OIL AND GAS LEASING ON LANDS ADMINISTERED BY THE DIXIE NATIONAL FOREST

Supplemental Information Report - Air Resources

US Department of Agriculture
Forest Service
Dixie National Forest

February 2010

Cooperating Agency:
US Department of the Interior
Bureau of Land Management
Cedar City Field Office

Cooperating Agency:
State of Utah

SUPPLEMENTAL INFORMATION REPORT to the Draft Environmental Impact Statement

Oil and Gas Leasing on Lands Administered by the Dixie National Forest

LEAD AGENCY:	Dixie National Forest U.S. Department of Agriculture
COOPERATING AGENCIES:	Bureau of Land Management U.S. Department of the Interior State of Utah
PROJECT LOCATION:	Garfield, Iron, Kane, Piute, and Washington Counties, Utah
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DATE COMMENTS MUST BE RECEIVED:	Comments should be submitted no later than 30 days from the publication of the Notice of Availability in the Federal Register.

Oil and Gas Leasing on the Dixie National Forest SUPPLEMENTAL INFORMATION REPORT

TABLE OF CONTENTS

1.0 Purpose of this SIR....1
2.0 Introduction....1
3.0 Chapter 3 DEIS Revision....3
3.12 Air Resources....3
3.12.1 Climate....3
3.12.2 General Air Quality....3
3.12.3 Sensitive Areas....5
3.12.4 Air Quality Regulatory Considerations....7
3.12.5 Criteria Pollutants....8
3.12.6 Existing Surrounding Sources....9
3.12.7 Air Monitoring....12
3.12.8 Regional Haze and Visibility....13
3.12.9 Greenhouse Gas Emissions and Sinks....15
3.12.10 Pine Valley Ranger District....16
3.12.11 Cedar City Ranger District....17
3.12.12 Powell Ranger District....17
3.12.13 Escalante Ranger District....17
4.0 Chapter 4 DEIS Revision....18
4.12 Air Resources....18
4.12.1 Introduction....18
4.12.2 Impacts Common to All Action Alternatives....18
4.12.3 Impacts by Alternative....26
5.0 Chapter 5 DEIS Revision....27
5.12 Air Resources....27
5.12.1 Description of Cumulative Effects Area....27
5.12.2 Past, Present, and Reasonably Foreseeable Future Actions....27
5.12.3 Cumulative Effects....29
6.0 References....37

LIST OF TABLES

Table 3.12-1 National Primary and Secondary Standards....4
Table 3.12-2 Allowable Pollutant Increases in Class I and Class II Areas....6
Table 3.12-3 Sensitive Areas near the Dixie National Forest....6
Table 3.12-4 Emissions Totals by County (tons per day)....8
Table 3.12-5 Permitted Significant Sources in the Six County Area....11
Table 3.12-6 Air Quality Index Ratings....12
Table 3.12-7 Ozone Monitoring Data from Zion National Park....14
Table 4.12-1 Construction Emissions....20
Table 4.12-2 Exploration Drilling (Connected Actions) Impacts....21
Table 4.12-3 Production Field Development Emissions....22
Table 4.12-4 Sustainable Production (Connected Actions) Impacts....23

LIST OF FIGURES

Figure 3.12-1 Non-Attainment Air Quality Areas in Utah 5
Figure 3.12-2 Emission Source Type (2005 Data).....9
Figure 3.12-3 Cedar City Windrose.....10
Figure 3.12-4 Trends in Mean Standard Visual Range in Nearby National Parks.....13
Figure 3.12-5 Trends in PM_{10} Concentrations in Nearby National Parks 14
Figure 5.12-1 Cumulative Effects Area for Air Resources 28
Figure 5.12-2 Current year 8-hour ozone Design Values (DVC) from the enhanced MATS unmonitored area analysis for the 2005 meteorological year.....32
Figure 5.12-3 Projected 2012 8-hour ozone Design Values (DVF) from the enhanced MATS unmonitored area analysis for the 2005 meteorological year.....33
Figure 5.12-4 Differences in the projected 2012 (DVF) and current year (DVC) 8-hour ozone Design Values from the enhanced MATS unmonitored area analysis for the 2005 meteorological year (DVF-DVC). 34

APPENDICES

Appendix SIR-1 Dixie and Fishlake National Forests Oil and Gas Leasing Environmental Impact Statements Air Quality Modeling Report
Appendix SIR-1A Dixie and Fishlake National Forest Screening Tables for Prompt Initial Estimates of Likely Impacts from Oil & Gas Development
Appendix SIR-1B Dixie and Fishlake National Forest Statistics Comparing Verification Run Results with Initial Screening Table Results
Appendix SIR-2 Climate Change
Appendix SIR-2A Dixie National Forest Greenhouse Gas Emission Annual Estimates

ACRONYMS

AO	Approval Order
AQI	Air Quality Index
AQRV	Air Quality-Related Values
ATV	All-Terrain Vehicle
BMP	Best Management Practices
CEA	Cumulative Effects Area
CMAQ	Community Multi-Scale Air Quality Model
DEIS	Draft Environmental Impact Statement
DVC	Design Values – Current
DVF	Design Values - Future
EPA	Environmental Protection Agency
FLAG	Federal Land Managers' Air Group
FLM	Federal Land Managers
GHG	Greenhouse Gas
IMPROVE	Interagency Monitoring of Protected Visual Environments
IPAMS	Independent Producers of the Mountain States
IPCC	Intergovernmental Panel on Climate Change
MATS	Modeled Attainment Test Software
NAAQS	National Ambient Air Quality Standards
NESHAP	National Emissions Standards for Hazardous Air Pollutants
NOI	Notice of Intent
NSPS	New Source Performance Standard
PSD	National Prevention of Significant Deterioration
RHR	Regional Haze Rule
RFDS	Reasonable Foreseeable Development Scenario
SIP	State Implementation Plan
SIR	Supplemental Information Report
SLT	Standard Lease Terms
SMP	Smoke Management Plan
UAA	Unmonitored Area Analysis
UBAQS	Uinta Basin Air Quality Study
UDAQ	Utah Department of Air Quality
USDA	United States Department of Agriculture
USFS	United States Forest Service
VOC	Volatile Organic Compounds

WRAP	Western Regional Air Partnership

ABBREVIATIONS

UNITS OF MEASURE

dv or Δdv	Deciviews (i.e., visibility) or change in deciviews
g/sec	Grams per second (of emissions)
HP	Horse power
kg/hect/yr	Kilograms per hectare per year
km	Kilometers
MMbtu/hr	Million British thermal units (of heat) per hour
MMt or MMT	Million metric tons
Mt	Metric tons
Mscf	Million standard cubic feet (i.e., gas volume)
MW	Megawatt
ppb	Parts per billion
ppm	Parts per million
µg/m3	Micrograms per cubic meter

CHEMICAL NOTATIONS

CO	Carbon monoxide
CO_2	Carbon dioxide
CO_{2e}	Carbon dioxide equivalent
NO_x	Nitrogen oxides
NO_2	Nitrogen dioxide
O_3	Ozone
Pb	Lead
PM	Particulate matter
PM_{10}	Particulate matter with diameter ≤ 10 microns
$PM_{2.5}$	Particulate matter with diameter ≤ 2.5 microns
SO_x	Sulfur oxides
SO_2	Sulfur dioxide
VOC	Volatile Organic Compounds

1.0 PURPOSE OF THIS SIR

This Supplemental Information Report (SIR) is being issued to the public to disclose additional information prepared in response to comments received on the air resources sections of the Oil & Gas Leasing Draft EIS (DEIS) for the Dixie National Forest. This information is being released for public review and comment prior to preparation of the Final EIS.

This review is for additional analysis purposes only. In order to be eligible to appeal the decision, you must have commented during the 60-day DEIS comment period (17 October to 15 December 2008).

2.0 INTRODUCTION

A DEIS was prepared to decide which lands administered by the Dixie National Forest with federal oil and gas rights to make administratively available for oil and gas leasing. The DEIS for this project was issued for public comment on 17 October 2008. During the 60-day comment period a number of comments were received relative to the impact analysis for air resources. The Environmental Protection Agency (EPA) provided their comments on the DEIS with the exception of comments on the air quality analysis, with the understanding that an updated air quality analysis would be released as an SIR to the DEIS. They recommended that this study use different air emission factors for the subject facilities-based emission limitations, which would become effective in the future. This revised modeling was conducted in collaboration with the EPA and the Utah Division of Air Quality (UDAQ). The report on this modeling was revised and is hereby being made available for public review.

In January 2009, the U.S. Forest Service (USFS) issued guidance on including climate change in the environmental analyses for future planning decisions. In accordance with this direction and in response to public comment, the Forest has prepared a new appendix to the EIS that considers the effects of the proposed oil and gas leasing on climate change and the effects of climate change on the proposed action. This appendix is hereby being made available for public review.

As a result of the two new sources of information described above, the Dixie National Forest has modified the Air Resources sections of the EIS to incorporate the revised air quality impact modeling results and the evaluation of climate change. These revised air resources sections of the EIS are being made available for public review at this time as the main body of the SIR, with references to the revised Air Quality Modeling Report and the Climate Change Report. The SIR does not address any other issues or analysis.

This SIR incorporates the updated air model and climate change analysis as pertains to Air Resources, in response to discussions with and comments received on the DEIS from EPA. This SIR includes revised Air Resources sections of the DEIS: **Section 3.12** (Affected Environment), **Section 4.12** (Environmental Consequences), and **Section 5.12** (Cumulative Effects). The air quality modeling previously prepared for the DEIS was updated with revised emission inventory information that was developed in collaboration between the USFS, EPA (Region 8), and UDAQ (**Appendix SIR-1**). Climate change is incorporated into the updated Air Resources sections where applicable, and a complete climate change presentation and analysis was prepared and is incorporated by reference (**Appendix SIR-2**).

Best Science

The techniques and methodologies used in this analysis consider the best available science. The analysis includes a summary of the credible scientific evidence that is relevant to evaluating reasonably foreseeable impacts. In addition, the analysis also identifies the methods used and references the scientific sources relied on. When appropriate, the conclusions are based on a scientific analysis that shows a thorough review of relevant scientific information, a consideration of responsible opposing views, and the acknowledgment of incomplete or unavailable information, scientific uncertainty, and risk.

3.0 CHAPTER 3 DEIS REVISION

3.12 Air Resources

3.12.1 Climate

Generally, the climate within the Dixie National Forest is dry with a high number of sunny days, but weather can change dramatically. Thunderstorms are common during the summer months and daytime temperatures are warm, with cool nighttime temperatures. With the Forest's mid-continent location including numerous canyons, plateaus, and mountainous terrain, it experiences wide temperature variations between seasons. Climates in the Dixie National Forest also vary greatly with elevation. During winter and spring, precipitation comes in the form of snow, with a moderate to heavy snowpack accumulating in many of the higher elevations. By late spring, temperatures warm up at the lower elevations, while the mountain snowpack begins to melt. Summer brings warm temperatures to most areas with hot temperatures in the more desert-like, lower elevation areas. Afternoon thunderstorms are common in June through September.

As discussed in **Appendix SIR-2**, warming of the climate system is unequivocal. The global warming observed over the past 50 years is due primarily to human-induced emissions of heat-trapping gases (i.e., greenhouse gases or GHG). These emissions come mainly from the burning of fossil fuels (coal, oil, and gas), with important contributions from the clearing of forests, agricultural practices, and other activities (USGCRP 2009). Through complex interactions on a regional and global scale, GHG emissions and net losses of biological carbon sinks cause a net warming effect of the atmosphere, primarily by decreasing the net amount of heat energy radiated by the earth back into space.

Global mean surface temperatures have increased nearly 1.8 degrees F in the last 100 years, and the rate of warming over the last 50 years is double that over the last 100 (IPCC 2007b). In their latest report, the Intergovernmental Panel on Climate Change (IPCC) found a widespread reduction in the number of frost days in mid-latitude regions, an increase in the number of warm extremes, and a reduction in the number of daily cold extremes in 70-75 percent of the land regions examined (IPCC 2007b). In Utah, the average temperature during the past decade was higher than observed during any comparable period of the past century, and roughly 2 degrees F higher than the 100-year average. Utah is projected to warm more than average for the entire globe and more than coastal regions of the contiguous United States (BRAC 2007: Appendix A).

3.12.2 General Air Quality

The climate and climatic conditions within the Dixie National Forest are one of the major reasons for its very good air quality and why it is currently meeting all National Ambient Air Quality Standards (NAAQS). Active mixing of air and average precipitation for Utah, along with an absence of major air pollution sources results in low pollutant background values for the Forest. According to EPA Air Quality Index (AQI) reports (see Section 3.12.7) the air quality within the Forest is considered good to excellent. In addition, the majority of land use within the Dixie National Forest results in little man-made air pollution. Recreational use, residential heating for support facilities, and limited vehicle traffic constitute the main emission sources. Prescribed burns and wildfires are a significant source of air pollution within these areas. The Utah Smoke Management Plan (SMP) requires certain climatic and pollution level criteria prior to initiating prescribed burns.

The NAAQS are defined in the Federal Clean Air Act as levels of pollutants above which detrimental effects on human health and welfare may occur. There are seven criteria pollutants designated with NAAQS: ozone (O_3), carbon monoxide (CO), nitrogen oxides (NO_x), sulfur dioxide (SO_2), particulate matter (PM) with aerodynamic diameter less than or equal to 10 microns and 2.5 microns (PM_{10} and $PM_{2.5}$), and lead (Pb). The NAAQS are shown in **Table 3.12-1**.

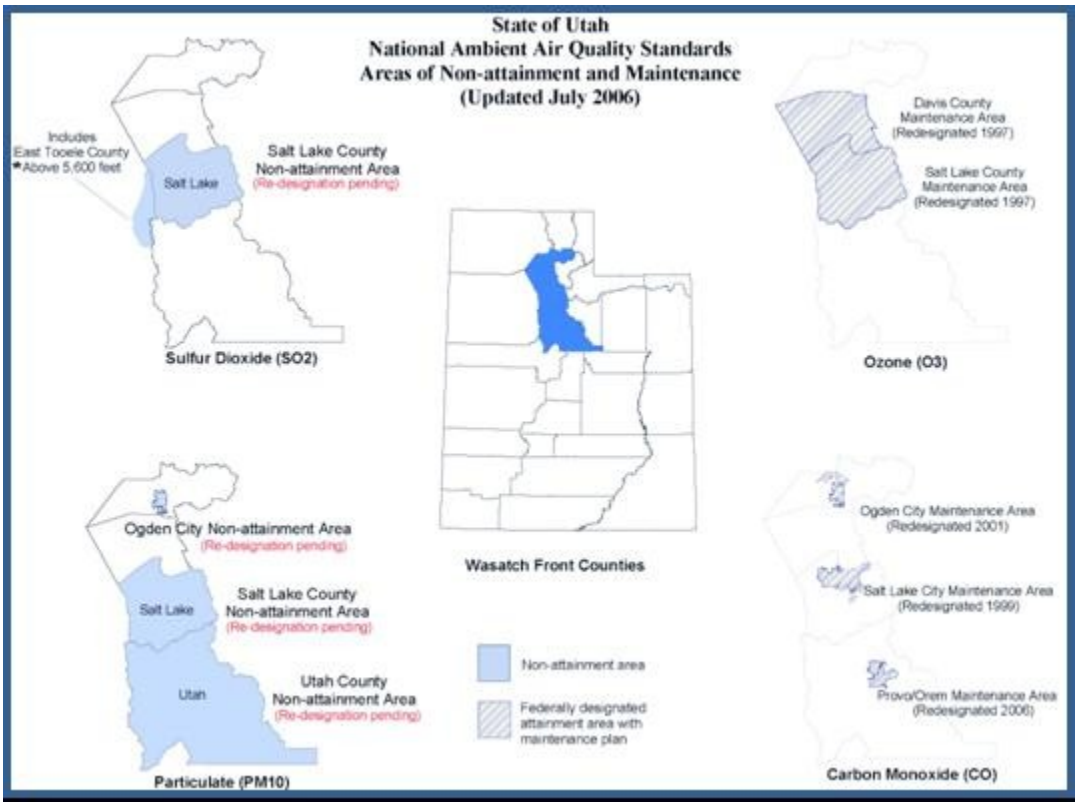
Table 3.12-1 National Primary and Secondary Standards

Pollutant	Averaging Time	Primary Concentration[1,2]	Secondary Concentration
Ozone	8 hours (5)	0.075 ppm	Same as primary
Carbon Monoxide (CO)	1 hour (1) 8 hours (1)	40,000 µg/m3 (35 ppm) 10,000 µg/m3 (9.0 ppm)	
Nitrogen Oxides (NO_x)	Annual Arithmetic Mean	100 µg/m3 (0.053 ppm)	Same as primary
Sulfur Dioxide (SO_2)	3 hours (1) 24 hours (1) Annual Arithmetic Mean	 (0.14 ppm) (0.03 ppm)	1,300 µg/m3 (0.5 ppm)
Particulate Matter as PM_{10} (Aerodynamic diameter < 10 microns)	24 hours (2)	150 µg/m3	Same as primary
Particulate Matter as $PM_{2.5}$ (Aerodynamic diameter < 2.5 microns)	24 hours (3) Annual Arithmetic Mean (4)	35 µg/m3 15 µg/m3	Same as primary
Lead (Pb)	Quarterly Arithmetic Mean	1.5 µg/m3	Same as primary

[1] µg/m3 = micrograms per cubic meter
[2] ppm = parts per million
Source: Code of Federal Regulations, 40 CFR Part 50, National
(1) Not to be exceeded more than once per year
(2) Not to be exceeded more than once per year on three year average
(3) The 3-year average of the weighted annual mean $PM_{2.5}$ concentrations from single or multiple community-oriented monitors
(4) The 3-year average of the 98th percentile of 24-hour concentrations at each population-oriented monitor within an area
(5) The 3-year average of the fourth-highest daily maximum 8-hour average ozone concentrations measured at each monitor within an area over each year

Regulations state that ambient air quality standards for NO_x, SO_2, and PM_{10} must not be exceeded at any time during the year in areas with general public access. Short-term standards for CO, NO_x, and SO_2 can be exceeded only once annually. Compliance with the 24-hour PM_{10} and $PM_{2.5}$ standards are based on the 98th percentile of 24-hour concentrations averaged over three years. Compliance with the new ozone standard is attained if the 3-year average of the annual 4th highest daily maximum 8-hour average at every ozone monitor does not exceed 0.075 ppm. Based on these federal regulations, Utah has several non-attainment areas within the State. Non-attainment areas, and the pollutant for which an area became non-attainment, are shown in **Figure 3.12-1**.

Figure 3.12-1 Non-Attainment Air Quality Areas in Utah



Source: Utah Department of Environmental Quality – subject to change in near future

None of these non-attainment areas affect the Dixie National Forest. Utah County, which is non-attainment for PM_{10}, is approximately 120 miles from the northernmost portion of the Dixie National Forest. Although the overall air quality in the Forest is rated good to excellent, there are portions of the Forest that lie near areas that have been closely reviewed and compared to the NAAQS. The UDAQ, EPA, and the SMP have designated the Forest area as Airsheds 2, 3, 4, 12, and 13, within the State of Utah. Utah Air Quality Control Rule 307-204 of the Air Quality Rules regulates the management of wildfires and prescribed burns. The SMP states that prescribed burns will not cause or significantly contribute to daily $PM_{2.5}$ or PM_{10} impacts or violate NAAQS. The purpose of the rules is to mitigate the impact on public health and visibility of prescribed fire and wildland fire. In some cases, air pollution generated in nearby urban Washington County has limited the ability of the Forest Service to implement prescribed burning.

3.12.3 Sensitive Areas

All areas of the state have been designated as either Class I or Class II for air quality. Pursuant to the Federal Clean Air Act, Class 1 areas include all National Parks greater than 6,000 acres and national wildernesses greater than 5,000 acres that were established as of 7 August 1977. Class I provides the most protection to these lands by severely limiting the amount of additional man-made pollution that can occur. Class II areas include all other areas of the country. Class II “Sensitive Areas” have been identified by the Forest Service, predominately as wilderness areas not considered Class I, although air quality regulators only distinguish between Class I and Class II. The regulations allow a specific increase or "increment" in pollution over and

above the existing air quality "baseline" pollution levels. Facilities that may impact Class I areas may be allowed to produce small increases in pollution, while facilities that impact only Class II areas are allowed somewhat larger increases. However, any facility that may increase pollution concentrations in these areas may not cause a violation of the NAAQS. The impact from a source is determined by using EPA-approved air dispersion models. **Table 3.12-2** shows the allowable increases of pollution to the ambient air environment of Class I and II areas.

Table 3.12-2 Allowable Pollutant Increases in Class I and Class II Areas

Pollutant	Period	Class I	Class II
		Increment	Increment
SO_2	3-hour	25 ug/m3	512 ug/m3
	24-hour	5 ug/m3	91 ug/m3
	Annual	2 ug/m3	20 ug/m3
NO_x	Annual	2.5 ug/m3	25 ug/m3
PM_{10}	24-hour	8 ug/m3	30 ug/m3
	Annual	4 ug/m3	17 ug/m3

µg/m3 = micrograms per cubic meter

These allowable criteria pollutants (SO_2, NO_x, and PM_{10}) are also the precursors to secondary pollutants that can contribute to acid rain, visibility, and regional haze. Based on the designation status from the State of Utah and several federal agencies, there are three Class I areas and six “sensitive” Class II areas that could be impacted by connected actions to leasing. The identified Class I areas are located within 100 kilometers (62 miles) of the Dixie National Forest. They include Bryce, Zion, and Capitol Reef National Parks. **Table 3.12-3** presents selected Class I and Class II areas that are sensitive areas that may be considered when addressing impacts. EPA and state regulators have no authority to regulate sensitive Class II Areas any differently than other Class II Areas, but land managers can request consideration of their sensitivities. See **Figure 5.12-1** in this report for Class I areas located within the Cumulative Effects Area (CEA).

Table 3.12-3 Sensitive Areas near the Dixie National Forest

Federal Class I & II Areas (unless otherwise specified)[1]	Managing Agency[2]	Class Category	State	Distance from Dixie National Forest (miles)
Bryce NP	NPS	Class I	UT	0
Zion NP	NPS	Class I	UT	0
Capital Reef NP	NPS	Class I	UT	9
Grand Canyon NP[3]	NP	Class I	AZ	68
Glen Canyon NRA[3]	NPS	Class II	UT	15
Cedar Breaks NM[3]	NPS	Class II	UT	0
Ashdown Gorge WA[3]	USFS	Class II	UT	0
Paria Canyon Vermillion Cliffs WA[3]	USFS	Class II	UT	25
Pine Valley Mountain WA[3]	USFS	Class II	UT	0
Box Death Hollow WA[3]	USFS	Class II	UT	0
Beaver Mountain WA[3]	USFS	Class II	UT/AZ	40
Moapa Valley NWR[4]	USFWS	Class II	NV	70
Grosvenor Arch, Markaguat Plateau, Santa Clara, Bald Knoll[3]	Various	Class II	UT	0-20

Federal Class I & II Areas (unless otherwise specified)[1]	Managing Agency[2]	Class Category	State	Distance from Dixie National Forest (miles)
Natural Bridges NM[3]	NP	Class II	UT	68
Grand Staircase-Escalante NM[3]	BLM	Class II	UT	0

[1] NP = National Park, NRA = National Recreation Area, NM = National Monument, WA = Wilderness Area, NWR = National Wildlife Refuge.
[2] NPS = US Department of the Interior, National Park Service, USFS = US Department of Agriculture, Forest Service, USFWS = US Department of the Interior, Fish and Wildlife Service.
[3] Sensitive Class II areas included in the analysis.
[4] Sensitive Class II areas not included in the analysis.

3.12.4 Air Quality Regulatory Considerations

The Land and Resource Management Plan for the Dixie National Forest (USFS 1986) requires compliance with all state and federal Air Quality Standards. The potentially applicable Air Quality Standards identified in the plan include:

- Utah Air Conservation Rules (Utah Administrative Code R307)
- Utah State Implementation Plan (SIP)
- National Ambient Air Quality Standards (NAAQS)
- National Standards of Performance for New Stationary Sources (New Source Performance Standards or NSPS)
- National Prevention of Significant Deterioration Standards (PSD)
- National Emissions Standards for Hazardous Air Pollutants (NESHAP)

The State of Utah's policy is to "maintain levels of air quality that will protect human health and safety, prevent injury to plant and animal life, and facilitate the enjoyment of natural attractions of the State" (Utah Air Conservation Act, pp 19-2-101.2). To enforce this policy, the State of Utah has promulgated a comprehensive set of rules, regulations, standards, and policies that are implemented by the UDAQ. Regulatory authority of the UDAQ is derived from the Utah Administrative Code Chapter 19-2 and the rules adopted by the Utah Air Quality Control Board. The state has been granted Administrative Authority to implement the provisions of the Federal Clean Air Act by the EPA. The UDAQ requires owners and operators of pollution generating facilities to obtain permits, install pollution control equipment and procedures, monitor emissions, maintain records, and implement other air quality protective activities. The Air Conservation Rules (R307-401) apply to any person intending to:

- construct a new installation which will or might reasonably be expected to become a source or an indirect source of air pollution, or
- make modifications or relocate an existing installation which will or might reasonably be expected to increase the amount or change the effect of, or the character of, air contaminants discharged, so that such installation may be expected to become a source or indirect source of air pollution, or
- install a control apparatus or other equipment intended to control emissions of air contaminants.

- operate a qualified air emission source; person must submit a Notice of Intent (NOI) and receive an Approval Order (AO) prior to initiation of construction. The NOI must include plans, specifications, and other information as is necessary to determine whether the proposed installation will be in accordance with all applicable requirements.
- Adhere to Best Management Practices (BMPs; see Appendix C of the DEIS, Conditions(s) 40)

Prior to issuing the AO, the state must provide an opportunity for public review and comment. A copy of the proposed AO is also sent to the applicant, the EPA, and to officials having cognizance over potentially impacted locations, including other states, city and county executives, regional land use planning agencies, state and federal land managers, and Indian Governmental bodies. The comments and concerns of the general public and government entities must be considered before the AO is issued.

Several of the New Source Performance Standards (NSPS) and National Emission Standards for Hazardous Air Pollutants (NESHAPs) would apply to the equipment and process of oil & gas production. These promulgated standards require that certain thresholds, based on a mass emission rate, are not exceeded. Applicable NSPS requirements could include Subpart Kb: Storage Vessels for Volatile Organic Liquids (including petroleum liquids), Subpart GG or KKKK: Stationary Gas Turbines, Subpart KKK: Equipment Leaks of Volatile Organic Compounds (VOC) from Onshore Natural Gas Processing Plants, Subpart LLL: Onshore Natural Gas Processing; SO_2 Emissions; NESHAPs, Subparts HH (oil and natural gas production), HHH (natural gas transmission and storage), and other more recently promulgated standards. Compliance with these applicable regulations is implicit and required for development of production oil well fields. Some of these requirements are expressed in the BMPs listed in Appendix C of the DEIS. Adherence to and compliance with these regulations that limit air pollutant emissions are addressed in the permitting phase of an oil and gas project.

3.12.5 Criteria Pollutants

Statewide emission inventories are updated every three years, with the latest published inventory in 2005 (Annual Report, Utah Division of Air Quality, UDEQ 2005a, 2007, and 2009). The Dixie National Forest is located in Garfield, Iron, Kane, Piute, Washington, and Wayne Counties. The tabulated emissions from state inventory surveys of all documented sources in these counties are shown in **Table 3.12-4**.

Table 3.12-4 Emissions Totals by County (tons per day)

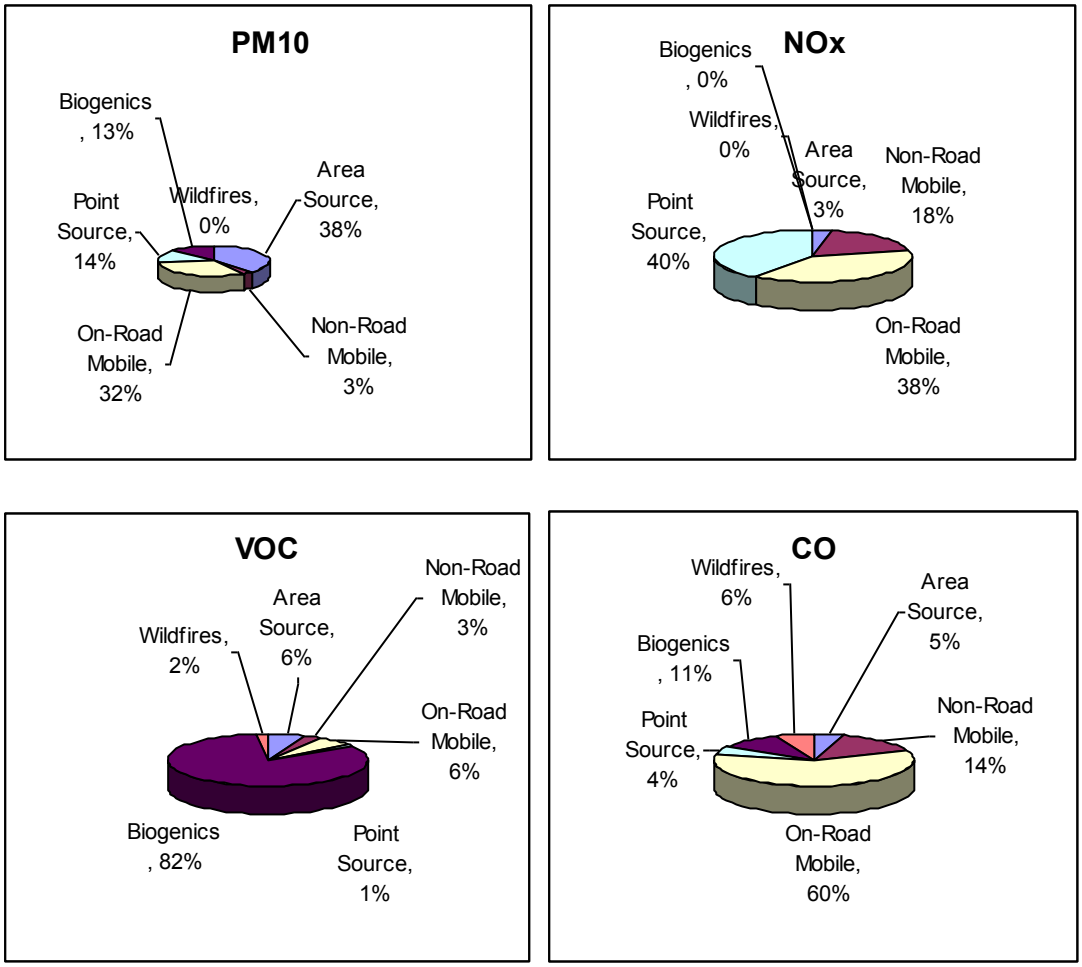
Year[1]	2002	2005	2002	2005	2002	2005	2002	2005	2002	2005
County	NO_x	NO_x	PM_{10}	PM_{10}	SO_x	SO_x	VOC	VOC	CO	CO
Garfield	4.5	1.78	13.80	4.70	0.26	0.16	140.6	125.0	139.6	44.30
Iron	11.00	8.98	5.60	5.83	1.50	0.82	112.3	111.0	101.5	79.16
Kane	1.50	1.79	2.00	2.45	0.20	0.15	134.0	135.4	44.9	45.44
Piute	0.50	0.38	0.90	0.70	0.10	0.05	35.7	32.07	11.3	8.25
Wash	12.70	17.26	2.10	17.40	0.80	0.75	160.9	171.7	155.4	21.30
Wayne	0.71	0.62	1.30	1.44	0.40	0.22	67.4	67.6	21.9	18.89

[1] The 2005 Annual Report listed 2002 emissions; the 2007 and 2009 Annual Reports listed 2005 emissions.

The different source-types are divided into six separate categories as seen in **Figure 3.12-2**. Point sources reference larger, stationary industry including manufacturing and power plants. Area sources are usually smaller stationary sources that, because of their greater number, are

accounted for by classes of sources operations, such as home heating units. Although biogenics and wildfires are area sources, they are separated in the following pie charts because they are non-anthropogenic (not produced by human activity). The following pie charts depict sources for all of Utah, but are representative of percentages of source-type emissions throughout the State of Utah.

Figure 3.12-2 Emission Source Type (2005 Data)



3.12.6 Existing Surrounding Sources

Industrial sources located to the southwest of the Forest are the most likely to impact the Forest due to prevailing winds. Prevailing winds are mainly from the south-southwest. **Figure 3.12-3** shows the annual prevailing winds from the Cedar City meteorological station (National Climatic Data Center 2008). The major sources located in the urban areas of the state are associated with typical industrial operations such as peaking power plants, sand and gravel operations, mining, and general industrial manufacturing. Other upwind sources of pollutants can include emissions from wildfires in Arizona, Nevada, or California. **Table 3.12-5** lists the major and significant sources that are located within the six county area of the Forest. "Significant" meaning the source is not major, but is in close proximity to the Forest boundary and emits measurable amounts of air pollutants. Major coal-fired power plants located outside the six-county area (west and south of the Pine Valley Ranger District and 125 miles to the northeast of the Escalante Ranger District) may also affect the air quality of the Forest. Coal mining

operations border the perimeter of the Forest but are not designated as major sources. These include the proposed Alton Coal Hollow operation located 10 miles south of the Cedar City Ranger District in Kane County, and the SUFCO and Emery Deep Mine (underground mines), which are located 35 miles northeast of the Escalante Ranger District.

Figure 3.12-3 Cedar City Windrose

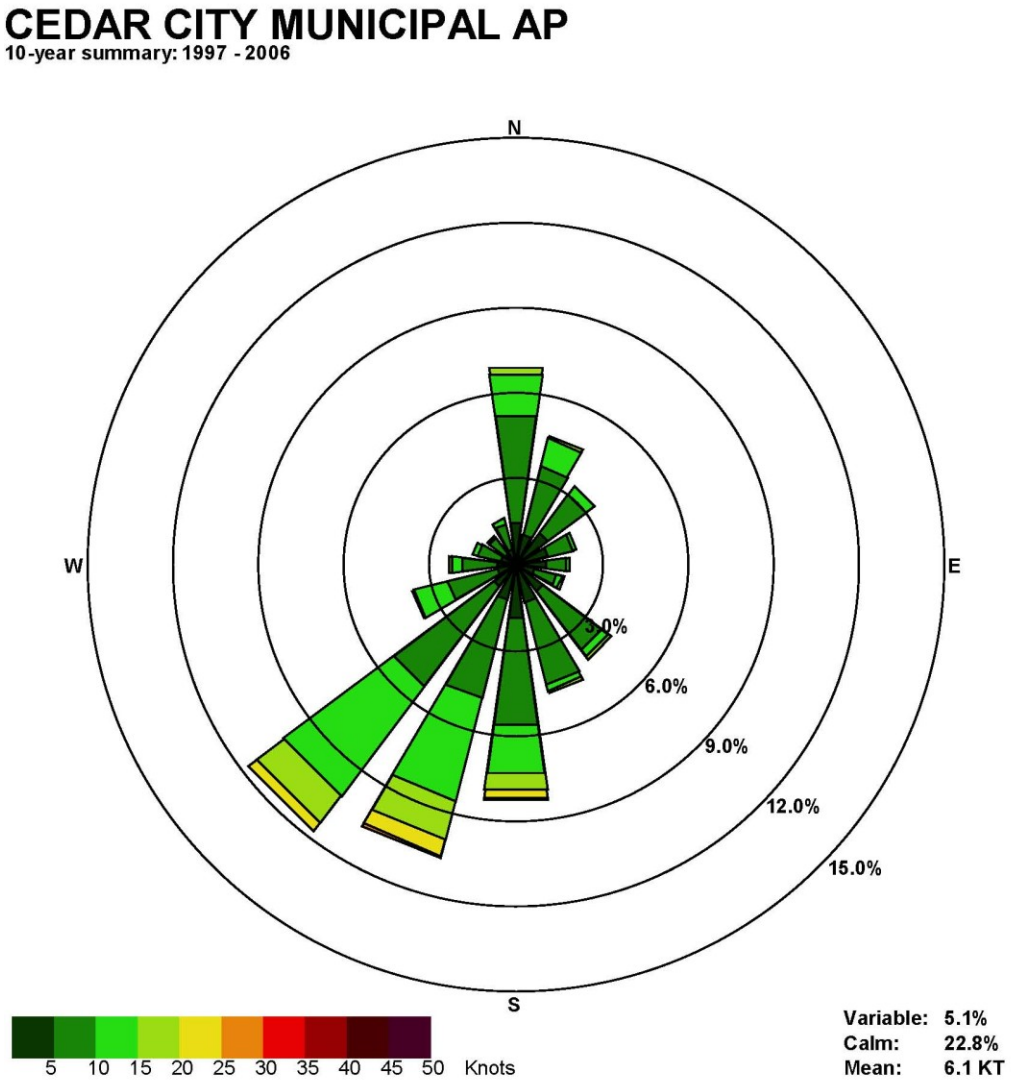


Table 3.12-5 Permitted Significant Sources in the Six County Area

Source	County, State
St. George Steel Fabrication	Washington, UT
Bear River Contractors	Washington, UT
Sorenson Pit	Washington, UT
Western Rock Products	Washington, UT
Washington County Landfill	Washington, UT
O'Sullivan Furniture	Iron, UT
OMG APEX	Washington, UT
Hilldale City Cogeneration	Washington, UT
Cedar City Yard	Iron, UT
City of St. George Power Plants Redrock, Millcreek & Bloomington	Washington, UT
Agrinautics	Iron, UT
Nuclear Fuel Service	Garfield, UT
USMX	Washington, UT
Bulldog Crushing/Hot Mix	Iron, UT
Cedar City Pit	Iron, UT
Panguitch Pit	Garfield, UT
St. George Pit	Washington, UT
GenPak Corporation	Iron, UT
Furniture Manufacturer	Iron, UT
Ft. Pearce Aggregate Plant	Washington, UT
NEVCO Energy 270 MW Coal-Fired Plant	Sevier, UT
Anderson Junction Aggregate Plant	Washington, UT
Reid Gardner Power Plant	Clark County, NV

In addition to permitted facilities located near the Forest, there are recreational activities within the Forest that are also sources of air pollution. These include motorized recreational vehicles such as powered watercraft, motorcycles, ATVs, and snowmobiles. While there is a national effort to improve emissions from these types of motors, the typical 2-stroke engine emits significantly more pollutants than those of more regulated highway vehicles. The criteria pollutants of concern from such recreational vehicles are NO_x, CO, and PM, and, to a lesser extent, VOCs and SO_2.

Minor stationary air emission sources within the Forest include residential heating sources (i.e., boilers and heaters) and propane-combustion electrical generators for remote cell towers. These sources are considered either minor or insignificant.

The Forest allows timber harvest activities in order to achieve management goals and provide opportunities for the local timber industry. Harvesting includes timber cutting, 2-stroke chainsaw engine emissions, miles of logging road reconstruction, and transportation of the timber. These activities result in particulate emissions from construction, timber harvesting activities, and haul road usage in addition to NO_x, CO, VOCs, and PM from logging truck exhaust.

Utah submitted its 2003 State Implementation Plan (SIP) and is in the process of developing an update to the current SIP. The current SIP addressed many issues including emissions from a wide variety of sources, including vehicles and anthropogenic fire. Smoke emissions are controlled with an Enhanced Smoke Management Plan. The updated SIP will address a backstop trading program for SO_2 from large industrial sources. The backstop trading program is essentially a "cap & trade" program, which would set a cap on the maximum amount of SO_2 emissions and allocate emission allowances to the affected sources. If the cap is not exceeded,

various emission controls and trading of emissions between sources may take place. The updated SIP will assess the impact of Utah sources of emissions on protected areas (Class I areas) in adjacent states, and the impact of emission sources in adjacent states on Utah's protected areas, and will set forth appropriate control measures as needed. The SIP update will address the effects of nitrogen oxide and PM emissions from Utah's large industrial sources on protected areas in Utah and adjacent states (UDEQ 2005b).

3.12.7 Air Monitoring

The Forest area is designated as attainment/unclassifiable for all criteria pollutants. As can be seen in **Figure 3.12-1**, Garfield, Iron, Kane, Piute, Washington, and Wayne Counties are classified as attainment or unclassified for all criteria pollutants.

The UDAQ runs 27 monitoring stations within the state. Only one of these stations is located near the Forest, in an urban setting within Washington County (City of Santa Clara). The Dixie National Forest also has cooperated with the National Park Service in operating Interagency Monitoring of Protected Visual Environments (IMPROVE) air quality monitoring sites. Three monitors have been set up in Bryce Canyon; 1) Bryce Point records visibility, 2) Repeater Hill monitors deposition, and 3) Yovimpa Point takes pictures for visibility monitoring. An IMPROVE monitor for visibility has also recently been established near the entrance to Zion National Park. Short-term ambient air monitors have also been placed near the Dixie National Forest for specific projects.

The Air Quality Index (AQI) is a daily EPA rating system that accounts for all measured criteria air pollutants in a geographic area and assigns the rating a qualitative description. The AQI focuses on health effects that may be experienced within a few hours or days after breathing polluted air. EPA calculates the AQI for five major air pollutants regulated by the Clean Air Act: ground-level ozone, PM, CO, SO_2, and NO_x. For each of these pollutants, EPA has established national air quality standards to protect public health. For example, if an area has an AQI rating of 0 to 50 it is classified as good air quality; if the rating is 101 to 150, it is classified as "unhealthy for sensitive groups". **Table 3.12-6** displays the AQI over the last three years for the monitoring location in the St. George area.

Table 3.12-6 Air Quality Index Ratings

Condition	2006[1]	2005[1]	2004[2]
Good (0-50)	324	325	309
Moderate (51-100)	38	34	39
Unhealthy (101-150)	0	3	0
Very Unhealthy (201-300)	1	1	0
Hazardous (>300)	1	0	0

[1] Washington County 363 days with AQI
[2] Washington County 348 days with AQI
Source: EPA AQI Reports

Table 3.12-6 shows that the number of good days increased between 2004 and 2006. The total number of moderate to hazardous days shows little trend. Since the prevailing winds are westerly, the pollutants indicated for the Washington County monitoring location can enter the Dixie National Forest, but at lower concentrations than recorded at the monitoring location due to the effects of air mixing and pollutant dispersion. Note that the total numbers of days recorded per year in the table may not sum to 365 due to monitoring equipment malfunction, recording, or data validation errors.

3.12.8 Regional Haze and Visibility

Regional haze is caused by fine particles in the air that settle out very slowly. Because of the impact that haze has on visibility in National Park Service units and Class I designated wilderness areas, many efforts to control and reduce man-made haze, and the air pollutants that cause it, are underway through national laws and regional collaboration. Such a collaboration, involving states, Indian tribes, industry, and environmental advocates, is being coordinated by the Western Regional Air Partnership (WRAP). The State of Utah along with United States Department of Agriculture (USDA) are members of WRAP and have been involved with developing visibility protection programs. Federal and state laws provide visibility protection for the 156 mandatory Class I areas in the U.S., five of which are located in Utah. Visibility protection programs are being developed for Class I areas in the western U.S.; these programs should also result in some visibility protection and improvement in the Class II wilderness areas on the Forest (WRAP 2003).

The Regional Haze Rule (RHR) requires that reasonable progress be demonstrated toward natural visibility conditions on the monitored "Worst 20 percent" of sample days, and no worsening of visibility for the monitored "Best 20 percent" of sample days be allowed at each mandatory federal Class I area. Baselines have been developed for Class I areas, although the data is still being checked for quality control. Glide rates or uniform rates of progress have been developed for each mandatory Class I area to measure the progress of the RHR. **Figure 3.12-4** shows the mean visual range measured by the IMPROVE monitoring system at the Grand Canyon, Bryce Canyon, Zion, and Capitol Reef National Parks from 1993 to 2003, the most recent year for which data is available. Mean visual ranges generally trended upward over this period.

Figure 3.12-4 Trends in Mean Standard Visual Range in Nearby National Parks

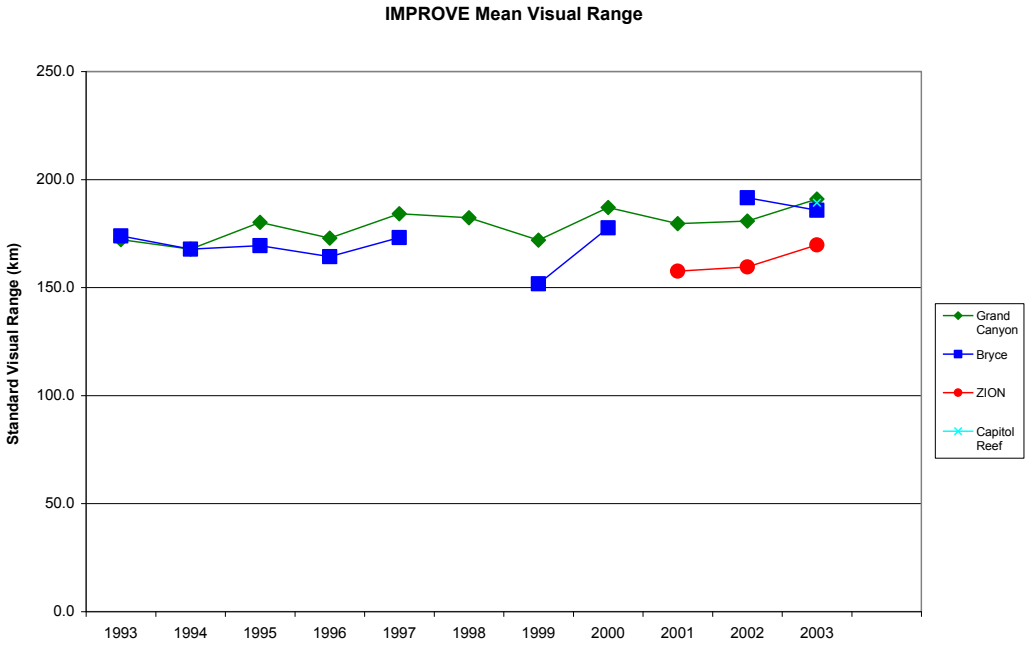
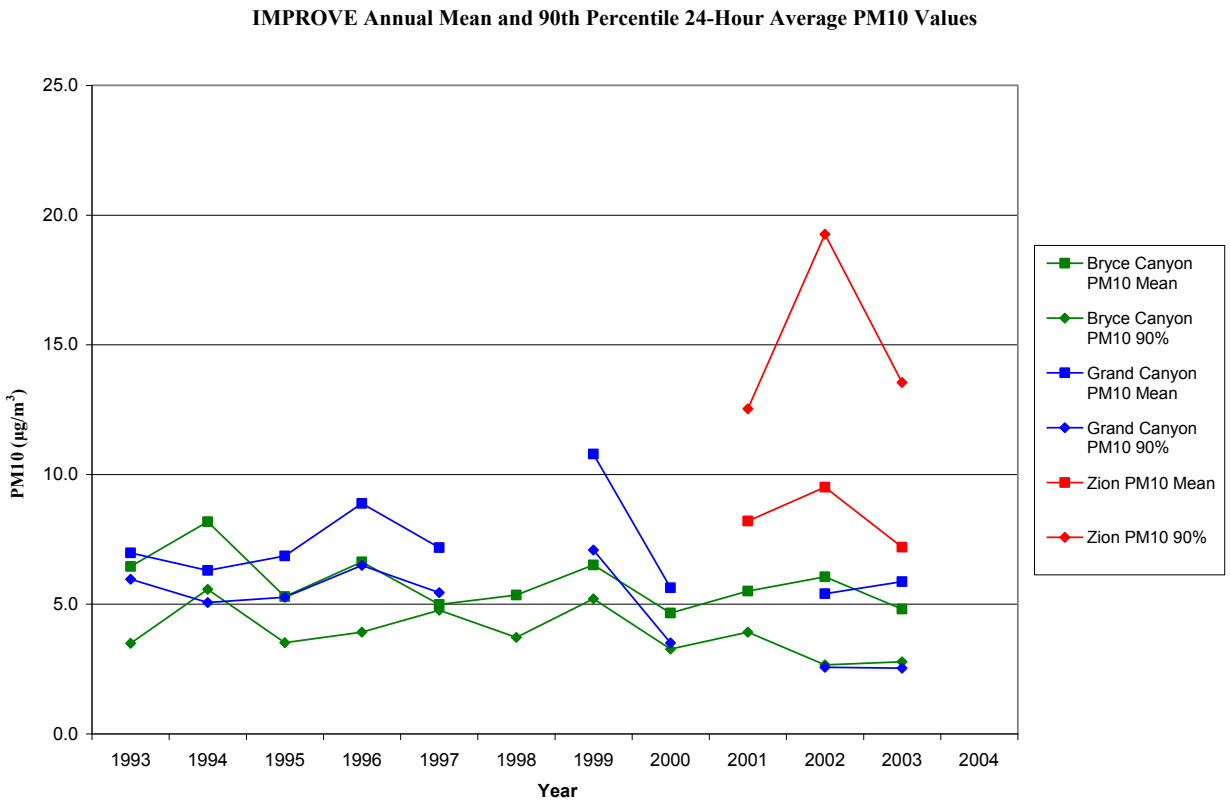


Figure 3.12-5 shows trends in particulate concentrations at nearby National park IMPROVE monitoring sites. The values show PM_{10} concentrations an order of magnitude or more below NAAQS standards. Trends over the decade from 1993 to 2003 have been flat to downward.

Figure 3.12-5 Trends in PM_{10} Concentrations in Nearby National Parks



The primary location in the vicinity of the Forest where ozone is routinely monitored is at Zion National Park, which has complete data since 2003. **Table 3.12-7** shows that ozone levels have been flat and below the historic NAAQS of 0.08 ppm, and a little below the current NAAQS of 0.075 ppm in place since May 2008, with the exception of a spike above the NAAQS in 2005.

Table 3.12-7 Ozone Monitoring Data from Zion National Park

MONITORING SITE	AVERAGING PERIOD	CASTNET OZONE CONC. (ppb)
		8 HR AVERAGE
Zion National Park	2007	71
	2006	72
	2005	91
	2004	74
NAAQS		75 [1]

[1] Based upon a three year average of the fourth highest daily maximum eight hour average, revised down in 2008 from 80.

The Air Quality Trends in National Parks 1994-2003 report assessed trends in Bryce Canyon NP. Pollutants that affect visibility, such as sulfate ion, nitrate ion, and ammonium ions were compared over this 9-year period. For Bryce Canyon National Park, overall visibility showed an

improvement (i.e., a decrease in concentration), as did sulfate ion concentration. Nitrate and ammonium ion concentrations increased.

The Preliminary 2018 Reasonable Progress Visibility Target Values of the federal RHR report prescribes visibility for Bryce National Park as requiring 3-5 deciviews (dv) improvement for the "Best 20 percent" Days and 0-0.5 dv decrease in Haze Index to meet the 2018 glide rate. A deciview is a linear measurement of visibility impairment derived from calculated light extinction. Zion National Park will require a 5-7 dv improvement for the "Best 20 percent" Days and 0.5-1.0 dv decrease in "Worst 20 percent" Days Haze Index to meet the 2018 glide rate.

3.12.8.1 FLAG and Air Quality-Related Values

The Federal Land Managers' Air Quality-Related Values Work Group (FLAG) is a cooperative working group consisting of National Park Service, USDA Forest Service and the U.S. Fish and Wildlife Service. The FLAG was formed (1) to provide consistent policies and processes for identifying air quality-related values (AQRVs) and for evaluating the effects of air pollution on AQRVs, primarily in Federal Class I air quality areas and (2) to provide State permitting authorities and potential permit applicants consistency on how to assess the impacts of new and existing sources on AQRVs. AQRVs include Visibility, Deposition, and Ozone. FLAG guidance uses EPA's estimates of natural visibility conditions under its Regional Haze Rule as reference levels for Class I visibility analyses. For deposition, FLAG assesses sulfur and nitrogen deposition impacts using concern thresholds, pollutant exposures, and deposition analysis thresholds. Visibility and Deposition with regard to FLAG are evaluated in Sections 4.12.2.1 and 4.12.2.2. Ozone is discussed in Section 5.12.3.1.

3.12.9 Greenhouse Gas Emissions and Sinks

Appendix SIR-2 contains a detailed discussion of climate change, including greenhouse gas (GHG) emissions and sinks and is incorporated by reference into this EIS. The reader may refer to this document for a complete discussion of greenhouse gases. The following discussion is a summary of climate change, and specifically greenhouse gas emissions and sinks, as it relates to the baseline condition of air resources on the Dixie National Forest.

In 2005, activities in Utah accounted for approximately 68.8 million metric tons (MMt) of gross carbon dioxide equivalents (CO_{2e}) emissions, an amount equal to 1 percent of total U.S. gross GHG emissions. Utah's gross GHG emissions are rising at a faster rate than those of the nation as a whole (gross emissions exclude carbon sinks, such as forests). Utah's gross GHG emissions increased by about 40 percent from 1990 to 2005; national emissions rose by 16 percent during the same period. On a per capita basis, Utahns emitted about 27 metric tons (Mt) of CO_{2e} in 2005, slightly higher than the national average of 25 $MtCO_{2e}$ /yr.

The principal source of Utah's GHG emissions is electricity generation in power plants fueled by coal or natural gas, accounting for 37 percent of total State gross GHG emissions in 2005. The next largest contributors to total gross GHG emissions are the transportation sector (25 percent) and the residential, commercial, and industrial fossil fuel combustion sector (18 percent; CCS 2007).

Estimates of carbon sequestration have been prepared by the EPA for forest ecosystems in the U.S. (EPA 2008a; NRS 2009), which include the overall carbon stock balance of carbon sequestered in forest media, wood products in use, and wood in solid waste disposal facilities. These estimates predict that U.S. forests contained approximately 43,000 MMt of "sequestered"

carbon in 2007. The Dixie National Forest has not conducted a Forest-specific estimate of GHG emissions from normal forest management activities. However, based on estimates from other western forests published in 2009 (and not including carbon sequestration; USFS 2009), the Dixie National Forest probably emits between 400 and 2,000 Mt of carbon dioxide per year. Taken together with carbon sequestration, it is assumed that the overall carbon stock balance for the Dixie National Forest follows the national trend described by the EPA (see **Appendix SIR-2**), in that carbon is being sequestered in both the Forest ecosystem and harvested wood obtained from the Forest, and that this is resulting in a net sequestration of carbon dioxide (CO_2) on an annual basis.

In addition to forest management activities, a significant amount of GHG is emitted from forest fires (i.e., wildfires). GHG emission estimates that have been made nationally and in other states have shown that forest fires are significant sources of GHG emissions, and forest fires on the Dixie National Forest would also produce large quantities of GHG emissions. EPA (2008b) estimated that across the U.S., GHG emissions from forest fires in 2006 were 268 MMt of carbon dioxide, 25 MMt of methane, and 2.5 Mt of nitrous oxide (see **Appendix SIR-2**).

3.12.10 Pine Valley Ranger District

The Pine Valley Ranger District is the western section of the Forest. The air quality in the southern portion of this ranger district can be influenced by Washington County's area, mobile, and point sources. Washington County is currently in a rapid population growth mode and produces significant amounts of pollutants associated with a growing urban population. Fugitive and stack particulates are the main pollutant of concern being emitted from these activities. PM pollutants are mainly from aggregate producers, land clearing, and unpaved roads. Prevailing winds are from the west and can influence the existing air quality of this ranger district. Wind events form the south would impact this ranger district even more due to the juxtaposition of sources and receptors. Recreational activities such as vehicle sight-seeing, off-road vehicles, and campfires also impact the air quality.

Existing major air emission sources located near the Pine Valley Ranger District include the City of St. George's peaking power plants and the Reid Power Plant located near Moapa, Nevada. St George's diesel and gas-fired turbines and boilers, when considered as one facility, constitute a major source for NO_x emissions. Significant emissions of SO_2, CO, and PM_{10} also are released from these facilities when operating. The Reid Gardner Power Plant is a coal-fired electric generating facility located west of the Pine Valley Ranger District. Historically, this facility has emitted over 1,000 tons of NO_x, SO_2,and CO_2 emissions annually. NV Energy Company, in a joint settlement plan with the State of Nevada, has agreed to reduce NO_x emissions by 30 percent and to close the oldest units (1 – 3) when a new 1,500 Megawatt (MW) coal-fired power plant, the Ely Energy Center, begins operations. Construction of the Ely Energy Center power plant was placed on hold by NV Energy in 2009. Emissions of NO_x and SO_2 are of concern for both ozone-forming and acid rain potential in the cumulative effects area.

The Toquop Energy Project is a proposed 750 MW coal-fired electric power plant that would be located 12 miles northwest of Mesquite, Nevada. While the proposed pollution control equipment would reduce NO_x by 90 percent and SO_2 by 98 percent compared with past practices (Toquop Energy Company 2007), if built, this plant would also impact the air resources of this ranger district.

3.12.11 Cedar City Ranger District

The Cedar City Ranger District also has influences from urban growth, mobile sources, and associated industry. With prevailing winds from the west, air resources in this ranger district are currently impacted by emission sources located to the west including: Cedar City, Interstate-15, and a variety of light industrial sources. Light industrial sources include a polystyrene foam and industrial chemical manufacturer, which emits significant amounts of VOCs. Alton Coal Company, located southeast of this ranger district, may be restarting coal surface mining in the near future. Recreational activities such as vehicle sight-seeing, off-road vehicles, and campfires to some extent impact the air quality. Three wells on private lands near the southern tip of the Cedar City and Powell Ranger Districts were drilled to test coals in the Dakota Sandstone; all three wells have been plugged. There are no major air emission sources located in the Cedar City Ranger District.

3.12.12 Powell Ranger District

The Powell Ranger District has similar air resources issues as Cedar City Ranger District, but without the impacts from mobile sources from Interstate-15 and nearby population growth. The town of Panguitch has a population about one percent of St. George and seven percent of Cedar City. Other very small towns are located on the borders of this ranger district, and some mining activities are located directly south. With Bryce Canyon National Park located along the southeast border, the general air quality is considered excellent. There are no major air emission sources bordering the Powell Ranger District. However, there are several coal mines, and the NEVCO and Hunter Power Plants, all located within 70 miles of the borders of the Powell Ranger District. The proposed Alton Coal Hollow project is near the southern end of the ranger district.

3.12.13 Escalante Ranger District

The Escalante Ranger District has no nearby emission sources such as major urban areas, highways, or significant area sources. The Upper Valley Oil Field, located along the southeastern boundary of this ranger district, was discovered in 1964. The field has produced over 27 million barrels of oil and more than 61.6 million cubic feet of gas (likely vented) and is still producing. The Upper Valley Oil Field has been electrified, thus reducing emissions to a very low level. The air quality of the Escalante Ranger District is typically excellent. Air emission sources bordering the Escalante Ranger District are similar to the sources in the Powell Ranger District. Recreational activities such as vehicle sight-seeing, off-road vehicles, and campfires to some extent impact the air quality.

4.0 CHAPTER 4 DEIS REVISION

4.12 Air Resources

4.12.1 Introduction

The context and intensity of the potential environmental effects of oil and gas operations on air resources do not require qualitative descriptions such as those discussed in Section 4.1 and **Table 4.1-1** (with the exception of climate change). That is because the air quality impact modeling results, which comprise the bulk of the impact assessment for Air Resources, are quantitative estimates that are directly compared to applicable regulatory standards and require no additional qualitative descriptors attached to them. Unlike a regulatory evaluation for permitting a given facility design, when impacts are evaluated for compliance with the ambient air quality standards in the specific vicinity of the facility; the evaluation in this EIS discloses the potential impacts to air quality at different distances from a hypothetical, but representative, oil production facility, which could be located anywhere in the Forest.

Representative, known emission rates for oil exploration and production facilities were selected for air pollutant emissions in this analysis. Selection of these emission values were a collaborative effort of the Dixie and Fishlake National Forests, EPA (Region 8), and UDAQ. Air dispersion models, based on unit emissions, were developed to allow for interpolation of emissions. Air dispersion modeling runs using emissions from a typical operation (exploration or production) were performed to verify the accuracy and conservativeness of the unit emission tables. Further discussion of the analysis process is discussed in the Air Quality Modeling Report contained in **Appendix SIR-1**. Greenhouse gas emission factors used in the climate change discussion were taken from a variety of sources and are discussed in detail in **Appendix SIR-2A**.

Measurement Indicators

- *Measurement Indicator #1* CHANGE IN AIR QUALITY ABOVE AMBIENT CONDITIONS
- *Measurement Indicator #2* NAAQS EXCEEDANCES
- *Measurement Indicator #3* CHANGE IN VISIBILITY COMPARED TO NATURAL BACKGROUND CONDITIONS
- *Measurement Indicator #4* INCREASE IN GREENHOUSE GAS EMISSIONS

4.12.2 Impacts Common to All Action Alternatives

No leasing options directly apply to air resources under any of the action alternatives. As a result, the impacts of connected actions under the Reasonably Foreseeable Development Scenario (RFDS) are discussed in this section assuming no restriction or stipulations on oil and gas activities relative to air resources other than those listed on BLM Lease Form 3100-11 Standard Lease Terms and Conditions (SLT) and the environmental protection measures that would be implemented by other laws and regulations as described in Section 1.8.5.2 (of the DEIS).

Impacts to air resources would only result if oil field exploration and construction activities, oil field development, operating and maintenance activities, and sustainable production occur. The amount of dust generated by these activities would depend on the soil type, moisture conditions, dust control efforts, and the amount of traffic on dirt or gravel roads. Vehicle exhaust emissions would primarily depend on the amount of traffic. Impacts to air resources would be dependent on the distance from the potential activities and their elevations. Further discussion of the impacts is covered in the Air Quality Modeling Report (**Appendix SIR-1**).

There is the potential for oil and gas exploration and development activities to encounter hydrogen sulfide gas in the subsurface. Hydrogen sulfide can be a component of petroleum and natural gas in widely varying concentrations and exhibits a range of toxic effects to human health depending on its concentration in the atmosphere. Releases of significant amounts of hydrogen sulfide are minimized through precautions normally taken by industry personnel, but serious accidents can potentially cause significant impacts to human health for several thousand feet from the location of the release. When hydrogen sulfide is known to be present at a facility, warning signs are posted, special vents or incinerators are installed on equipment, contingency plans are prepared, and all workers at the facilities receive special training on dealing with accidental releases of the gas.

Criteria pollutants exist that could be released during oil and gas exploration and development activities that can contribute to acid rain impacts. The criteria pollutants sulfur dioxide (SO_2) and nitrogen oxides (NO_x) are precursors to acid rain, which is a result of chemical changes in the atmosphere. Acid rain could affect the pH of the lakes and the vitality of the vegetation in each of the ranger districts. Also criteria pollutant emissions could have an impact on visibility and regional haze. Regional haze is caused by fine particles in the air (emitted directly or formed as secondary pollutants formed from NO_x and SO_2 emissions) that settle out very slowly. Increased criteria pollutant particulate emissions resulting from well field development could affect the visibility of the entire forest.

Carbon dioxide and methane emissions contribute to the carbon cycle, which may indirectly contribute to the effects of climate change described in **Appendix SIR-2**. Increases in GHG emissions are described in Section 4.12.2.5.

4.12.2.1 Construction and Exploration

The primary potential emissions resulting from exploratory drilling activities predicted in the RFDS are NO_x, SO_x, and VOCs from engine exhaust, product management, and tank breathing losses. Construction of the well pads will also result in measurable emissions of PM_{10} (see **Table 4.12-1**). Assuming that connected actions to leasing do occur, exploratory and construction impacts would be localized and short term. Impact analyses for VOCs require regional photochemical modeling. There is no practical technical approach for estimating VOC impacts from an individual project or small series of projects; this must be performed on a regional basis when cumulative regional development activity indicates enough emissions to justify it. For this reason, this analysis focuses on the impacts of criteria air pollutants.

Based on the UDAQ regulations and the Utah SIP, dust emissions cannot exceed 20 percent opacity, as verified by EPA Method 22 observations, at the leased property boundary. Emissions from predicted construction and exploration activities would not be expected to exceed Class I or Class II standards because of construction duration, low emission rates, existing good air quality, and dispersion. Additional BMPs for dust control might be needed when there is regular public access near the drilling site. With any industrial activity, owners

and operators must comply with the Clean Air Act and the Utah Air Quality Regulations, which regulate both operations that cause air emissions and air emissions.

Table 4.12-1 Construction Emissions

Source Name	Pollutant	Emission Rate (g/sec)
Natural Gas Exploration Flare	CO	0.0532
	NO_x	0.0098
	PM_{10}	0.00089
Well Pad Construction[1]	PM_{10}	4.946E-7
	$PM_{2.5}$	7.574E-8
Road[2]	PM_{10}	0.00238
	$PM_{2.5}$	0.000363

[1] Values include well pad construction, construction traffic, drilling traffic, and test and completion traffic.
[2] Values for roads, from Trinity Consultants (Trinity 2004)

Vehicle traffic volume estimates, which were used to derive road dust emission rates, were prepared consistent with the "Highway Freight Traffic Associated with Development of O&G Wells" document prepared in 2006 by Daniel Kuhn of the Utah Department of Transportation.

The evaluation of air resource impacts from the predicted exploration activities in the RFDS included the following activities:

- Construction of 5.5-acre drilling locations;
- A diesel fuel-fired drill rig engine with emissions based upon the 13.5 tons NO_x per well reported in the WRAP Oil and Gas Emission Inventory prepared in December 2005 by Environ, and the 2005 Wyoming field survey from which that data was developed, with actual emissions adjusted downward to be compliant with recent tiered engine requirements, and SO_2 emissions consistent with AP-42 assuming the 0.15 percent sulfur content in diesel scheduled to be required during the operational phase;
    - The WRAP study indicated the mean drilling time is approximately 90 days per well continuously around the clock except for maintenance. Therefore, the longer term average impact predictions effectively assume four wells drilled back to back in relatively close proximity;
- Construction of 1.1 miles of new access roads;
- Support traffic to supply, maintain, and staff the drilling effort; and
- A low volume of flaring of natural gas during exploration, equal to 100 million standard cubic feet (Mscf) per year.

Impact analyses, under the assumption that all of the connected actions described in the RFDS would occur, were conducted for distances ranging from 0.25 to 200 km (124.3 miles) from the source and at seven receptor elevations that ranged from 2,500 feet above to 2,500 feet below the source. The highest receptor impacts occurred when the model receptors were at or near the same elevation as the source. **Table 4.12-2** documents the maximum predicted criteria pollutants NO_2, SO_2, and PM_{10} concentrations ($\mu g/m^3$) as well as the maximum visibility impairment impacts at a variety of distances, for the scenario where the receptors were at the same elevation as the source. The tabulated impacts represent the maximum impact at the given distance for any of the elevation scenarios.

Table 4.12-2 Exploration Drilling (Connected Actions) Impacts

Criteria Pollutant	Period	Class I	Class II	Concentrations (µg/m^3) at kilometers			
		Increment	Increment	1	5	10	20
SO_2	3-hour	25 µg/m^3	512 µg/m^3	0.16	0.05	0.02	0.01
	24-hour	5 µg/m^3	91 µg/m^3	0.07	0.02	0.01	0.00
	Annual	2 µg/m^3	20 µg/m^3	0.02	0.01	0.00	0.00
NO_2	Annual	2.5 µg/m^3	25 µg/m^3	10.1	3.39	1.63	0.77
PM_{10}	24-hour	8 µg/m^3	30 µg/m^3	12.4	2.77	1.20	0.53
	Annual	4 µg/m^3	17 µg/m^3	3.09	0.69	0.30	0.13
AQRV	**Metric**	**Increment**	**Increment**	**1**	**5**	**10**	**20**
Deposition	NO_2 Dep	0.005	kg/hect/yr	0.356	0.0056	0.0022	0.0008
	SO_2 Dep	0.005	kg/hect/yr	0.0001	0.0000	0.0000	0.0000
Visibility [1]	Days Δdv >0.5	Less than baseline	NA	6	2	2	1
	Days Δdv >1.0	Less than baseline	NA	0	0	0	0

Data is based on maximum impact values listed in Appendix A of the modeling report (**Appendix SIR-1A**).
[1] Visibility threshold: FLAG recommends that federal land managers report a change in light extinction (Δdv) impact of 10 percent, and consider requesting further analysis if change in light extinction (Δdv) reaches 5 percent with any regularity.

The modeling results shown in **Table 4.12-2** indicate that emissions from predicted exploration activities would comply with the applicable NAAQS for Class II areas at all distances shown. The results also indicate there could be potential problems with compliance with incremental degradation limits for Class I areas for NO_2 out to between 5 and 10 km (3.1 - 6.2 miles).

As articulated in the FLAG document (USFS et al. 2008), Federal Land Managers (FLMs) have a responsibility to protect AQRVs, and in this respect, may consider whether emissions from a new or modified source may have an adverse impact on AQRVs and provide their comments to permitting authorities (States or EPA). **Table 4.12-2** reports the necessary data to evaluate impacts on Visibility and Deposition AQRVs from connected actions to oil and gas leasing near Class I areas, in terms of the levels established in the FLAG Phase I Report (USFS et al. 2008). Section 4.12.2.5 discusses the results of the Visibility and Deposition data with regard to FLAG.

4.12.2.2 Production FieldDevelopment, Operating and Maintenance

The potential emissions resulting from oil field development activities predicted in the RFDS are NO_x, SO_2, and VOCs from the production facilities, and PM_{10} emissions from the operating and maintenance activities. The Air Quality Modeling Report developed generalized emissions from a 20-well oil field development scenario. Emission estimates in the Modeling Report were based on the equipment needed to support oil exploration and/or oil field development. Estimates in the report are conservative and utilized the following resources: Utah State Government's "Analysis of Emissions from O&G Wells in Utah", the O&G Emission Inventory Workbook for the Uinta Basin Study, information from existing oil field development on the Dixie and Fishlake National Forests, regional and national oil and gas field emission analyses, and EPA and industry emission factors to develop the emission estimates. **Table 4.12-3** summarizes the emissions expected from a 20-well oil field in the Dixie National Forest. Note

that these are estimates only and will vary depending on the actual location of the predicted oil field, the geology of the producing formations, the quantity of fossil fuel present, and the specific equipment necessary to extract the fossil fuel resources found at the site.

Table 4.12-3 Production Field Development Emissions

Source	PM_{10} (lb/hr)	NO_x (lb/hr)	SO_2 (lb/hr)
Drill Rig Engine	0.26	8.47	0.01
Exploration Flare	0.00	1.10	0.00
Compressors	0.04	2.20	0.00
Heater Treaters	0.07	0.95	0.01
Dehydration Units	0.01	0.10	0.00
Well Pumps	0.97	13.2	4.10
Production Flare	0.00	2.45	0.00
On-site Roads and Fugitives	1.00	0.20	0.00
Total	2.36	28.69	4.12

Assuming the connected actions predicted in the RFDS occur, the density of well fields, well field characteristics, and the success of development will be factors that determine impacts from connected actions to leasing. As stated above with any industrial activity, owners and operators must comply with the Clean Air Act and the Utah Air Quality Regulations, which regulate both operations that cause air emissions and air emissions. During the pre-construction stage of any proposed well field development, a site specific air analysis that includes refined air dispersion modeling would be required.

4.12.2.3 Sustainable Production

The potential emissions resulting from sustainable production fields predicted in the RFDS are primarily NO_x, SO_2, PM_{10}, CO, and CO_2 resulting from oil and gas production, and ongoing oil field operating and maintenance activities. The emission estimates in **Table 4.12-3** for the predicted production field development would also apply to sustained production. The impacts of specific pollutants are evaluated based on elevation and distance from the hypothetical production field. Impacts resulting from oil field development are further discussed in the Air Quality Specialist Report (13.0) and in the Modeling Report (**Appendix SIR-1**). A summary of the impact analysis is presented below.

The modeling for the hypothetical production field included the following activities that affect air quality:

- Construction of twenty 5.5-acre drilling locations;
- One diesel fuel-fired drill rig engine with emissions based upon the 13.5 tons NO_x and 3.5 tons SO_2 per well reported in the WRAP Oil and Gas Emission Inventory prepared by Environ, and the 2005 Wyoming field survey from which that data was developed, with actual emissions adjusted downward to be compliant with recent tiered engine requirements;
    - The WRAP study indicated the mean drilling time is approximately 90 days per well, around the clock. Therefore, the longer-term average impact predictions effectively assume four wells drilled back to back in relatively close proximity;
- One exploratory flare, flaring off small quantities of gas;

- Total ground disturbance including new roads, well pads, central processing, and staging areas would be 270 acres;
- Support traffic to supply, maintain, and staff the drilling and pumping effort;
- Twenty 0.5 MMbtu/hr heater / treater separators, one at each well pad;
- Twenty diesel-powered, 100 HP well pumps to extract oil, one for each well; and
- One 0.5 MMbtu/hr dehydrator and one 500 HP compressor processing a low volume of natural gas at partial capacity.

Diesel-fired well pumps are assumed because the predicted development sites are expected to be remote from the electric power grid. Though a slight amount of natural gas production is included for conservatism, producible natural gas is not routinely expected and is not anticipated in sufficient quantity to power the well pumps. If sufficient natural gas was found to fuel the well pumps, well pump emissions would be reduced.

Impact analyses, under the assumption that all of the connected actions described in the RFDS would occur, were conducted for distances ranging from 0.25 to 200 km (124.3 miles) from the source and at seven receptor elevations that ranged from 2,500 feet above to 2,500 feet below the source. The highest receptor impacts occurred when the model receptors were at or near the same elevation as the source. **Table 4.12-4** documents the maximum predicted criteria pollutants NO_2, SO_2, and PM_{10} concentrations (μg/m^3) as well as the maximum visibility impairment impacts at a variety of distances, for the scenario where the receptors were at the same elevation as the source. The tabulated impacts represent the maximum impact at the given distance for any of the elevation scenarios.

Table 4.12-4 Sustainable Production (Connected Actions) Impacts

Criteria Pollutant	Period	Class I	Class II	Concentrations (μg/m^3) at kilometers			
		Increment	Increment	1	5	10	20
SO_2	3-hour	25 μg/m^3	512 μg/m^3	67.9	22.2	10.0	4.46
	24-hour	5 μg/m^3	91 μg/m^3	30.2	9.84	4.46	1.98
	Annual	2 μg/m^3	20 μg/m^3	7.55	2.46	1.11	0.50
NO_2	Annual	2.5 μg/m^3	25 μg/m^3	29.8	10.0	4.80	2.27
PM_{10}	24-hour	8 μg/m^3	30 μg/m^3	25.0	5.62	2.44	1.06
	Annual	4 μg/m^3	17 μg/m^3	6.25	1.40	0.61	0.27
AQRV	**Metric**	**Increment**	**Increment**	**1**	**5**	**10**	**20**
Deposition	NO_2 Dep	0.005	kg/hect/yr	0.0774	0.0148	0.0059	0.0022
	SO_2 Dep	0.005	kg/hect/yr	0.0314	0.0055	0.0027	0.0011
Visibility [1]	Days Δdv >0.5	Less than baseline	NA	77	70	57	38
	Days Δdv >1.0	Less than baseline	NA	46	37	311	17

Data is based on maximum impact values listed in Appendix A of the modeling report (**Appendix SIR-1A**).
[1] Visibility threshold: FLAG recommends that federal land managers report a change in light extinction (Δdv) impact of 10 percent, and consider requesting further analysis if change in light extinction (Δdv) reaches 5 percent with any regularity.

Modeled emissions for the case where the receptors are at the same elevation as the source (**Table 4.12-4**) indicates potential compliance problems with the Class II NAAQS only in the very near vicinity (about 1km or less) for NO_2. The modeling results indicate potential compliance problems with the Class I NAAQS out to distances of approximately 10 km (6.2 miles) for SO_2; approximately 5 km (3.1 miles) for PM_{10}; and approximately 20 km (12.4 miles) for NO_2. Note that provincial background pollutant concentrations vary and need to be considered for all air dispersion modeling evaluations. Section 4.12.2.5 discusses the results of the Visibility and Deposition data with regard to FLAG.

The modeling also indicated that these emissions would be less if the receptors are lower than the source. This modeling indicated compliance with all NAAQS for Class I areas within a distance of about 10 to 15 km (6.2 - 9.3 miles) and all Class II areas within about 2.5 to 5 km (1.6 - 3.1 miles) when the receptors are lower than the source.

The emission inventory for this analysis was conservative in that it assumed one new well was being drilled while the full field was operating, and also assumed that diesel-fired pumps were used at each well head. NO_2, SO_2, and visibility impacts would be decreased if either no well drilling occurred simultaneously with the operation of 20 wells, or if enough natural gas was recovered onsite to fuel the well pumps so that diesel-fired pumping would not be required. Further, NO_x, SO_2, and visibility impacts would be approximately 90 percent lower if electric power lines were built to power the oil production field and no fuel was needed to operate the well pumps.

4.12.2.4 Class I Cumulative Impact Analysis

If exploration drilling were to occur on the Forest, as predicted in the RFDS, the air quality modeling for a single exploration well shows the need to perform a cumulative air quality impact analysis in the future for criteria pollutants if Class I areas exist within 5 km (3.1 miles) of the drilling location.

If a production field were proposed on the Forest, the 20-well production scenario in the Air Model, using a set of reasonable assumptions, shows the need to perform a future cumulative impact analysis for criteria pollutants if Class I areas exist within 60 km (37.3 miles) of the production field.

4.12.2.5 Visibility and Deposition Analysis - FLAG

The visibility analyses showed that isolated exploratory wells were not likely to have any significant impact. Class I area deposition thresholds are met from 5 km (3.1 miles) out for SO_2 and from approximately 13 km (8.1 miles) out for NO_2. However, the development scenario could have visibility impacts potentially reaching the FLAG limit of 1 deciview out to 55 kilometers (34.1 miles) for the 20-well development scenario. Those analyses also indicate that the Federal Land Managers could request a future cumulative visibility impact analysis for receptors out to 100 kilometers (62 miles) for the 20-well development scenario if it were to be built.

Similarly, FLAG-recommended deposition impact thresholds for Class I areas could be reached out to 45 km (27.9 miles) for the 20-well development scenario. Those estimates are driven by the assumption of diesel well pumps. If natural gas could be recovered in sufficient quantity to power the well pumps, the extent of potential visibility and deposition impacts would drop, probably by at least one third, mainly due to sulfur deposition. If electric power was available,

emissions of pollutants affecting visibility impacts would be considerably lower than those used for the visibility impact analyses reported here. Comparably lower deposition impacts could be estimated using the screening tables (see **Appendix SIR-1A**).

4.12.2.6 Greenhouse Gas Emissions

Greenhouse gas emissions could increase if oil and gas activities on the Dixie National Forest occurred as predicted in the RFDS. Because there are no regulatory standards for comparison, these potential increases in greenhouse gases are compared to those at the state, national, and global scales. An increase in greenhouse gas emissions as a result of connected actions to leasing as predicted in the RFDS may also contribute to the global concentration of greenhouse gases that affect climate change.

If all oil and gas activities that are predicted in the RFDS do occur, these activities could emit greenhouse gases into the atmosphere. The specific oil and gas activities that could contribute to these emissions are listed below:

- Exploration drilling
- Production operations- drilling and pumping
- Transportation of crude oil from field to refinery
- Refining of crude oil into final product
- Transportation of final product to end user
- End use of product

Emissions from seismic exploration are not analyzed due to the relatively small contribution of these emissions to the total, and because seismic exploration could occur outside of the action alternatives. Including emissions from refining, transportation of refined product, and product end use is a conservative impact estimate because these emissions may occur regardless of the product source in order to satisfy current and future market conditions, and it could be argued that these actions are not necessarily related to oil and gas production on the Dixie National Forest.

Total emissions estimates for each predicted activity are summarized in **Table 4.12-5**. Emissions are reported in metric tons of Carbon Dioxide Equivalent (CO_{2e}) which is the standard unit of measure established by the EPA for GHG emissions. Non- CO_2 gases were converted to CO_{2e} by multiplying by the Global Warming Potential for each gas.

Table 4.12-5 Estimated Emissions for Connected Actions to Leasing (Metric Tons of Carbon Dioxide Equivalent)

Oil and Gas Activity	CO_{2e}
Exploration	9,993
Production	43,443
Transportation of Crude	2,161
Refining	21,019
Transportation of Refined	868
Product End Use (off-site)	268,312
TOTAL	**345,796**

As discussed in **Appendix SIR-2**, CO_2 emissions from predicted oil and gas activities on the Dixie National Forest (i.e., connected actions to leasing) could increase U.S. and world CO_2 emissions. At the national and global scales, this would be a negligible impact. On a state scale,

CO_2 emissions from connected actions on the Dixie would constitute a minor increase over CO_2 emissions for Utah in 2007. It should also be noted that this GHG emission estimate for connected actions has included emissions from refining, transportation of refined product, and product end use. This is a conservative impact estimate because it could be argued that the emissions from the refinery and later activities are not connected actions to potential Dixie National Forest oil and gas production and may occur regardless of the product source in order to satisfy current and future market conditions.

Greenhouse gas emissions from potential oil and gas activities would incrementally contribute a relatively small amount to the total volume of greenhouse gases in the CEA (defined in Section 5.12.1) and consequently could be responsible for an increment of the predicted effects of climate change discussed in **Appendix SIR-2**. This incremental impact from connected actions to leasing on the Dixie National Forest would be negligible to minor and its duration would likely be long term. Climate change effects are global and cumulative in nature, thus the main discussion of climate change impacts with regard to air resources can be found under Cumulative Effects (Section 5.12.3).

4.12.3 Impacts by Alternative

With the exception of Alternative A, estimated changes to ambient conditions (*Measurement Indicator #1*) and NAAQS exceedances (*Measurement Indicator #2*) would be the same under all alternatives. Changes in visibility (*Measurement Indicator #3*) compared to natural background conditions would be the same under all alternatives except Alternative A. Increases in GHG emissions (*Measurement Indicator #4*) would be the same for all alternatives, with the exception of Alternative A, because the action alternatives do not differ in terms of what activities are predicted under the RFDS.

Impacts by alternative are thus the same and as described in Section 4.12.2.

5.0 CHAPTER 5 DEIS REVISION

5.12 Air Resources

5.12.1 Description of Cumulative Effects Area

The Cumulative Effects Area (CEA) for air resources is the Dixie National Forest boundary and the Dixie National Forest airsheds as described by the UDAQ, EPA, and Utah SMP as airsheds 2, 3, 4, 12, and 13 within Utah (**Figure 5.12-1**). Within the CEA are three Class 1 Areas (Bryce, Zion, and Capitol Reef National Parks) and 6 sensitive Class II areas (designated by the Forest Service only) that would be impacted by connected actions to leasing. Climate change effects are discussed on national, regional, and state levels (by reference, in **Appendix SIR-2**), although climate change effects are actually global in nature.

5.12.1.1 Rationale

Impacts to air resources would be within the immediate area of the Dixie National Forest and the Forest designated airsheds. Air resources impacts could extend past the borders of the Forest and designated airsheds, impacting regional haze and visibility.

5.12.2 Past, Present, and Reasonably Foreseeable Future Actions

The lands within the CEA are mostly (79 percent) administered by federal agencies (49 percent USFS, 29 percent BLM, and 1 percent National Park Service) and actions on these lands were, are, or will be subject to NEPA. The remaining lands (21 percent) are either privately owned (16 percent) or administered by the State of Utah (5 percent).

Existing activities on the Dixie National Forest that contribute to air quality emissions include recreational vehicle use, residential heating sources, propane-combustion electrical generators for remote cell towers, timber harvesting, and wildfires as well as prescribed burns. The residential heating sources and cell tower generators are considered minor and insignificant sources. The past, present, and reasonably foreseeable future levels of recreational vehicle use, timber harvesting, and fires (wild and prescribed) are described in Section 5.1.2.1. These activities result in emissions of NO_x, CO, VOCs, $PM_{2.5}$, and PM_{10}. Activities on the Dixie National Forest that are assumed to be contributing to emissions of GHGs, including the heating and powering of Forest buildings and facilities as well as operation of on- and off-road vehicles and equipment, also have occurred, are occurring, and will continue to occur into the foreseeable future. Foreseeable future responses to climate change are discussed Section 5 of **Appendix SIR-2**.

Past oil and gas activity within the CEA has been relatively low, with the Upper Valley Field being the only producing oil field. The Upper Valley oil field is described in further detail in Section 5.1.2.1 and Section 3.12.13. There has been a renewed interest in oil and gas within the CEA with the exploration and production field located north of the Dixie National Forest in the Covenant Field. As of 2008, there were 122 authorized leases and 14 pending leases, with a combined total lease area of 101,682 acres (BLM 2008). While these leases occur throughout the CEA, they tend to occur in clusters. Some of the larger clusters are to the south and north of the Cedar City Ranger District, in between the Cedar City and Powell Ranger Districts, and off the southeast corner of the Escalante Ranger District (an extension of the Upper Valley Field). Only the Upper Valley Field is currently active.

Original data was compiled from multiple source data and may not meet the U.S. National Mapping Accuracy Standard of the Office of Management and Budget. For specific dates and/or additional digital information, contact the Forest Supervisor, Dixie National Forest, Cedar City, Utah. This map has no warranties to its contents or accuracy.

Kanosh
Richfield
Glenwood
Elsinore
Beaver
Powell Ranger District
Cedar City Ranger District
Pine Valley Ranger District
Cedar City
Panguitch
Escalante
Escalante Ranger District
Bryce Canyon National Park
Canyonlands National Park
Glen Canyon National Recreation Area
Grand Staircase-Escalante National Monument
Zion National Park
St. George
NEVADA
UTAH
COLORADO
ARIZONA
Miles
0 10 20 30 40

Oil and Gas Leasing EIS on Lands Administered by the Dixie National Forest

FIGURE 5.12-1
Air Cumulative Effects Area
Utah Airsheds

12 August 2008	1:2,000,000	Horizontal Datum = NAD 83 Coordinate System = Zone 12N

Cities
Freeways
Water Bodies
County Boundaries
State Lines

National Forest System Lands
Dixie National Forest
Fishlake National Forest
Brian Head Ski Resort

Other Land Administration
Bureau of Land Management
GSENM*
National Park Service
Private
State of Utah
Tribal
Cumulative Effects Area**

*Grand Staircase-Escalante National Monument. Managed by the Bureau of Land Management.
**Includes Utah Smoke Management Airsheds 2, 3, 12, 13, & 14. Digitized from http://www.wrh.noaa.gov/slc/projects/ifp/images/UTsheds.gif

As of 2008, other recent activity on these leases has been the drilling of a few wildcat wells on state and private land, including one coal bed methane well, all of which had been capped and abandoned (UDNR 2008a). Current oil and gas activities result in NO_2, SO_2, PM_{10}, and CO emissions. The Upper Valley Oil Field is predominately electrified.

In addition to oil and gas activity, there are numerous small minerals activities managed on public lands; more than half are on BLM land surrounding the Pine Valley Ranger District. These mineral activities are usually small operations (less than 5 acres) and primarily target materials such as sandstone, limestone, silica, rhyolite, alabaster, and travertine (UDNR 2008b). There are a few larger mines for iron, gold, and silver; however, most of these are inactive or in some stage of reclamation. Mining activities result in PM_{10} emissions with lesser amounts of NO_x and CO.

All of the above types of activities and development are expected to continue to some degree on the Forest and within the CEA into the foreseeable future. ATV use will continue to trend upward. The use of prescribed fire and mechanical fuel treatments are also anticipated to increase over the next 5 to 10 years. The amount burned by prescribed fires will likely increase to over 10,000 acres per year in the near future. Most prescribed burns have minor and short-term effects on air resources in the CEA. Further, an increase in the number of prescribed fires and mechanical fuel treatments should ultimately lead to a decrease in the number of large, catastrophic fires, thus reducing the resulting PM, $PM_{2.5}$, and PM_{10} emissions associated with those fires. Wildfires may increase in frequency in the CEA, however, due in part to climate change (discussed in Section 5.12.3).

In addition, there is the possibility of unquantified drilling for coal bed methane on State land within the John's Valley area within the next 15 years. This could involve not only drilling but also establishing a gas delivery system to market the gas if it occurred in paying quantities. Production would most likely be gas rather than oil.

Timber harvesting will continue to be a part of the management goals of the forest. The existing mining activities are expected to continue and more exploratory wells may be drilled. Existing forests in the CEA will continue to serve as carbon dioxide sinks/storage.

Currently, there are several proposed or existing power plants or large industrial facilities within and surrounding the CEA. Multi-source, short, and long range, multi-pollutant air dispersion modeling would have to be conducted to determine cumulative effects and intensity associated with the measurement indicators. With the information provided we cannot make assumptions about existing and preexisting sources in the CEA. The proposed Intermountain Power Plant third unit and Rocky Mountain Power's Unit 4 at the Hunter Plant have been cancelled. NEVCO's Sevier Power Plant, located north of the Dixie National Forest, experienced difficulties in obtaining the necessary permits to construct and may be delayed or cancelled.

5.12.3 Cumulative Effects

Under any alternative, surrounding sources, population growth, vehicular traffic, and proposed coal-fired power plants in the general area could affect the Forest air resources now and in the foreseeable future.

Cumulative effects to air resources would not vary by alternative, except for Alternative A. Alternative A would not result in oil and gas-related emissions on the Forest. Thus, the

remaining cumulative effects discussion pertains to all action alternatives (Alternatives B, C, D, and E).

Impacts of oil field development and sustainable production, if these activities occurred as predicted in the RFDS, would be long term and would vary greatly depending on how many fields are developed, the density of the field, and oil productivity. Presumably, with current air quality regulations, permitting, and periodic testing requirements, the impacts would be controlled if a source emits more than five tons per year of any Criteria Pollutant. The Modeling Report (**Appendix SIR-1**) is a proportional-based estimate of emission and visibility impacts that can be applied to a variety of scenarios using the tables in **Appendix SIR-1A**. Emissions from a proposed well field development would have to be modeled during the pre-construction permitting phase to show that all the emissions would comply with applicable regulatory standards. Air dispersion modeling, using an approved EPA model and protocol, would be used to determine whether the allowable emissions result in NAAQS or Class I visibility exceedances.

In addition, increased NO_2 and SO_2 emissions from both the predicted oil field-related activities and nearby permitted sources could contribute to acid rain deposition. Based on the emission estimates, an individual well field would not cause acid range deposition. However, numerous well fields along with provincial coal-fired power plants could cumulatively impact the forests, mountain lakes, and vegetation with acid rain. Emissions from well field production also include ozone precursors (PM_{10} and NO_x) and could cumulatively contribute to regional haze and visibility issues within the Forest boundaries and Class I areas.

5.12.3.1 Ozone

Unlike other atmospheric pollutants, ozone is not primarily emitted into the atmosphere. Ozone is produced in the atmosphere as a result of combining precursor pollutants with solar radiation. These precursor pollutants can reside in the atmosphere for significant amounts of time and travel over significant distances. As a result, ozone impacts are best assessed on a regional level, accounting for the precursor pollutant emissions from all available sources within a reasonable distance. Such an analysis should account for the emission and transport of ozone and its precursors as well as the atmospheric chemistry that would result from their interaction. Although a new analysis of this complexity is beyond the scope of this leasing EIS, previously created regional analyses can provide an assessment of impacts for ozone that are directly related to connected actions to the leasing decision described in this EIS.

The Uinta Basin Air Quality Study (UBAQS) was initiated in 2008 and completed in June, 2009 (IPAMS 2009). The study, funded by the Independent Producers of the Mountain States (IPAMS), sought to assess the regional air quality impacts of oil and gas production on the Uinta Basin in Utah. Although the study was targeted to assess impacts in the Uinta Basin, the domain of the project was sufficiently large to allow assessments of air quality in regions throughout much of Utah. As a result, this air quality study will be used to address the ozone impacts associated with the connected actions described in this EIS.

UBAQS sought to assess the cumulative change in air quality from the expansion of oil and gas resources. In order to develop this assessment, primary and precursor emissions were developed for two modeled scenarios. These scenarios, occurring in model year 2006 and 2012, included recorded (for 2006) and reasonably foreseeable (for 2012) emissions from all sources that resided or would reside within the model domain. Proposed oil and gas-related sources for both modeled scenarios were sourced from regional and sub-regional emissions assessments. They utilized best available information to determine spatially representative oil

and gas emissions. These emissions were then extrapolated forward in time to account for growth of oil and gas production throughout the domain for the 2012 scenario.

Emissions developed for both the base year (2006) and future years (2012) were modeled utilizing the Community Multi-Scale Air Quality Model (CMAQ). EPA guidance for projecting future 8-hour ozone concentrations recommends using the model in a relative sense to scale current observed 8-hour ozone Design Values. In order to perform this scaling operation EPA developed the Modeled Attainment Test Software (MATS) tool that uses modeling results, observed 8-hour ozone Design Values to project 8-hour ozone concentrations that reflect the change in emissions from a base case to an alternative emissions scenario.

For the UBAQS, the MATS tool was used to assess the effects of oil and gas development activities as well as regional emissions in the modeling domain on 8-hour ozone. The MATS tool performs 8-hour ozone Design Value projections at existing monitoring sites for comparison with the 8-hour ozone NAAQS. Additionally, the MATS tool has a capability to perform an Unmonitored Area Analysis (UAA) that performs a spatial interpolation of the current year observed 8-hour ozone Design Values using the ozone concentration gradients calculated from the gridded model base year outputs.

Because the nearest existing ozone monitoring location to the Dixie National Forrest is located in Canyonlands National Park, approximately 150 miles to the east, the UAA developed in the UBAQS was used to provide an assessment of impacts associated with this EIS. **Figures 5.12-2** and **5.12-3** below present the current and future year predicted 8-hour ozone design values for the entire UBAQS modeling domain. **Figure 5.12-4** presents the projected increase or decrease in design value from the base to the future projection year.

Based on an area-weighted average for the regions managed by the Dixie National Forest, both the base year (2006) and the future year (2012) model predictions indicate that the region will remain in attainment of the current 8-hour ozone NAAQS. Depending on the particular sub-region of the forest, design values associated with the impact of potential future oil and gas development, as well as regional growth, is forecast to remain stagnant for much of the Forest with only a slight increase or decrease in some regions. Both growth and contraction of the region's projected 8-hour ozone design values are constrained to less than one part per billion in ambient air. These findings support that the connected actions to leasing described in this EIS will not result in a significant impact on regional cumulative ozone concentrations.

Figure 5.12-2 Current year 8-hour ozone Design Values (DVC) from the enhanced MATS unmonitored area analysis for the 2005 meteorological year.

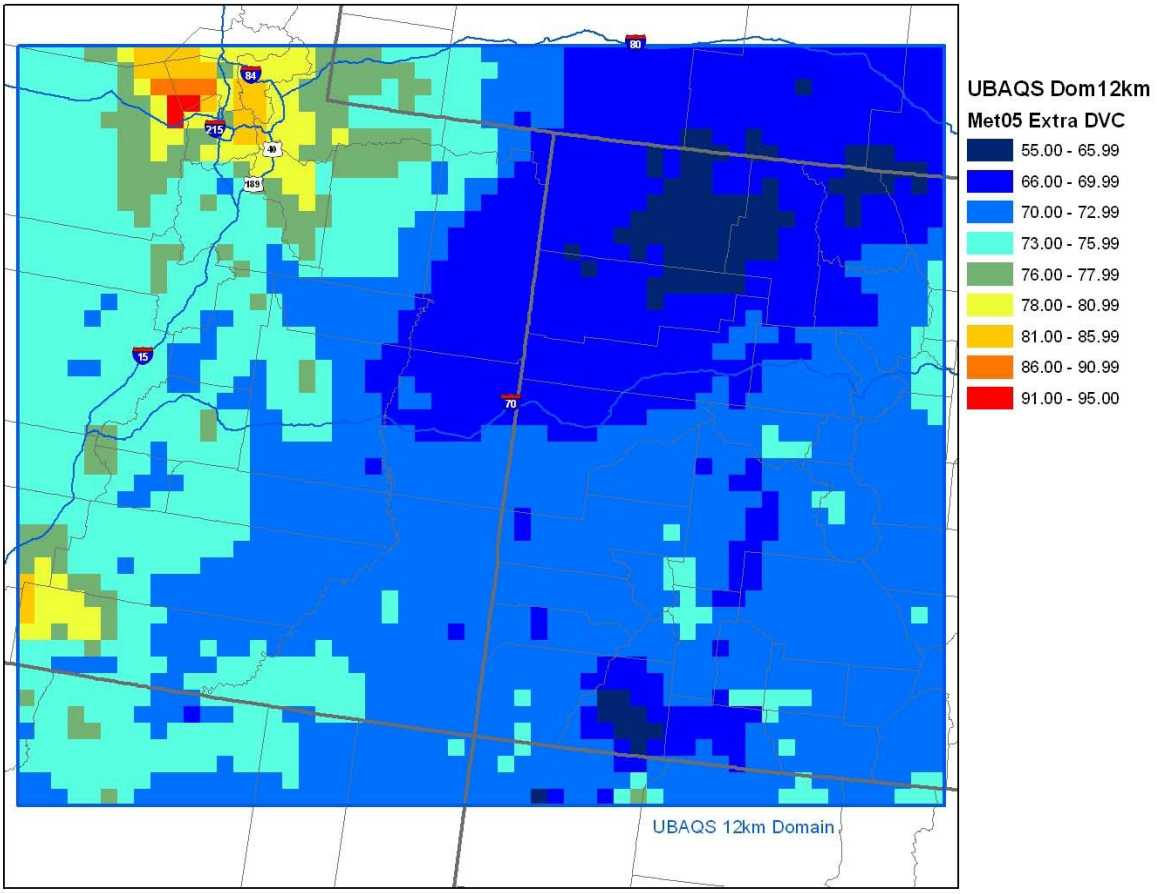


Figure 5.12-3 Projected 2012 8-hour ozone Design Values (DVF) from the enhanced MATS unmonitored area analysis for the 2005 meteorological year.

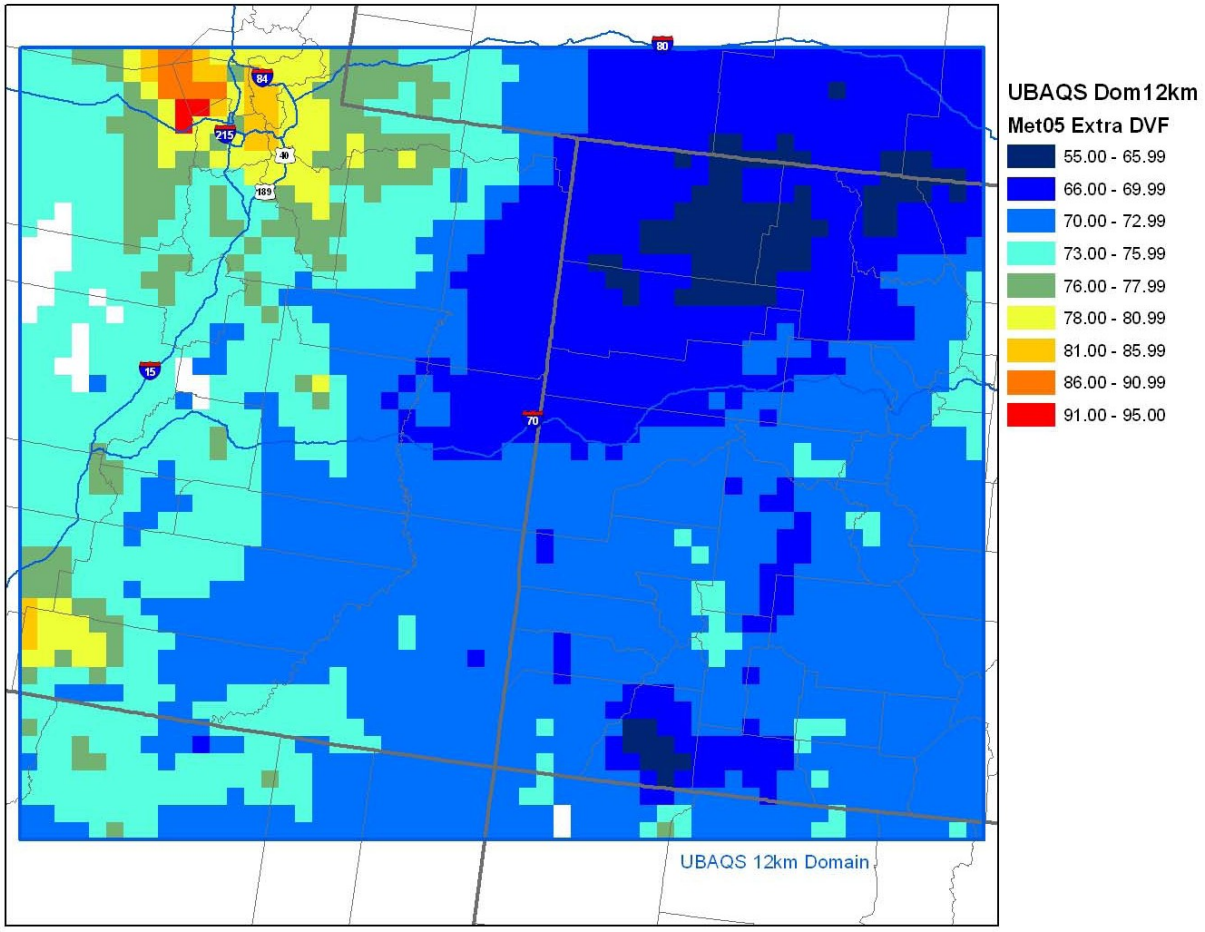
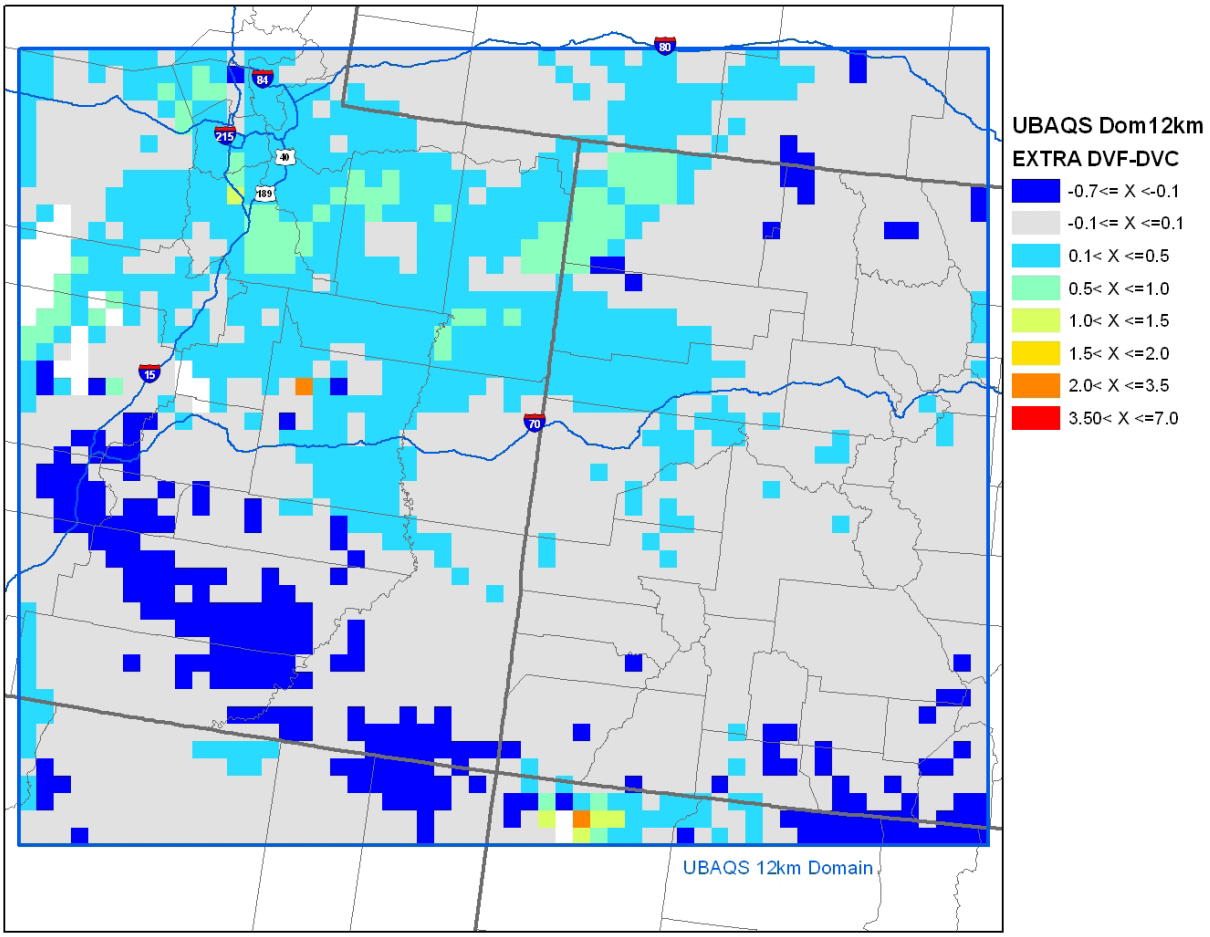


Figure 5.12-4 Differences in the projected 2012 (DVF) and current year (DVC) 8-hour ozone Design Values from the enhanced MATS unmonitored area analysis for the 2005 meteorological year (DVF-DVC).



5.12.3.2 Climate Change

Climatic conditions described in Section 3.12.1 have, to some degree, already been affected by climate change and thus these past and current climate change effects are already included in the impact analysis of the EIS. Future climate change has the potential to further impact many of the same environmental resources in ways that are described in **Appendix SIR-2** (Section 2). It is difficult to predict with any certainty the cumulative effects of future climate change along with the environmental impacts already described in the EIS.

The IPCC continental-scale modeling conducted for North America indicates warmer temperatures and generally less precipitation in the southwest U.S. on an annual basis (Christensen et al. 2007, p.850, p.887-888). For the western U.S., the IPCC modeling suggests modest changes in average annual precipitation ranging from slightly less than normal in the south to slightly greater than normal in the north. Change in winter precipitation is predicted to be variable with more winter precipitation in the northern part of the western U.S. and less in the Southwest. Summer precipitation is predicted to be less throughout the West. However, it is also noted that the continental-scale regions encompass a broad range of climates and are too large to be used as a basis for conveying quantitative regional climate change information.

The IPCC projection of less warming over the ocean than the land, and amplification and northward displacement of the subtropical anticyclone is likely to cause a decrease in annual precipitation in the southwestern U.S. (Christensen et al. 2007). According to the Fourth Assessment Report of the IPCC (Christensen et al. 2007), the following general climate change projections were made for the southwest U.S.:

- Seasonally, warming is *likely* to be largest in summer.
- Maximum summer temperatures are *likely* to increase more than the average summer temperature.
- Annual mean precipitation is *likely* to decrease.
- Snow season length and snow depth are *very likely* to decrease.

Wagner et al. (2003) reviewed the work of a number of climatologists, evaluated 20th century climate records for trends, and conducted two large computer models with the assumption that CO_2 concentrations would double in the 21st century to predict climate change effects in the Great Basin/Rocky Mountain region. They noted that use of global-scale models cannot be expected to project climate changes at localized areas with highly variable climates and great topographic variation like the Great Basin/Rocky Mountain area. Their modeling results showed year-round increases in temperature with the greatest increases occurring in winter. They also showed that annual precipitation was predicted to increase with the greatest increase occurring in winter.

Most of Utah's water resources originate in mountainous areas above 6,500 feet in elevation, which cover about 19 percent of the state (BRAC 2007). The primary source of this water is snowpack, which releases months of stored precipitation in about 4 to 8 weeks during spring and summer, as described in Section 2.3.2 of **Appendix SIR-2**. Clear and robust long-term snowpack declines have yet to emerge in Utah's mountains, as they have in low-elevation mountains in other states (i.e., in the Pacific Northwest and California). In addition, recent temperature increases in Utah appear to have had little impact on snowpack in the high mountains of the Intermountain West. However, studies of precipitation and runoff over the past

several centuries and climate model projections for the next century indicate that ongoing GHG emissions at or above current levels will likely result in a decline in Utah's mountain snowpack, thus the threat of severe and prolonged episodic drought in Utah is real (BRAC 2007). In addition, changes in snowpack will result in a declining water supply. Current climate models project a decline in summer precipitation across all of Utah (BRAC 2007).

The population of the Intermountain West (eight states including Utah) is projected to increase by 65 percent from 2000 to 2030, representing one-third of all U.S. population growth (USGCRP 2009). Between 2000 and 2005, Utah was among the five fastest growing states in the U.S. (US GCRP 2008). Projections of decreased snowpack and earlier spring melting suggest lower stream flows in the future, particularly during the high-demand period of summer (USGCRP 2008). There is a high likelihood that water shortages will limit power plant electricity production in many regions, and constraints in production by 2025 are projected in ten states including Utah (USGCRP 2009).

Forests are generally adapted to recent climatic conditions and variability (Hamrick 2004), but the rate of temperature change expected during the next century will greatly exceed that produced naturally over the past several thousand years. Apart from other human-related factors such as forest management practices and land-use changes, future climate change is likely to contribute to drier conditions in Utah forests as well as increased wildfire intensity, more insect outbreaks, and reduced forest health.

Droughts in Utah have exacerbated declining forest health across the state, and consequently Utah's forests have become more susceptible to intense wildfire, insects, and disease (UDNR 2003). The ecological impacts of wildfires as well as forest pests and diseases are expected to rise with climate warming, with extended periods of high fire risk and large increases in area burned (IPCC 2007b; USGCRP 2009). A study of historical spruce beetle outbreaks on the Markagunt Plateau revealed that small-scale disturbances have been the norm over the past century, and that large-scale outbreaks occurring in recent history (in the early 1990s, in this study) are an unprecedented phenomenon (DeRose and Long 2007).

6.0 REFERENCES

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