69.9	65	1984-2003
Bridger	Lazy Boy	43º19'57"	109º43'47"	18.8	1	1997
Bridger	Upper Frozen	42º41'13"	109º09'39"	5.0	6	1997-2003
Fitzpatrick	Ross	43º22'41"	109º39'30"	53.5	44	1988-2003
GLEES(1)	West Glacier Lake	41º22'38"	106º15'31"	35.2	14	1988-1996
Mount Zirkel	Lake Elbert	40º38'3"	106º42'25"	51.9	55	1985-2003
Mount Zirkel	Seven Lakes	40º53'45"	106º40'55"	36.2	55	1985-2003
Mount Zirkel	Summit Lake	40º32'43"	106º40'55"	47.3	95	1985-2003
Popo Agie	Lower Saddlebag	42º37'24"	108º59'38"	55.5	43	1989-2003
Rawah	Island Lake	40º37'38"	105º56'26"	68.7	15	1996-2002
Rawah	Kelly Lake	40º37'32"	105º57'34"	181.1	13	1995-2002
Rawah	Rawah Lake #4	4040'16"	105º57'28"	41.2	13	1996-2002

1 GLEES (Glacier Lakes Ecosystem Experiments Site) – Medicine Bow National Forest, Snowy Range, WY.

4.6 IMPACT ASSESSMENT

CALPUFF modeling was performed to compute direct Project impacts for both the Atlantic Rim and Seminoe Road Projects and for estimating cumulative impacts from Project and regional sources. The analyzed alternatives, as described in Section 4.2, represent maximum emissions scenarios that included the last year of field development, at the maximum annual construction activity rate, combined with nearly full-field production. Regional emissions inventories of existing state-permitted RFD and RFFA sources, as described in Chapter 2.0, were modeled in combination with each Project alone to estimate cumulative impacts for the No Action

Alternative. Specifically, the No Action Alternative scenario computed for the Atlantic Rim Project included impacts from the Seminoe Road Project and the No Action scenario computed for the Seminoe Road Project included impacts from the Atlantic Rim Project. These regional inventories were modeled in combination with Project alternatives to provide cumulative impact estimates for each Project.

For each far-field sensitive area, CALPUFF-modeled concentration impacts were post-processed with POSTUTIL and CALPOST to derive: 1) concentrations for comparison to ambient standards (WAAQS and NAAQS), PSD Class I significance thresholds, and PSD Class I and II Increments; 2) deposition rates for comparison to S and N deposition thresholds and to calculate changes to acid neutralizing capacity (ANC) at sensitive lakes; and 3) light extinction changes for comparison to visibility impact thresholds. For in-field locations, CALPUFF concentrations were post-processed to compute maximum concentration impacts for comparison to WAAQS and NAAQS.

4.6.1 Concentration

The CALPOST and POSTUTIL post-processors were used to summarize concentration impacts of NO_2, SO_2, PM_{10}, and $PM_{2.5}$ at PSD Class I and sensitive PSD Class II areas, and at in-field locations. Predicted impacts are compared to applicable ambient air quality standards, PSD Class I and Class II increments, and significance levels as shown in Table 4.7.

PM_{10} concentrations were computed by adding predicted CALPUFF concentrations of PM_{10} (fraction of PM greater than $PM_{2.5}$), $PM_{2.5}$, SO_4, and NO_3. $PM_{2.5}$ concentrations were calculated as the sum of modeled $PM_{2.5}$, SO_4, and NO_3 concentrations. In post-processing the PM_{10} impacts at all far-field receptor locations, the PM_{10} impacts from Project alternative traffic emissions (production and construction) were not included in the total estimated impacts, only the $PM_{2.5}$ impacts were considered. This assumption was based on supporting documentation from the Western Regional Air Partnership (WRAP) analyses of mechanically generated fugitive dust emissions that suggest that particles larger than $PM_{2.5}$ tend to deposit out rapidly near the emissions source and do not transport over long distances (Countess et al. 2001). This phenomenon is not modeled adequately in CALPUFF; therefore, to avoid overestimates of PM_{10} impacts at far-field locations, these sources were not considered in the total modeled impacts. However, the total PM_{10} impacts from traffic emissions were included in all in-field concentration estimates.

Far-Field Results

The maximum predicted concentrations of NO_2, SO_2, PM_{10}, and $PM_{2.5}$ at each of the analyzed PSD Class I and sensitive Class II areas, for each modeled Project alternative and cumulative source scenarios, are provided in Appendix F. Predicted direct impacts are compared to

Table 4.7 Ambient Standards, PSD Class I and Class II Increments, and Significance Levels for Comparison to Far-Field Analysis Results ($\mu g/m^3$).

Pollutant/Averaging Time	NAAQS	WAAQS	PSD Class I Increment	PSD Class II Increment	PSD Class I Significant Impact Level[1]	PSD Class II Significance Level
Nitrogen dioxide (NO_2)						
Annual[2]	100	100	2.5	25	0.1	1.0
Sulfur dioxide (SO_2)						
3-hour[3]	1,300	1,300	25	512	1.0	25
24-hour[3]	365	260	5	91	0.2	5
Annual[2]	80	60	2	20	0.1	1
PM_{10}						
24-hour[3]	150	150	8	30	0.3	5
Annual[2]	50	50	4	17	0.2	1
$PM_{2.5}$						
24-hour[4]	65	65	--	--	--	--
Annual [4]	15	15	--	--	--	--

1 Proposed Class I significant impact levels, *Federal Register*/Vol. 61, No. 142, pg. 38292, July 23, 1996.
2 Annual arithmetic mean.
3 No more than one exceedance per year.
4 Proposed.

applicable PSD Class I and Class II increments and significance levels, and applicable NAAQS, WAAQS, and CAAQS when representative background pollutant concentrations, shown in Table 4.3, are added. Cumulative impacts from all analyzed alternatives are compared directly to applicable PSD Class I and Class II increments, and to the NAAQS, WAAQS, and CAAQS when background pollutant concentrations are added. Tables F1.1.1 – F1.1.3 provide the maximum modeled NO_2 concentrations at each of the sensitive areas for the Atlantic Rim Project. Tables F2.1.1 – F2.1.5 provide the maximum modeled NO_2 concentrations at each of the sensitive areas for the Seminoe Road Project scenarios. The maximum modeled SO_2 concentrations are provided in Tables F1.2.1 – F1.2.3 (AR) and Tables F2.2.1 – F2.2.5 (SR). The maximum modeled PM_{10} impacts are provided in Tables F1.3.1 – F1.3.3 (AR), and Tables F2.3.1 – F2.3.5 (SR), and the maximum modeled $PM_{2.5}$ impacts are provided in Tables F1.4.1 – F1.4.3 (AR), and Tables F2.4.1 – F2.4.5 (SR).

The modeling results indicate that, for both the Atlantic Rim and Seminoe Road Projects, neither direct Project impacts nor cumulative source impacts would exceed any air quality standards (WAAQS, CAAQS, and NAAQS) or PSD increment. In addition direct Project impacts are below the proposed PSD Class I significant impact levels. The PSD demonstrations are for informational purposes only and do not constitute a regulatory PSD increment consumption analysis.

<u>In-Field Results</u>

The maximum predicted concentrations of NO_2, SO_2, PM_{10}, and $PM_{2.5}$ within and nearby each Project Area, for each of the modeled direct Project and cumulative scenarios are provided in Appendix F. The maximum in-field concentrations predicted for the Atlantic Rim Project are shown in Tables F1.5.1 – F.5.3, and in Tables F2.5.1 – F2.5.5 for the Seminoe Road Project. Predicted direct Project and cumulative impacts are added to representative background pollutant concentrations and are compared to applicable NAAQS and WAAQS. As shown in these tables there would be no exceedances of the NAAQS or WAAQS within and nearby the ARPA and

SRPA from field-wide Project sources and cumulative sources. This analysis further supports the compliance demonstrations shown in Section 3.4 for maximum near-field impacts.

4.6.2 Deposition

Maximum predicted sulfur (S) and nitrogen (N) deposition impacts were estimated for each analyzed Project alternative and cumulative source scenarios. The POSTUTIL utility was used to estimate total S and N fluxes from CALPUFF predicted wet and dry fluxes of SO_2, SO_4, NO_x, NO_3, and HNO_3. CALPOST was then used to summarize the annual S and N deposition values from the POSTUTIL program. Predicted direct Project impacts were compared to the NPS deposition analysis thresholds (DATs) for total N and S deposition in the western U.S., which are defined as 0.005 kg/ha-yr for both N and S. Total deposition impacts from Project alternative and regional sources and background values were compared to USDA Forest Service levels of concern, defined as 5 kg/ha-yr for S and 3 kg/ha-yr for N (Fox et al. 1989). It is understood that the USDA Forest Service no longer considers these levels to be protective; however, in the absence of alternative FLM-approved values, comparisons with these values were made. The maximum predicted N and S deposition impacts are provided in Appendix F, Tables F1.6.1 and F1.6.2 for the Atlantic Rim Project and in Tables F2.6.1 and F2.6.2 for Seminoe Road. Total deposition impacts include background values measured at Pinedale for the Bridger Fitzpatrick, and Popo Agie Wilderness Areas, Dinosaur National Monument and Wind River Roadless Area, and at Centennial for the Rawah, Savage Run and Mount Zirkel Wilderness Areas, and Rocky Mountain National Park. Modeling results for both projects indicate that there would be no direct project N or S deposition impacts above the DAT, and that all total N and S deposition impacts would be below the levels of concern.

4.6.3 Sensitive Lakes

The CALPUFF-predicted annual deposition fluxes of S and N at sensitive lake receptors listed in Section 4.2.3 were used to estimate the change in ANC. The change in ANC was calculated following the January 2000, USDA Forest Service Rocky Mountain Region's *Screening*

Methodology for Calculating ANC Change to High Elevation Lakes, User's Guide (USDA Forest Service 2000). The predicted changes in ANC are compared with the USDA Forest Service's Level of Acceptable Change (LAC) thresholds of 10% for lakes with ANC values greater than 25 microequivalents per liter (μeq/l) and 1 μeq/l for lakes with background ANC values of 25 μeq/l or less. Of the 14 lakes listed in Table 4.6 and identified by the USDA Forest Service as acid sensitive, Upper Frozen and Lazy Boy lakes are considered extremely acid sensitive.

ANC calculations were performed for each of the analyzed Project alternative and cumulative source scenarios, with the results presented in Appendix F, Tables F1.7.1 – F1.7.3 (AR) and Tables F2.7.1 – F2.7.5 (SR). The modeling results indicate that, for either Project, deposition impacts from direct Project and cumulative emissions would not contribute significantly to an increase in acidification at any of the sensitive lakes.

4.6.4 Visibility

The CALPUFF model-predicted concentration impacts at far-field PSD Class I and sensitive Class II areas were post-processed with CALPOST to estimate potential impacts to visibility (regional haze) for each analyzed alternative and cumulative source scenario for comparison to visibility impact thresholds. CALPOST estimated visibility impacts from predicted concentrations of PM_{10}, $PM_{2.5}$, SO_4, and NO_3. Similar to what was done for post-processing far-field PM_{10} concentration impacts (see Section 4.6.1), PM_{10} impacts from Project traffic emissions were not included in the total estimated impacts, only the $PM_{2.5}$ impacts were considered.

Visibility impairment calculations were performed using estimated natural background visibility conditions obtained from FLAG (2000) (FLAG method) and measured background visibility conditions from the Bridger and Mount Zirkel Wilderness Areas and Rocky Mountain National Park IMPROVE sites (IMPROVE method). IMPROVE-method data are based on the quarterly mean of the 20% cleanest days as shown in Table 4.4. The IMPROVE background visibility data are provided as reconstructed aerosol total extinction data, based on the quarterly mean of the 20% cleanest days measured at each site for the historical monitoring period of record through December 2002.

For the FLAG method, estimated natural background visibility values as provided in Appendix 2.B of FLAG (2000), and monthly relative humidity factors as provided in the *Guidance for Estimating Natural Visibility Conditions Under the Regional Haze Rule* (EPA 2003) were used. The natural background visibility data used with the FLAG visibility analysis are shown in Table 4.8. The values are the same for each of the PSD Class I and sensitive PSD Class II areas analyzed.

The IMPROVE method used the measured background conditions at the Bridger and Mount Zirkel Wilderness Areas and at the Rocky Mountain National Park site, and the monthly relative humidity factors as provided in EPA (2003). Visibility data from the Bridger Wilderness Area IMPROVE site were used for the Bridger, Fitzpatrick, and Popo Agie Wilderness Areas and for the Wind River Roadless Area, and visibility data from the Mount Zirkel Wilderness Area IMPROVE site were used for the Rawah and Savage Run Wilderness Areas and for Dinosaur National Monument.

Table 4.8 FLAG Report Background Extinction Values.[1]

Season	Hygroscopic (Mm^{-1})	Non-hygroscopic (Mm^{-1})
Winter	0.6	4.5
Spring	0.6	4.5
Summer	0.6	4.5
Fall	0.6	4.5

[1] FLAG (2000).

As recommended in EPA (2003), monthly relative humidity factors determined from the Bridger IMPROVE site were used for the Bridger and Fitzpatrick Wilderness Areas; Mount Zirkel IMPROVE data were used for the Mount Zirkel and Rawah Wilderness Areas, and Rocky Mountain National Park IMPROVE data were used for Rocky Mountain National Park. Relative humidity data for the Bridger site were also used for the Popo Agie Wilderness Area and for the Wind River Roadless Area and data for Mount Zirkel were also used for the Savage Run Wilderness Area and for Dinosaur National Monument. Table 4.9 provides the relative humidity factors that were used in the analyses.

Change in atmospheric light extinction relative to background conditions is used to measure regional haze. Analysis thresholds for atmospheric light extinction are set forth in FLAG (2000), with the results reported in percent change in light extinction and change in deciview (dv). The thresholds are defined as 5% and 10% of the reference background visibility or 0.5 and 1.0 dv for projects sources alone and cumulative source impacts, respectively. The BLM considers a 1.0 dv change as a significant adverse impact; however, there are no applicable local, state, tribal, or federal regulatory visibility standards.

Table 4.9 Monthly Relative Humidity Factors Based on Representative IMPROVE Sites.

IMPROVE Site	Quarter	Months	f(RH) Values
Bridger Wilderness Area[1]	1	Jan, Feb, Mar	2.5, 2.3, 2.3
	2	Apr, May, Jun	2.1, 2.1, 1.8
	3	Jul, Aug, Sep	1.5, 1.5, 1.8
	4	Oct, Nov, Dec	2.0, 2.5, 2.4
Mount Zirkel Wilderness Area[2]	1	Jan, Feb, Mar	2.2, 2.2, 2.0
	2	Apr, May, Jun	2.1, 2.2, 1.8
	3	Jul, Aug, Sep	1.7, 1.8, 2.0
	4	Oct, Nov, Dec	1.9, 2.1, 2.1
Rocky Mountain National Park	1	Jan, Feb, Mar	1.9, 2.0, 2.0
	2	Apr, May, Jun	2.1, 2.3, 2.0
	3	Jul, Aug, Sep	1.9, 1.9, 2.0
	4	Oct, Nov, Dec	1.8, 2.0, 1.9

[1] Also used for Fitzpatrick and Popo Agie Wilderness Areas, and Wind River Roadless Area.
[2] Also used for Rawah and Savage Run Wilderness Areas, and Dinosaur National Monument.

Far-Field Results

The maximum predicted far-field visibility impacts for the analyzed Atlantic Rim and Seminoe Road Project alternatives are provided in Appendix F, Tables F1.8.1 – F1.8.3, for Atlantic Rim and Tables F2.8.1 – F2.8.5 for Seminoe Road. Predicted impacts are shown using both the FLAG and IMPROVE background visibility data. For each Class I and sensitive Class II area the

maximum predicted change in deciview and the estimated number of days per year that could potentially exceed 0.5 and 1.0 dv thresholds are provided.

For both the Atlantic Rim and Seminoe Road projects direct visibility impacts from Project sources were predicted to be below the 0.5-dv threshold for all areas using both the FLAG and IMPROVE background visibility data.

Cumulative visibility impacts from each Project and regional sources were predicted to be above the 1.0-dv threshold at the Bridger and Popo Agie Wilderness Areas, and at the Wind River Roadless Area. For both the Atlantic Rim and Seminoe Road projects the highest frequency of predicted cumulative visibility impacts occurred at the Bridger Wilderness where there were 4 days per year (IMPROVE) and 1 day per year (FLAG) when visibility impacts were predicted to be above the 1.0-dv threshold. For both Projects the maximum deciview change at the Bridger Wilderness Area was estimated as 2.1 dv (IMPROVE) and 1.8 dv (FLAG).

As defined in the FLAG report, a 0.4 percent change in extinction (0.04 dv) is considered a Project specific significance level for cumulative visibility analyses. If the direct Project's contribution to a cumulative visibility impact of 1.0 dv or greater is less than 0.04 dv, the project is regarding as having an insignificant contribution to the cumulative visibility impact.

For all days and sensitive receptor areas where the estimated cumulative visibility impacts were predicted to be at or above the 1.0-dv threshold, and the direct Project impacts were predicted to be 0.04 dv or greater, an analysis was performed to determine whether or not each Project's contribution to the total impact was significant. The results indicate that for all days where the cumulative visibility impacts were estimated to be 1.0 dv or greater, both the Atlantic Rim and Seminoe Road project specific impacts were below the 0.04 dv visibility significance threshold. The results of this analysis are provided in Appendix F, Table F1.8.4 (AR) and Table F2.8.6 (SR).

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APPENDIX A:

AIR QUALITY IMPACT ASSESSMENT PROTOCOL

APPENDIX B1:

ATLANTIC RIM EMISSIONS INVENTORY

APPENDIX B2:

SEMINOE ROAD EMISSIONS INVENTORY

APPENDIX C:

REGIONAL INVENTORY METHODOLOGY

APPENDIX D1:

ATLANTIC RIM NEAR-FIELD MODELING,
SOURCE EMISSIONS AND MODELING PARAMETERS

APPENDIX D2:

SEMINOE ROAD NEAR-FIELD MODELING,
SOURCE EMISSIONS AND MODELING PARAMETERS

APPENDIX E:

SURFACE AND UPPER AIR METEOROLOGICAL STATIONS
AND PRECIPITATION STATIONS USED IN THE ANALYSIS

APPENDIX F1:
ATLANTIC RIM FAR-FIELD MODELING RESULTS

APPENDIX F2:

SEMINOE ROAD FAR-FIELD MODELING RESULTS