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Utah Air Resource Management Strategy Modeling Project Impact Assessment Report

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September 30, 2014

Leonard Herr
BLM Utah State Office
440 West 200 South, Suite 500
Salt Lake City, UT 84101

Subject: Final Utah Air Resource Management Strategy Modeling Project Impact Assessment Report

Dear Mr. Herr:

AECOM Technical Services, Inc. (AECOM) is pleased to submit the final *Utah Air Resource Management Strategy Modeling Project Impact Assessment Report* (the ARMS Impacts Assessment) for the Utah Bureau of Land Management's (BLM) Air Resource Management Strategy (ARMS). The primary objective of the ARMS Modeling Project is to develop an air quality management tool that is appropriate to assess the potential air impacts from future activities occurring on BLM-administered land in the Uinta Basin. The reusable modeling framework developed as part of the ARMS Modeling Project also could be used to assess the potential cumulative impacts from future project-specific NEPA actions, which will facilitate consistency and efficiency with the planning activities in the area. The key findings of the ARMS Modeling Project are provided in this Impacts Assessment Report.

Enclosed with this letter is an electronic copy of the final ARMS Impacts Assessment Report, in Adobe format (PDF).

If you have any questions relative to the impacts reported, or would like to discuss this study, please contact Courtney Taylor (Courtney.Taylor@aecom.com) or call (970) 493-8878.

Yours sincerely,

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Executive Summary

1.1 Study Background

This report presents the potential impacts to air quality and air quality related values (AQRVs) predicted by the Bureau of Land Management (BLM) Utah State Office's Air Resource Management Strategy (ARMS) Modeling Project. The ARMS Modeling Project is one of several studies that will inform and support the Utah BLM's air management strategy. As part of the ARMS, the Utah BLM, together with other state and federal agencies, has commissioned several studies to further understand and analyze current ambient air and meteorological conditions in the Uinta Basin, and to develop emissions inventories appropriate for ozone modeling applications. These studies include special monitoring studies (Energy Dynamics Laboratory 2011; Utah Department of Environmental Quality 2011) and an emissions inventory development study (AECOM 2013). The results of these studies are being used in the ARMS Modeling Project and are essential to the overall understanding of the issues affecting air quality in the Uinta Basin.

The ARMS Modeling Project is being conducted by AECOM, Inc., dba AECOM Environment (AECOM) and Sonoma Technology, Incorporated (STI) under the direction of the Utah BLM. This report is one of several documents that was developed for the ARMS Modeling Project, including a modeling protocol, Model Performance Evaluation (MPE) Reports for the meteorological model and the air quality model, and an emissions inventory report. The ARMS Modeling Project is not a project-specific National Environmental Policy Act (NEPA) analysis, and the modeling files and reports are not NEPA products. It also is not a policy study, analysis of regulatory actions, or an analysis of the impacts of project-specific development. Rather, the ARMS Modeling Project is a cumulative assessment of potential future air quality impacts associated with predicted oil and gas activity in the Uinta Basin. The ARMS Modeling Project provides data, models, and estimates of future air quality impacts to facilitate BLM's future NEPA and land use planning efforts.

1.2 Modeling Method and Assessment Approach

As described in the Protocol (AECOM 2012), a Photochemical Grid Modeling (PGM) system was used to assess base year (2010) conditions. Given the complexity and emerging understanding of wintertime ozone formation, the Utah Air Resource Technical Advisory Group (RTAG) advised the Utah BLM to investigate two state-of-the-science PGM systems in an attempt to replicate the winter ozone events and to assess cumulative impacts to air quality and AQRVs. The two PGM models selected for evaluation were the: 1) Community Multi-Scale Air Quality (CMAQ) modeling system; and 2) Comprehensive Air Quality Model with Extensions (CAMx).

The CMAQ and CAMx models were configured for the ARMS Modeling Project following the methods and approach detailed in the Utah Air Resource Management Strategy Air Quality Modeling and Assessment Protocol (AECOM 2012). The air quality modeling domains include a coarse domain centered on the continental United States (U.S.) at a 36-kilometer (km) horizontal grid resolution and two refined domains of 12-km and 4-km grid resolutions focused on the area of interest. The vertical grid is composed of 36 layers with thinner (more) layers in the planetary boundary layer (PBL). Thinner model layers lower in the atmosphere, within the PBL, are better able to capture boundary layer characteristics for the transport and diffusion of emitted pollutants, which is important for air quality modeling, particularly during winter inversions.

The performance of CMAQ and CAMx were evaluated and intercompared as documented in the Air Quality MPE Report. Based on the intercomparison of the models' performance, the CMAQ model was recommended for assessment of future impacts in the Uinta Basin. This recommendation was driven primarily by the fact that the CMAQ model was able to replicate wintertime ozone formation and timing in the Uinta Basin better than the CAMx model. Also CMAQ provided slightly better performance for total particulate matter with an aerodynamic diameter less than or equal to 2.5 microns ($PM_{2.5}$) in the Uinta Basin during wintertime, as well as better domain-wide performance for ozone and wet deposition

Once the CMAQ modeling system was selected as the preferred model, the following model simulations were conducted to analyze potential future year impacts:

- Typical Year Modeling. A typical year emissions inventory was developed by annualizing the base year 2010 emissions for key source groups. Annualizing the base year emissions inventory provides a consistent basis for estimating the change in impacts due to future year activities. Annualizing the base year emissions is important, since future year emissions are also annualized. This process removes any modeled high impacts that occur in the base year, but cannot be anticipated to occur in the future year (e.g., startup and shut down operations at large sources, drilling operations near monitors, etc.). This process also normalizes the impacts for comparison to future years. The typical year emissions inventory was modeled with the preferred model and configuration and using the 2010 meteorological data developed for the base year conditions simulation.
- Future Year Scenarios. The objective of the future year model simulations was to evaluate the potential cumulative air quality impacts of projected oil and gas development in the Uinta Basin relative to the typical year modeled air quality and AQRVs. This analysis was performed using the 2010 meteorological data developed for the base year simulation but with the future year emissions inventories developed for 2021. The future year analysis include four scenarios:
  - 2021 On-the-books (OTB) case. A maximum emissions year with applicable on-the-books controls applied. The future year 2021 was selected as this maximum emissions year based on projected development in the Uinta Basin and the time-horizon selected for future year analysis.
  - 2021 Scenario 1. A control scenario with NO_x emissions controls was developed and applied to the emissions inventory for 2021
  - 2021 Scenario 2. A control scenario with VOC emissions controls was developed and applied to the emissions inventory for 2021; and
  - 2021 Scenario 3. A control scenario with combined NO_x and VOC emissions controls was developed and applied to the emissions inventory for 2021

Assessment areas were selected for analysis of model results and include all regional Class I areas and other environmentally sensitive areas (e.g., national parks and monuments, wilderness areas, etc.) near the Uinta Basin. Cumulative air quality impacts within the Uinta Basin study area were assessed for:

- Criteria pollutants including nitrogen dioxide (NO_2), CO, SO_2, ozone, PM_{10}, and $PM_{2.5}$; and
- AQRVs (limited to applicable Class I, sensitive Class II areas, and sensitive lakes), including changes in visibility, atmospheric deposition, and the Acid Neutralizing Capacity (ANC).

1.3 Study Findings

In general, it is found that the highest modeled ozone occurs in the Uinta Basin study area regardless of model scenario and that all scenarios predict exceedences of the ozone NAAQS and state AAQS in the Uinta Basin. Typically, the ozone concentrations are highest during the winter period in the Uinta Basin, while the ozone concentrations are highest during the summer period in Class I and Class II areas outside the Uinta Basin study area (i.e., Class I and sensitive Class II assessment areas excluding Dinosaur National Monument, the High Uintas WA, and the Uintah and Ouray IR).

It is important to qualify that the model performance evaluation for ozone indicated a negative model bias during winter and a positive model bias during summer in the 4-km domain (AECOM and STI 2014). A negative bias indicates that the model may predict lower concentrations than might actually occur and conversely a positive bias indicates that the model may predict higher concentrations than might actually occur. Therefore, for this study, the model-predicted winter ozone concentrations might underestimate future concentrations and model-predicted summer ozone concentrations might overestimate future concentrations.

During non-winter months in the Uinta Basin the model predicts that ozone may exceed the NAAQS and state AAQS; however, model-adjusted results from the MATS tool indicate that non-winter ozone concentrations are below the NAAQS and state AAQS for all monitors and areas analyzed. Furthermore, the future year mitigation scenarios have minimal effect on model-predicted ozone concentrations during non-winter months. For these reasons, the ozone assessment focuses on the relative differences between the model scenarios and the corresponding effects on winter ozone concentrations in the Uinta Basin study area.

When evaluating the ozone impacts associated with the future year mitigation scenarios, 2021 Scenario 2 tends to have the lowest ozone relative to all other future year scenarios. The 4th highest daily maximum 8-hour ozone concentration in 2021 Scenario 2 is 3 ppb lower compared to the 2021 OTB Scenario, while 2021 Scenarios 1 and 3 are predicted to have higher ozone impacts than either the 2010 Typical year and the 2021 OTB Scenario. 2021 Scenarios 1 and 3 are fairly similar to each other. Both scenarios predict a relatively large increase in ozone concentrations within the vicinity of Ouray (where the concentrations are already largest) indicating potential ozone disbenefits associated with NOx control mitigation measures.

When comparing Scenario 2 to the OTB Scenario, a potential reduction in ozone concentrations occurs in the vicinity of the Ouray site. While the reduction of ozone is not particularly large, there is no predicted ozone disbenefit associated with Scenario 2 mitigation measures (i.e., there is no area with predicted ozone increases relative to the OTB Scenario). That Scenario 2, which is designed to reduce VOC emissions, provides the lowest ozone impacts of all future year scenarios supports the assessment that peak ozone impacts are in VOC-limited areas.

While all modeled NO_2, CO, SO_2, $PM_{2.5}$, and PM_{10} values are well below the NAAQS and state AAQS in the Uinta Basin, the model performance is an important consideration to qualify and understand the model-predicted concentrations of these pollutants. The model performance evaluation for $PM_{2.5}$ and PM_{10} indicated a negative model bias throughout the year in the 4-km domain (AECOM and STI 2014) with the largest bias occurring in summer. As a result, the model-predicted $PM_{2.5}$ and PM_{10} concentrations may underestimate future impacts. Model-adjusted results from the MATS tool, which account for model performance biases, indicate that $PM_{2.5}$ concentrations may exceed the NAAQS and state AAQS for select monitors and assessment areas. There are seven monitoring stations within the 4-km domain with daily $PM_{2.5}$ concentrations that exceed the NAAQS and state AAQS during the baseline. All future model scenarios predict that only one of these monitoring station would continue to exceed the NAAQS and state AAQS. For annual $PM_{2.5}$, no monitoring stations within the 4-km domain exceed the NAAQS and state AAQS during the baseline or future years; however, two unmonitored areas within the Uinta Basin exceed the NAAQS and state AAQS during the baseline and impacts in these areas tend to increase for all future year scenarios except for mitigation Scenario 3. It is predicted that under mitigation Scenario 3, the annual $PM_{2.5}$ impacts would decrease in the Uinta Basin relative to the baseline due to a reduction of combustion control measures.

The future year scenarios generally have lower NO_2, CO, SO_2, $PM_{2.5}$, and PM_{10} concentrations than the 2010 Typical Year scenario, except for areas within the Uinta Basin. In the future year, all assessment areas are within the applicable PSD increments for annual NO_2, 3-hour SO_2, annual SO_2, and annual PM_{10} while most assessment areas exceed the 24-hour $PM_{2.5}$ PSD increment.[1]

Visibility conditions in Class I and sensitive Class II areas generally show improvement in the 2021 future year scenarios relative to the 2010 Base Year and 2010 Typical Year. There are not substantial differences in the 20th percentile best and worst visibility days between the 2010 Base Year and 2010 Typical Year. There also are not substantial differences in the 20th percentile best and worst visibility days between the four future year scenarios.

Results generally show a decrease in deposition values for the 2021 future year scenarios relative to the 2010 Typical Year. However, the differences in estimated deposition values between all four future year scenarios are generally very small. ANC change at all seven sensitive lakes exceeds the 10 percent limit of acceptable change for all model scenarios.

[1] The comparison of model concentrations to the PSD Class I or Class II increments does not represent a formal, regulatory PSD increment consumption analysis since the modeling effort does not separate emissions sources into PSD increment-consuming and non-PSD increment-consuming sources. Rather, the modeled levels are compared to the established PSD increments for informational purposes only.

Acronyms and Abbreviations

AAQS	Ambient Air Quality Standards
ACM2	Asymmetric Convective Model version 2
agl	above ground level
AQRVs	air quality-related values
AQS	Air Quality System
ARMS	Air Resource Management Strategy
b_{ext}	light extinction coefficient
BLM	Bureau of Land Management
BMP	Best Management Practices
CAMx	Comprehensive Air Quality Model with Extensions
CASTNet	Clean Air Status and Trends Network
CB05	Carbon Bond V
CM	carbon mass
CMAQ	Community Multi-scale Air Quality
CO	carbon monoxide
°	degrees
EA	environmental assessment
EBI	Euler Backward Iterative
EC	elemental carbon
EGU	electric generating unit
EIS	environmental impact statement
FB	fractional bias
f(RH)	relative humidity adjustment factor
g/ha/day	grams per hectare per day
GEOS-Chem	Goddard Earth Observing System-Chemical
HNO_3	nitric acid
IC/BC	initial conditions and boundary conditions
IMPROVE	Interagency Monitoring of Protected Visual Environments
ISORROPIA	Inorganic Aerosol Thermodynamics/Partitioning
°K	degrees Kelvin
kg/ha	kilogram per hectare
K_h	eddy diffusivity for heat
km	kilometer
Kv	coefficient of vertical eddy diffusion

LCC	Lambert Conformal Conic
LDT	Local Daylight Time
Ln[p]	natural log-pressure
lpm	liters per minute
LST	Local Standard Time
m^2/s	square meters per second
MATS	Modeled Attainment Test Software
mb	millibar
MCIP	Meteorology-Chemistry Interface Processor
MDT	Mountain Daylight Time
MFB	mean fractional bias
MFGE	mean fractional gross error
$\mu g/m^3$	micrograms per cubic meter
Mm^{-1}	inverse megameters
MNB	mean normalized bias
MNGE	mean normalized gross error
MOU	Memorandum of Understanding
MPE	model performance evaluation
MPES	Model Performance Evaluation Software
MST	Mountain Standard Time
MYJ	Mellor, Yamada, and Janic
NAAQS	National Ambient Air Quality Standard
NADP	National Atmospheric Deposition Program
NASA	National Aeronautics and Space Administration
NCDC	National Climate Data Center
NEPA	National Environmental Policy Act
NH_3	ammonia
NH_4	ammonium
NMB	normalized mean bias
NME	normalized mean error
NO	nitrogen oxide
NO_2	nitrogen dioxide
NO_3	nitrate
NO_X	oxides of nitrogen
NOAA	National Oceanic and Atmospheric Administration
NP	National Park

NPS	National Park Service
NTN	National Trends Network
O_3	ozone
OC	organic carbon
PAMS	Photochemical Assessment Monitoring Stations
PBL	planetary boundary layer
PGM	photochemical grid model
PIXE	particle-induced x-ray
PM	particulate matter
PM_{10}	particulate matter with an aerodynamic diameter less than or equal to 10 microns
$PM_{2.5}$	particulate matter with an aerodynamic diameter less than or equal to 2.5 microns
POI	periods of interest
ppb	parts per billion
ppbv	parts per billion by volume
ppm	parts per million
ppmv	parts per million by volume
RADM	Regional Acid Deposition Model
RPO	Regional Planning Organization
RTAG	Resource Technical Advisory Group
SMOKE	Sparse Matrix Operator Kernel Emissions
SOAP	Secondary Organic Aerosol Formation/partitioning
SO_2	sulfur dioxide
SO_4	sulfate
SS	sea salt
STI	Sonoma Technology, Incorporated
STN	Speciation Trends Network
TUV	total ultraviolet
UGRB	Upper Green River Basin
U.S.	United States
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
UTC	Coordinated Universal Time
UV	ultraviolet
VOC	volatile organic compound
WA	wilderness area
WRAP	Western Regional Air Partnership

WRF	Weather Research and Forecasting
XRF	x-ray flourescence

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1.0 Introduction

This document presents the air quality impact assessment for the Air Resource Management Strategy (ARMS) Modeling Project. This study was conducted by AECOM, Inc., dba AECOM Environment (AECOM) under the direction of the Bureau of Land Management (BLM) Utah State Office (Utah BLM).

1.1 Study Background

The BLM is required to complete a National Environmental Policy Act (NEPA) analysis (environmental impact statement [EIS] or environmental assessment [EA]) for each proposed project that would occur on BLM-administered federal land. In the recent past, there has been concerns about the methods used to assess potential air quality impacts and air quality related values (AQRVs) associated with proposed oil and gas projects. These concerns have led to several procedural changes including the establishment of the June 2011 Memorandum of Understanding (MOU), referred to hereafter as the National MOU, and, specifically in Utah, the ARMS. It is important to note that the National MOU and the ARMS Modeling Project have some differences in their objectives. The National MOU is a guidance document for multiple federal agencies to design and execute a consistent and efficient air quality analysis for a specific NEPA action. On the other hand, the ARMS is designed to develop a reusable air management tool applicable to multiple projects for activities in the Uinta Basin. The ARMS modeling framework also could be used to assess the potential cumulative impacts associated with future project-specific NEPA actions, which will facilitate consistency and efficiency with the planning activities in the area. The Uinta Basin (shown in **Figure 1-1**) is an area in northeastern Utah that is projected to have extensive development of oil and gas reserves in the foreseeable future.

The ARMS Modeling Project is one of several studies that will inform and support the Utah ARMS. As part of the ARMS, the Utah BLM, together with other state and federal agencies, has commissioned several studies to further understand and analyze current ambient air and meteorological conditions in the Uinta Basin, and to develop emissions inventories appropriate for ozone modeling applications. These studies include special monitoring studies (Energy Dynamics Laboratory [EDL] 2011, Utah Department of Environmental Quality [UDEQ] 2011) and an emissions inventory development study (AECOM 2011). The results of these studies have been used extensively in the ARMS Modeling Project and have been essential to the overall understanding of the issues affecting air quality in the Uinta Basin.

In addition to the studies described above, as part of ARMS, the Utah BLM established the Utah Air Resource Technical Advisory Group (RTAG) to provide a forum to discuss and review the results of the BLM-funded studies. The RTAG and the ARMS studies fulfill several objectives of the National MOU, including collaboration and transparency among multiple federal agencies. The ARMS Modeling Project is designed to meet a goal of the National MOU by developing a Reusable Modeling Framework, which, in this case, has been developed for the Uinta Basin. It is expected that future NEPA actions could be evaluated with the reusable modeling framework developed by this study.

While the procedures described in the National MOU will be followed, as appropriate, during the ARMS Modeling Project, it is important to note that this particular study is not a project-specific NEPA analysis, and the modeling files and reports are not NEPA products. Rather, the ARMS Modeling Project is a cumulative assessment of potential future air quality impact associated with predicted oil and gas activity in the Uinta Basin. The ARMS Modeling Project provides data, modeling products and estimates of future air quality impacts to facilitate BLM's future NEPA and land use planning efforts. Therefore, the National MOU guidance applicable to project-specific emissions, impacts, and analyses will not be required as part of this study. It also is not a policy study, analysis of regulatory actions, or an analysis of the impacts of project-specific development. While the ARMS Modeling Project is not a project-specific NEPA analysis, it may result in specific mitigation measures or Best Management Practices (BMP) applicable to future NEPA actions.

One of the main air quality concerns related to continued development of oil and gas reserves in the Uinta Basin is the elevated ozone levels measured during the winter. Several winter episodes of elevated 8-hour ozone concentrations have been measured in the Uinta Basin since monitoring began in 2009. Observations of elevated winter ozone concentrations initially were detected in the Upper Green River Basin (UGRB) in Wyoming during the winter of 2005. Since then multiple ambient air monitoring studies have been conducted both in the UGRB and in the Uinta Basin. The United States (U.S.) Environmental Protection Agency's (USEPA) National Ambient Air Quality Standards (NAAQS) for the 8-hour average ozone concentration is 75 parts per billion (ppb). In the Uinta Basin, observed 8-hour average concentrations have exceeded 130 ppb during the winter in 2011.[1] These episodes of elevated ozone concentrations typically occur in the late winter and early spring, but sustained ozone concentrations above natural background are evident in these areas during summer conditions as well.

While continued winter monitoring studies are on-going in the Uinta Basin, air quality assessment tools are currently under development. To date, no refined model has successfully replicated the key wintertime ozone formation processes and timing. It is important to have such a tool operational in order to assess the effect of control measures on wintertime ozone formation. Given the complexity and emerging understanding of wintertime ozone formation, RTAG advised the Utah BLM to investigate two state-of-the-science Photochemical Grid Modeling (PGM) systems in an attempt to replicate the wintertime ozone events and to assess cumulative impacts to air quality and AQRVs during the rest of the year. The two PGM models selected for evaluation were the: 1) the Community Multi-Scale Air Quality (CMAQ) modeling system; and 2) the Comprehensive Air Quality Model with Extensions (CAMx). Based on the RTAG recommendations, both CMAQ and CAMx were run and evaluated as part of this study to determine which model is more appropriate for the conditions under which ozone and other air pollutants formation occur in the Uinta Basin.

1.2 Study Objectives

The Utah BLM's primary goal is to develop a reusable modeling framework suitable for air quality management decisions affecting the Uinta Basin. In support of this goal, two study objectives have been defined:

1. Determine a preferred PGM system and configuration for the ARMS using emissions, meteorological model data, and ambient air quality data for 2010.
2. Use the preferred PGM system as an air quality management tool to assess cumulative future air quality impacts associated with reasonably foreseeable development and application of control technology.

For this modeling study, an air quality study area has been defined for the Uinta Basin. The Uinta Basin air quality study area is shown in **Figure 1-1**, and contains portions of Carbon, Duchesne, Daggett, and Uintah counties in Utah and Moffat and Rio Blanco counties in Colorado. The Uinta Basin study area encompasses most of the area administered by the BLM Vernal Field Office, as well as portions of the Price Field Office in Utah and White River Field Office and Little Snake Field Office in Colorado. In addition to BLM-administered land, the study area also includes state, private, and tribal lands and areas administered by other federal agencies. The Uinta Basin air quality study area was developed based on

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[1] It is important to note that the official form of the 8-hour ozone NAAQS is the annual fourth-highest daily maximum 8-hour ozone concentration averaged over 3 years cannot exceed 75 ppb. Three full years of ozone monitoring data have not yet been collected in the Uinta Basin as of the writing of this report, and therefore the reported 8-hour average concentrations are not directly comparable to the form of the USEPA NAAQS.

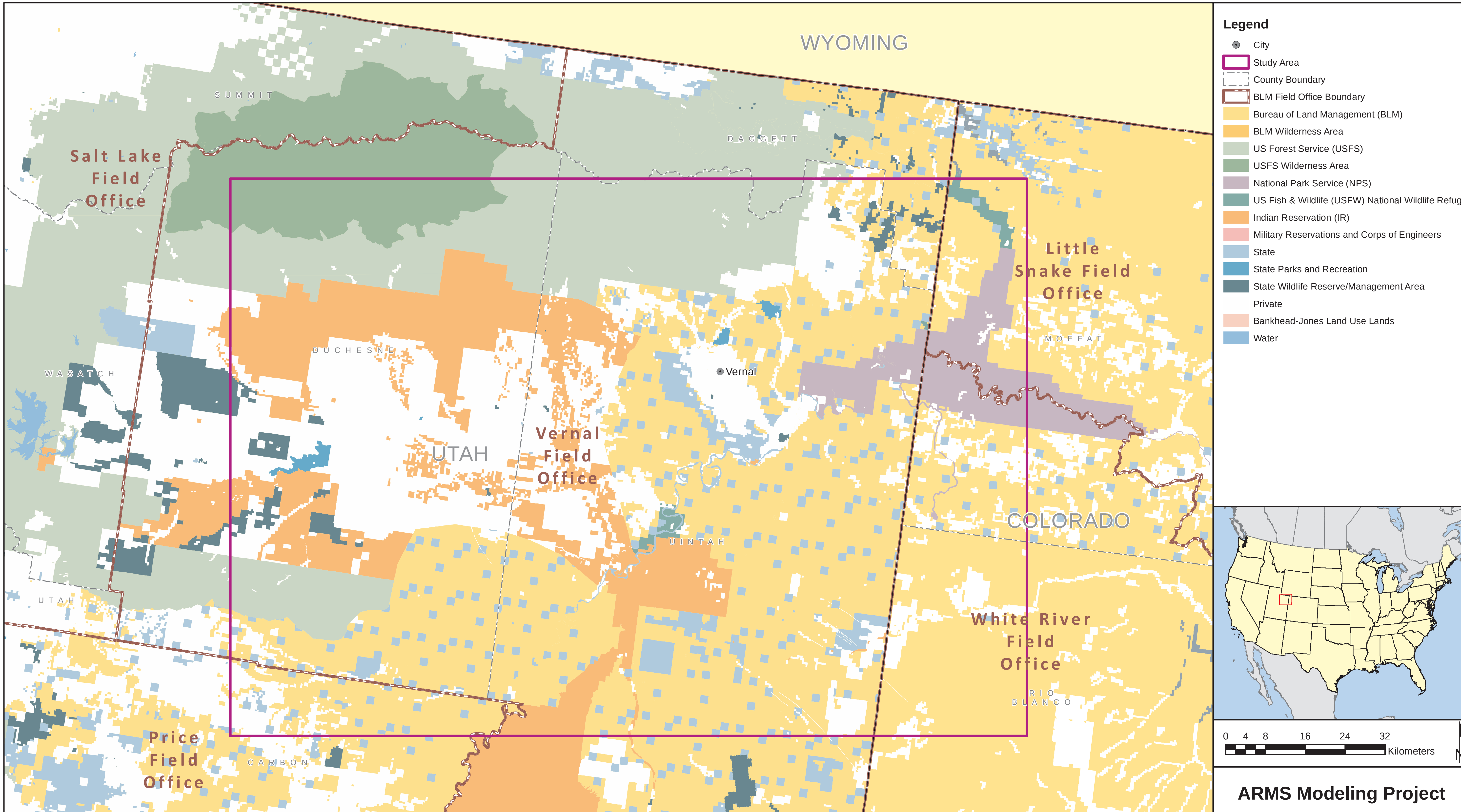

Figure 1-1
Uinta Basin Study Area

X:\0Projects\BLM_UTSO_ARMS_60225687\Figures\Doc\ImpactAssessmentReport\Fig_1-1_ARMS_Study_Area.mxd topographic features that influence air flow patterns, not political or geological boundaries. The Uinta Basin air quality study area does not completely contain the geological extent of the Uinta Basin's oil and gas reserves,[2] but it does include the areas within the basin that have historically shown elevated ozone concentrations (EDL 2011), which are of most concern for this study.

1.3 Modeling Overview

In coordination with the BLM, the following two models were selected for a model performance evaluation of base year (2010) conditions for this study:

- The CMAQ modeling system (version 5.0, or most current version), and
- The CAMx modeling system (version 5.40, or most current version).

Both models are state-of-science 'One-Atmosphere' photochemical grid models (PGMs) capable of simultaneously addressing ozone and other criteria pollutants, visibility, and acid deposition at the regional and urban scale.

Emissions data was developed for oxides of nitrogen (NO_X), carbon monoxide (CO), sulfur dioxide (SO_2), particulate matter with an aerodynamic diameter less than or equal to 10 microns (PM_{10}), particulate matter with an aerodynamic diameter less than or equal to 2.5 microns ($PM_{2.5}$), total volatile organic compounds (VOC), and speciated VOCs. In order to create PGM-ready emission inventories (EIs), the Sparse Matrix Operator Kernel Emissions (SMOKE) modeling system was used. PGM-ready air emissions data were developed for a set of nested modeling domains. To meet the study objectives, it was determined that five EIs would be developed. The development and purpose of the five EIs are summarized briefly below:

- <u>Base Year EI</u>. A base year EI was developed for 2010, the same year for which meteorological data are available. The primary purpose of this EI is for model performance evaluation purposes.
- <u>Future Year EI</u>. The future year with the maximum emissions in the Uinta Basin was determined to be 2021. A comprehensive emissions inventory was developed for 2021.
- <u>Three Mitigation Scenarios</u>. Three mitigation scenarios were developed to target reductions in VOC emissions, NO_X emissions, and combined reductions.

To ensure the best possible air quality model performance, both PGM systems were configured based on the latest scientific and numerical options that were available at the beginning of this project. Once the 2010 base year model simulations and model performance evaluations (MPE) were completed, the preferred PGM system and model configuration were locked in and used for the subsequent future year model simulations. The following summarizes the model simulations that were conducted as part of this project:

- <u>2010 Base Year Sensitivity Test Runs.</u> Two sensitivity simulations were performed for the months of February and August with both CMAQ and CAMx. The objective of these sensitivity tests was to evaluate the contribution of non-local sources of ozone in the Uinta basin study area: 1) a boundary condition test followed the evolution of ozone concentrations from the 36-km lateral boundaries to the inner domains; and 2) a natural background test followed the evolution

[2] The exact extent of the Uinta Basin oil and gas reserves is unknown; however, extraction of Uinta Basin reserves is occurring in the northern portions of Grand and Emery counties, which are to the south and outside of the Uinta Basin air quality study area. As described later in this report, emissions (and therefore air quality impacts) associated with Uinta Basin oil and gas activities are included for the entire basin. It is just the detailed assessment of air quality impacts and model performance that does not include portions of Grand and Emery counties.

of ozone and $PM_{2.5}$ concentrations from the lateral boundaries and from natural background (i.e., non-anthropogenic) sources.

- 2010 Base Year Annual Run and Selection of the Preferred Model. An annual 2010 (base year) simulation was completed for each model using the configuration based on the best available information. As described in Chapter 2, the base year modeling used the 2010 emissions inventory. The primary objective of the base year simulation was to complete a comprehensive model performance evaluation (MPE) by comparing model predictions to ambient monitoring data for 2010. The MPE evaluated and compared the performance of both models. The preferred PGM and configuration was selected based on the MPE results.
- Typical Year Modeling. A typical year emissions inventory was developed by annualizing the base year 2010 emissions for key source groups. Annualizing the base year emissions inventory provides a consistent basis for estimating the change in impacts due to future year activities. Annualizing the base year emissions is important, since future year emissions are also annualized. This process removes any modeled high impacts that occur in the base year, but cannot be anticipated to occur in the future year (e.g., startup and shut down operations at large sources, drilling operations near monitors, etc.). This process also normalizes the impacts for comparison to future years. The typical year emissions inventory was modeled with the preferred model and configuration and using the 2010 meteorological data developed for the base year conditions simulation.
- Future Year Runs. The objective of the future year model simulations was to evaluate the potential cumulative air quality impacts of projected oil and gas development in the Uinta Basin relative to the typical base year modeled air quality and AQRVs. This analysis was performed using the 2010 meteorological data developed for the base year simulation but with the future year emissions inventories developed for the future year 2021. The future year analysis include four scenarios:
  - 2021 OTB case. A maximum emissions year with applicable on-the-books controls applied. The future year 2021 was selected as this maximum emissions year based on projected development in the Uinta Basin and the time-horizon selected for future year analysis.
  - 2021 Scenario 1. A control scenario with NO_x emissions controls was developed and applied to the emissions inventory for 2021
  - 2021 Scenario 2. A control scenario with VOC emissions controls was developed and applied to the emissions inventory for 2021; and
  - 2021 Scenario 3. A control scenario with combined NO_x and VOC emissions controls was developed and applied to the emissions inventory for 2021

Based on a detailed model inter-comparison performed between CMAQ and CAMx, CMAQ was selected as the recommended modeling system for the ARMS Modeling Platform. This recommendation is driven primarily by the fact that CMAQ provided superior performance for ozone and total $PM_{2.5}$ in the Uinta Basin during wintertime ozone episodes. CMAQ also provided slightly better overall annual performance for ozone and wet deposition. Both models performed similarly well for total annual $PM_{2.5}$ concentration and visibility.

Once the preferred model was selected, the future year modeling scenarios described above were conducted with CMAQ. These modeling results comprise a regional air quality assessment, with the focus on the change in cumulative impacts resulting from Reasonably Foreseeable Future Development (RFFD) scenarios. Assessment areas for the air quality model were developed to include all regional Class I areas and other environmentally sensitive areas (e.g., national parks and monuments, wilderness areas, etc.) near the Uinta Basin. Cumulative air quality impacts within the Uinta Basin study area were assessed for:

- Criteria pollutants including nitrogen dioxide (NO_2), CO, SO_2, ozone, PM_{10}, and $PM_{2.5}$; and
- AQRVs (limited to applicable Class I, sensitive Class II areas, and sensitive lakes), including changes in visibility, atmospheric deposition to soils, and the Acid Neutralizing Capacity (ANC).

This Impact Assessment Report for the ARMS Modeling Project summarizes the modeled cumulative air quality impacts for the typical year, future year, and control scenarios and presents a comparison of future impacts to the modeled 2010 typical conditions. Results are presented in this report in tables and graphical displays as appropriate.

1.4 ARMS Modeling Project Documents and Participating Agencies

This Impact Assessment Report is the final document in a series of documents developed for the ARMS Modeling Project. In addition to this Impact Assessment Report, there are several other supplemental reports that provide more detailed information about the ARMS Modeling Project, specifically:

- Utah ARMS Air Quality Modeling and Assessment Protocol (AECOM 2012);
- Utah ARMS Meteorological Model Performance Evaluation Report (AECOM and STI 2013);
- Utah State BLM Emissions Inventory Technical Support Document (AECOM 2013); and
- Utah ARMS Air Quality Model Performance Evaluation Report (AECOM and STI 2014).

The Modeling and Assessment Protocol (AECOM 2012) outlines the proposed approach, tools, and selected assessment areas in the ARMS Modeling Project. The Meteorological MPE Report (AECOM and STI 2013) provides detailed information about the meteorological model configuration and resulting model performance. The emissions inventory development, processing, and final emissions for all model scenarios is detailed in the Emissions Inventory Technical Support Document (TSD) (AECOM 2013). The Air Quality MPE Report (AECOM and STI 2014) provides detailed information about the air quality model configuration, model performance, and selection of the preferred air quality model. This Impact Assessment Report summarizes the modeled cumulative air quality and AQRV impacts and presents a comparison of future impacts to the modeled 2010 typical conditions.

In order to ensure the technical credibility of the data, methodology, projections, interpretations, and conclusions of the ARMS Modeling Project, as well as the usefulness of the results other agencies, the BLM sought the input of other federal and state agencies participating in RTAG. RTAG is composed of agency representatives with technical expertise in air quality resources. Key participating agencies included the BLM, Utah Division of Air Quality (UDAQ), USEPA, Forest Service (FS), National Park Service (NPS), and U.S. Fish and Wildlife Service (USFWS). This technical advisory group has provided feedback on all aspects of the ARMS Modeling Project during their review of the ARMS Modeling Project related documents listed above.

1.5 Impact Assessment Report Organization

Following this introduction, Chapter 2 provides a summary of the modeling domains, assessment areas and approach, meteorological data, model performance, and emissions inventory data used in this study. Chapter 3 presents a detailed analysis of cumulative air quality impacts, with a focus on ozone and $PM_{2.5}$. Chapters 4 and 5 present an assessment of visibility impacts and atmospheric deposition, respectively, for applicable assessment areas. Chapter 6 summarizes the major findings presented in this report.

2.0 Technical Approach

As described in Chapter 1, the goal of ARMS Modeling Project is to use a PGM system to assess base year and projected future cumulative impacts to air quality and other AQRVs at selected assessment areas. The PGM system selected for this study includes the air quality model, CMAQ, the meteorological model (the Weather Research and Forecasting [WRF] model), and the emissions processor system (SMOKE). The CMAQ modeling system was used to address all components of the cumulative air quality impact analysis, including air quality conditions for criteria pollutants and ozone, as well as AQRVs, such as changes to visibility, atmospheric deposition, and ANC of sensitive lakes.

This chapter provides a summary of the impact assessment approach and the configuration of the modeling system used to conduct the assessment. The details regarding the modeling approach and analysis techniques are provided in the next section. Following the section on the modeling approach, the modeling domains, assessment areas, meteorological data, model performance, and emissions inventory data used in this study are presented.

2.1 Model Domains and Assessment Areas

The air quality modeling domains include a coarse domain centered on the continental United States (U.S.) at a 36-kilometer (km) horizontal grid resolution and two refined domains of 12-km and 4-km grid resolutions focused on the area of interest. **Figure 2-1** shows the nested horizontal domains for the CMAQ model relative to the horizontal domains of the WRF meteorological model. All modeling domains use the standard map projection from the Regional Planning Organization (RPO) unified grid, which was used by the Western Regional Air Partnership (WRAP) in its prior analyses. The RPO unified grid consists of a Lambert Conformal Conic (LCC) map projection using the map projection parameters listed in **Table 2-1**. A complete description of the model domains is provided in **Table 2-2**.

Table 2-1 RPO Unified Grid Definition

Parameter	Value
projection	LCC
datum	World Geodetic System 1984
alpha	33 degrees (°) latitude
beta	45° latitude
x center	97° longitude
y center	40° latitude

Table 2-2 Model Domain Dimensions

Model	Domain	Number of Grid Cells	Coordinates of Southwestern Corner of Grid (km)
WRF	36-km	165 x 129	-2952, -2304
	12-km	127 x 130	-1980, -756
	4-km	166 x 175	-1560, -324
CMAQ and SMOKE	36-km	148 x 112	-2736, -2088
	12-km	111 x 111	-1872, -612
	4-km	144 x 126	-1500, -264

The domains are the same for all modeling performed for this study. The vertical grid is composed of 36 layers with thinner (more) layers in the planetary boundary layer (PBL). Thinner model layers lower in the atmosphere, within the PBL, are better able to capture boundary layer characteristics for the transport and diffusion of emitted pollutants, which is important for air quality modeling, particularly during winter inversions. The proposed layer structure is summarized in **Table 2-3**. The altitudes above sea level are estimated according to standard atmosphere assumptions.[1]

Table 2-3 Vertical Layer Structure for Air Quality Modeling Simulations

Model Layer	Sigma	Pressure (millibars [mb])	Height (meters)	Depth (meters)
36 – top	0.000	50	20,559	4,262
35	0.050	98	16,297	2,527
34	0.100	145	13,770	1,805
33	0.150	193	11,965	1,407
32	0.200	240	10,559	1,185
31	0.250	288	9,374	1,035
30	0.300	335	8,339	931
29	0.350	383	7,408	832
28	0.400	430	6,576	760
27	0.450	478	5,816	701
26	0.500	525	5,115	652
25	0.550	573	4,463	609
24	0.600	620	3,854	572
23	0.650	668	3,282	540
22	0.700	715	2,741	412
21	0.740	753	2,329	298

[1] Standard equations and assumptions include: surface pressure of 1,000 mb, model top at 100 mb, surface temperature of 275 degrees Kelvin (°K), and lapse rate of 50°K/ natural log-pressure (ln[p]).

Table 2-3 Vertical Layer Structure for Air Quality Modeling Simulations

Model Layer	Sigma	Pressure (millibars [mb])	Height (meters)	Depth (meters)
20	0.770	782	2,032	290
19	0.800	810	1,742	188
18	0.820	829	1,554	185
17	0.840	848	1,369	182
16	0.860	867	1,188	178
15	0.880	886	1,009	175
14	0.900	905	834	87
13	0.910	915	747	85
12	0.920	924	662	85
11	0.930	934	577	85
10	0.940	943	492	83
9	0.950	953	409	83
8	0.960	962	326	83
7	0.970	972	243	81
6	0.980	981	162	41
5	0.985	986	121	41
4	0.990	991	80	20
3	0.9929	993	60	20
2	0.995	995	40	20
1	0.9976	998	20	20
0 – ground	1.000	1,000	0	0

The locations of the Class I and sensitive Class II areas within the 12- and 4-km modeling domains are shown in **Figure 2-2**. Model results for all assessment areas are reported in this document from either the 12-km or the 4-km domain, depending on their location relative to each of these domains. In addition to the Uinta Basin, air quality and AQRVs impacts were assessed for all Class I and sensitive Class II areas that are within 300-km of the Uinta Basin study area. The locations of these sensitive areas, with respect to the modeling domains, are shown in **Figure 2-2**. The following Class I areas and sensitive Class II areas are contained entirely within either the 4-km or the 12-km modeling domain:

- Arches National Park (NP) (Class I)
- Black Canyon of the Gunnison Wilderness Area (WA) (Class I)
- Bridger WA (Class I)
- Bryce Canyon NP (Class I)
- Canyonlands NP (Class I)
- Capitol Reef NP (Class I)
- Dinosaur National Monument (Class II)
- Eagles Nest WA (Class I)

- Fitzpatrick WA (Class I)
- Flaming Gorge National Recreation Area (Class II)
- Flat Tops WA (Class I)
- Fort Hall Indian Reservation (IR) (Class II)
- Goshute IR (Class II)
- High Uintas WA (Class II)
- La Garita WA (Class I)
- Maroon Bells-Snowmass WA (Class I)
- Mesa Verde NP (Class I)
- Mount Zirkel WA (Class I)
- Navajo IR (Class II)
- Paiute IR (Class II)
- Rocky Mountain NP (Class I)
- Rawah WA (Class I)
- Skull Valley IR (Class II)
- Southern Ute IR (Class II)
- Uintah and Ouray IR (Class II)
- Ute Mountain IR (Class II)
- Weminuche WA (Class I)
- West Elk WA (Class I)
- Wind River IR (Class II)

The sensitive lakes included in this study are shown in relation to the Uinta Basin study area in **Figure 2-3**. The changes to the ANC are assessed for the following sensitive lakes:

- Dean Lake, Class II High Uintas WA;
- Fish Lake, Class II High Uintas WA;
- Heart Lake, Class II High Uintas WA;
- Walk Up Lake, Class II Ashley National Forest;
- 4D2-039, Class II High Uintas WA; and
- 4D1-044, Class II High Uintas WA.

These sensitive lakes were selected for analyses as they are located within 100 km of the Uinta Basin study area.

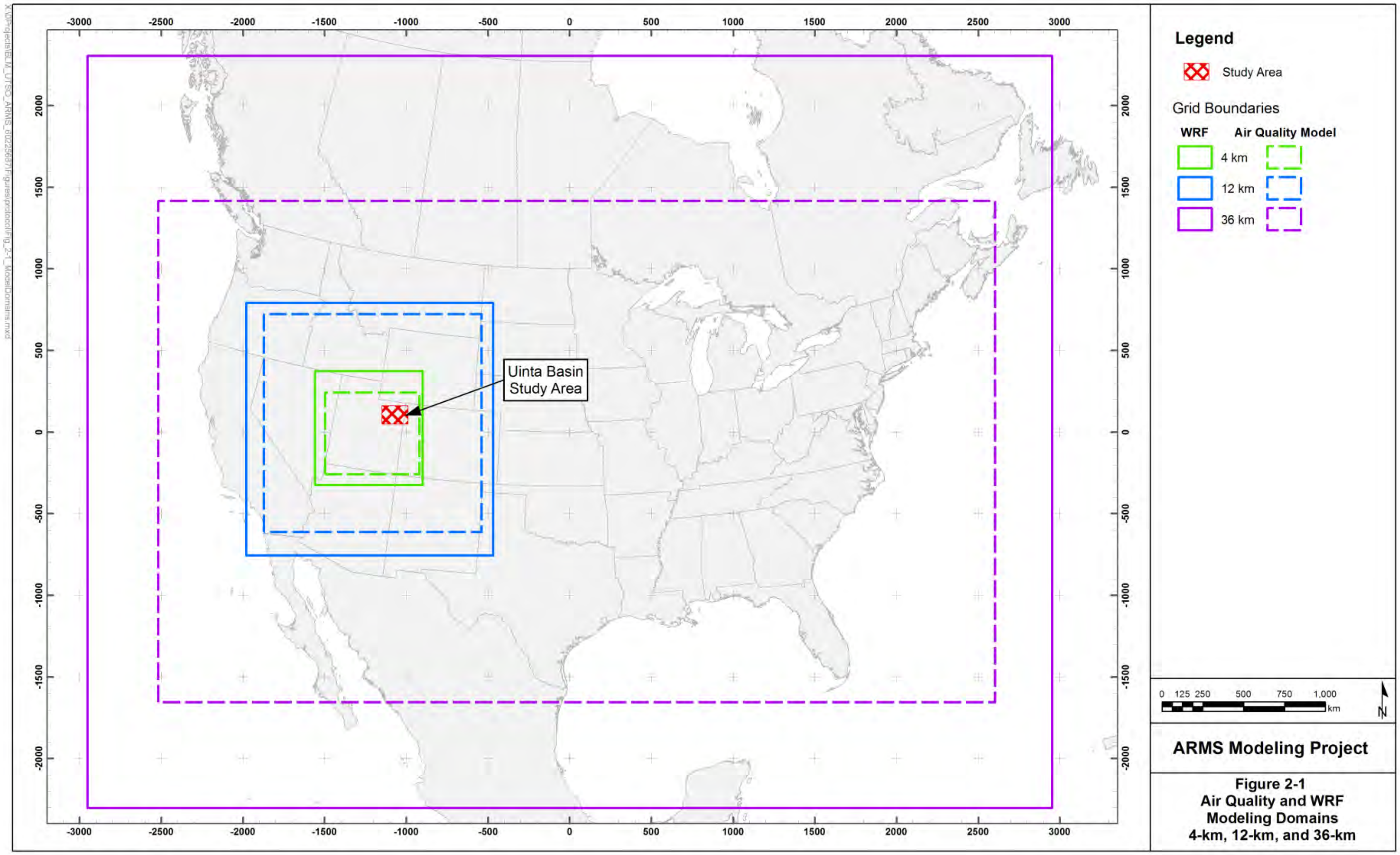

Figure 2-1
Air Quality and WRF
Modeling Domains
4-km, 12-km, and 36-km

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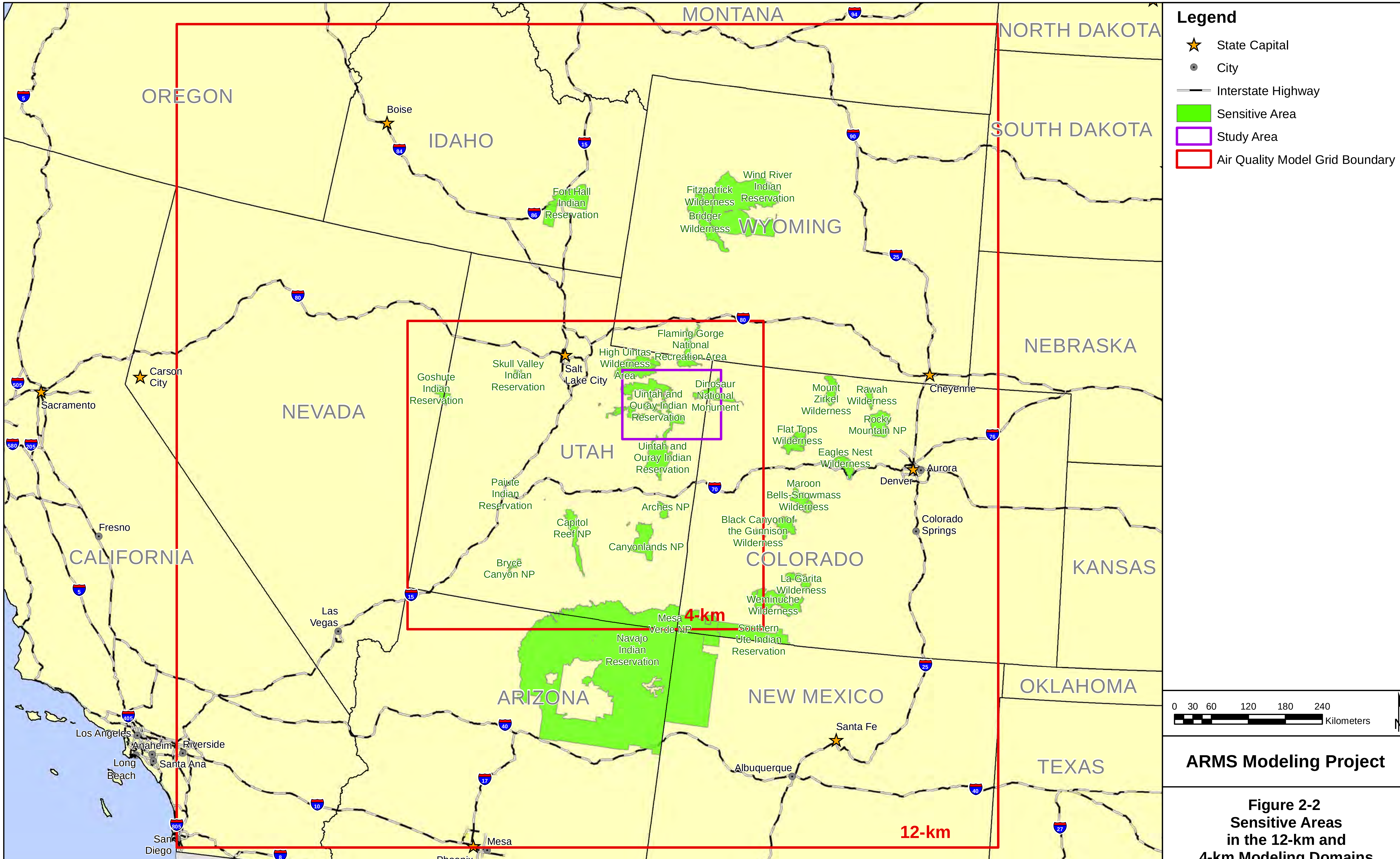
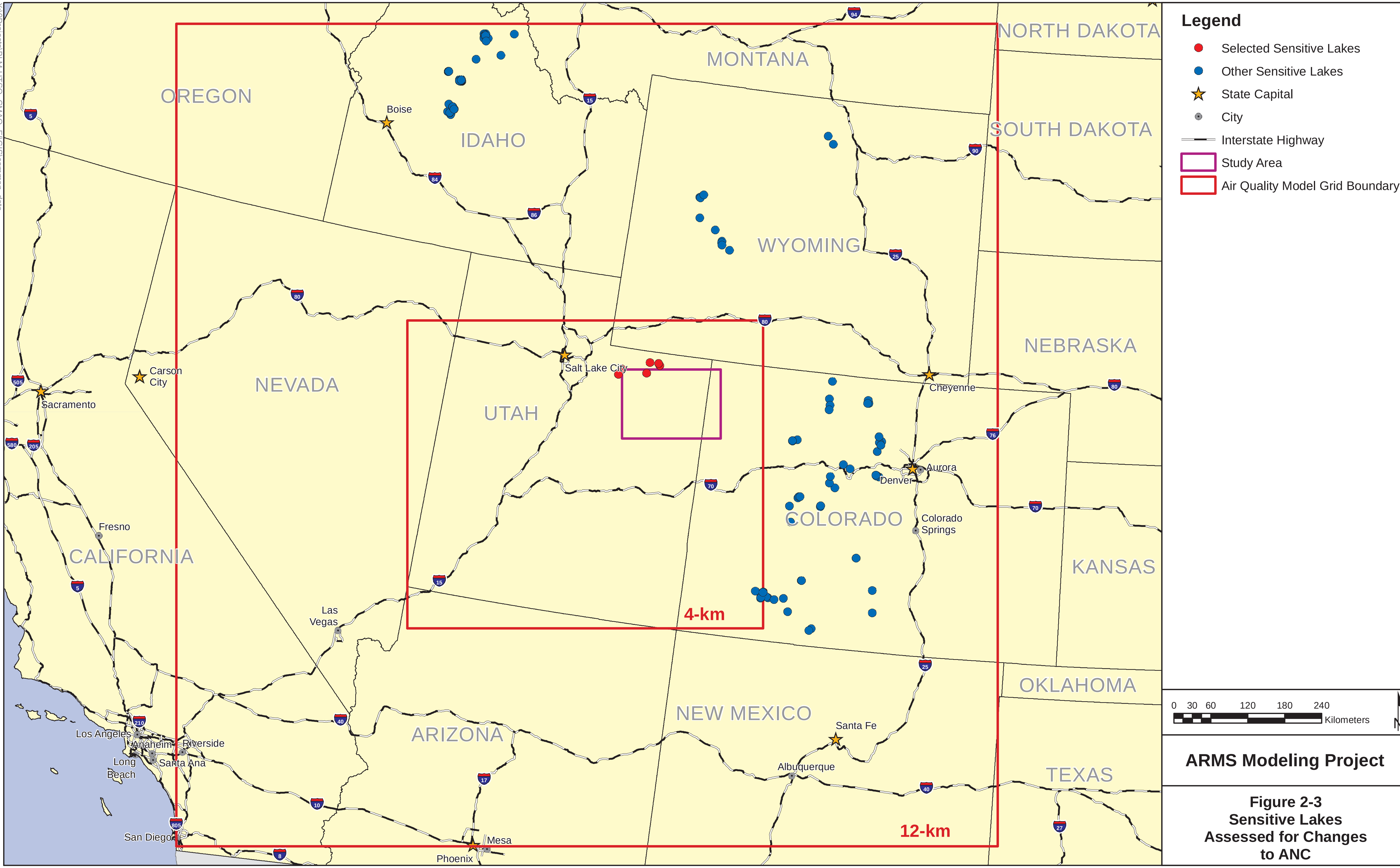


Figure 2-2
Sensitive Areas in the 12-km and 4-km Modeling Domains



ARMS Modeling Project

Figure 2-3
Sensitive Lakes
Assessed for Changes
to ANC

2.2 Overview of Assessment Approach

The CMAQ modeling system was used to estimate potential cumulative air quality and AQRV impacts on selected assessment areas. Model-predicted concentrations of NO_2, CO, SO_2, ozone, PM_{10}, and $PM_{2.5}$, as well as visibility impairment (aerosol light extinction) and nitrogen (N) and sulfur (S) deposition were evaluated. The modeled hourly values of applicable pollutant concentrations were processed to compute 3-hour, 8-hour, 24-hour, and annual average concentrations for comparison to appropriate standards and criteria.

The AQRVs evaluated include visibility, atmospheric deposition, and changes in ANC. Visibility impacts were evaluated at the assessment areas by using the new Interagency Monitoring of Protected Visual Environment (IMPROVE) equation (Hand and Malm 2006). Visibility estimates were analyzed for 24-hour average periods. Atmospheric deposition impacts were assessed for both soils (terrestrial deposition) and lakes (aquatic deposition). The potential nutrification and acidification impacts to terrestrial and aquatic ecosystems are analyzed based on model-predicted nitrogen and sulfur deposition. Nutrification and acidification impacts to terrestrial and aquatic ecosystems are analyzed at Class I areas, sensitive Class II areas, and sensitive lakes for all model scenarios. Nutrification impacts were assessed in terms of total nitrogen deposition relative to nitrogen critical loads (Pardo et al. 2011; Baron et al. 2011) using the methods in Ellis et al. (2013). The changes in nitrogen and sulfur deposition between the future years and the typical year were assessed and compared to deposition analysis thresholds (DATs) (FLAG 2010). Acidification impacts were assessed in terms of ANC by comparing predicted annual total atmospheric deposition of nitrogen and sulfur to current ANC based on the USFS-recommended prediction methods (USFS 2000). Atmospheric deposition impacts were analyzed as the total cumulative annual deposition.

The model results are processed into a form for comparison to the appropriate standard or air quality metric for each assessment area. The following air quality and AQRV assessments were conducted and are summarized in this report:

- Comparison of the modeled cumulative air quality impacts to the applicable state Ambient Air Quality Standards (AAQS) and NAAQS;
- Comparison of modeled cumulative air quality impacts to the applicable Prevention of Significant Deterioration (PSD) increments (Class I or Class II, depending on the grid cell location). While the impacts will be numerically compared to PSD increments, there will be no formal assessment of increment-consuming emissions or of expected increment consumption; and
- Evaluation of the modeled change in air quality conditions and in AQRVs.

There are three types of assessment areas: the Uinta Basin study area, Class I and sensitive Class II areas, and sensitive lakes. Each of these areas has different applicable thresholds for evaluating air quality and AQRV impacts which, in turn, require different air quality assessment methods. **Table 2-4** shows the assessment areas, the applicable air quality analyses and the assessment methodology. The assessment methods and applicable thresholds are described in more detail in Chapters 3 (criteria impacts), 4 (visibility), and 5 (atmospheric deposition).

Modeled results must be interpreted in consideration of all applicable limitations. The CMAQ modeling system and the model limitations for each air quality metric are discussed in the ARMS Air Quality MPE Report (AECOM and STI, 2014). The ARMS Modeling Project is a cumulative study designed to assess the potential future cumulative impacts and the results are not intended to evaluate project-specific NEPA analysis. The requirements for future project-specific modeling or other required site-specific analyses would be determined in response to state or other regulatory requirements at that time. Modeled results presented in this report should be used in concert with other data to further identify concerns for specific areas or related to specific actions.

Table 2-4 Analysis Methods for Specific Model Scenario and Assessment Area Combinations

<table>
<tr><th rowspan="2">Area</th><th rowspan="2">Model Scenario</th><th colspan="2">Criteria Pollutants</th><th colspan="3">AQRVs</th></tr>
<tr><th>State and National AAQS</th><th>PSD Increment</th><th>Visibility</th><th>Deposition</th><th>ANC</th></tr>
<tr><td rowspan="4">Uinta Basin Study Area (Class II)</td><td>2010 Base Year</td><td>Yes</td><td>Yes</td><td rowspan="4" colspan="3">NA</td></tr>
<tr><td>2010 Typical Year (TY)</td><td>Yes</td><td>Yes</td></tr>
<tr><td>Future Years (FYs)</td><td>Yes</td><td>Yes</td></tr>
<tr><td>FYs minus TY</td><td>NA</td><td>Yes</td></tr>
<tr><td rowspan="4">Class I and Sensitive Class II Areas</td><td>2010 Base Year</td><td>Yes</td><td>Yes</td><td>Yes</td><td>Yes</td><td rowspan="4">NA</td></tr>
<tr><td>2010 Typical Year (TY)</td><td>Yes</td><td>Yes</td><td>Yes</td><td>Yes</td></tr>
<tr><td>Future Years (FYs)</td><td>Yes</td><td>Yes</td><td>Yes</td><td>Yes</td></tr>
<tr><td>FYs minus TY</td><td>NA</td><td>Yes</td><td>Yes</td><td>Yes</td></tr>
<tr><td rowspan="4">Sensitive Lakes</td><td>2010 Base Year</td><td rowspan="4">NA</td><td rowspan="4">NA</td><td rowspan="4" colspan="2">NA</td><td>Yes</td></tr>
<tr><td>2010 Typical Year (TY)</td><td>Yes</td></tr>
<tr><td>Future Years (FYs)</td><td>Yes</td></tr>
<tr><td>FYs minus TY</td><td>Yes</td></tr>
</table>

2.3 Meteorological Data

Meteorological data are required to estimate emissions from selected source sectors and simulate air quality conditions as inputs for using PGMs. Since observed data are not available for the full gridded model domain, a numerical meteorological model was required to provide these inputs. The WRF meteorological model was selected for the ARMS Modeling Project. The WRF configuration was tested extensively for the Uinta Basin Study Area to determine a preferred WRF configuration for the annual simulation. The result of these test led to two configurations: one for winter months and another for non-winter months. The primary differences between the two configurations are the planetary boundary layer scheme, the microphysics scheme, the short-wave radiation scheme, and the land surface model.

Both qualitative and quantitative (statistical) analyses were used to examine the performance of the final annual WRF simulation. Qualitative analyses of the meteorological model performance were conducted for four air quality episodes. The four selected episodes are: January 8 to 23, 2010; February 21 to March 8, 2010; August 19 to 29, 2010; and September 27 to October 5, 2010. The model results for these time periods were compared with:

- Observations of surface and upper-level pressure patterns;
- The spatial variability of observed precipitation, precipitation amounts, and snow cover; and
- The observed vertical profiles of wind speed, direction, temperature, and dew point.

In general, it was found that the WRF model was capable of reproducing the observed synoptic and precipitation patterns, including snow cover, during the events analyzed; however, the model tended to over-predict the extent of snow coverage during shoulder seasons. The model generally was able to simulate the vertical profiles of the atmosphere, including the vertical variability in wind direction and speed, as well as the height of the planetary boundary layer. However, the model had difficulty replicating sharp vertical changes in the dew point temperature. Altogether, the model's ability to reproduce important synoptic and vertical patterns provides confidence in the model's ability to reproduce important physical processes during periods with elevated concentrations of air pollutants.

The quantitative assessment of the 2010 annual simulation compared model results to observations using various statistical measures. The statistical results were evaluated over different temporal and spatial extents to assess the WRF model's performance for accuracy, consistency, and reasonableness with respect to available observations. Statistical summaries were generated for the 4-km, 12-km, and 36-km model domains with a focus on the assessment of the 4-km results. In addition to domain-wide statistical summaries, the model performance was evaluated exclusively for the Uinta Basin study area to provide additional information about the area of interest for the ARMS study.

In general, the 2010 annual simulation performed well for all meteorological parameters evaluated. The model results were slightly better for the 4-km domain than the 12-km domain, likely as a result of both the finer resolution grid and the use of observation nudging in the 4-km domain. On an annual and seasonal basis, most meteorological parameters were within the traditional performance benchmarks. Moreover, when the results are evaluated relative to performance benchmarks for complex terrain, all results for the 4-km domain are within the accepted range.

Based on the model performance evaluation, it is found that the model tends to under-predict wind speeds and temperature during winter, while over-predicting temperature in the fall and mixing ratio in the summer. In the Uinta Basin, the model wind speed tends to be biased slightly low independent of season with somewhat higher errors in the summer season. Model wind direction tends to be biased low during summer months and biased high in winter months. The model tends to over-estimate temperature in winter months and mixing ratio in summer months.

Based on these findings, the 2010 annual ARMS WRF modeling simulation demonstrated good performance and is considered suitable for use for the ARMS Modeling Project.

The meteorological data developed for year 2010 were used to estimate base/typical year (2010) and future year (2021) emissions (for a subset of source sectors) as well as model the cumulative air quality impacts for the corresponding years. More detailed information regarding the development and performance of these meteorological data is available in the Meteorological MPE Report (AECOM and STI 2013).

2.4 Air Quality Model

As described in the Protocol (AECOM 2012), the PGM system was used to assess base year (2010) conditions. Given the complexity and emerging understanding of wintertime ozone formation, the Utah RTAG advised the Utah BLM to investigate two state-of-the-science PGM systems in an attempt to replicate the winter ozone events and to assess cumulative impacts to air quality and AQRVs during the rest of the year. The two PGM models selected for evaluation were the: 1) Community Multi-Scale Air Quality (CMAQ) modeling system; and 2) Comprehensive Air Quality Model with Extensions (CAMx). Both CMAQ and CAMx have been run and evaluated as documented in ARMS Air Quality MPE report (AECOM and STI 2014). In brief, the CMAQ and CAMx models were configured for the ARMS Modeling Project following the methods and approach detailed in the Utah Air Resource Management Strategy Air Quality Modeling and Assessment Protocol (AECOM 2012). The air quality modeling domains are shown in **Figure 2-1**. Key model configuration options for CMAQ used for the ARMS Modeling Project are listed in **Table 2-5**.

The models' results were assessed relative to the monitored ambient air quality conditions in 2010. The model performance evaluation focused primarily on ozone and speciated $PM_{2.5}$, with analysis of other pollutants and AQRV included to provide a broader understanding of model performance. A detailed model inter-comparison between CAMx and CMAQ was performed using a variety of statistical and graphical analyses. These analyses were examined to understand how both models performed relative to USEPA performance benchmarks, and to each other.

For ozone, both models performed well on a domain-wide basis for all three modeling domains, with biases and errors well within USEPA recommended performance criteria for all months except December, when ozone monitoring data are limited. CMAQ biases were generally smaller in magnitude than in CAMx, except during the summer months in the 4-km domain. In the Uinta Basin, both models produced enhanced ozone concentrations during the observed winter ozone episodes. Although both models under-predicted peak daily ozone concentrations, CMAQ produced higher ozone concentrations and reproduced observed maximum concentrations better than CAMx when observed ozone concentrations were highest in the Uinta Basin.

For total $PM_{2.5}$, both models performed reasonably well on a domain-wide basis for all three modeling domains. For most months, biases and errors fell within USEPA recommended performance criteria. However, in the Uinta Basin, CMAQ produced significantly higher $PM_{2.5}$ concentrations and reproduced observed concentrations better than CAMx during the winter air quality episodes. For individual particulate species, model performance tendencies varied depending on domain, season, species, and monitoring network. For both models, performance metrics consistently fell within USEPA recommended performance criteria for sulfate (SO_4), nitrate (NO_3), and ammonium (NH_4), with CMAQ producing slightly smaller annual SO_4 biases than CAMx.

Table 2-5 CMAQ Model Configurations

Parameter	CMAQ	Details
Model Version	CMAQ (v.5.0)	
Horizontal Grid Mesh	36-, 12-, and 4-km (see **Figure 2-1**)	
Vertical Grid Mesh	36 layers (see **Table 2-3**)	Using WRF layers with no collapsing
Grid Interaction	One-way nesting	
Initial Conditions	15 days spin-up for the 36-km domain and 7 days of spin-up for the 12-km and 4-km nested domain	Separately run four quarters of 2010
Boundary Conditions	2010 Goddard Earth Observing System-Chemical (GEOS-Chem) data is used as boundary conditions for the 36-km domain and each domain is extracted as boundary conditions for the finer resolution domain	
Meteorological Processor	Meteorology-Chemistry Interface Processor (MCIP) (v.4.0)	For processing WRF meteorology
Emissions Processor	Sparse Matrix Operator Kernel Emissions (SMOKE) (v.3.0)	
Chemistry		
Gas Phase Chemistry	Carbon Bond V (CB05)-TU	CB05-TU is CB05 with updated toluene chemistry and can use the SMOKE output configured for CB05
Aerosol Chemistry	AERO5 and ISORROPIA2.1	
Cloud Chemistry	RADM-type aqueous chemistry	
Numerics		
Gas Phase Chemistry Solver	Euler Backward Iterative (EBI) solver on 36-km and 12-km domains; Rosenbrock solver on 4-km domain.	
Horizontal Advection	YAMO scheme	
Vertical Advection	VWRF scheme	
Diffusion		
Horizontal Diffusion	Multiscale	

Table 2-5 CMAQ Model Configurations

Parameter	CMAQ	Details
Vertical Diffusion	Asymmetric Convective Model Version 2 (ACM2)	K_z_min = 0.01 m^2/s
Deposition		
Dry Deposition	CCTM in-line	
Wet Deposition	CMAQ-specific	Rain, snow, graupel
Integration Time Step	Wind speed dependent	

Based on the detailed model inter-comparison performed between CMAQ and CAMx, CMAQ is the recommended modeling system for the ARMS Modeling Platform. This recommendation is driven primarily by the fact that:

1. CMAQ model was able to replicate wintertime ozone formation and timing in the Uinta Basin better than the CAMx model.
2. CMAQ provided slightly better performance for $PM_{2.5}$ in the Uinta Basin during wintertime,
3. CMAQ provided better performance domain-wide for ozone and wet deposition.

Once the preferred model, CMAQ was selected, the same model configurations and input data, including meteorological data, initial and boundary conditions, as base year modeling were used to perform all typical year and future year modeling scenarios.

2.5 Modeled Typical and Future Years Emissions Inventories

One of the objectives of the ARMS project is to assess the potential air quality and ARQV impacts associated with proposed oil and gas projects that would occur on BLM-administrated federal land. The ARMS Modeling Project requires a set of model-ready emissions inventories (EIs) for the assessment of potential impacts.

Emissions data were developed for NO_X, CO, SO_2, PM_{10}, $PM_{2.5}$, total VOC, and speciated VOCs. In order to create PGM-ready EIs, the SMOKE modeling system was used. **Table 2-6** summarizes the SMOKE system configuration for this study. The SMOKE model is configured to be compatible with the ARMS gridded meteorological data as well as the configuration of the ARMS PGM models (AECOM and Sonoma Technology Incorporated [STI] 2013, AECOM 2012).

A comprehensive emission inventory includes point sources, area sources, and on-road and non-road mobile sources, as well as fugitive dust, ammonia, biogenic, fire, and emissions outside the U.S., such as Mexico, Canada, and offshore sources. Given the predominance of oil and gas activities in the project area and surrounding region, special care was taken to develop a comprehensive oil and gas emissions inventory. All EIs were processed with the SMOKE modeling system for the series of 36-km, 12-km, and 4-km nested grids in a format compatible with the CMAQ model domains. To meet the study objectives, it was determined that five EIs would be developed. The development and purpose of the five EIs are summarized briefly below:

- Typical Year EI. A baseline year EI was developed for 2010, the same year for which meteorological data are available. The primary purpose of this EI is to provide a baseline EI suitable for future year comparisons.
- Future Year EI. The future year with the maximum emissions in the Uinta Basin was determined to be 2021. A comprehensive emissions inventory was developed for 2021.
- Three Mitigation Scenarios. Three mitigation scenarios were developed to target reductions in VOC emissions, NO_X emissions, and combined reductions.

The EIs are configured so that future emissions control measures or mitigation strategies can be applied to specific segments of oil and gas development and production. More detailed information about the development of the five EIs can be found in Utah State Office Emissions Inventory TSD (AECOM 2013). An overview of each modeled EI and total emissions are outlined in the following sections.

Table 2-6 Emissions Model Configuration for SMOKE

Emissions Component	Configuration	Details/Comments
Vertical Layer	17 layers for elevated point sources	Meteorological modeling has 36 layers, but emissions were not injected into layers above layer 17
On-Road mobile Sources	MOVES2010a	
Temporal Adjustments	USEPA surrogate data	Based on latest collected information and Continuous Emissions Monitoring System (CEMS)-based profiles
Chemical Speciation	2005 update of the Carbon Bond V (CB05)	VOC emissions will be speciated according to the lumped bond species used in CB05
Gridding	USEPA spatial surrogates	
Quality Assurance	Quality assurance tools in SMOKE	Additional quality assurance with AECOM's post-processing tools

2.5.1 Typical Year Emissions Inventory

A typical year emission inventory is developed by annualizing the base year 2010 emissions for source sectors that have temporal variability that is not reasonable to expect in future years. Annualizing the base year emission inventory provides a method to estimate the change in impacts between the base year and future years as a result of future year activities. This process removes any modeled high impacts that occur in the base year, but that cannot be anticipated to occur in the future year at the same time and place. For the typical year emission inventory, the following three source sectors were temporally normalized: EGU point sources, Uinta Basin oil and gas completion and drilling activities, and fire emissions within Utah State. **Table 2-7** shows the typical emissions for the 36-km, 12-km, and 4-km modeling domains.

Table 2-7 Typical Year Annual Emissions by Domain

Domain	NO_X (tpy)	TOG (tpy)	CO (tpy)	SO_2 (tpy)	NH_3 (tpy)	$PM_{2.5}$ (tpy)	PM_{10} (tpy)
36-km	21,943,914	92,609,133	100,756,009	14,598,580	5,644,629	4,587,625	10,945,611
12-km	1,852,874	6,291,702	5,254,554	616,383	500,376	202,563	589,159
4-km	295,426	1,997,610	1,022,883	55,234	196,792	40,630	74,955

As a comparison, **Figure 2-4** shows the spatial distribution of the annual total emissions in the 4-km domain for the Typical Year for NOx and VOC. Also shown in **Figure 2-4** are the spatial differences between the Base Year emissions and Typical Year.

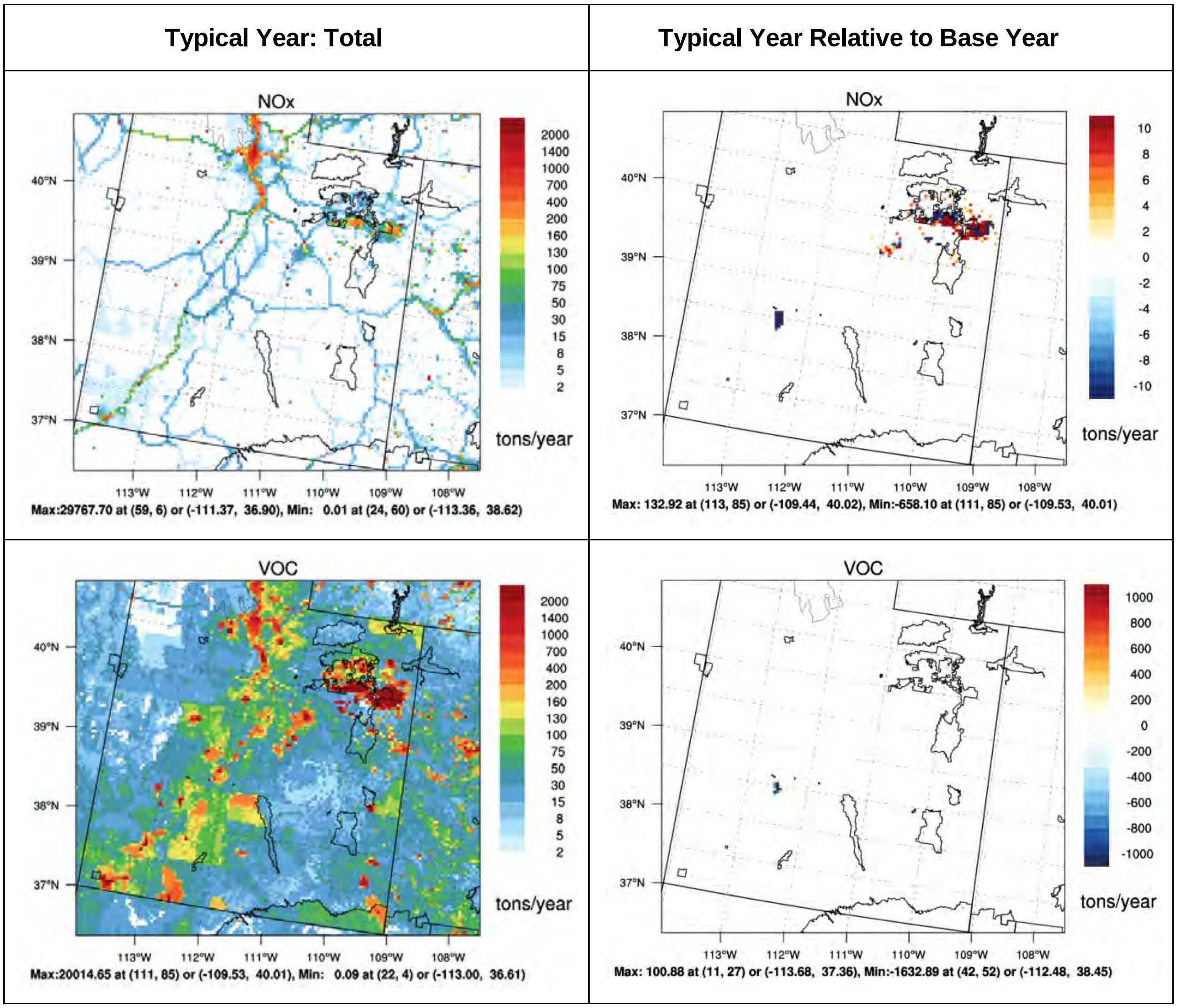


Figure 2-4 4-km Domain Spatial Distribution of Typical Year NOx and VOC Emissions

2.5.2 Future Year Emissions Inventory

As part of the study, an analysis the Uinta Basin oil and gas base year EI was projected into the future to determine the year with the maximum NO_X and maximum VOC emissions. The Uinta Basin oil and gas emissions inventory included portions of Uintah, Duchesne, Carbon, Emery, and Grand counties. Future year emissions were estimated by applying growth factors and applicable control requirements. The total NO_X and VOC emissions in the 5-counties in the Uinta Basin were evaluated for each year between the base year and 2021. The maximum NO_X and VOC emissions were projected to occur in 2021. All other emission sources necessary for a comprehensive PGM EI were obtained or developed and processed for the maximum year. Since the 2021 emissions are grown from 2010 emissions using the growth factors and "on the books" controls are applied, the emission scenario for the future base case is referred to as "OTB". **Table 2-8** shows the 2021 OTB emissions inventory by source sector in the 4-km model domain. The development of 2021 OTB EI is described in detail in Utah State Office Emissions Inventory TSD (AECOM 2013).

Table 2-8 Year 2021 OTB Emissions by Source Sector in the 4-km Model Domain

Source Sector	NO_X (tpy)	TOG (tpy)	CO (tpy)	SO_2 (tpy)	NH_3 (tpy)	$PM_{2.5}$ (tpy)	PM_{10} (tpy)
EGU Point	99,514	718	9,181	34,186	373	7,595	10,154
Non-EGU Point	27,772	16,751	60,624	7,682	448	4,690	9,810
Oil and Gas	35,257	800,376	87,081	339	0	2,347	2,367
Area	13,718	720,675	234,289	1,847	170,098	15,860	29,034
Non-Road	7,224	16,369	122,367	22	21	821	870
On-Road	24,626	14,100	238,333	243	783	718	773
Ammonia	0	0	0	0	23,543	0	0
Fire	1,406	4,295	24,100	196	486	2,514	2,984
Biogenic	5,248	465,492	69,557	0	0	0	0
Dust (fugitive and road)	0	0	0	0	0	7,633	19,022
Total	**215,436**	**2,038,758**	**855,995**	**44,526**	**195,751**	**42,722**	**75,560**

As a comparison, **Table 2-9** shows the annual total emissions differences between 2010 Typical Year and 2021 OTB case, and **Figure 2-5** shows the spatial distribution of the annual total emissions in the 4-km domain for 2021 OTB for NOx and VOC and the differences between the 2010 Typical Year.

Table 2-9 Annual Total Emissions in the 4-km Domain for the 2010 Typical Year and 2021 OTB

Scenario	NO_X (tpy)	TOG (tpy)	CO (tpy)	SO_2 (tpy)	NH_3 (tpy)	$PM_{2.5}$ (tpy)	PM_{10} (tpy)
2010 Typical Year	295,426	1,997,610	1,022,883	55,234	196,792	40,630	74,955
2021 OTB Controls	215,436	2,038,758	855,995	44,526	195,751	42,722	75,560
Difference (total mass)	-79,990	41,148	-166,888	-10,708	-1,041	2,092	605
Difference (percent)	-27.1%	2.1%	-16.3%	-19.4%	0.0%	5.1%	0.8%

2.5.3 Mitigation Emissions Inventories

Three mitigation scenarios are developed to target reductions in VOC emissions and NO_X emissions in the Uinta Basin in the future year:

- 2021 Scenario 1 (referred to as SCEN1) – NOx controls
- 2021 Scenario 2 (referred to as SCEN2) – VOC controls
- 2021 Scenario 3 (referred to as SCEN3) – Combined NOx and VOC controls

The three scenarios are based on BLM selection of applicable control technology and the measures are applied to the maximum future Uinta Basin EI (2021 OTB). The objective of developing the mitigation EIs is to provide information to evaluate and compare the effectiveness of proposed mitigation measures. The resulting Uinta Basin emissions inventories are shown in **Table 2-10** for the three mitigation scenarios relative to the on-the-books (OTB) controlled emissions included in the base case future year emissions inventory. The development of the three mitigation EIs is described in detail in Utah State BLM Emissions Inventory TSD (AECOM 2013).

Table 2-10 Uinta Basin Mitigation Scenario Emissions

Scenario	NO_X (tpy)	VOC (tpy)	CO (tpy)	SO_2 (tpy)	$PM_{2.5}$ (tpy)	PM_{10} (tpy)
2010 Base and Typical Year	16,529	109,705	48,875	32	601	601
OTB	26,167	138,775	80,060	63	1,998	1,998
SCEN1	20,527	138,343	80,060	63	1,768	1,768
SCEN2	26,777	120,096	89,083	78	2,461	2,461
SCEN3	19,701	119,664	60,218	56	703	703

As a comparison, **Table 2-11** shows summaries of the differences in NOx and VOC emissions between each mitigation scenario and 2021 OTB. **Figures 2-6** through **2-8** show the spatial distribution of the annual total emissions for NOx and VOC in the 4-km domain for each mitigation scenario, respectively. Each figure also shows the spatial differences between the mitigation scenario and the 2021 OTB for both the 4-km domain and Uinta Basin study area.

Table 2-11 Mitigation Scenarios NOx and VOC Emissions Compared to 2021 OTB Scenario

Emissions		OTB	Scenario 1	Scenario 2	Scenario 3
NO_X	Total (tpy)	26,167	20,527	26,777	19,701
	Difference Relative to OTB (total mass)	NA	-5,640	610	-6,466
	Difference Relative to OTB (percent)	NA	-21.60%	2.30%	-24.70%
VOC	Total (tpy)	138,775	138,343	120,096	119,664
	Difference Relative to OTB (total mass)	NA	-432	-18,679	-19,112
	Difference Relative to OTB (percent)	NA	-0.30%	-13.50%	-13.80%

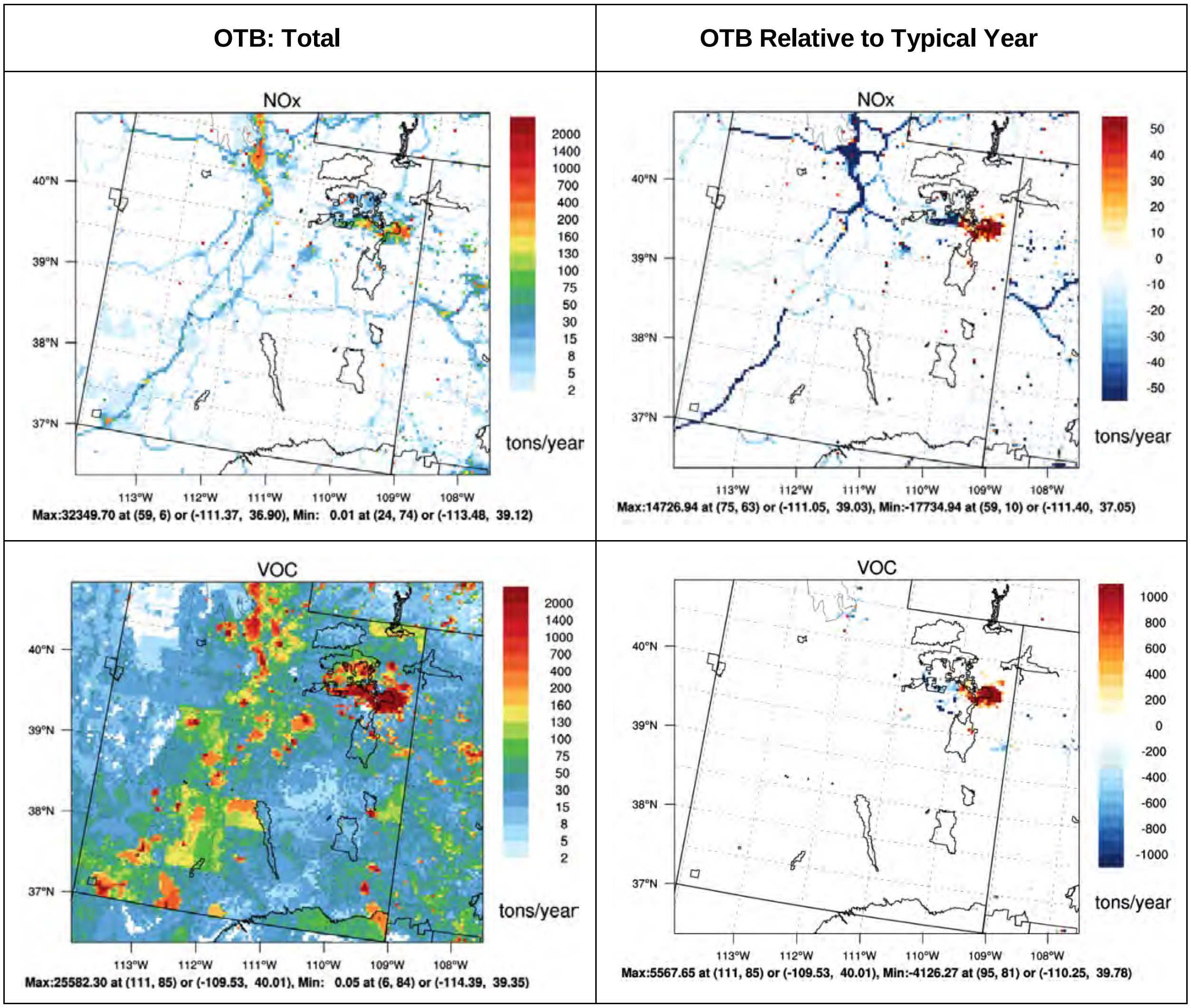


Figure 2-5 4-km Domain Spatial Distribution of On-the-Books Case NOx and VOC Emissions

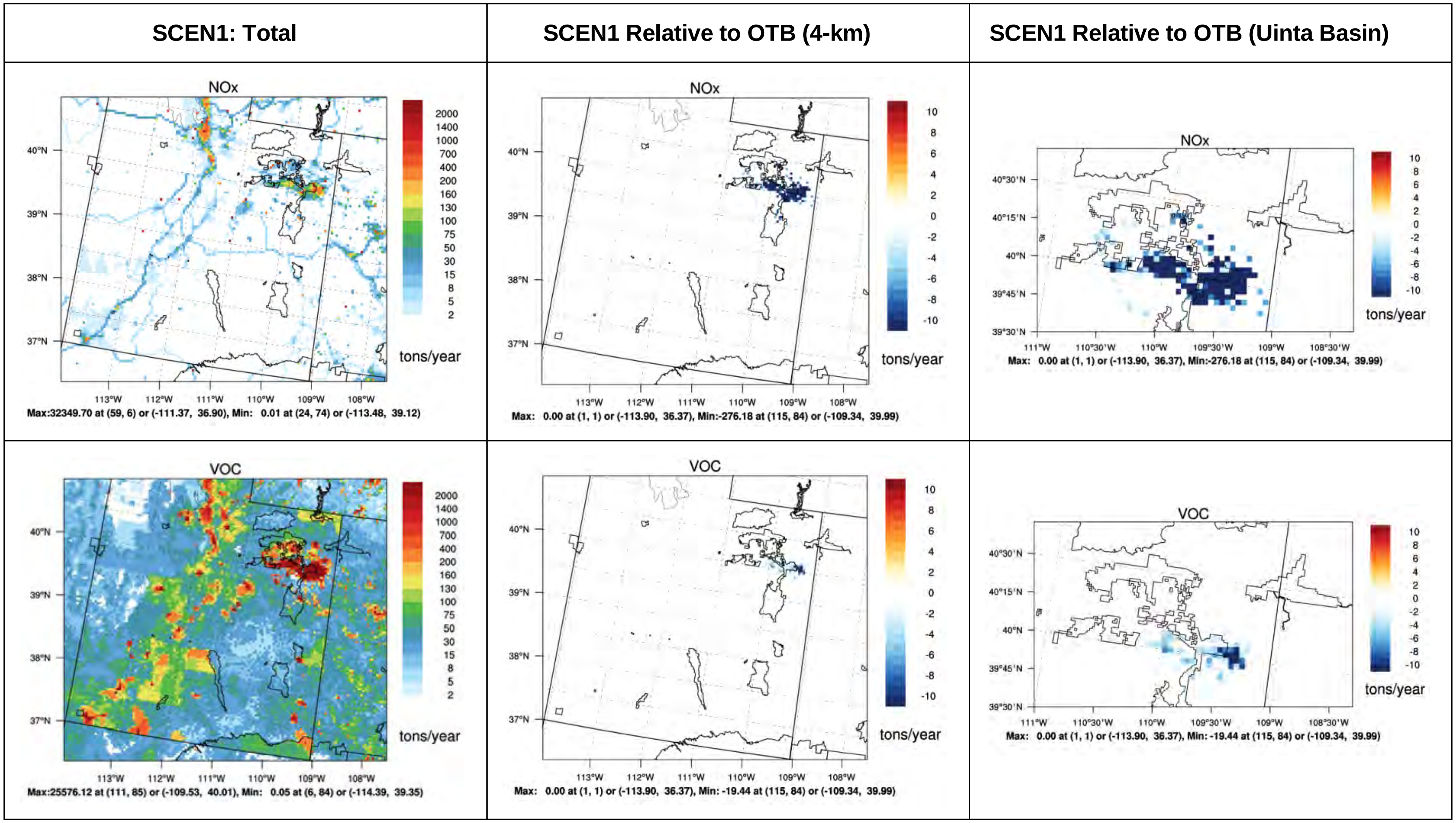


Figure 2-6 Spatial Distribution of Scenario 1 NOx and VOC Emissions

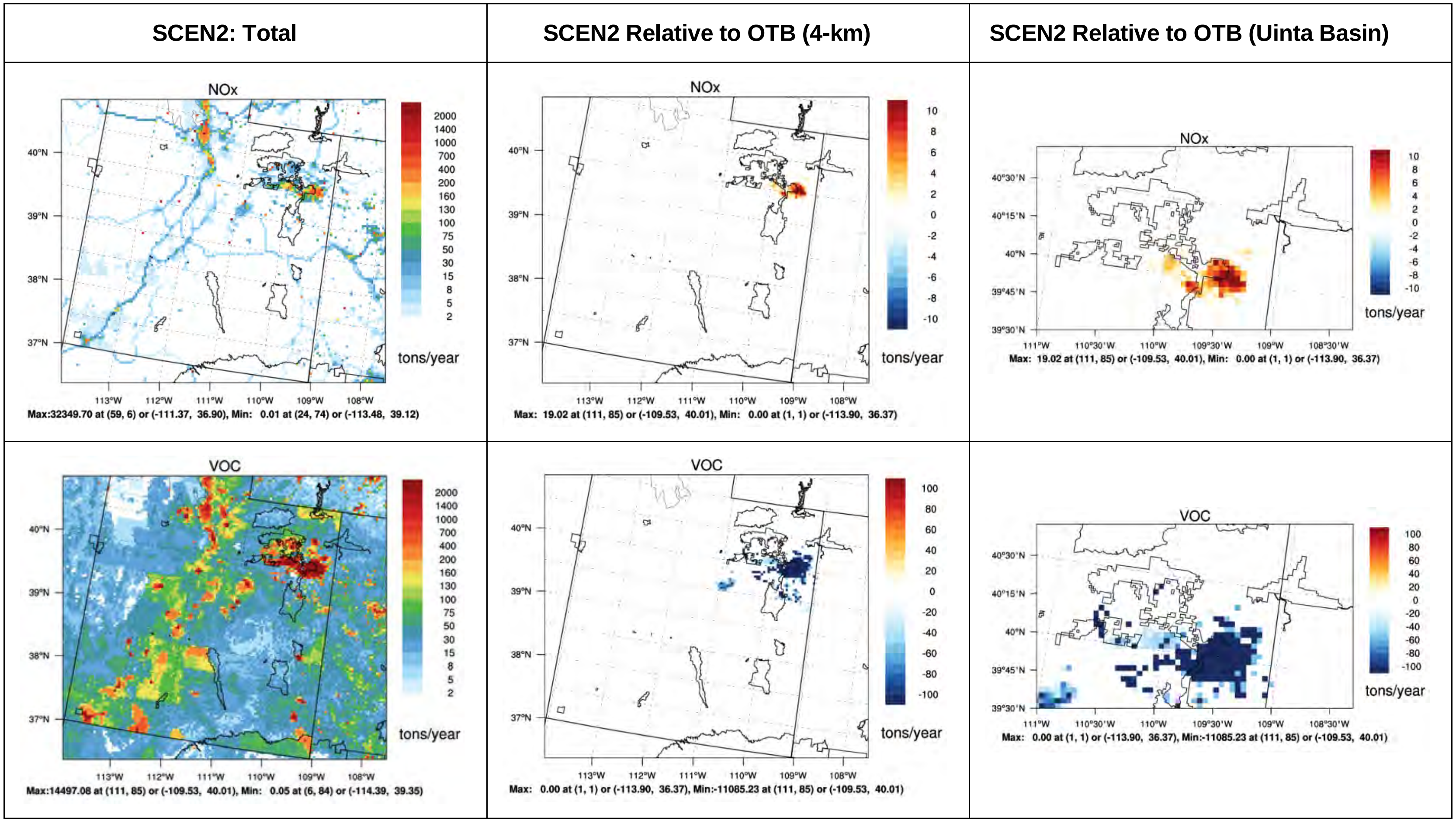


Figure 2-7 Spatial Distribution of Scenario 2 NOx and VOC Emissions

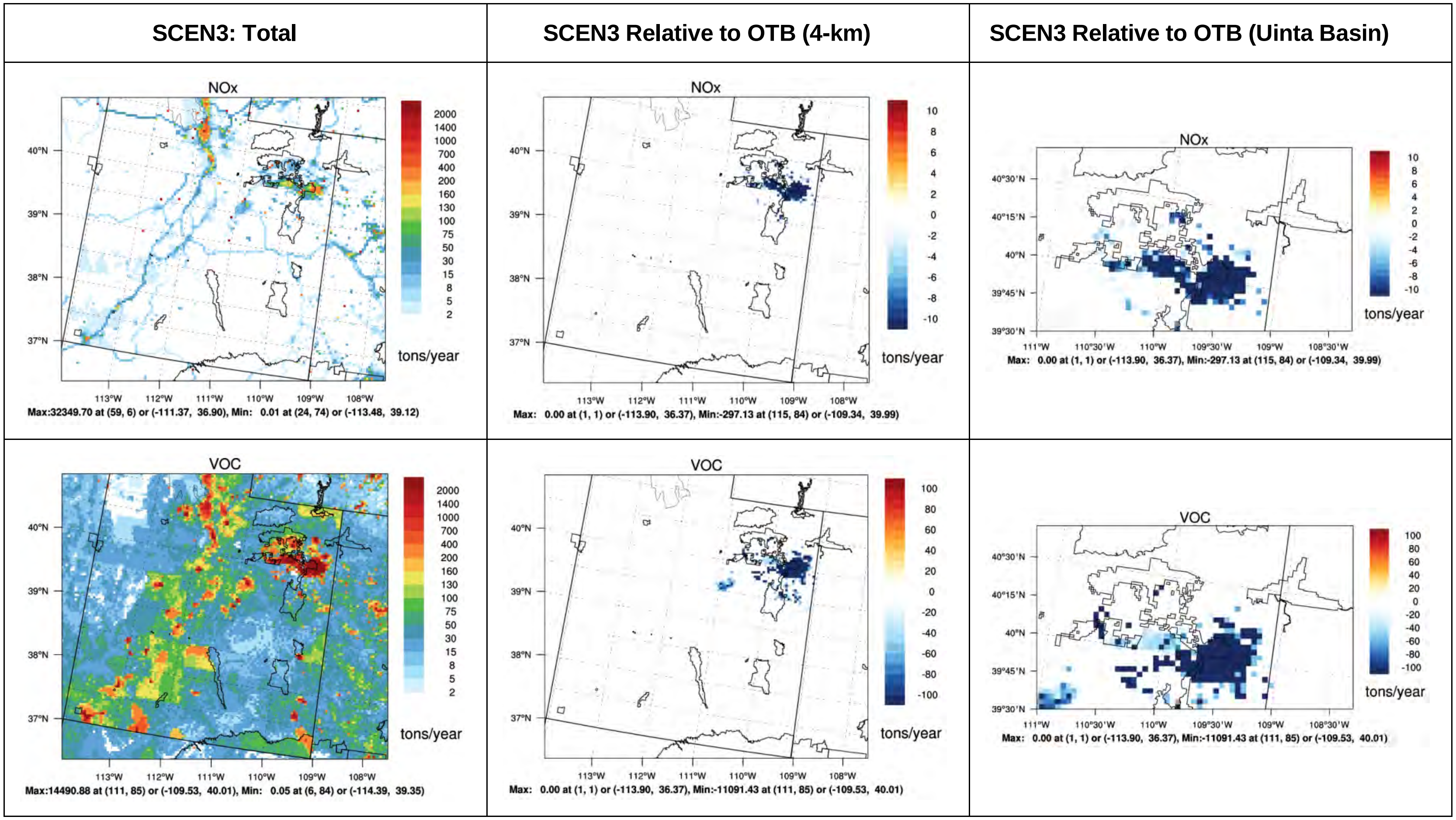


Figure 2-8 Spatial Distribution of Scenario 3 NOx and VOC Emissions

3.0 Ambient Air Quality Impacts

To evaluate the potential future cumulative air quality impacts, the air quality modeling results are compared with applicable standards and thresholds. Model-predicted concentrations of NO_2, CO, SO_2, ozone, $PM_{2.5}$, and PM_{10} are evaluated at selected assessment areas (described in Chapter 2). The air quality impacts are reported in the form of the appropriate standard or appropriate air quality metric for each assessment area. The following air quality assessments are conducted and reported in this chapter for each model scenario:

- Comparison of the modeled cumulative air quality impacts to the applicable state Ambient Air Quality Standards (AAQS) and NAAQS;
- Comparison of the model-adjusted ozone and $PM_{2.5}$ impacts to the applicable NAAQS and state AAQS;
- Comparison of modeled cumulative air quality impacts to the applicable Prevention of Significant Deterioration (PSD) increments (Class I or Sensitive Class II, depending on the designation of the assessment area). While the impacts are numerically compared to PSD increments, there is no formal assessment of increment-consuming sources; and
- Evaluation of the model-predicted change in air quality conditions relative to the different scenarios.

Three types of assessment areas are evaluated: the Uinta Basin study area, Class I, and sensitive Class II areas. Each of these areas has different applicable thresholds for evaluating air quality impacts which, in turn, require different air quality assessment methods. The locations of the assessment areas are shown in **Figure 2-2** relative to the model domains.

3.1 Assessment Methods and Thresholds

3.1.1 Ambient Air Quality

The modeled concentrations of criteria pollutants at selected assessment areas were compared with applicable health- and welfare-related NAAQS and state AAQS shown in **Table 3-1**. The NAAQS and state AAQS for Utah and Colorado are established for NO_2, CO, SO_2, ozone, $PM_{2.5}$, and PM_{10}. Model-predicted concentrations for all criteria pollutants (except lead) are reported for the 2010 base year, typical year, and future year (2021) scenarios. All model results are presented in tabular format for each assessment area. For ozone, graphical plots of model results are presented for the 12-km and 4-km domains and the Uinta Basin study area. The plots depict both the location of maximum impact and the spatial extent of the elevated ozone concentrations.

Table 3-1 Applicable Ambient Air Quality Standards

Pollutant (units)	Averaging Period	AAQS[1]			PSD Increments[17]	
		National[2]	Utah[3]	Colorado[4]	Class I	Class II
NO_2 (parts per billion [ppb])	1-hour	100[12]	100[12]	100[12]	--	--
	Annual[5]	53	53	53	1.3	13.3
CO (parts per million [ppm])	1-hour[6]	35	35	35	--	--
	8-hour[6]	9	9	9	--	--

Table 3-1 Applicable Ambient Air Quality Standards

Pollutant (units)	Averaging Period	AAQS[1]			PSD Increments[17]	
		National[2]	Utah[3]	Colorado[4]	Class I	Class II
SO_2 (ppb)	1-hour	75[13]	75[13]	75[13]	--	--
	3-hour[6]	500	500	500	9.5	195.5
	24-hour[7]	--	--	--	1.9[6]	34.8[6]
	Annual[7]	--	--	--	0.76[5]	7.6[5]
Ozone (ppm)	1-hour[8]	--	--	--	--	--
	8-hour[9]	0.075	0.075	0.075	--	--
$PM_{2.5}$ (micrograms per cubic meter [µg/m^3])	24-hour[10]	35	35	35	2[6]	9[6]
	Annual[5]	12[14]	12[14]	12[14]	1	4
	Annual[5]	15[15]	15[15]	15[15]	1	4
PM_{10} (µg/m^3)	24-hour[11]	150	150	150	8[6]	30[6]
	Annual[5]	--[16]	--[16]	--[16]	4	17

1 Due to the lack of an identified regional issue for lead, it was not analyzed as part of this study.

2 Source: http://www.epa.gov/air/criteria.html#3.

3 Source: http://www.deq.utah.gov/locations/uintahbasin/docs/2013/09Sep/NatAmbAirQualStand.pdf.

4 Source: http://www.colorado.gov/airquality/permits/guide.pdf.

5 Not to be exceeded.

6 Not to be exceeded more than once per year.

7 Final rule signed June 2, 2010. The 24-hour and annual SO_2 standards from 1971 were revoked in that same rulemaking. However, these standards remain in effect until 1 year after an area is designated for the 2010 standard, except in areas designated nonattainment for the 1971 standards, where the 1971 standards remain in effect until implementation plans to attain or maintain the 2010 standard are approved.

8 The USEPA revoked the 1-hour ozone standard in all areas, although some areas have continuing obligations under that standard. The standard is attained when the expected number of days per calendar year with maximum hourly average concentrations above 0.12 ppm is less than or equal to 1.

9 To attain this standard, 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 must not exceed 0.075 ppm. A new 8-hour ozone standard is anticipated to be finalized by the USEPA in 2013.

10 24-hour average of the 98th percentile concentrations (effective December 17, 2006).

11 Not to be exceeded more than once per year on average over 3 years.

12 The 3-year average of the 98th percentile of the daily maximum 1-hour average is not to exceed this standard.

13 The 3-year average of the 99th percentile of the daily maximum 1-hour average is not to exceed this standard.

14 Primary standard, annual mean, averaged over 3 years.

15 Secondary standard, annual mean, averaged over 3 years.

16 The annual PM_{10} NAAQS of 50 µg/m^3 was revoked by the USEPA on September 21, 2006; see Federal Register, volume 71, number 200, 10/17/06.

17 Source: 40 Code of Federal Regulations Part 52, Section 21, as amended by the Final Rule in Federal Register, volume 70, number 59582, 10/12/05 and Federal Register, volume 75, number 64863, 10/20/10.

3.1.2 Model Adjusted Ozone and $PM_{2.5}$ Impact Assessment at Monitor Locations and Locations Removed from Monitors

The USEPA guidance for projecting future ozone and $PM_{2.5}$ concentrations recommends using the PGM in a relative sense to adjust measured design values (USEPA 2007). For ozone, a design value is defined as a 5-year average of the fourth-highest daily maximum 8-hour ozone concentration at a monitor. The locations of all monitors used for calculating model-adjusted impacts are shown in

Figure 3-1. It is important to note that there is insufficient data collected at regulatory monitors in the Uinta Basin study area to calculate a true ozone design value. All ozone values reported for the Uinta Basin do not represent actual design values and are for informational purposes only. The MATS ozone design values were calculated in accordance with 40 CFR Part 50.10, and Appendix I to Part 50.

To perform the ozone and $PM_{2.5}$ projections at monitored locations, the USEPA has developed the Model Attainment Test Software (MATS) tool (Abt Associates Inc. 2009). MATS tool incorporates modeling results, ozone and $PM_{2.5}$ design values, and USEPA guidance (USEPA 2007) to project potential future concentrations for attainment purposes.

The USEPA's guidance on modeled attainment demonstration (USEPA 2007) suggests a supplemental assessment of the impacts in areas removed from monitor locations. This is referred to as the Unmonitored Area Analysis (UAA), and information from this type of test can help to determine if further action is required despite passing the modeled attainment test at all monitoring sites. Additionally, it also helps to determine if any assessment areas could have potential future AAQS exceedences. It is important, however, to emphasize that the UAA is subject to larger uncertainty than the analysis of monitored areas due to the need to spatial interpolate monitoring data to areas without monitors.

More information on the process and settings used to run MATS is found in **Appendix A**. In the following sections, MATS analyses are presented for monitored and unmonitored locations within the 4-km domain for the future year simulations only. MATS-predicted future year design values for ozone, annual $PM_{2.5}$, and daily $PM_{2.5}$ are shown in tabular form for monitor locations. For unmonitored locations, the UAA addresses ozone and annual $PM_{2.5}$ future year design values using spatial plots and tables with the maximum values for each assessment area.

3.1.3 PSD Increments

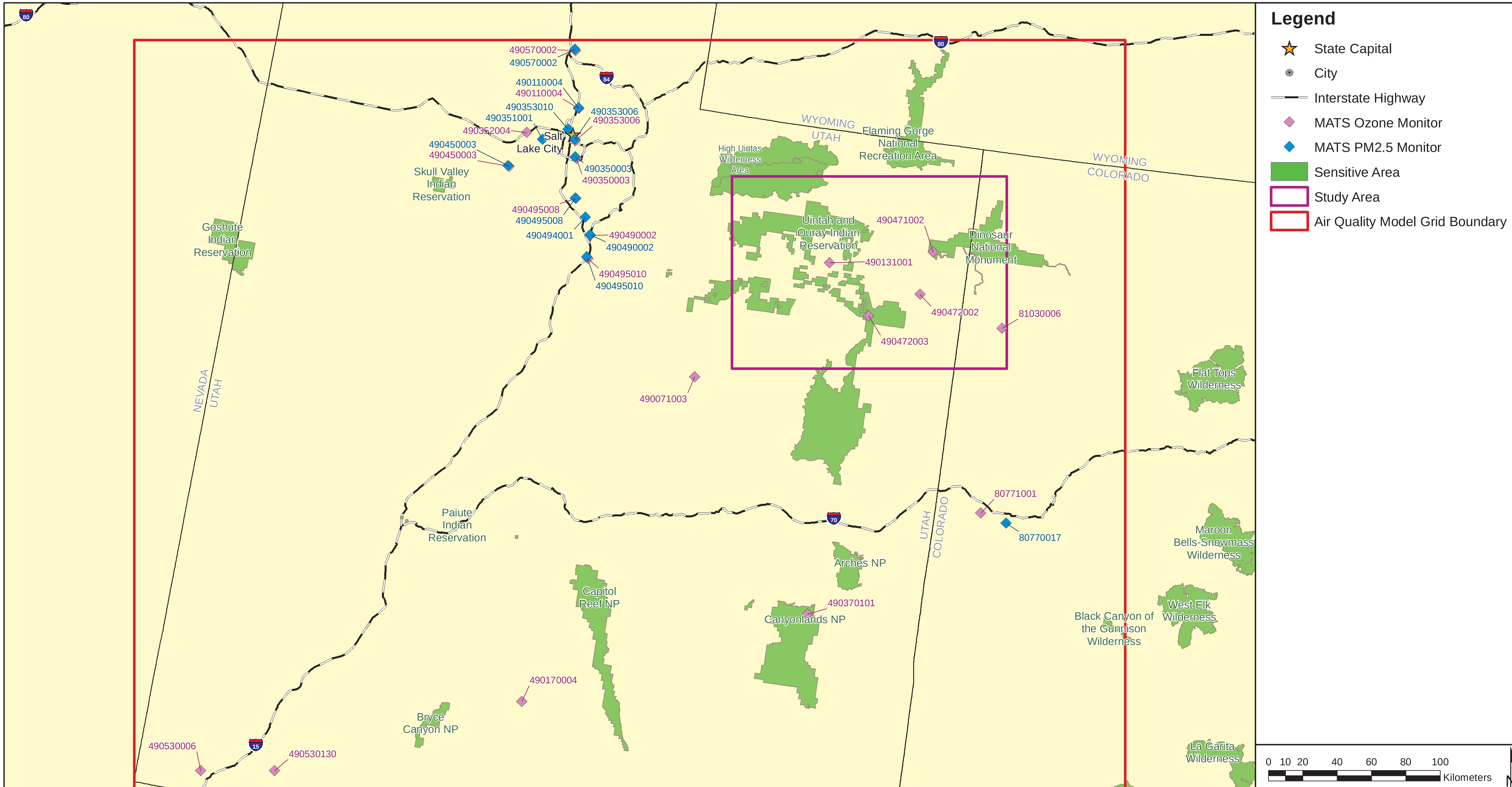
The PSD increments are shown in **Table 3-1**. The comparison of model concentrations to the PSD Class I or Class II increments does not represent a formal, regulatory PSD increment consumption analysis since the modeling effort does not separate emissions sources into PSD increment-consuming and non-PSD increment-consuming sources. Rather, the modeled levels are compared to the established PSD increments for informational purposes only. Therefore, the results cannot be used to determine increment consumption for a particular site.

The model results are present in tabular form for each assessment area for all pollutants and averaging periods with a PSD threshold. The Uinta Basin study area and monitoring stations are classified as a Class II area and are compared with Class II PSD increments. The Class I and sensitive Class II areas are comparable to the Class I and Class II PSD increment thresholds, respectively.

Note that for the same pollutant and averaging period, the A and PSD increments often have different forms. For example, the $PM_{2.5}$ 24-hour average A is exceeded when the 24-hour average of the 98th percentile concentrations is above the value in **Table 3-1**, while the PSD increment is exceeded the second time in a year that the 24-hour average concentration is above the value in **Table 3-1**. As a result of the different forms, the model results are processed differently for A versus PSD increments and reported results may be different for the same pollutant and averaging times.

3.2 Summary of Air Quality Impacts

The 2010 Base Year and Typical Year modeling scenarios were assessed and modeled cumulative air quality impacts are compared to each other. The modeled future years (OTB controls, Scenario 1, Scenario 2, and Scenario 3) were evaluated and modeled cumulative air quality impacts are compared to the air quality conditions for 2010 Typical Year. The modeled results from the 2021 Scenario 1, 2, and 3 are also compared to the 2021 OTB Controls modeling results.



ARMS Modeling Project

Figure 3-1

Ozone and Annual PM2.5 MATS Monitors

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4/29/2014

A summary of modeled impacts for the key components of the air quality analysis for all modeling scenarios (2010 Base Year, 2010 Typical Year, 2021 OTB Controls, 2021 Scenario 1, 2021 Scenario 2, and 2021 Scenario 3) are presented in **Table 3-2**.

3.3 2010 Base Year Scenario

3.3.1 Model-Predicted Cumulative Criteria Pollutant Impacts

Table 3-3 presents the 2010 Base Year modeled cumulative air quality impacts for all assessment areas. In addition, the winter and non-winter model-predicted ozone concentrations are shown in **Table 3-3**. For this study winter is defined as December, January, February, and March and non-winter is defined as April through November. Based on the modeling results, all NO_2, CO, SO_2, $PM_{2.5}$, and PM_{10} values are well below the NAAQS and state AAQS. Model-predicted ozone concentrations exceed the ambient standards in the Uinta Basin study area, two Uinta Basin monitoring sites, nine Class I areas, and nine sensitive Class II areas. The highest modeled ozone concentration occurs in the Uinta Basin study area during winter.

The modeled 2010 Base Year spatial plots of the 4^{th} highest daily maximum 8-hour average ozone concentrations are shown in **Figure 3-2**. The figures show the 12-km domain, 4-km domain and the Uinta Basin study area, from left to right, top to bottom. For reference, the outline of all assessment areas also is included. Note that due to the method of determining the 4^{th} highest daily maximum 8-hour ozone concentration, the values shown in these plots do not necessarily occur during the same time in the model simulation. The 12-km domain spatial plot shows that ozone levels at or above 0.075 ppm are modeled in: southern California, Nevada, Salt Lake City area, Denver metropolitan area, and the Uinta Basin study area. Areas in the far northwestern portion of the 12-domain have the lowest values. Within the 4-km domain, the highest ozone values at or above 0.075 ppm are in the Uinta Basin, Salt Lake City area, Wasatch Mountain Range. In addition, the southwest and southeast corners of the domain have modeled ozone values that exceed the NAAQS.

As shown in **Table 3-3**, the highest modeled ozone occurs in the Uinta Basin study area. This result also is shown in the spatial plots. The spatial plot of Uinta Basin study area shows the largest modeled ozone occurs near the Ouray monitor with values exceeding 0.100 ppm spreading southeast from the monitor. The spatial extent of the elevated ozone concentrations includes a majority of the Uintah and Ouray IR, while Dinosaur and Redwash monitors are near the edge of the modeled elevated ozone.[1]

Note that only the ozone spatial plots are provided since all other modeled criteria pollutants are well below the NAAQS and state AAQS for the 2010 Base Year model scenario.

3.3.2 PSD Increment Assessment

For informational purposes, the model-predicted impacts are compared to the PSD increments in **Table 3-4**. If all modeled emissions sources were increment consuming, model-predicted impacts exceed allowable increments for all assessment areas for annual SO_2 and PM_{10} values. Areas within the Uinta Basin study area surpass the PSD increment for 24-hour $PM_{2.5}$, annual $PM_{2.5}$, and 24-hour PM_{10}. For the Uinta Basin study area, 1-hour and 3-hour SO_2 are below the PSD increments and annual $PM_{2.5}$ values, with the exception of the Ouray Site. For Class I areas, all areas exceed the 24-hour and annual $PM_{2.5}$ allowable PSD increment and all but one area, La Garita WA, exceeds the 24-hour PM_{10} PSD increment threshold. In addition, a few Class I areas are above the 3-hour and 24-hour SO_2 PSD increment. Some sensitive Class II areas exceed the PSD increment for 24-hour $PM_{2.5}$ and PM_{10}, while none of the sensitive Class II areas are above the PSD increment for 1-hour and 3-hour SO_2, and annual $PM_{2.5}$.

[1] Note that the modeled spatial extent of elevated ozone is not completely consistent with monitoring studies. Monitoring studies indicate that actual concentrations are higher in the northern area of the basin than predicted by the model (AECOM and STI 2014).

Table 3-2 Summary of Modeled Air Quality Impacts

Model Scenario	Area	NAAQS		PSD Increments	MATS	
		Ozone	Other Standards		Ozone Design Values	$PM_{2.5}$ Design Values
2010 Base Year	Uinta Basin study area	Uinta Basin study area, Ouray, and Dinosaur exceed the NAAQS	All areas below the NAAQS	All areas are within PSD increment for annual NO_2, annual SO_2, 3-hour SO_2, 24-hour SO_2, and annual PM_{10}. All areas exceed PSD increment for 24-hour $PM_{2.5}$.	NA	NA
	Class I	Nine Class I areas exceed the NAAQS	All areas below the NAAQS	All areas are within PSD increment for annual PM_{10} and annual SO_2. All or most areas exceed PSD increment for 24-hour $PM_{2.5}$, annual $PM_{2.5}$, and 24-hour PM_{10}.		
	Sensitive Class II	Nine Sensitive Class II areas exceed the NAAQS	All areas below the NAAQS	All areas are within PSD increment for annual NO_2, annual PM_{10}, annual $PM_{2.5}$, 3-hour SO_2, 24-hour SO_2, and annual SO_2. Most areas exceed PSD increment for 24-hour $PM_{2.5}$.		
2010 Typical Year	Uinta Basin study area	Uinta Basin study area, Ouray, and Dinosaur Station exceed the NAAQS	All areas below the NAAQS	All areas are within PSD increment for annual NO_2, annual SO_2, 3-hour SO_2, 24-hour SO_2, and annual PM_{10}. All areas exceed PSD increment for 24-hour $PM_{2.5}$.	NA	NA

Table 3-2 Summary of Modeled Air Quality Impacts

		NAAQS			MATS	
Model Scenario	**Area**	**Ozone**	**Other Standards**	**PSD Increments**	**Ozone Design Values**	**$PM_{2.5}$ Design Values**
	Class I	Nine Class I areas exceed the NAAQS	All areas below the NAAQS	All areas are within PSD increment for annual PM_{10} and annual SO_2. All or most areas exceed PSD increment for 24-hour $PM_{2.5}$, annual $PM_{2.5}$, and 24-hour PM_{10}.		
	Sensitive Class II	Nine Sensitive Class II areas exceed the NAAQS	All areas below the NAAQS	All areas are within PSD increment for annual NO_2, annual PM_{10}, annual $PM_{2.5}$, 3-hour SO_2, 24-hour SO_2, and annual SO_2. Most areas exceed PSD increment for 24-hour $PM_{2.5}$.		
2021 OTB Controls	Uinta Basin study area	Uinta Basin study area, Ouray, and Dinosaur Station exceed the NAAQS	All areas below the NAAQS	All areas are within PSD increment for annual NO_2, 3-hour SO_2, 24-hour SO_2, annual SO_2, and annual PM_{10}. All areas exceed PSD increment for 24-hour $PM_{2.5}$.	Four monitors have design values over the NAAQS versus two monitors with design values over the NAAQS during the baseline. Design values for most monitors are lower in 2021 than during the baseline.	All monitors have annual $PM_{2.5}$ design values below the NAAQS. One monitor has daily $PM_{2.5}$ design values above the NAAQS. Annual $PM_{2.5}$ design values for all monitors are lower in 2021 than during the baseline; however, the design value is predicted to exceed the NAAQS in some areas without monitors, including the Uinta Basin study area.
	Class I	Three Class I areas exceed the NAAQS	All areas below the NAAQS	All areas are within PSD increment for annual NO_2, 3-hour SO_2, annual SO_2, and annual PM_{10}. All or most areas exceed PSD increment for 24-hour $PM_{2.5}$, annual $PM_{2.5}$, and 24-hour PM_{10}.		

Table 3-2 Summary of Modeled Air Quality Impacts

Model Scenario	Area	NAAQS		PSD Increments	MATS	
		Ozone	Other Standards		Ozone Design Values	$PM_{2.5}$ Design Values
	Sensitive Class II	Two Sensitive Class II areas exceed the NAAQS	All areas below the NAAQS	All areas are within PSD increment for annual NO_2, annual PM_{10}, annual $PM_{2.5}$, 3-hour SO_2, 24-hour SO_2, and annual SO_2. Most areas exceed PSD increment for 24-hour $PM_{2.5}$.		
2021 Scenario 1	Uinta Basin study area	Uinta Basin study area and Ouray Station exceed the NAAQS	All areas below the NAAQS	All areas are within PSD increment for annual NO_2, 3-hour SO_2, 24-hour SO_2, annual SO_2, and annual PM_{10}. All areas exceed PSD increment for 24-hour $PM_{2.5}$.	Four monitors have design values that exceed the NAAQS versus two monitors with design values exceeding the NAAQS during the baseline. Design values for most monitors are lower in 2021 than during the baseline. Ozone design values in Uinta Basin increase relative to the 2021 On-the-Books case.	All monitors have annual $PM_{2.5}$ design values below the NAAQS. One monitor has daily $PM_{2.5}$ design values above the NAAQS. Annual $PM_{2.5}$ design values for all monitors are lower in 2021 than during the baseline; however, the design value is predicted to exceed the NAAQS in some areas without monitors, including the Uinta Basin study area. Annual $PM_{2.5}$ design values in Uinta Basin decrease relative to the 2021 On-the-Books case.
	Class I	Three Class I areas exceed the NAAQS	All areas below the NAAQS	All areas are within PSD increment for annual NO_2, 3-hour SO_2, annual SO_2, and annual PM_{10}. All or most areas exceed PSD increment for 24-hour $PM_{2.5}$, annual $PM_{2.5}$, and 24-hour PM_{10}.		
	Sensitive Class II	Two Sensitive Class II areas exceed the NAAQS	All areas below the NAAQS	All areas are within PSD increment for annual NO_2, annual PM_{10}, annual $PM_{2.5}$, 3-hour SO_2, 24-hour SO_2, and annual SO_2. Most areas exceed PSD increment for 24-hour $PM_{2.5}$.		

Table 3-2 Summary of Modeled Air Quality Impacts

		NAAQS			MATS	
Model Scenario	**Area**	**Ozone**	**Other Standards**	**PSD Increments**	**Ozone Design Values**	**$PM_{2.5}$ Design Values**
2021 Scenario 2	Uinta Basin study area	Uinta Basin study area, Ouray, and Dinosaur Stations exceed the NAAQS	All areas below the NAAQS	All areas are within PSD increment for annual NO_2, 3-hour SO_2, 24-hour SO_2, annual SO_2, and annual PM_{10}. All areas exceed PSD increment for 24-hour $PM_{2.5}$.	Three monitors have design values that exceed the NAAQS versus two monitors with design values exceeding the NAAQS during the baseline. Design values for most monitors are lower in 2021 than during the baseline. Ozone design values in Uinta Basin decrease relative to the 2021 On-the-Books case.	All monitors have annual $PM_{2.5}$ design values below the NAAQS. One monitor has daily $PM_{2.5}$ design values above the NAAQS. Annual $PM_{2.5}$ design values for all monitors are lower in 2021 than during the baseline; however, the design value is predicted to exceed the NAAQS in some areas without monitors, including the Uinta Basin study area. Annual $PM_{2.5}$ design values in Uinta Basin decrease relative to the 2021 On-the-Books case.
	Class I	Three Class I areas exceed the NAAQS	All areas below the NAAQS	All areas are within PSD increment for annual NO_2, 3-hour SO_2, annual SO_2, and annual PM_{10}. All or most areas exceed PSD increment for 24-hour $PM_{2.5}$, annual $PM_{2.5}$, and 24-hour PM_{10}.		
	Sensitive Class II	Two Sensitive Class II areas exceed the NAAQS	All areas below the NAAQS	All areas are within PSD increment for annual NO_2, annual PM_{10}, annual $PM_{2.5}$, 3-hour SO_2, 24-hour SO_2, and annual SO_2. Most areas exceed PSD increment for 24-hour $PM_{2.5}$.		
2021 Scenario 3	Uinta Basin study area	Uinta Basin study area, Ouray Stations exceed the NAAQS	All areas below the NAAQS	All areas are within PSD increment for annual NO_2, 3-hour SO_2, 24-hour SO_2, annual SO_2, and annual PM_{10}. All areas exceed PSD increment for 24-hour $PM_{2.5}$.	Four monitors have design values that exceed the NAAQS versus two monitors with design values exceeding the NAAQS during the baseline. Design values for most	All monitors have annual $PM_{2.5}$ design values below the NAAQS. One monitor has daily $PM_{2.5}$ design values above the NAAQS. Annual $PM_{2.5}$ design values for all

Table 3-2 Summary of Modeled Air Quality Impacts

		NAAQS			MATS	
Model Scenario	Area	Ozone	Other Standards	PSD Increments	Ozone Design Values	$PM_{2.5}$ Design Values
	Class I	Three Class I areas exceed the NAAQS	All areas below the NAAQS	All areas are within PSD increment for annual NO_2, 3-hour SO_2, annual SO_2, and annual PM_{10}. All or most areas exceed PSD increment for 24-hour $PM_{2.5}$, annual $PM_{2.5}$, and 24-hour PM_{10}.	monitors are lower in 2021 than during the baseline. Ozone design values in Uinta Basin increase relative to the 2021 On-the-Books case.	monitors and most unmonitored areas are lower in 2021 than during the baseline. Annual $PM_{2.5}$ design values in Uinta Basin decrease relative to the 2021 On-the-Books case.
	Sensitive Class II	Two Sensitive Class II areas exceed the NAAQS	All areas below the NAAQS	All areas are within PSD increment for annual NO_2, annual PM_{10}, annual $PM_{2.5}$, 3-hour SO_2, 24-hour SO_2, and annual SO_2. Most areas exceed PSD increment for 24-hour $PM_{2.5}$.		

Table 3-3 Model-Predicted Ambient Air Quality Impacts Compared to NAAQS – 2010 Base Year

Receptor Site	NO_2 (ppb)		CO (ppm)		SO_2 (ppb)		O_3 (ppm) 8-hour			$PM_{2.5}$ (μg/m^3)		PM_{10} (μg/m^3)
	1-hour	Annual	1-hour	8-hour	1-hour	3-hour	Annual	Winter	Non-Winter	24-hour	Annual	24-hour
Uinta Basin Study Area												
Uinta Basin Study Area	18	2	3	3	2	0	**0.129**	**0.129**	**0.081**	14	3.4	40
Dinosaur AQS Station	3	1	0	0	1	0	**0.077**	**0.077**	0.073	14	3.7	20
Ouray AQS Station	29	6	1	0	1	0	**0.101**	**0.101**	0.075	24	6.8	30
Rangely AQS Station	15	4	0	0	1	0	0.072	0.064	0.072	7	2.6	10
Redwash AQS Station	13	3	0	0	2	0	0.074	0.074	0.072	13	3.8	20
Class I Areas												
Arches NP	2	1	0	0	2	0	**0.081**	0.067	**0.081**	8	2.7	20
Black Canyon of the Gunnison WA	2	0	0	0	1	0	0.071	0.067	0.071	4	1.7	10
Bridger WA	1	0	0	0	2	0	0.073	0.068	0.073	4	1.5	10
Bryce Canyon NP	1	0	0	0	1	0	**0.080**	0.064	**0.080**	6	2.3	20
Canyonlands NP	2	0	0	0	2	0	**0.080**	0.071	**0.080**	8	2.4	20
Capitol Reef NP	2	0	0	0	2	0	**0.080**	0.071	**0.080**	7	2.3	20
Eagles Nest WA	6	1	0	0	2	0	0.074	0.067	0.074	4	1.8	10
Fitzpatrick WA	1	0	0	0	1	0	0.071	0.066	0.071	4	1.5	10
Flat Tops WA	3	0	0	0	2	0	0.074	0.069	0.074	4	1.6	10
La Garita WA	1	0	0	0	2	0	0.073	0.072	0.072	3	1.3	10
Maroon Bells-Snowmass WA	2	0	0	0	1	0	0.072	0.070	0.072	3	1.4	10
Mesa Verde NP	9	1	0	0	10	0	**0.079**	0.070	**0.079**	5	2.0	10
Mount Zirkel WA	4	1	0	0	3	0	**0.077**	0.071	**0.077**	4	1.8	10
Rawah WA	3	1	0	0	2	0	**0.076**	0.070	**0.076**	4	1.7	10
Rocky Mountain NP	4	1	1	0	4	0	**0.087**	0.070	**0.087**	4	1.7	30
Weminuche WA	3	0	0	0	2	0	**0.076**	**0.076**	0.074	3	1.3	10
West Elk WA	1	0	0	0	1	0	0.073	0.069	0.073	3	1.5	10

Table 3-3 Model-Predicted Ambient Air Quality Impacts Compared to NAAQS – 2010 Base Year

Receptor Site	NO_2 (ppb)		CO (ppm)		SO_2 (ppb)		O_3 (ppm) 8-hour			$PM_{2.5}$ (µg/m³)		PM_{10} (µg/m³)
	1-hour	Annual	1-hour	8-hour	1-hour	3-hour	Annual	Winter	Non-Winter	24-hour	Annual	24-hour
Class II Areas												
Dinosaur National Monument	3	1	1	0	1	0	**0.089**	**0.089**	0.075	9	2.7	20
Flaming Gorge National Recreation Area	5	1	0	0	7	0	**0.080**	**0.080**	**0.077**	9	2.5	20
Fort Hall IR	10	2	1	0	4	0	0.072	0.071	0.072	10	3.1	30
Goshute IR	0	0	0	0	1	0	**0.076**	0.060	**0.076**	3	1.3	10
High Uintas WA	1	0	0	0	1	0	**0.080**	**0.080**	**0.076**	5	2.0	10
Navajo IR	11	1	0	0	12	100	**0.082**	0.072	**0.082**	7	2.2	40
Paitute IR	5	1	1	1	2	0	**0.089**	**0.089**	**0.078**	7	2.5	40
Skull Valley IR	3	0	0	0	1	0	0.073	0.071	0.073	7	2.1	10
Southern Ute IR	27	4	1	0	6	0	**0.078**	0.074	**0.078**	5	1.9	40
Uintah and Ouray IR	21	2	3	1	4	0	**0.127**	**0.127**	**0.081**	15	3.4	60
Ute Mountain IR	16	3	1	0	16	0	**0.078**	0.073	**0.078**	7	2.4	20
Wind River IR	4	1	0	0	13	0	0.075	0.067	0.075	5	1.7	10

Note: Model-predicted concentrations that exceed the NAAQS are shown in **red bold** text.

Table 3-4 Model-Predicted PSD Increment Values – 2010 Base Year

Receptor Site	NO_2 (ppb)		SO_2 (ppb)		$PM_{2.5}$ (µg/m^3)		PM_{10} (µg/m^3)	
	Annual	3-hour	24-hour	Annual	24-hour	Annual	24-hour	Annual
Uinta Basin Study Area								
Uinta Basin Study Area	1.91	11.7	5.7	0.18	**36.5**	3.4	**42.8**	3.9
Dinosaur AQS Station	0.76	1.4	0.8	0.17	**17.0**	3.7	17.8	4.3
Ouray AQS Station	6.19	1.5	0.6	0.13	**29.6**	**6.8**	**30.6**	7.4
Rangely AQS Station	3.59	1.6	1.0	0.20	**10.9**	2.6	12.0	3.4
Redwash AQS Station	3.38	2.5	1.2	0.24	**19.3**	3.8	19.7	4.2
Class I Areas								
Arches NP	0.55	4.1	1.7	0.20	**16.9**	**2.7**	**17.3**	3.2
Black Canyon of the Gunnison WA	0.48	1.9	0.8	0.17	**6.2**	**1.7**	7.7	2.1
Bridger WA	0.17	2.7	1.3	0.15	**5.8**	**1.5**	7.9	1.9
Bryce Canyon NP	0.25	2.1	1.0	0.16	**13.6**	**2.3**	**17.6**	2.9
Canyonlands NP	0.37	**14.1**	**3.9**	0.21	**17.4**	**2.4**	**18.0**	2.9
Capitol Reef NP	0.27	2.8	**1.9**	0.16	**19.5**	**2.3**	**19.9**	2.8
Eagles Nest WA	1.21	3.4	1.5	0.21	**7.3**	**1.8**	**9.2**	2.2
Fitzpatrick WA	0.16	1.7	0.9	0.13	**5.3**	**1.5**	**8.3**	1.9
Flat Tops WA	0.41	4.8	1.4	0.20	**5.5**	**1.6**	**8.4**	2.0
La Garita WA	0.22	2.2	1.0	0.15	**4.0**	**1.3**	6.6	1.6
Maroon Bells-Snowmass WA	0.35	1.7	0.9	0.16	**4.3**	**1.4**	**8.1**	1.8
Mesa Verde NP	**1.31**	**15.2**	**4.8**	0.49	**8.3**	**2.0**	**8.9**	2.4
Mount Zirkel WA	0.94	4.5	**2.5**	0.39	**7.0**	**1.8**	7.7	2.2
Rawah WA	0.60	3.4	1.6	0.27	**8.3**	**1.7**	**9.8**	2.0

Table 3-4 Model-Predicted PSD Increment Values – 2010 Base Year

Receptor Site	NO_2 (ppb)		SO_2 (ppb)		$PM_{2.5}$ (µg/m^3)		PM_{10} (µg/m^3)	
	Annual	3-hour	24-hour	Annual	24-hour	Annual	24-hour	Annual
Rocky Mountain NP	0.79	5.8	**3.0**	0.26	**24.4**	**1.7**	**25.8**	2.1
Weminuche WA	0.45	6.6	**2.0**	0.18	**5.0**	**1.3**	**8.5**	1.7
West Elk WA	0.25	1.9	0.9	0.16	**7.9**	**1.5**	**9.2**	1.8
Class II Areas								
Dinosaur National Monument	0.56	3.6	1.4	0.19	**17.3**	2.7	17.9	3.1
Flaming Gorge National Recreation Area	0.82	31.2	8.4	0.28	**14.3**	2.5	20.0	3.0
Fort Hall IR	1.68	9.4	5.8	0.37	**21.0**	3.1	26.2	4.4
Goshute IR	0.15	1.5	0.9	0.11	6.9	1.3	11.5	1.8
High Uintas WA	0.24	1.7	1.1	0.13	**9.5**	2.0	11.6	2.5
Navajo IR	1.45	110.8	29.6	0.41	**38.4**	2.2	**39.5**	2.9
Paitute IR	0.89	3.1	1.4	0.26	**39.1**	2.5	**40.9**	3.3
Skull Valley IR	0.43	1.9	1.0	0.15	**13.8**	2.1	14.3	2.6
Southern Ute IR	4.20	16.4	4.4	0.34	**31.1**	1.9	**35.7**	2.4
Uintah and Ouray IR	2.09	14.5	6.8	0.18	**49.7**	3.4	**55.0**	4.0
Ute Mountain IR	2.57	34.0	13.1	0.74	**22.2**	2.4	23.7	3.1
Wind River IR	0.60	34.1	21.6	0.50	**13.0**	1.7	14.6	2.1

Note: Model-predicted concentrations that exceed the PSD Increments are shown in **red bold** text.

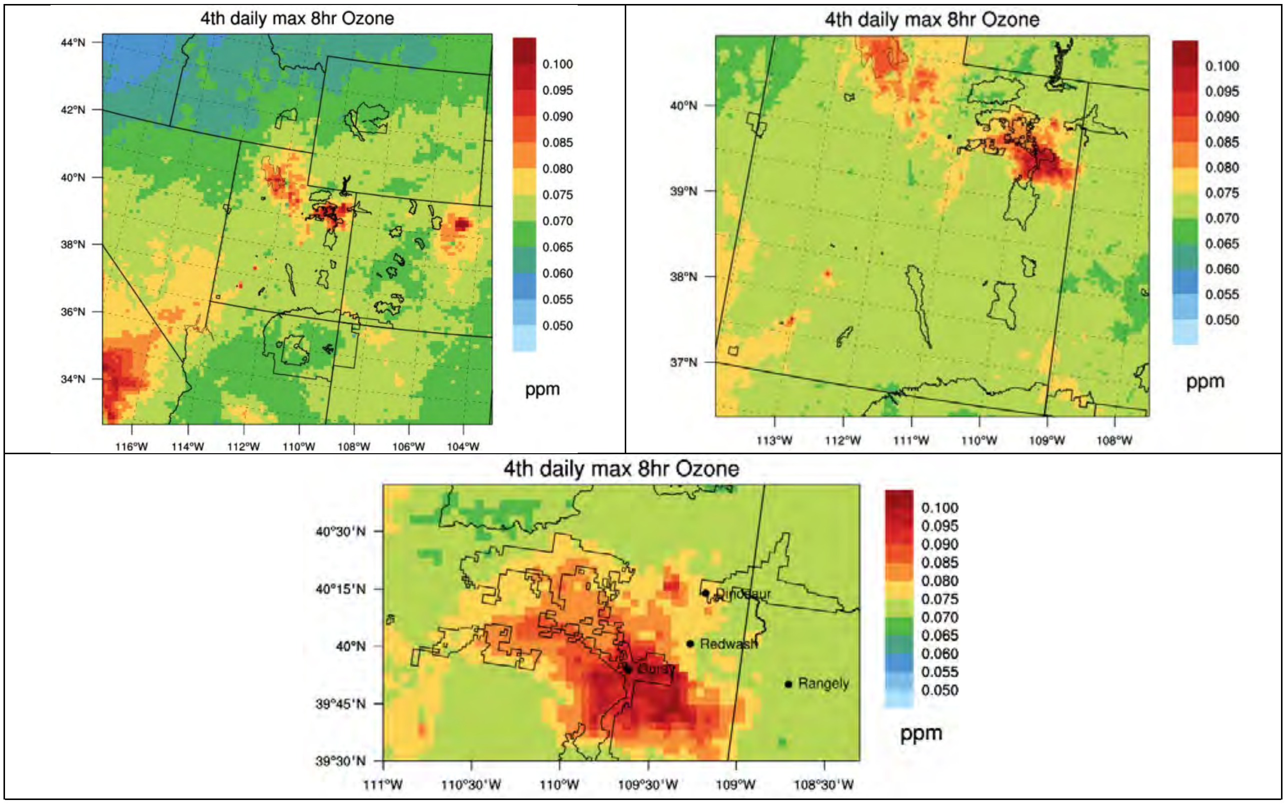

Figure 3-2 2010 Base Year Model-Predicted 4th Highest Daily Maximum 8-hour Ozone Spatial Plots

3.4 Typical Year 2010 Scenario

3.4.1 Model-Predicted Cumulative Criteria Pollutants Impacts

Table 3-5 presents the modeled 2010 Typical Year cumulative air quality impacts for all assessment including the winter and non-winter model-predicted ozone concentrations. Similar to the 2010 Base Year modeling, only ozone is predicted to be above the NAAQS and state AAQS. The locations with elevated ozone concentrations are the same locations shown in the 2010 Base Year modeling. **Table 3-6** shows the absolute difference between the 2010 Typical Year and Base Year modeling scenarios. As expected the differences between the Base Year and Typical Year modeling results are negligible. Eleven assessment areas show a modeled difference in ozone between the modeling scenarios. Of those assessment areas, six areas show a modeled decrease of ozone in the Typical Year and five areas have a modeled increase of ozone. For both the Uinta Basin Study area and Ouray Station, two locations with the highest ozone concentrations, the Typical Year model results show a small decrease in ozone relative to the Base Year.

The modeled 2010 Typical Year spatial plots of the 4^{th} maximum ozone concentrations are shown in **Figure 3-3**. **Figure 3-4** presents the absolute difference between the 2010 Typical Year and the Base Year modeling scenario of the 4^{th} highest maximum ozone concentrations. The figures show the 12-km domain, 4-km domain and the Uinta Basin study area, from left to right, top to bottom. Note that figures are only displayed for ozone as all modeled 2010 Typical Year values for other pollutants are well below the NAAQS and state AAQS. In addition, due to the method of determining the 4^{th} highest daily maximum 8-hour ozone concentration, the values shown in these plots do not necessarily occur during the same time in the model simulation. Typical Year modeled ozone is very similar to the 2010 Base Year scenario aside from areas within the Uinta Basin study area (**Figure 3-4**). Throughout the 12-km and 4-km domains, very small differences of 2 ppb (0.002 ppm) occur between the two scenarios. However, the area with the greatest difference between the two scenarios is the Uinta Basin study area where some portions of the Typical Year ozone values are about 6 ppb (0.006 ppm) less than the Base Year. The difference between the Typical and Base Year modeling results within the Uinta Basin are likely due to the annualizing the drilling and completion emissions as discussed in Section 2.5.

3.4.2 PSD Increment Assessment

For informational purposes, the 2010 Typical Year model-predicted impacts are compared to the PSD increments in **Table 3-7**. If all model sources were increment consuming sources, model predicted impact exceed allowable increments for 24-hour $PM_{2.5}$ for most assessment areas. Similar to the 2010 Base Year modeling scenario, annual SO_2 and PM_{10} are below the PSD increment for all assessment areas. In general, there are fewer assessment areas with modeled concentrations exceeding the PSD increments in the Typical Year than the Base Year, which is especially true for sensitive Class II areas. For Class I areas, the modeling results are similar to the 2010 Base Year scenario.

The model-predicted change in air quality between 2010 Typical Year and Base Year are shown relative to PSD increments in **Table 3-8**. Overall, there are minor differences between the two modeling scenarios. The majority of differences show a small decrease in concentrations in the Typical Year modeling scenario. The largest differences between the modeling scenarios are seen in the Paitute and Navajo IR for 24-hour PM_{10}/$PM_{2.5}$ and 3-hour SO_2, respectively. The relatively large PM differences shown at Paitute IR is likely due to the area's proximity to the fire removed in the Typical Year scenario. None of the assessment areas show a modeled difference between annual SO_2 and annual PM_{10}. For annual NO_2 and annual $PM_{2.5}$, only a few assessment areas have even small differences between the two scenarios. The similarities between 2010 Typical Year and Base Year for the annual AAQS is due to the small differences in the emissions inventories between the two scenarios. The annual emissions from all source categories are the same except that the Uinta Basin oil and gas and power plant emissions are distributed differently in time. Due to the similar emissions inventories, it is expected that there would be only small differences the Typical Year and Base Year modeling results.

Table 3-5 Model-Predicted Ambient Air Quality Impacts Compared to NAAQS – 2010 Typical Year

Receptor Site	NO_2 (ppb)		CO (ppm)		SO_2 (ppb)		O_3 (ppm) 8-hour			$PM_{2.5}$ (µg/m^3)		PM_{10} (µg/m^3)
	1-hour	Annual	1-hour	8-hour	1-hour	3-hour	Annual	Winter	Non-Winter	24-hour	Annual	24-hour
Uinta Basin Study Area												
Uinta Basin Study Area	19	2	4	3	2	0	**0.126**	**0.126**	**0.082**	14	3.4	40
Dinosaur AQS Station	3	1	0	0	1	0	**0.077**	**0.077**	0.073	14	3.7	20
Ouray AQS Station	29	6	1	0	1	0	**0.098**	**0.098**	0.075	25	6.8	30
Rangely AQS Station	15	4	0	0	1	0	0.072	0.064	0.072	7	2.6	10
Redwash AQS Station	13	3	0	0	2	0	0.074	0.073	0.072	13	3.8	20
Class I Areas												
Arches NP	2	1	0	0	2	0	**0.081**	0.067	**0.081**	9	2.7	20
Black Canyon of the Gunnison WA	2	0	0	0	1	0	0.073	0.067	0.073	4	1.7	10
Bridger WA	1	0	0	0	2	0	0.074	0.068	0.074	4	1.5	10
Bryce Canyon NP	1	0	0	0	1	0	**0.080**	0.065	**0.080**	6	2.3	20
Canyonlands NP	2	0	0	0	2	0	**0.080**	0.072	**0.080**	8	2.4	20
Capitol Reef NP	2	0	0	0	2	0	**0.080**	0.072	**0.080**	7	2.3	20
Eagles Nest WA	6	1	0	0	2	0	0.074	0.067	0.074	4	1.8	10
La Garita WA	1	0	0	0	2	0	0.073	0.072	0.072	4	1.5	10
Fitzpatrick WA	1	0	0	0	1	0	0.071	0.066	0.071	4	1.6	10
Flat Tops WA	3	0	0	0	2	0	0.074	0.069	0.074	3	1.3	10
Maroon Bells-Snowmass WA	2	0	0	0	1	0	0.072	0.071	0.072	3	1.4	10
Mesa Verde NP	9	1	0	0	10	0	**0.078**	0.070	**0.078**	5	1.9	10
Mount Zirkel WA	4	1	0	0	3	0	**0.077**	0.071	**0.077**	4	1.8	10
Rawah WA	3	1	0	0	3	0	**0.076**	0.070	**0.076**	4	1.7	10
Rocky Mountain NP	4	1	1	0	4	0	**0.087**	0.070	**0.087**	4	1.7	30
Weminuche WA	3	0	0	0	2	0	**0.076**	**0.076**	0.074	3	1.3	10
West Elk WA	1	0	0	0	1	0	0.074	0.069	0.074	3	1.5	10
Class II Areas												

Table 3-5 Model-Predicted Ambient Air Quality Impacts Compared to NAAQS – 2010 Typical Year

Receptor Site	NO_2 (ppb)		CO (ppm)		SO_2 (ppb)		O_3 (ppm) 8-hour			$PM_{2.5}$ (µg/m^3)		PM_{10} (µg/m^3)
	1-hour	Annual	1-hour	8-hour	1-hour	3-hour	Annual	Winter	Non-Winter	24-hour	Annual	24-hour
Dinosaur National Monument	2	1	1	0	1	0	**0.088**	**0.088**	0.075	9	2.7	20
Flaming Gorge National Recreation Area	5	1	0	0	7	0	**0.080**	**0.080**	**0.077**	8	2.5	20
Fort Hall IR	10	2	1	0	4	0	0.072	0.071	0.072	10	3.1	30
Goshute IR	0	0	0	0	1	0	**0.076**	0.060	**0.076**	3	1.3	10
High Uintas WA	1	0	0	0	1	0	**0.081**	**0.081**	**0.076**	5	2.0	10
Navajo IR	11	1	0	0	11	100	**0.082**	0.072	**0.082**	7	2.2	40
Paitute IR	5	1	1	0	2	0	**0.089**	**0.089**	**0.078**	6	2.4	20
Skull Valley IR	3	0	0	0	1	0	0.073	0.071	0.073	7	2.1	10
Southern Ute IR	27	4	1	0	6	0	**0.078**	0.074	**0.078**	5	1.9	40
Uintah and Ouray IR	21	2	3	1	4	0	**0.125**	**0.125**	**0.080**	15	3.4	50
Ute Mountain IR	15	3	1	0	15	0	**0.078**	0.073	**0.078**	7	2.4	20
Wind River IR	4	1	0	0	13	0	0.075	0.068	0.075	5	1.7	10

Note: Model-predicted concentrations that exceed the NAAQS are shown in **red bold** text.

Table 3-6 Change in Model-Predicted Ambient Air Quality Impacts Between 2010 Typical Year and 2010 Base Year

Receptor Site	NO_2 (ppb)		CO (ppm)		SO_2 (ppb)		O_3 (ppm) 8-hour			$PM_{2.5}$ (µg/m^3)		PM_{10} (µg/m^3)
	1-hour	Annual	1-hour	8-hour	1-hour	3-hour	Annual	Winter	Non-Winter	24-hour	Annual	24-hour
Uinta Basin Study Area												
Uinta Basin Study Area	1	0	1	0	0	0	-0.003	-0.003	0.001	0	0.0	0
Dinosaur AQS Station	0	0	0	0	0	0	0.000	0.000	0.000	0	0.0	0
Ouray AQS Station	0	0	0	0	0	0	-0.003	-0.003	0.000	1	0.0	0
Rangely AQS Station	0	0	0	0	0	0	0.000	0.000	0.000	0	0.0	0
Redwash AQS Station	0	0	0	0	0	0	0.000	-0.001	0.000	0	0.0	0
Class I Areas												
Arches NP	0	0	0	0	0	0	0.000	0.000	0.000	1	0.0	0
Black Canyon of the Gunnison WA	0	0	0	0	0	0	0.002	0.000	0.002	0	0.0	0
Bridger WA	0	0	0	0	0	0	0.001	0.000	0.001	0	0.0	0
Bryce Canyon NP	0	0	0	0	0	0	0.000	0.001	0.000	0	0.0	0
Canyonlands NP	0	0	0	0	0	0	0.000	0.001	0.000	0	0.0	0
Capitol Reef NP	0	0	0	0	0	0	0.000	0.001	0.000	0	0.0	0
Eagles Nest WA	0	0	0	0	0	0	0.000	0.000	0.000	0	0.0	0
La Garita WA	0	0	0	0	1	0	0.002	0.006	0.001	0	0.0	0
Fitzpatrick WA	-2	0	0	0	-1	0	-0.003	-0.003	-0.003	0	0.0	0
Flat Tops WA	2	0	0	0	0	0	0.001	-0.003	0.002	0	0.0	0
Maroon Bells-Snowmass WA	0	0	0	0	0	0	0.000	0.001	0.000	0	0.0	0
Mesa Verde NP	0	0	0	0	0	0	-0.001	0.000	-0.001	0	-0.1	0
Mount Zirkel WA	0	0	0	0	0	0	0.000	0.000	0.000	0	0.0	0
Rawah WA	0	0	0	0	1	0	0.000	0.000	0.000	0	0.0	0
Rocky Mountain NP	0	0	0	0	0	0	0.000	0.000	0.000	0	0.0	0
Weminuche WA	0	0	0	0	0	0	0.000	0.000	0.000	0	0.0	0
West Elk WA	0	0	0	0	0	0	0.001	0.000	0.001	0	0.0	0

Table 3-6 Change in Model-Predicted Ambient Air Quality Impacts Between 2010 Typical Year and 2010 Base Year

Receptor Site	NO_2 (ppb)		CO (ppm)		SO_2 (ppb)		O_3 (ppm) 8-hour			$PM_{2.5}$ (µg/m^3)		PM_{10} (µg/m^3)
	1-hour	Annual	1-hour	8-hour	1-hour	3-hour	Annual	Winter	Non-Winter	24-hour	Annual	24-hour
Class II Areas												
Dinosaur National Monument	-1	0	0	0	0	0	-0.001	-0.001	0.000	0	0.0	0
Flaming Gorge National Recreation Area	0	0	0	0	0	0	0.000	0.000	0.000	-1	0.0	0
Fort Hall IR	0	0	0	0	0	0	0.000	0.000	0.000	0	0.0	0
Goshute IR	0	0	0	0	0	0	0.000	0.000	0.000	0	0.0	0
High Uintas WA	0	0	0	0	0	0	0.001	0.001	0.000	0	0.0	0
Navajo IR	0	0	0	0	-1	0	0.000	0.000	0.000	0	0.0	0
Paitute IR	0	0	0	-1	0	0	0.000	0.000	0.000	-1	-0.1	-20
Skull Valley IR	0	0	0	0	0	0	0.000	0.000	0.000	0	0.0	0
Southern Ute IR	0	0	0	0	0	0	0.000	0.000	0.000	0	0.0	0
Uintah and Ouray IR	0	0	0	0	0	0	-0.002	-0.002	-0.001	0	0.0	-10
Ute Mountain IR	-1	0	0	0	-1	0	0.000	0.000	0.000	0	0.0	0
Wind River IR	0	0	0	0	0	0	0.000	0.001	0.000	0	0.0	0

Table 3-7 Model-Predicted PSD Increment Values – 2010 Typical Year

Receptor Site	NO_2 (ppb)	SO_2 (ppb)			$PM_{2.5}$ (µg/m^3)		PM_{10} (µg/m^3)	
	Annual	3-hour	24-hour	Annual	24-hour	Annual	24-hour	Annual
Uinta Basin Study Area								
Uinta Basin Study Area	1.99	12.9	6.2	0.18	37.0	3.4	43.6	3.9
Dinosaur AQS Station	0.74	1.4	0.8	0.17	17.6	3.7	18.4	4.3
Ouray AQS Station	6.34	1.5	0.6	0.13	29.9	6.8	30.8	7.4
Rangely AQS Station	3.56	1.5	0.9	0.20	10.9	2.6	12.0	3.3
Redwash AQS Station	3.29	2.5	1.2	0.24	19.7	3.8	20.1	4.2
Class I Areas								
Arches NP	0.54	3.5	1.6	0.19	16.9	2.7	17.4	3.2
Black Canyon of the Gunnison WA	0.48	1.8	0.7	0.17	6.3	1.7	7.8	2.1
Bridger WA	0.17	2.7	1.3	0.15	5.8	1.5	7.9	1.9
Bryce Canyon NP	0.25	2.1	1.0	0.16	13.6	2.3	17.6	2.9
Canyonlands NP	0.37	13.8	3.8	0.21	17.7	2.4	18.2	2.9
Capitol Reef NP	0.27	2.4	1.9	0.16	18.3	2.3	18.7	2.8
Eagles Nest WA	1.21	3.5	1.5	0.21	7.3	1.8	9.2	2.2
Fitzpatrick WA	0.16	1.7	0.9	0.13	5.3	1.5	8.3	1.9
Flat Tops WA	0.41	4.7	1.4	0.20	5.6	1.6	8.4	2.0
La Garita WA	0.23	2.1	0.9	0.15	4.1	1.3	6.6	1.6
Maroon Bells-Snowmass WA	0.35	1.6	0.9	0.16	4.3	1.4	8.1	1.8
Mesa Verde NP	1.30	15.5	4.4	0.48	8.4	1.9	9.0	2.4
Mount Zirkel WA	0.92	4.7	2.6	0.39	7.1	1.8	7.7	2.2
Rawah WA	0.59	3.6	1.7	0.27	8.3	1.7	9.7	2.0
Rocky Mountain NP	0.79	5.9	2.9	0.26	24.2	1.7	25.6	2.1
Weminuche WA	0.45	6.6	2.0	0.18	5.0	1.3	8.5	1.7
West Elk WA	0.25	1.8	0.9	0.16	7.8	1.5	9.1	1.8

Table 3-7 Model-Predicted PSD Increment Values – 2010 Typical Year

Receptor Site	NO_2 (ppb)	SO_2 (ppb)			$PM_{2.5}$ (µg/m^3)		PM_{10} (µg/m^3)	
	Annual	3-hour	24-hour	Annual	24-hour	Annual	24-hour	Annual
Class II Areas								
Dinosaur National Monument	0.56	2.6	1.3	0.19	**17.7**	2.7	18.4	3.1
Flaming Gorge National Recreation Area	0.82	31.2	8.4	0.28	**14.4**	2.5	20.0	3.0
Fort Hall IR	1.68	9.4	5.8	0.37	**21.0**	3.1	26.2	4.4
Goshute IR	0.15	1.5	0.8	0.11	6.9	1.3	11.5	1.8
High Uintas WA	0.24	1.7	1.1	0.13	**9.5**	2.0	11.6	2.5
Navajo IR	1.44	99.7	30.5	0.39	**38.5**	2.2	**39.6**	2.9
Paitute IR	0.86	2.6	1.2	0.26	**14.8**	2.4	17.7	3.3
Skull Valley IR	0.43	1.9	0.9	0.15	**13.8**	2.1	14.3	2.6
Southern Ute IR	4.20	15.8	4.4	0.33	**31.1**	1.9	**35.7**	2.4
Uintah and Ouray IR	2.13	14.2	7.0	0.18	**49.0**	3.4	**54.3**	4.0
Ute Mountain IR	2.56	32.9	14.0	0.73	**22.1**	2.4	23.5	3.1
Wind River IR	0.60	34.1	21.6	0.50	**12.8**	1.7	14.5	2.1

Note: Model-predicted concentrations that exceed the PSD Increments are shown in red bold text.

Table 3-8 Change in PSD Increment Values Between 2010 Typical Year and Base Year

Receptor Site	NO_2 (ppb)	SO_2 (ppb)			$PM_{2.5}$ (µg/m^3)		PM_{10} (µg/m^3)	
	Annual	3-hour	24-hour	Annual	24-hour	Annual	24-hour	Annual
Uinta Basin Study Area								
Uinta Basin Study Area	0.1	1.2	0.5	0.0	0.5	0.0	0.8	0.0
Dinosaur AQS Station	0.0	0.0	0.0	0.0	0.6	0.0	0.6	0.0
Ouray AQS Station	0.1	0.0	0.0	0.0	0.3	0.0	0.3	0.0
Rangely AQS Station	0.0	-0.2	-0.1	0.0	0.0	0.0	0.0	0.0
Redwash AQS Station	-0.1	0.0	0.0	0.0	0.4	0.0	0.4	0.0
Class I Areas								
Arches NP	0.0	-0.6	0.0	0.0	0.1	0.0	0.0	0.0
Black Canyon of the Gunnison WA	0.0	-0.2	0.0	0.0	0.1	0.0	0.1	0.0
Bridger WA	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Bryce Canyon NP	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0
Canyonlands NP	0.0	-0.3	0.0	0.0	0.2	0.0	0.3	0.0
Capitol Reef NP	0.0	-0.4	-0.1	0.0	-1.2	0.0	-1.2	0.0
Eagles Nest WA	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0
Fitzpatrick WA	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Flat Tops WA	0.0	-0.1	0.0	0.0	0.1	0.0	0.0	0.0
La Garita WA	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.0
Maroon Bells-Snowmass WA	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.0
Mesa Verde NP	0.0	0.3	-0.4	0.0	0.1	0.0	0.1	0.0
Mount Zirkel WA	0.0	0.2	0.1	0.0	0.0	0.0	0.0	0.0
Rawah WA	0.0	0.2	0.1	0.0	0.0	0.0	0.0	0.0

Table 3-8 Change in PSD Increment Values Between 2010 Typical Year and Base Year

Receptor Site	NO_2 (ppb)	SO_2 (ppb)			$PM_{2.5}$ (µg/m^3)		PM_{10} (µg/m^3)	
	Annual	3-hour	24-hour	Annual	24-hour	Annual	24-hour	Annual
Rocky Mountain NP	0.0	0.1	-0.1	0.0	-0.2	0.0	-0.2	0.0
Weminuche WA	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
West Elk WA	0.0	-0.1	0.0	0.0	-0.1	0.0	-0.1	0.0
Class II Areas								
Dinosaur National Monument	0.0	-1.0	0.0	0.0	0.4	0.0	0.5	0.0
Flaming Gorge National Recreation Area	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0
Fort Hall IR	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0
Goshute IR	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
High Uintas WA	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Navajo IR	0.0	-11.1	0.9	0.0	0.1	0.0	0.1	0.0
Paitute IR	0.0	-0.5	-0.2	0.0	-24.3	-0.1	-23.2	-0.1
Skull Valley IR	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Southern Ute IR	0.0	-0.6	-0.1	0.0	0.0	0.0	0.0	0.0
Uintah and Ouray IR	0.0	-0.3	0.2	0.0	-0.7	0.0	-0.7	0.0
Ute Mountain IR	0.0	-1.1	1.0	0.0	-0.1	0.0	-0.2	0.0
Wind River IR	0.0	0.0	0.0	0.0	-0.2	0.0	-0.1	0.0

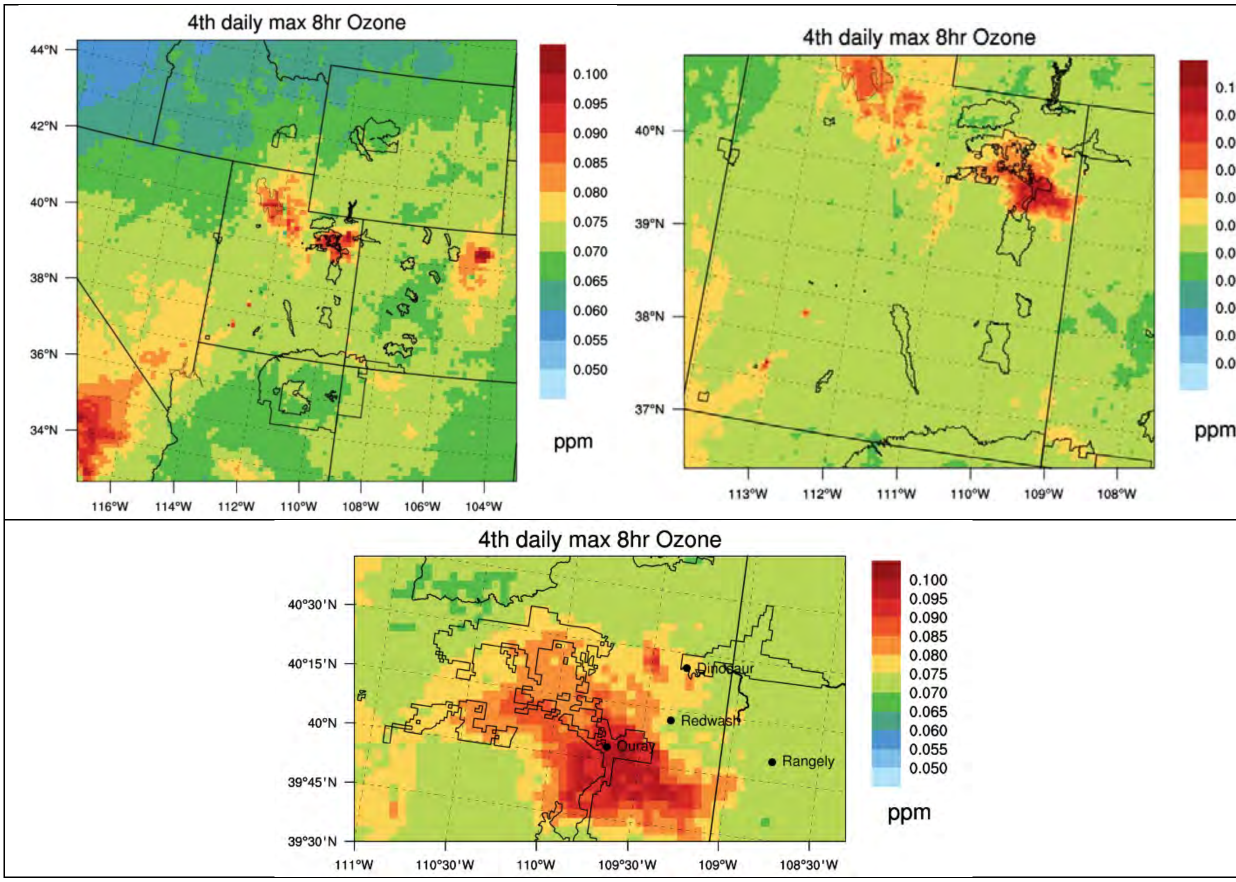

Figure 3-3 2010 Typical Year Model-Predicted 4th Highest Daily Maximum 8-hour Ozone Spatial Plots

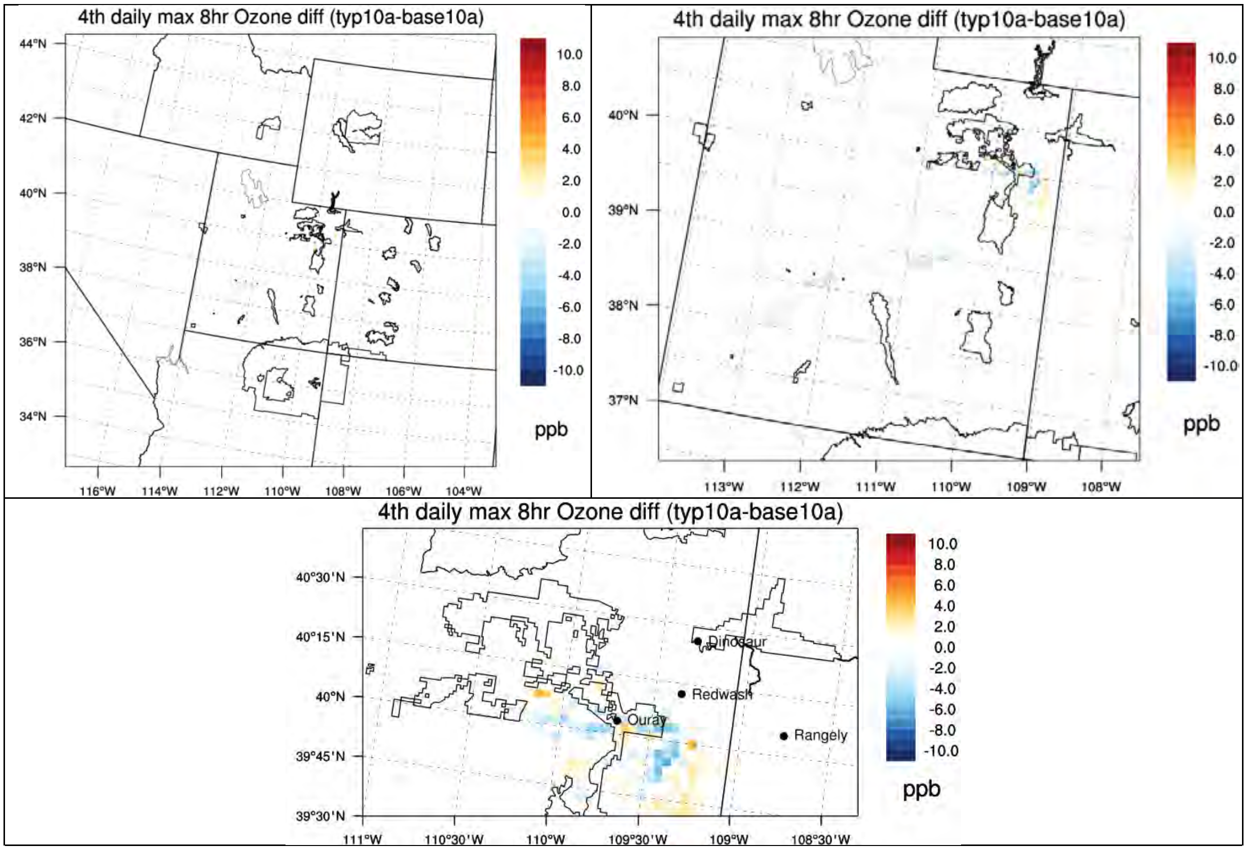

Figure 3-4 Absolute Difference between 2010 Typical Year and Base Year Model-Predicted 4th Highest Daily Maximum 8-hour Ozone Spatial Plots

3.5 2021 On-the-Books Controls

For the purpose of this study, the 2021 OTB Control modeling scenario is analyzed both individually and relative to the 2010 Typical Year modeling scenario. A detailed explanation of the differences between the two scenarios is found in **Chapter 2**.

3.5.1 Model-Predicted Cumulative Criteria Pollutant Impacts

3.5.1.1 Absolute Model Impacts for all Pollutants

Table 3-9 presents the modeled cumulative air quality impacts for the assessment areas, including the winter and non-winter model-predicted ozone concentrations, for the 2021 OTB Control modeling scenario. Similar to the 2010 Base Year and Typical Year modeling, only ozone is predicted to be above the NAAQS and state AAQS. For the 2021 OTB Control modeling results, fewer assessment areas are above the NAAQS and state AAQS. Three areas within the Uinta Basin study area, three Class I areas, and two Sensitive Class II areas exceed the ozone standard. Similar to the 2010 modeling scenarios, the Uinta Basin study area has the highest modeled ozone concentrations which occur during winter. The other criteria pollutants are well below their respective NAAQS standards at the majority of the assessment areas.

The difference between the 2021 OTB Control and 2010 Typical Year modeling scenarios is presented in **Table 3-10**. With the exception of the Uinta Basin study area, the 2021 OTB Control scenario modeling results generally has lower concentrations than the 2010 Typical Year scenario. Only one assessment area, Redwash Station, has higher ozone values in the 2021 OTB Control scenario. For several stations within the Uinta Basin study area, the 2021 OTB Control has higher 1-hour and annual NO_2, 24-hour and annual $PM_{2.5}$, and 24-hour PM_{10} NAAQS values. The increase of the criteria pollutant concentrations within the Uinta Basin study area could be due to a projected increase in oil and gas emissions as shown in **Table 2-10**.

The modeled 2021 OTB Control scenario spatial plots of the 4^{th} maximum ozone concentrations are shown in **Figure 3-5**. **Figure 3-6** presents the difference between the 2021 OTB Control and 2010 Typical Year modeling scenarios of the 4^{th} maximum ozone concentrations. The figures show the 12-km domain, 4-km domain and the Uinta Basin study area, from left to right, top to bottom. Similar to the 2010 Typical Year modeling scenarios, regions of the highest ozone values are shown in southern California, north central Colorado, and northern Utah. Also, like the Typical Year modeling results the northwestern portion of the 12-km domain has the lowest model ozone values. However, unlike the Typical Year where the majority the spatial extent within the 4- and 12- km domain exceeds the ozone NAAQS standard, the 2021 OTB Control model results show a few isolated regions exceeding the ozone NAAQS. These regions include: Los Angeles metropolitan area, Denver metropolitan area, Salt Lake City and Wasatch Range, and the Uinta Basin.

The 12-km spatial plot of the scenario differences (**Figure 3-6**) shows large differences within the Uinta Basin with higher ozone values (up to 10 ppb) in the 2021 OTB Control. These large differences are not modeled on the 4-km domain, which is considered to be a more refined domain. For the Uinta basin, the 4-km domain modeling results show the difference between the modeling scenarios to be lower in magnitude. When compared to the 2010 Typical Year modeling results (**Figure 3-3**), the 2021 OTB Control modeling results (**Figure 3-5**) have larger spatial extent of ozone values above 0.075 ppm. As shown in **Figure 3-6**, the ozone concentrations for the 2021 OTB Control increases north of Ouray relative to the 2010 Typical Year and decreases south of Ouray. A more detailed analysis of the modeled ozone differences between the 2021 OTB Controls and the 2010 Typical Year is available in **Appendix B**.

3.5.1.2 Relative Model Impacts for Ozone and $PM_{2.5}$

Ozone

Table 3-11 provides the MATS 8-hour ozone design values for baseline and 2021 OTB Controls at available monitoring sites in the 4-km domain over the full year, as well as winter and non-winter time periods. **Figure 3-1** shows the location of the monitoring sites relative to the assessment areas. As discussed in Section 3.1 and **Appendix A**, the baseline year is 2010 for the MATS monitoring sites. As shown in **Table 3-11**, the baseline design value exceed the ozone NAAQS for 2 of the 26 monitors.[2] Based on the model-predicted ozone changes between 2021 OTB Controls and the baseline, the design value is projected to decrease at most monitoring sites; however, there is an increase in the number of monitors that are projected to exceed the NAAQS from two monitoring sites in 2010 to four monitoring sites in 2021. The highest predicted ozone design value in 2021 is 0.087 ppm, which occurs at site 490472003, Ouray, Utah, within the Uinta Basin. Importantly, this is a 10 ppb decrease relative to the baseline. Within the Uinta Basin, 2 of the 4 monitors are projected to have ozone design values that exceeding the NAAQS both in 2010 and in 2021.

For the unmonitored area analysis (UAA), the spatial interpolation of ozone design values are shown in **Figure 3-7** and the maximum ozone design value for assessment areas are presented in **Table 3-12**. For the spatial plots, the circles show the model-predicted design value at the monitoring sites as reported in **Table 3-11**. For the most part, the design values at monitoring sites correspond to the UAA. As shown in **Figure 3-7**, the 2021 predicted ozone design values near or exceeding the NAAQS in Uinta Basin and Salt Lake City metropolitan area. These areas correspond to the same areas predicted to have elevated 8-hour ozone concentrations from the absolute model results (shown in **Figure 3-5**).

As shown in **Table 3-12**, the assessment areas with the highest ozone design values for the 2021 OTB Controls are within or near the Uinta Basin study area. For the 2021 OTB Controls, ozone design values are lower than baseline values and the number of areas predicted to exceed the NAAQS decreases from 5 areas to 2 areas: the Uinta Basin study area and Uintah and Ouray IR. All other assessment areas have ozone design values below the NAAQS in 2021. **Table 3-13** shows the winter and non-winter ozone design values at unmonitored locations within the 4-km domain.

$PM_{2.5}$

In addition to the ozone analysis, an analysis of the relative model impacts of annual and daily $PM_{2.5}$ was conducted using MATS. **Table 3-14** presents the MATS-estimated baseline and 2021 OTB Control $PM_{2.5}$ design values at monitor locations within the 4-km domain. Due to the limited number $PM_{2.5}$ monitors, the closest monitors to the Uinta Basin study area are in and around Salt Lake City. For annual $PM_{2.5}$, none of the monitors exceed the NAAQS in 2021 or in the baseline. For daily $PM_{2.5}$, the design value is projected to decrease at all monitoring sites. In addition, the number of monitors that are projected to exceed the NAAQS decreases from seven monitors in 2010 to one monitor in 2021. The monitor with the projected exceedence in 2021 is in Salt Lake City area, site ID 490350003.

For the UAA, spatial plots of the spatially interpolated annual $PM_{2.5}$ design values are shown in **Figure 3-8**. Since MATS does not provided spatial interpolation of daily $PM_{2.5}$, only the annual $PM_{2.5}$ is used for the UAA. The maximum annual $PM_{2.5}$ design value for the assessment areas are shown in **Table 3-12**. Like the ozone deign value spatial plot, the circles show the model-predicted design value at the monitoring sites as reported in **Table 3-14**. In general the monitor values correspond to the spatial interpolation. However, there are large spatial gradients in the modeled concentrations, which can make it difficult to visually compare the monitoring values to the UAA spatial plot values. Throughout the 4-km domain, MATS spatial analysis show several small isolated areas with annual $PM_{2.5}$ design values close

[2] It is important to note that currently there is insufficient data collected at regulatory monitors in the Uinta Basin study area to calculate a true ozone design value. All future year ozone design values reported for the Uinta Basin do not represent actual design values and are for informational purposes only.

or exceeding the NAAQS. Large areas of elevated annual $PM_{2.5}$ design values include the Uinta Basin study area and Salt Lake City area. For 2021 OTB Controls the assessment areas within or near the Uinta Basin have the highest maximum annual $PM_{2.5}$ design values, as well as Fort Hall IR, Navajo IR, and Wind River IR (**Table 3-12**). The only assessment areas with annual $PM_{2.5}$ design values above the NAAQS are the Uinta Basin study area and Uintah and Ouray IR for both the baseline and 2021 OTB Controls.

3.5.2 PSD Increment Assessment

Table 3-15 presents the 2021 OTB Controls model results relative to PSD increments for the assessment areas. If all model sources were increment consuming sources, the model predicted impacts exceed the 24-hour $PM_{2.5}$ increments at most assessment areas while all assessment areas are within the 3-hour SO_2, annual SO_2, NO_2, and annual PM_{10} PSD increments. Within the Uinta Basin study area all sites exceeding the 24-hour $PM_{2.5}$ increment, Ouray station and in other locations within the Uinta Basin study area exceed the 24-hour PM_{10} increment, and Ouray and Redwash stations exceed the annual $PM_{2.5}$ increment. The model results for the other increments and assessment areas are similar to the 2010 Typical Year results.

The model-predicted change in air quality between 2021 OTB Controls and 2010 Typical Year is shown relative to PSD increments in **Table 3-16**. Similar to the NAAQS tables, the majority of the PSD increment values are predicted to be lower for the 2021 OTB Controls than the 2010 Typical Year at most assessment areas, except for areas near or within the Uinta Basin study area where the PSD increments values increase for PM.

Table 3-9 Model-Predicted Ambient Air Quality Impacts Compared to NAAQS – 2021 OTB Controls

Receptor Site	NO_2 (ppb)		CO (ppm)		SO_2 (ppb)		O_3 (ppm) 8-hour			$PM_{2.5}$ (µg/m^3)		PM_{10} (µg/m^3)
	1-hour	Annual	1-hour	8-hour	1-hour	3-hour	Annual	Winter	Non-Winter	24-hour	Annual	24-hour
Uinta Basin Study Area												
Uinta Basin Study Area	29	2	2	2	2	0	**0.117**	**0.117**	**0.081**	16	3.5	50
Dinosaur AQS Station	4	1	0	0	1	0	**0.077**	**0.077**	0.069	14	3.7	20
Ouray AQS Station	46	11	1	1	1	0	**0.091**	**0.091**	0.072	28	8.1	40
Rangely AQS Station	6	2	0	0	1	0	0.070	0.065	0.070	7	2.5	10
Redwash AQS Station	28	7	1	0	2	0	0.075	0.075	0.070	14	4.6	20
Class I Areas												
Arches NP	1	0	1	0	1	0	**0.079**	0.060	**0.079**	6	2.2	10
Black Canyon of the Gunnison WA	1	0	0	0	1	0	0.067	0.061	0.067	3	1.4	10
Bridger WA	1	0	0	0	3	0	0.070	0.062	0.070	4	1.5	10
Bryce Canyon NP	1	0	0	0	1	0	0.074	0.059	0.074	4	1.9	20
Canyonlands NP	1	0	0	0	1	0	**0.078**	0.064	**0.078**	6	2.0	10
Capitol Reef NP	1	0	0	0	1	0	0.075	0.068	0.075	5	1.9	10
Eagles Nest WA	3	1	0	0	2	0	0.070	0.062	0.070	4	1.6	10
Fitzpatrick WA	1	0	0	0	3	0	0.069	0.061	0.069	4	1.4	10
Flat Tops WA	1	0	0	0	1	0	0.072	0.063	0.072	3	1.5	10
La Garita WA	1	0	0	0	1	0	0.070	0.067	0.070	3	1.2	10
Maroon Bells-Snowmass WA	1	0	0	0	1	0	0.068	0.062	0.068	3	1.3	10
Mesa Verde NP	4	1	0	0	2	0	0.073	0.067	0.073	4	1.7	10
Mount Zirkel WA	2	0	0	0	2	0	0.071	0.069	0.071	4	1.6	10
Rawah WA	2	0	0	0	2	0	0.072	0.066	0.072	4	1.5	10
Rocky Mountain NP	2	0	1	0	4	0	**0.076**	0.067	**0.076**	4	1.6	20
Weminuche WA	1	0	0	0	1	0	0.070	0.070	0.070	3	1.2	10
West Elk WA	1	0	0	0	1	0	0.068	0.063	0.068	3	1.3	10
Class II Areas												

Table 3-9 Model-Predicted Ambient Air Quality Impacts Compared to NAAQS – 2021 OTB Controls

Receptor Site	NO_2 (ppb)		CO (ppm)		SO_2 (ppb)		O_3 (ppm) 8-hour			$PM_{2.5}$ (µg/m³)		PM_{10} (µg/m³)
	1-hour	Annual	1-hour	8-hour	1-hour	3-hour	Annual	Winter	Non-Winter	24-hour	Annual	24-hour
Dinosaur National Monument	3	1	1	0	1	0	**0.094**	**0.094**	0.074	9	2.5	20
Flaming Gorge National Recreation Area	3	1	1	0	4	0	0.074	0.071	0.074	8	2.3	20
Fort Hall IR	7	1	1	0	5	0	0.067	0.065	0.067	12	3.8	50
Goshute IR	0	0	0	0	0	0	0.070	0.058	0.070	3	1.2	10
High Uintas WA	1	0	0	0	1	0	0.073	0.071	0.073	4	1.8	10
Navajo IR	6	1	0	0	3	0	0.075	0.068	0.075	6	1.9	30
Paitute IR	2	0	1	0	1	0	0.072	0.072	0.072	5	2.0	10
Skull Valley IR	2	0	0	0	2	0	0.070	0.068	0.069	6	1.9	10
Southern Ute IR	16	3	1	0	1	0	0.072	0.069	0.072	4	1.7	40
Uintah and Ouray IR	34	3	3	2	2	0	**0.114**	**0.114**	**0.079**	18	3.6	50
Ute Mountain IR	7	1	1	0	3	0	0.072	0.067	0.072	6	2.0	20
Wind River IR	2	0	0	0	7	0	0.071	0.062	0.071	4	1.5	10

Note: Model-predicted concentrations that exceed the NAAQS are shown in **red bold** text.

Table 3-10 Change in Model-Predicted Ambient Air Quality Impacts Between 2021 OTB Controls and 2010 Typical Year

Receptor Site	NO_2 (ppb)		CO (ppm)		SO_2 (ppb)		O_3 (ppm) 8-hour			$PM_{2.5}$ (µg/m^3)		PM_{10} (µg/m^3)
	1-hour	Annual	1-hour	8-hour	1-hour	3-hour	Annual	Winter	Non-Winter	24-hour	Annual	24-hour
Uinta Basin Study Area												
Uinta Basin Study Area	10	0	-2	-1	0	0	-0.009	-0.009	-0.001	2	0.1	10
Dinosaur AQS Station	1	0	0	0	0	0	0.000	0.000	-0.004	0	0.0	0
Ouray AQS Station	17	5	0	1	0	0	-0.007	-0.007	-0.003	3	1.3	10
Rangely AQS Station	-9	-2	0	0	0	0	-0.002	0.001	-0.002	0	-0.1	0
Redwash AQS Station	15	4	1	0	0	0	0.001	0.002	-0.002	1	0.8	0
Class I Areas												
Arches NP	-1	-1	1	0	-1	0	-0.002	-0.007	-0.002	-3	-0.5	-10
Black Canyon of the Gunnison WA	-1	0	0	0	0	0	-0.006	-0.006	-0.006	-1	-0.3	0
Bridger WA	0	0	0	0	1	0	-0.004	-0.006	-0.004	0	0.0	0
Bryce Canyon NP	0	0	0	0	0	0	-0.006	-0.006	-0.006	-2	-0.4	0
Canyonlands NP	-1	0	0	0	-1	0	-0.002	-0.008	-0.002	-2	-0.4	-10
Capitol Reef NP	-1	0	0	0	-1	0	-0.005	-0.004	-0.005	-2	-0.4	-10
Eagles Nest WA	-3	0	0	0	0	0	-0.004	-0.005	-0.004	0	-0.2	0
Fitzpatrick WA	0	0	0	0	1	0	-0.004	-0.011	-0.003	0	-0.1	0
Flat Tops WA	0	0	0	0	0	0	0.001	-0.003	0.001	-1	-0.1	0
La Garita WA	-2	0	0	0	-1	0	-0.004	-0.002	-0.004	0	-0.1	0
Maroon Bells-Snowmass WA	-1	0	0	0	0	0	-0.004	-0.009	-0.004	0	-0.1	0
Mesa Verde NP	-5	0	0	0	-8	0	-0.005	-0.003	-0.005	-1	-0.2	0
Mount Zirkel WA	-2	-1	0	0	-1	0	-0.006	-0.002	-0.006	0	-0.2	0
Rawah WA	-1	-1	0	0	-1	0	-0.004	-0.004	-0.004	0	-0.2	0
Rocky Mountain NP	-2	-1	0	0	0	0	-0.011	-0.003	-0.011	0	-0.1	-10
Weminuche WA	-2	0	0	0	-1	0	-0.006	-0.006	-0.004	0	-0.1	0
West Elk WA	0	0	0	0	0	0	-0.006	-0.006	-0.006	0	-0.2	0

Table 3-10 Change in Model-Predicted Ambient Air Quality Impacts Between 2021 OTB Controls and 2010 Typical Year

Receptor Site	NO_2 (ppb)		CO (ppm)		SO_2 (ppb)		O_3 (ppm) 8-hour			$PM_{2.5}$ (µg/m³)		PM_{10} (µg/m³)
	1-hour	Annual	1-hour	8-hour	1-hour	3-hour	Annual	Winter	Non-Winter	24-hour	Annual	24-hour
Class II Areas												
Dinosaur National Monument	1	0	0	0	0	0	0.006	0.006	-0.001	0	-0.2	0
Flaming Gorge National Recreation Area	-2	0	1	0	-3	0	-0.006	-0.009	-0.003	0	-0.2	0
Fort Hall IR	-3	-1	0	0	1	0	-0.005	-0.006	-0.005	2	0.7	20
Goshute IR	0	0	0	0	-1	0	-0.006	-0.002	-0.006	0	-0.1	0
High Uintas WA	0	0	0	0	0	0	-0.008	-0.010	-0.003	-1	-0.2	0
Navajo IR	-5	0	0	0	-8	-100	-0.007	-0.004	-0.007	-1	-0.3	-10
Paitute IR	-3	-1	0	0	-1	0	-0.017	-0.017	-0.006	-1	-0.4	-10
Skull Valley IR	-1	0	0	0	1	0	-0.003	-0.003	-0.004	-1	-0.2	0
Southern Ute IR	-11	-1	0	0	-5	0	-0.006	-0.005	-0.006	-1	-0.2	0
Uintah and Ouray IR	13	1	0	1	-2	0	-0.011	-0.011	-0.001	3	0.2	0
Ute Mountain IR	-8	-2	0	0	-12	0	-0.006	-0.006	-0.006	-1	-0.4	0
Wind River IR	-2	-1	0	0	-6	0	-0.004	-0.006	-0.004	-1	-0.2	0

Table 3-11 MATS-Estimated Ozone Impacts at Monitored Locations – 2021 OTB Controls

Receptor Site Name or City	Site ID	Latitude	Longitude	Annual (ppm)			Winter (ppm)			non-Winter (ppm)		
				Baseline Monitor O_3 Design Value	2021 OTB Controls O_3 Design Value	Difference	Baseline Monitor O_3 Design Value	2021 OTB Controls O_3 Design Value	Difference	Baseline Monitor O_3 Design Value	2021 OTB Controls O_3 Design Value	Difference
Uinta Basin Study Area												
Dinosaur NM, Uintah County, Utah*	490471002	40.4300	-109.3000	0.071	0.071	0.000	0.072	0.071	-0.001	0.065	0.063	-0.002
Ouray Site, Uintah County, Utah*	490472003	40.0500	-109.6800	**0.097**	**0.087**	-0.010	**0.096**	**0.086**	-0.010	0.063	0.060	-0.003
Rangely Site, Rio Blanco County, Colorado*	81030006	40.0800	-108.7600	0.064	0.064	0.000	0.046	0.046	0.000	0.064	0.061	-0.003
Red Wash Site, Uintah County, Utah*	490472002	40.2000	-109.3500	**0.086**	**0.076**	-0.010	**0.084**	0.075	-0.009	0.061	0.058	-0.003
Utah Stations Outside of Uinta Basin Study Area												
Bountiful Site, Davis County, Utah	490110004	40.9000	-111.8800	0.071	0.070	-0.001	NA	NA	NA	0.071	0.067	-0.004
Canyonlands NP Site, San Juan County, Utah	490370101	38.4500	-109.8100	0.069	0.065	-0.004	0.058	0.052	-0.006	0.067	0.065	-0.002
Cottonwood Site, Salt Lake County, Utah	490350003	40.6400	-111.8400	0.075	**0.077**	0.002	NA	NA	NA	0.074	0.073	-0.001
Escalante Site, Garfield County, Utah	490170004	37.7700	-111.6100	0.053	0.050	-0.003	0.045	0.042	-0.003	NA	NA	NA
Fruitland Site, Duchesne County, Utah	490131001	40.3000	-110.0000	0.067	0.065	-0.002	0.049	0.047	-0.002	0.065	0.063	-0.002
Harrisville Site, Weber County, Utah	490571003	41.3000	-111.9800	0.073	0.070	-0.003	NA	NA	NA	0.072	0.068	-0.004
Hawthorne Site, Salt Lake County, Utah	490353006	40.7300	-111.8700	0.075	**0.076**	0.001	0.049	0.055	0.006	0.075	0.072	-0.003
Highland Site, Utah County, Utah	490495008	40.4300	-111.8000	0.067	0.066	-0.001	NA	NA	NA	0.066	0.062	-0.004
Lakepoint Site, Salt Lake County, Utah	490352004	40.7300	-112.2100	0.074	0.068	-0.006	NA	NA	NA	0.072	0.066	-0.006
North Provo Site, Utah County, Utah	490490002	40.2500	-111.6600	0.069	0.066	-0.003	0.047	0.049	0.002	0.069	0.065	-0.004
Ogden Site, Weber County, Utah	490570002	41.2000	-111.9700	0.072	0.069	-0.003	0.046	0.044	-0.002	0.071	0.067	-0.004
Price Site, Carbon County, Utah	490071003	39.6000	-110.8000	0.070	0.064	-0.006	0.049	0.044	-0.005	0.068	0.064	-0.004
Spanish Fork Site, Utah County, Utah	490495010	40.1300	-111.6500	0.069	0.066	-0.003	NA	NA	NA	0.068	0.064	-0.004
St. George Site, Washington County, Utah	490530006	37.1200	-113.6300	0.067	0.060	-0.007	NA	NA	NA	0.066	0.059	-0.007
Tooele Site, Tooele County, Utah	490450003	40.5400	-112.2900	0.072	0.065	-0.007	NA	NA	NA	0.071	0.066	-0.005
Zion NP Site, Washington County, Utah	490530130	37.1900	-113.1500	0.071	0.063	-0.008	0.057	0.049	-0.008	0.070	0.063	-0.007

Table 3-11 MATS-Estimated Ozone Impacts at Monitored Locations – 2021 OTB Controls

Receptor Site Name or City	Site ID	Latitude	Longitude	Annual (ppm)			Winter (ppm)			non-Winter (ppm)		
				Baseline Monitor O_3 Design Value	2021 OTB Controls O_3 Design Value	Difference	Baseline Monitor O_3 Design Value	2021 OTB Controls O_3 Design Value	Difference	Baseline Monitor O_3 Design Value	2021 OTB Controls O_3 Design Value	Difference
Colorado												
Cortez Site, Montezuma County, Colorado	80830006	37.3500	-108.5900	0.066	0.060	-0.006	0.053	0.049	-0.004	0.065	0.059	-0.006
Grand Junction Site, Mesa County, Colorado	80771001	39.1000	-108.7400	0.064	0.060	-0.004	0.062	0.056	-0.006	0.062	0.059	-0.003
Meeker Site, Rio Blanco County, Colorado	81030005	40.0300	-107.8400	0.064	0.060	-0.004	0.053	0.049	-0.004	0.064	0.061	-0.003
Mesa Verde NP Site, Montezuma County, Colorado	80830101	37.1900	-108.4900	0.068	0.062	-0.006	0.000	0.000	0.000	0.000	0.000	0.000
Wyoming												
Evanston Site, Uinta County, Wyoming	560410101	41.3700	-111.0400	0.060	0.054	-0.006	0.052	0.047	-0.005	0.062	0.055	-0.007
Wamsutter Southeast Site, Sweetwater County, Wyoming	560370200	41.6700	-108.0200	0.064	0.059	-0.005	0.055	0.052	-0.003	0.062	0.057	-0.005

Note: Model-predicted concentrations that exceed the NAAQS are shown in **red bold** text.

Table 3-12 MATS-Estimated Ozone and $PM_{2.5}$ Impacts at Unmonitored Locations – 2021 OTB Controls

Receptor Site	Ozone Design Value (ppm)			Annual $PM_{2.5}$ Design Value (µg/m^3)		
	Baseline	2021 OTB Controls	Difference	Baseline	2021 OTB Controls	Difference
Uinta Basin Study Area						
Uinta Basin Study Area	0.102	0.092	-0.010	14.9	21.9	7.0
Class I Areas						
Arches NP	0.068	0.065	-0.003	4.6	4.4	-0.2
Black Canyon of the Gunnison WA	0.066	0.061	-0.005	3.4	3.1	-0.3
Bridger WA	0.073	0.067	-0.006	5.3	5.5	0.2
Bryce Canyon NP	0.062	0.058	-0.004	2.7	2.6	-0.1
Canyonlands NP	0.068	0.065	-0.003	3.2	3.0	-0.2
Capitol Reef NP	0.063	0.060	-0.003	3.2	3.0	-0.2
Eagles Nest WA	0.067	0.063	-0.004	3.8	3.5	-0.3
Fitzpatrick WA	0.071	0.066	-0.005	3.9	4.1	0.2
Flat Tops WA	0.067	0.063	-0.004	2.7	2.6	-0.1
La Garita WA	0.068	0.064	-0.004	2.6	2.5	-0.1
Maroon Bells-Snowmass WA	0.067	0.062	-0.005	2.3	2.2	-0.1
Mesa Verde NP	0.067	0.061	-0.006	4.1	3.8	-0.3
Mount Zirkel WA	0.071	0.064	-0.007	2.3	2.3	0.0
Rawah WA	0.070	0.064	-0.006	2.7	2.6	-0.1
Rocky Mountain NP	0.076	0.067	-0.009	3.7	3.6	-0.1
Weminuche WA	0.070	0.064	-0.006	3.0	2.9	-0.1
West Elk WA	0.066	0.062	-0.004	2.8	2.6	-0.2

Table 3-12 MATS-Estimated Ozone and $PM_{2.5}$ Impacts at Unmonitored Locations – 2021 OTB Controls

Receptor Site	Ozone Design Value (ppm)			Annual $PM_{2.5}$ Design Value ($\mu g/m^3$)		
	Baseline	2021 OTB Controls	Difference	Baseline	2021 OTB Controls	Difference
Class II Areas						
Dinosaur National Monument	**0.076**	0.073	-0.003	5.5	5.5	0.0
Flaming Gorge National Recreation Area	0.061	0.058	-0.003	7.1	7.2	0.1
Fort Hall IR	0.070	0.065	-0.005	7.2	11.2	4.0
Goshute IR	0.067	0.061	-0.006	2.9	2.9	0.0
High Uintas WA	0.065	0.060	-0.005	3.9	3.6	-0.3
Navajo IR	0.072	0.067	-0.005	7.5	11.1	3.6
Paitute IR	**0.076**	0.064	-0.012	5.7	5.5	-0.2
Skull Valley IR	0.065	0.060	-0.005	3.4	3.3	-0.1
Southern Ute IR	0.070	0.064	-0.006	4.6	4.6	0.0
Uintah and Ouray IR	**0.102**	**0.087**	-0.015	**12.1**	**21.9**	9.8
Ute Mountain IR	0.072	0.067	-0.005	7.0	6.8	-0.2
Wind River IR	0.072	0.067	-0.005	11.0	10.0	-1.0

Note: Model-predicted concentrations that exceed the NAAQS are shown in **red bold** text.

Table 3-13 MATS-Estimated Winter and Non-Winter Ozone Impacts at Unmonitored Locations – 2021 OTB Controls

Receptor Site	Winter Ozone Design Value (ppm)			Non-Winter Ozone Design Value (ppm)		
	Baseline	2021 OTB Controls	Difference	Baseline	2021 OTB Controls	Difference
Uinta Basin Study Area						
Uinta Basin Study Area	**0.098**	**0.085**	-0.013	0.067	0.065	-0.002
Class I Areas						
Arches NP	0.056	0.050	-0.006	0.066	0.063	-0.003
Bryce Canyon NP	0.051	0.047	-0.004	0.068	0.064	-0.004
Canyonlands NP	0.058	0.053	-0.005	0.068	0.065	-0.003
Capitol Reef NP	0.051	0.048	-0.003	0.068	0.064	-0.004
Mesa Verde NP	0.056	0.052	-0.004	0.066	0.060	-0.006
Class II Areas						
Dinosaur National Monument	0.075	0.073	-0.002	0.065	0.062	-0.003
Flaming Gorge National Recreation Area	0.053	0.050	-0.003	0.062	0.059	-0.003
Goshute IR	0.044	0.041	-0.003	0.066	0.060	-0.006
High Uintas WA	0.052	0.047	-0.005	0.066	0.062	-0.004
Paitute IR	0.070	0.057	-0.013	0.070	0.064	-0.006
Skull Valley IR	0.049	0.047	-0.002	0.064	0.060	-0.004
Uintah and Ouray IR	**0.098**	**0.084**	-0.014	0.067	0.063	-0.004

Note: Model-predicted concentrations that exceed the NAAQS are shown in **red bold** text.

Table 3-14 MATS-Estimated $PM_{2.5}$ Impacts at Monitored Locations – 2021 OTB Controls

Receptor Site Name or City	Site ID	Latitude	Longitude	Annual $PM_{2.5}$ Design Value (µg/m^3)			Daily $PM_{2.5}$ Design Value (µg/m^3)		
				Baseline Monitor	2021 OTB Controls	Difference	Baseline Monitor	2021 OTB Controls	Difference
Bountiful Site, Davis County, Utah	490110004	40.9030	-111.8845	10.2	9.6	-0.60	**37.40**	32.8	-4.60
Cottonwood Site, Salt Lake County, Utah	490350003	40.6467	-111.8497	11.1	10.6	-0.50	**45.40**	**39.8**	-5.60
Harrisville Site, Weber County, Utah	490571003	41.3036	-111.9879	8.9	8.1	-0.80	**35.10**	27.3	-7.80
Highland Site, Utah County, Utah	490495008	40.4303	-111.8039	8.5	7.7	-0.80	31.70	25.6	-6.10
Lindon Site, Utah County, Utah	490494001	40.3414	-111.7136	10.3	9.3	-1.00	**37.90**	31.2	-6.70
Magna Salt Lake City Site, Salt Lake County, Utah	490351001	40.7086	-112.0947	8.6	8.5	-0.10	32.40	27.6	-4.80
Ogden Site, Weber County, Utah	490570002	41.2063	-111.9755	10.3	9.3	-1.00	**38.40**	31.1	-7.30
Provo Site, Utah County, Utah	490490002	40.2536	-111.6631	9.9	8.8	-1.10	33.30	26.1	-7.20
Rose Park Salt Lake City Site, Salt Lake County, Utah	490353010	40.7842	-111.9310	10.4	9.8	-0.60	**39.00**	33.3	-5.70
Spanish Fork Site, Utah County, Utah	490495010	40.1363	-111.6605	9.1	8.0	-1.10	**38.50**	30.9	-7.60
Tooele Site, Tooele County, Utah	490450003	40.5433	-112.2996	6.8	6.4	-0.40	25.40	20.9	-4.50

Note: Model-predicted concentrations that exceed the NAAQS are shown in **red bold** text.

Table 3-15 Model-Predicted PSD Increment Values – 2021 OTB Controls

Receptor Site	NO_2 (ppb)	SO_2 (ppb)			$PM_{2.5}$ (µg/m^3)		PM_{10} (µg/m^3)	
	Annual	3-hour	24-hour	Annual	24-hour	Annual	24-hour	Annual
Uinta Basin Study Area								
Uinta Basin Study Area	2.32	9.6	4.2	0.14	**48.8**	3.5	**49.1**	4.0
Dinosaur AQS Station	0.77	0.8	0.5	0.13	**20.0**	3.7	20.6	4.2
Ouray AQS Station	11.25	0.8	0.5	0.12	**35.9**	**8.1**	**36.3**	8.6
Rangely AQS Station	1.60	1.3	0.6	0.14	**10.6**	2.5	11.6	3.2
Redwash AQS Station	7.35	2.6	1.2	0.20	**21.1**	**4.6**	21.4	5.0
Class I Areas								
Arches NP	0.31	1.0	0.5	0.11	**10.5**	**2.2**	**10.7**	2.7
Black Canyon of the Gunnison WA	0.24	0.6	0.4	0.09	**4.8**	**1.4**	7.4	1.8
Bridger WA	0.21	4.1	**2.7**	0.24	**5.5**	**1.5**	8.0	1.9
Bryce Canyon NP	0.16	0.8	0.6	0.08	**12.0**	**1.9**	**15.8**	2.5
Canyonlands NP	0.22	3.5	1.0	0.11	**10.0**	**2.0**	**10.4**	2.4
Capitol Reef NP	0.18	2.1	0.7	0.10	**14.6**	**1.9**	**14.9**	2.4
Eagles Nest WA	0.63	3.5	1.3	0.12	**6.3**	**1.6**	**8.1**	1.9
Fitzpatrick WA	0.16	4.1	**2.5**	0.19	**4.6**	**1.4**	**8.4**	1.8
Flat Tops WA	0.24	2.2	0.8	0.12	**4.5**	**1.5**	**8.4**	1.8
La Garita WA	0.14	0.7	0.5	0.07	**3.8**	**1.2**	6.6	1.5
Maroon Bells-Snowmass WA	0.20	1.6	0.7	0.09	**4.1**	**1.3**	**8.1**	1.6
Mesa Verde NP	0.53	3.2	1.0	0.16	**6.3**	**1.7**	**8.6**	2.1
Mount Zirkel WA	0.46	2.6	1.4	0.23	**5.7**	**1.6**	7.5	2.0
Rawah WA	0.30	2.7	0.9	0.17	**6.8**	**1.5**	**8.1**	1.8

Table 3-15 Model-Predicted PSD Increment Values – 2021 OTB Controls

Receptor Site	NO_2 (ppb)	SO_2 (ppb)			$PM_{2.5}$ (µg/m^3)		PM_{10} (µg/m^3)	
	Annual	3-hour	24-hour	Annual	24-hour	Annual	24-hour	Annual
Rocky Mountain NP	0.38	6.1	**2.9**	0.17	**23.2**	**1.6**	**24.5**	1.9
Weminuche WA	0.25	1.4	0.7	0.08	**4.8**	**1.2**	**8.5**	1.6
West Elk WA	0.16	1.0	0.5	0.08	**7.6**	**1.3**	**8.9**	1.7
Class II Areas								
Dinosaur National Monument	0.51	1.6	0.7	0.14	**21.2**	2.5	21.6	2.9
Flaming Gorge National Recreation Area	0.52	21.4	6.1	0.19	**21.2**	2.3	21.8	2.7
Fort Hall IR	1.24	8.8	3.4	0.31	**28.4**	3.8	**45.0**	5.7
Goshute IR	0.10	0.6	0.3	0.06	5.3	1.2	11.5	1.8
High Uintas WA	0.16	2.1	0.7	0.10	7.5	1.8	11.6	2.2
Navajo IR	0.81	20.5	5.7	0.16	**25.7**	1.9	**30.7**	2.6
Paitute IR	0.41	2.2	0.6	0.10	**11.8**	2.0	14.7	2.8
Skull Valley IR	0.33	2.0	0.7	0.12	**12.3**	1.9	12.8	2.4
Southern Ute IR	2.53	4.8	1.0	0.12	**30.5**	1.7	**35.1**	2.1
Uintah and Ouray IR	2.56	9.7	4.7	0.14	**48.8**	3.6	**53.3**	4.1
Ute Mountain IR	1.07	9.4	3.7	0.22	**19.7**	2.0	20.4	2.6
Wind River IR	0.35	18.0	10.9	0.39	**9.9**	1.5	11.6	1.9

Note: Model-predicted concentrations that exceed the PSD Increments are shown in **red bold** text.

Table 3-16 Change in PSD Increment Values Between 2021 OTB Controls and 2010 Typical Year

Receptor Site	NO_2 (ppb)	SO_2 (ppb)			$PM_{2.5}$ ($\mu g/m^3$)		PM_{10} ($\mu g/m^3$)	
	Annual	3-hour	24-hour	Annual	24-hour	Annual	24-hour	Annual
Uinta Basin Study Area								
Uinta Basin Study Area	0.3	-3.3	-2.1	0.0	11.8	0.1	5.4	0.1
Dinosaur AQS Station	0.0	-0.6	-0.3	0.0	2.4	0.0	2.2	-0.1
Ouray AQS Station	4.9	-0.7	-0.1	0.0	6.0	1.3	5.5	1.2
Rangely AQS Station	-2.0	-0.2	-0.3	-0.1	-0.3	-0.1	-0.5	-0.2
Redwash AQS Station	4.1	0.0	-0.1	0.0	1.5	0.9	1.3	0.8
Class I Areas								
Arches NP	-0.2	-2.6	-1.1	-0.1	-6.5	-0.5	-6.7	-0.5
Black Canyon of the Gunnison WA	-0.2	-1.1	-0.4	-0.1	-1.5	-0.2	-0.4	-0.3
Bridger WA	0.0	1.4	1.4	0.1	-0.4	0.0	0.1	0.0
Bryce Canyon NP	-0.1	-1.2	-0.5	-0.1	-1.5	-0.4	-1.8	-0.4
Canyonlands NP	-0.1	-10.3	-2.9	-0.1	-7.6	-0.5	-7.8	-0.5
Capitol Reef NP	-0.1	-0.3	-1.2	-0.1	-3.7	-0.4	-3.8	-0.4
Eagles Nest WA	-0.6	-0.1	-0.2	-0.1	-1.0	-0.2	-1.1	-0.2
Fitzpatrick WA	0.0	2.4	1.7	0.1	-0.7	0.0	0.1	0.0
Flat Tops WA	-0.2	-2.5	-0.6	-0.1	-1.1	-0.2	0.0	-0.2
La Garita WA	-0.1	-1.5	-0.5	-0.1	-0.2	-0.1	0.0	-0.1
Maroon Bells-Snowmass WA	-0.1	0.0	-0.2	-0.1	-0.2	-0.1	0.0	-0.1
Mesa Verde NP	-0.8	-12.3	-3.4	-0.3	-2.1	-0.3	-0.4	-0.3
Mount Zirkel WA	-0.5	-2.1	-1.2	-0.2	-1.4	-0.2	-0.2	-0.2
Rawah WA	-0.3	-0.8	-0.7	-0.1	-1.5	-0.2	-1.6	-0.2

Table 3-16 Change in PSD Increment Values Between 2021 OTB Controls and 2010 Typical Year

	NO_2 (ppb)	SO_2 (ppb)			$PM_{2.5}$ (µg/m^3)		PM_{10} (µg/m^3)	
Receptor Site	**Annual**	**3-hour**	**24-hour**	**Annual**	**24-hour**	**Annual**	**24-hour**	**Annual**
Rocky Mountain NP	-0.4	0.2	0.0	-0.1	-1.0	-0.2	-1.1	-0.2
Weminuche WA	-0.2	-5.1	-1.3	-0.1	-0.2	-0.1	0.0	-0.1
West Elk WA	-0.1	-0.7	-0.4	-0.1	-0.2	-0.2	-0.2	-0.2
Class II Areas								
Dinosaur National Monument	0.0	-1.0	-0.7	0.0	3.5	-0.1	3.2	-0.2
Flaming Gorge National Recreation Area	-0.3	-9.8	-2.3	-0.1	6.8	-0.2	1.9	-0.3
Fort Hall IR	-0.4	-0.6	-2.3	-0.1	7.4	0.7	18.8	1.3
Goshute IR	0.0	-0.9	-0.5	-0.1	-1.6	-0.1	-0.1	-0.1
High Uintas WA	-0.1	0.4	-0.3	0.0	-2.0	-0.2	0.0	-0.2
Navajo IR	-0.6	-79.3	-24.8	-0.2	-12.8	-0.3	-8.9	-0.3
Paitute IR	-0.4	-0.5	-0.6	-0.2	-3.0	-0.4	-3.0	-0.4
Skull Valley IR	-0.1	0.1	-0.2	0.0	-1.6	-0.2	-1.5	-0.1
Southern Ute IR	-1.7	-11.0	-3.4	-0.2	-0.6	-0.2	-0.6	-0.3
Uintah and Ouray IR	0.4	-4.5	-2.3	0.0	-0.2	0.2	-1.0	0.1
Ute Mountain IR	-1.5	-23.6	-10.3	-0.5	-2.5	-0.4	-3.2	-0.6
Wind River IR	-0.3	-16.1	-10.7	-0.1	-2.8	-0.1	-2.9	-0.1

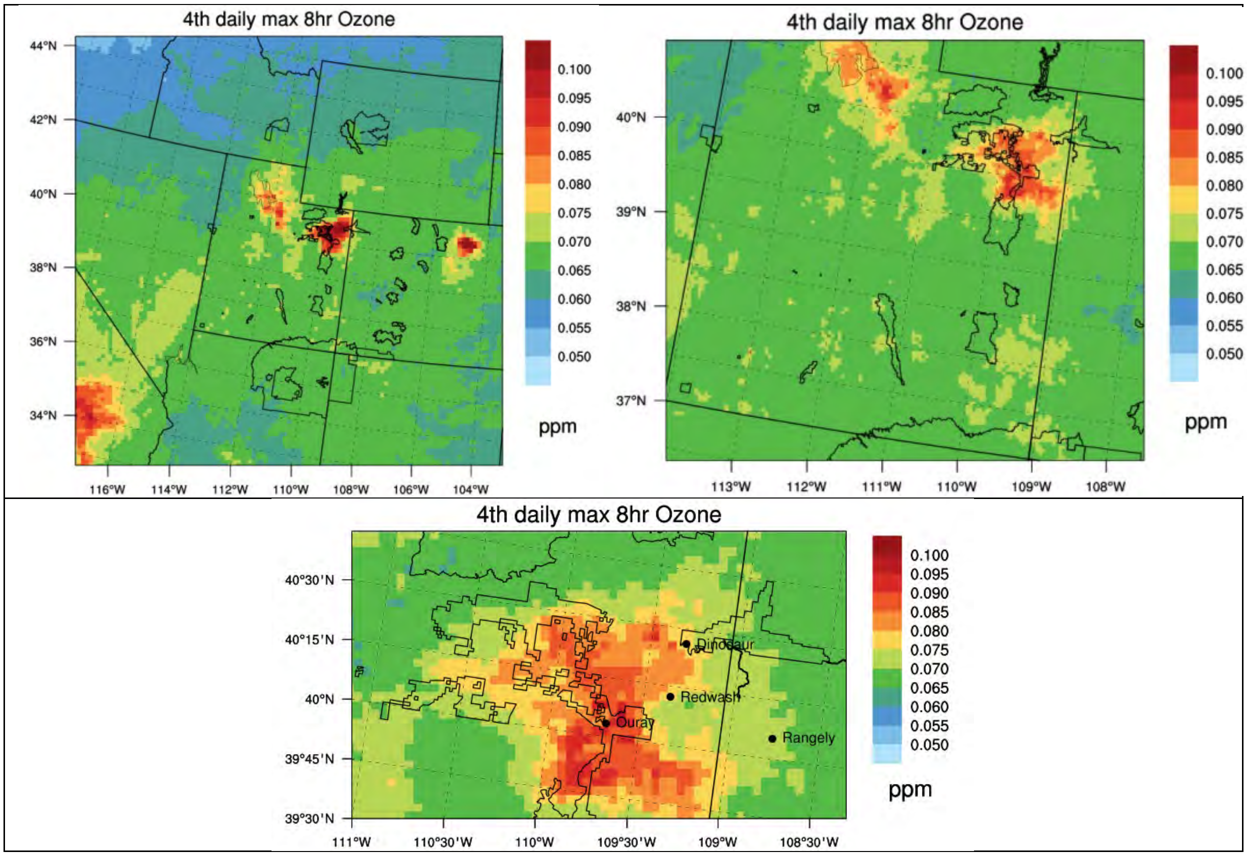

Figure 3-5 2021 OTB Controls Model-Predicted 4th Highest Daily Maximum 8-hour Ozone Spatial Plots

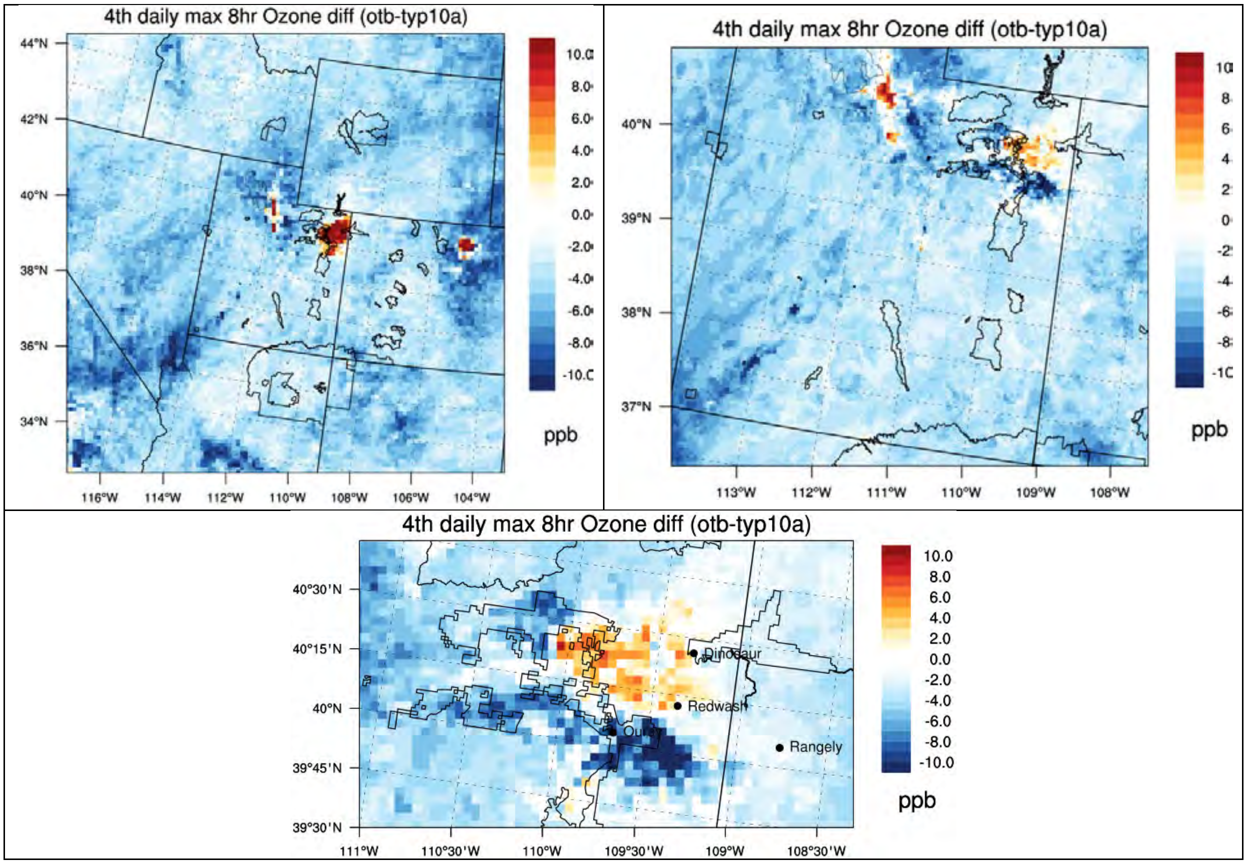

Figure 3-6 Absolute Difference between 2021 OTB Controls and 2010 Typical Year Model-Predicted 4th Highest Daily Maximum 8-hour Ozone Spatial Plots

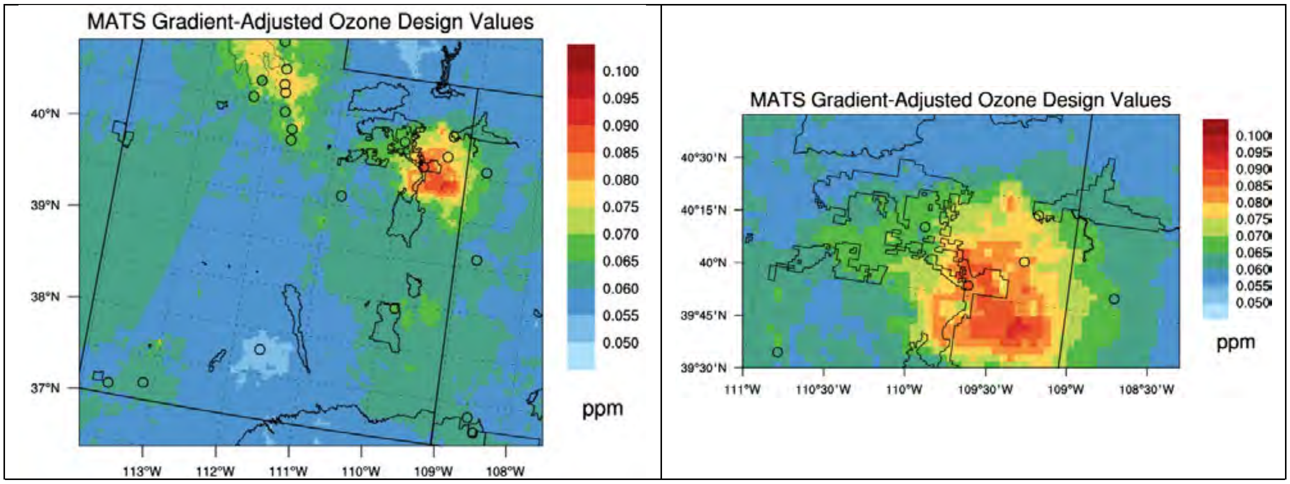

Figure 3-7 MATS Interpolated 2021 OTB Controls Ozone Design Values

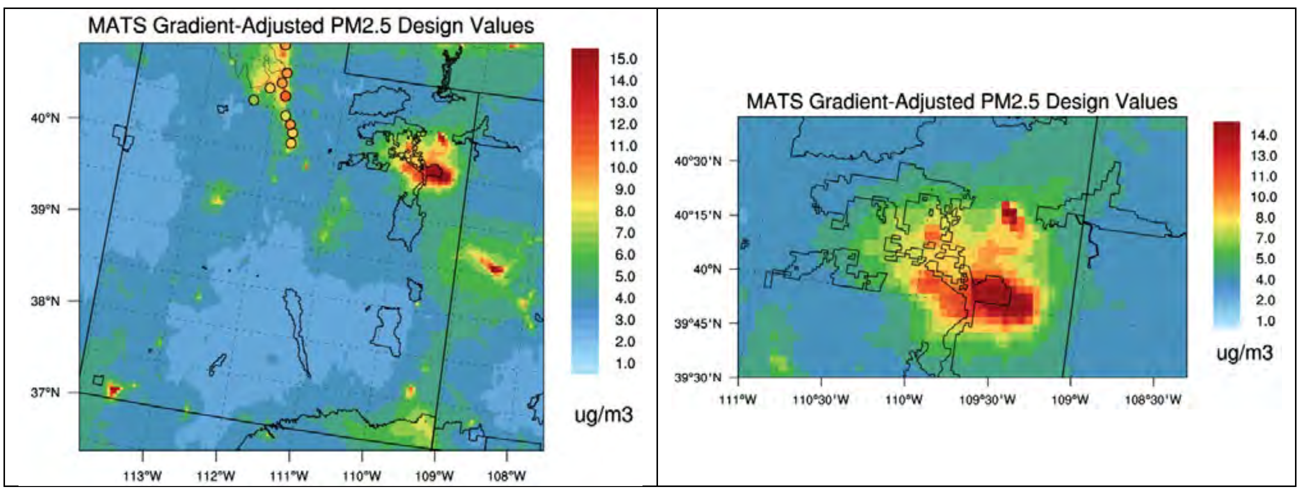

Figure 3-8 MATS Interpolated 2021 OTB Controls Annual $PM_{2.5}$ Design Values

3.6 2021 Scenario 1

For the purpose of this study, the results for the 2021 Scenario 1 are analyzed:

- Individually;
- Relative to the 2010 Typical Year; and
- Relative to 2021 OTB Controls.

An explanation of the differences between the three scenarios is found in Chapter 2. With the exception of the Uinta Basin study area, the emission inventories for the 2021 OTB Controls and Scenario 1 modeling scenarios are same. It is expected that 2021 Scenario 1 modeling results outside of the Uinta Basin study area are similar to the 2021 OTB Controls. Therefore, when comparing the 2021 Scenario to the 2021 OTB Controls, the discussion of the modeling results is limited to new results not previously seen or discussed.

3.6.1 Model-Predicted Cumulative Criteria Pollutant Impacts

3.6.1.1 Absolute Model Impacts for all Pollutants

Table 3-17 presents the 2021 Scenario 1 modeled cumulative air quality impacts at all assessment areas. In addition, the winter and non-winter model-predicted ozone concentrations are shown in **Table 3-17**. Similar to the previous model scenarios, only ozone is predicted to be above the NAAQS and state AAQS when evaluating the absolute model concentrations.[3] For the 2021 Scenario 1, one monitor within the Uinta Basin study area, three Class I areas, and two Sensitive Class II areas exceed the ozone standard. Similar to the other scenarios, the Uinta Basin study area is predicted to have the highest ozone concentration. The other criteria pollutants are well below their respective NAAQS for all assessment areas.

The differences between the 2021 Scenario 1 and 2010 Typical Year are presented in **Table 3-18**. Areas removed from the Uinta Basin study area generally have lower concentrations in 2021 Scenario 1 than the 2010 Typical Year scenario. Within the Uinta Basin study area, criteria pollutant concentrations tend to increase in 2021 Scenario 1 relative to 2010 Typical Year, particularly at Redwash and Ouray sites; however, ozone values within or near the Uinta Basin study area are slight smaller than the 2010 Typical Year.

The 4th highest daily maximum 8-hour ozone concentrations spatial plots are shown in **Figure 3-9** for the 2021 Scenario 1. The figure shows the 12-km domain, 4-km domain, and the Uinta Basin study area, from left to right, top to bottom. Similar to previous scenarios, regions with the highest ozone values occur in southern California, north central Colorado, and northern Utah with the lowest model ozone values in the northwestern portion of the 12-km domain. Similar to the 2021 OTB Control, the Scenario 1 results show the ozone NAAQS occur in isolated areas while a majority of the domain is under the standard. Within the Uinta Basin study area, the areas with highest ozone values are south of Ouray and Ouray is predicted to exceed the NAAQS, while other areas (Dinosaur, Redwash, and Rangely sites) are predicted be below the NAAQS. The spatial distribution is similar 2010 Typical Year modeling results (**Figure 3-3**). A more detailed analysis of the modeled ozone differences between the 2021 Scenario 1 and the 2021 OTB Scenario is available in Section 3.6.2 and **Appendix B**.

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[3] Note that in contrast to absolute model impacts, the MATS tool, which is used to calculate model-adjusted concentrations based on monitoring values, predicts potential exceedances of the NAAQS for $PM_{2.5}$.

3.6.1.2 Relative Model Impacts for Ozone and $PM_{2.5}$

Ozone

Table 3-19 provides the MATS 8-hour ozone design values for baseline and 2021 Scenario 1 at available monitoring sites in the 4-km domain for annual, winter and non-winter time periods. **Figure 3-1** shows the location of the monitoring sites relative to the assessment areas. As discussed in Section 3.1 and **Appendix A**, the baseline year is 2010 for the MATS monitoring sites. As shown in **Table 3-19**, the baseline design value exceed the ozone NAAQS for 2 of the 26 monitors.[4] Based on the model-predicted ozone changes between 2021 Scenario 1 and the baseline, the design value is projected to decrease at most monitoring sites; however, there is an increase in the number of monitors that are projected to exceed the NAAQS from two monitoring sites in 2010 to four monitoring sites in 2021. The highest predicted ozone design value in 2021 is 0.098 ppm, which occurs at Ouray within the Uinta Basin. Importantly, this is a 1 ppb increase relative to the baseline. Within the Uinta Basin, 2 of the 4 monitors are projected to have ozone design values that exceeding the NAAQS both in 2010 and in 2021.

For the UAA, the spatial interpolation of ozone design values are shown in **Figure 3-10** and the maximum ozone design value for assessment areas are presented in **Table 3-20**. **Table 3-21** shows the winter and non-winter ozone design values at unmonitored locations within the 4-km domain. For the spatial plots, the circles show the model-predicted design value at the monitoring sites as reported in **Table 3-19**. For the most part, the design values at monitoring sites correspond to the UAA. As shown in **Figure 3-10**, the 2021 predicted ozone design values that are close to or exceeding the NAAQS occur in Uinta Basin and Salt Lake City metropolitan area. These areas correspond to the same areas predicted to have elevated 8-hour ozone concentrations from the absolute model results (shown in **Figure 3-9**).

As shown in **Table 3-20**, the assessment areas with the highest ozone design values for the 2021 Scenario 1 are within or near the Uinta Basin study area. For the 2021 Scenario 1, ozone design values are lower than baseline values, except within the Uinta Basin study area where there is a 2 ppb increase. The number of areas predicted to exceed the NAAQS decreases from 5 areas to 2 areas: the Uinta Basin study area and Uintah and Ouray IR. All other assessment areas have ozone design values below the NAAQS in 2021.

$PM_{2.5}$

In addition to the ozone analysis, an analysis of the relative model impacts of annual and daily $PM_{2.5}$ was conducted using MATS. **Table 3-22** presents the MATS-estimated baseline and 2021 Scenario 1 $PM_{2.5}$ design values at monitor locations within the 4-km domain. Due to the limited number $PM_{2.5}$ monitors, the closest monitors to the Uinta Basin study area are near Salt Lake City. For annual $PM_{2.5}$, only one monitor is modeled with design values above the NAAQS, 490350003. All of the monitors have lower annual and daily $PM_{2.5}$ design values modeled in 2021 Scenario 1 relative to the baseline. In addition, the number of monitors that are projected to exceed the NAAQS decreases from seven monitors in 2010 to one monitor in 2021. The monitor with the projected exceedence in 2021 is in Salt Lake City area, site ID 490350003.

For the UAA, spatial plots of the spatially interpolated annual $PM_{2.5}$ design values are shown in **Figure 3-11**. Since MATS does not provided spatial interpolation of daily $PM_{2.5}$, only the annual $PM_{2.5}$ is used for the UAA. The maximum annual $PM_{2.5}$ design value for the assessment areas are shown in **Table 3-20**. Like the ozone deign value spatial plot, the circles show the model-predicted design value at the monitoring sites as reported in **Table 3-22**. In general the monitor values correspond to the spatial interpolation. However, there are large spatial gradients in the modeled concentrations, which can make

[4] It is important to note that currently there is insufficient data collected at regulatory monitors in the Uinta Basin study area to calculate a true ozone design value. All future year ozone design values reported for the Uinta Basin do not represent actual design values and are for informational purposes only.

it difficult to visually compare the monitoring values to the UAA spatial plot values. Throughout the 4-km domain, MATS spatial analysis show several small isolated areas with annual $PM_{2.5}$ design values close or exceeding the NAAQS. Areas of elevated annual $PM_{2.5}$ design values include the Uinta Basin study area, Salt Lake City area, and the southwest corner of Utah. For 2021 Scenario 1 the assessment areas within or near the Uinta Basin have the highest maximum annual $PM_{2.5}$ design values, as well as Fort Hall IR, Navajo IR, and Wind River IR (**Table 3-20**). The only assessment areas with annual $PM_{2.5}$ design values above the NAAQS are the Uinta Basin study area and Uintah and Ouray IR for both the baseline and 2021 Scenario 1, and both these areas are predicted to increase in 2021 relative to the baseline.

3.6.2 Comparison of Control Scenario 1 to OTB Controls

In the following sections, the 2021 Scenario 1 modeling results are compared to the 2021 OTB Controls modeling results. Due to the location of the emission inventory differences, the focus of the comparison is on results near and in the Uinta Basin study area. For completeness, differences for all assessment areas and domains are shown.

3.6.2.1 Differences in Absolute Model Impacts for all Pollutants

Table 3-23 shows the change in the model predicted ambient air quality impacts between 2021 Scenario 1 and OTB Controls. As expected, the largest differences are modeled near the Uinta Basin study area, where the differences in the emissions inventory occur. Relative to the 2021 OTB Controls, the NO_2, PM_{10}, and $PM_{2.5}$ <u>emissions</u> for the 2021 Scenario 1 decrease while the SO_2, CO, and VOC <u>emissions</u> are relatively similar (as shown in **Table 2-10**). Correspondingly, the 1-hour and annual NO_2, 24-hour and annual $PM_{2.5}$, and annual PM_{10} values for areas within or near the Uinta Basin study area are predicted to be lower for 2021 Scenario 1 than the 2021 OTB Controls. Small or no differences are shown with 1-hour and 8-hour CO and 1-hour and 3-hour SO_2. For 2021 Scenario 1 ozone values relative to 2021 OTB Controls, four assessment areas have slightly lower concentrations, three assessment areas have concentrations 6-13 ppb higher, and the remaining assessment areas are unchanged.

Spatial plots of the difference in the 4^{th} maximum ozone concentrations between 2021 Scenario 1 and OTB Controls are shown in **Figure 3-12**. The only areas with measureable differences in the ozone concentrations are near or within the Uinta Basin study area. Within the Uinta Basin study area, it appears that the areas with highest ozone values are shifted slightly south and east. Relative to the 2021 OTB Controls, the modeled ozone values have decreased in northern half of the study area and increased in the southern half. The largest increase (up to 10 ppb) is shown southeast of Ouray which corresponds to the area with the highest ozone concentrations in 2021 Scenario 1. As discussed in **Appendix B**, the differences in the ozone impact between 2021 Scenario 1 and the OTB Controls are related to the implementation of mitigations measures and spatial differences in the NOx-limited and VOC-limited areas.

3.6.2.2 Differences in Relative Model Impacts for Ozone and $PM_{2.5}$

The change in the MATS-estimated ozone and $PM_{2.5}$ impacts between 2021 Scenario 1 and OTB Controls are shown in **Tables 3-24** and **3-25,** respectively, for all monitored locations.

<u>Ozone</u>

As shown in **Table 3-24**, the Dinosaur monitor is predicted to have a lower ozone design value, while Ouray and Redwash are predicted to have higher ozone deign values in Scenario 1 than is predicted for OTB Controls. The predicted ozone impacts are unchanged for all other monitors. Importantly, both the absolute model impacts (**Table 3-23**) and relative model impacts (**Table 3-24**) predict an ozone increase in Scenario 1 relative to OTB Controls at Ouray. However, at the Redwash Site, analysis of the absolute model impacts shows a slight ozone decrease of about 1 ppb, whereas the MATS analysis shows an ozone increase of about 7 ppb. This difference highlights the importance of assessing the relative model impacts. In this case, the difference between the absolute and relative model results is attributable to higher ozone concentrations within the vicinity of the Redwash monitor that are incorporated into the MATS results, but not the absolute model impacts which only evaluate the concentrations at the Redwash monitor.

The change in UAA ozone design values are shown in **Table 3-26** for all assessment areas. **Table 3-17** shows the change in winter and non-winter ozone design values at unmonitored locations within the 4-km domain. **Table 3-26** shows that under Scenario 1 the predicted ozone design values would increase relative to the OTB Controls in: the Uinta Basin study area, Uintah and Ouray IR, and Dinosaur National Monument. All other areas have slightly lower predicted ozone or are unchanged relative to the OTB Controls.

$PM_{2.5}$

As shown in **Table 3-25**, one monitor near Salt Lake City has a lower daily $PM_{2.5}$ design value for Scenario 1 relative to OTB Controls. On the other hand, the UAA (shown in **Tables 3-26**) shows that four assessment areas are predicted to have lower annual $PM_{2.5}$ design values than the OTB Controls. These areas are: Uinta Basin study area, Uintah and Ouray IR, Dinosaur National Monument, and Flaming Gorge National Recreation Area. The largest decrease of annual $PM_{2.5}$ design values is modeled for Uintah and Ouray IR.

3.6.3 PSD Increment Assessment

The PSD increments for 2021 Scenario 1 are shown in **Table 3-28** for all assessment areas. If all model sources were increment consuming sources, model predicted impacts would exceed allowable increments for 24-hour $PM_{2.5}$ at most assessment areas. Similar to the results from the 2021 OTB Controls, 3-hour SO_2, annual SO_2, annual NO_2, and annual PM_{10} impacts are within allowable PSD increments for all assessment areas. Within the Uinta Basin study area, all sites exceed the 24-hour $PM_{2.5}$ increment. In addition, the annual $PM_{2.5}$ increment is exceeded at the Ouray and Redwash stations, and the 24-hour PM_{10} increment is exceeded the Ouray station and Uinta Basin study area is above increment. The model results for the other increments and assessment areas are similar to the 2021 OTB Controls and 2010 Typical Year results.

Table 3-29 shows the model-predicted change in air quality between 2021 Scenario 1 and 2010 Typical Year for the PSD increments. Relative to the 2010 Typical Year, the majority of the PSD increments at most assessment areas are modeled lower for the 2021 Scenario 1. For the Ouray and Redwash stations, the annual NO_2 and annual $PM_{2.5}$ PSD increments are higher in 2021 Scenario 1 than the 2010 Typical Year. In addition, the 24-hour $PM_{2.5}$ PSD increments are higher at Uinta Basin study area, Ouray station, and the Flaming Gorge National Recreation Area. For the most part, all of the impacts are lower near or within the Uinta Basin study area in 2021 Scenario 1 than in the 2010 Typical Year. With the exception of the PM differences shown at Fort Hall IR, the majority of the modeled differences for all assessment areas are relatively small.

3.6.3.1 Comparison of Control Scenario 1 to OTB Controls

Changes between 2021 Scenario 1 and OTB Controls are shown in **Table 3-30** relative to PSD Increments. As discussed previously due to the changes in the emission inventory, the largest differences between the scenarios occur at assessment areas near or within the Uinta Basin study area. However, it should be noted that there are small changes seen in the 24-hour PM values at assessment areas farther from Uinta Basin study area. The annual NO_2 and all PM concentrations are lower in Scenario 1 corresponding to the NO_x, $PM_{2.5}$, and PM_{10} emissions reductions (**Table 2-10**). Since the Scenario 1 SO_2 emissions did not change from the OTB Controls, there is no model difference in the SO_2 values between the scenarios.

Table 3-17 Model-Predicted Ambient Air Quality Impacts Compared to NAAQS – 2021 Scenario 1

Receptor Site	NO_2 (ppb)		CO (ppm)		SO_2 (ppb)		O_3 (ppm) 8-hour			$PM_{2.5}$ (µg/m^3)		PM_{10} (µg/m^3)
	1-hour	Annual	1-hour	8-hour	1-hour	3-hour	Annual	Winter	Non-Winter	24-hour	Annual	24-hour
Uinta Basin Study Area												
Uinta Basin Study Area	22	2	2	1	2	0	**0.127**	**0.127**	**0.082**	13	3.2	40
Dinosaur AQS Station	3	1	0	0	1	0	0.075	0.075	0.068	12	3.4	20
Ouray AQS Station	40	9	1	1	1	0	**0.097**	**0.097**	0.073	25	7.0	30
Rangely AQS Station	5	2	0	0	1	0	0.070	0.066	0.069	7	2.4	10
Redwash AQS Station	24	7	0	0	2	0	0.074	0.074	0.069	13	4.2	20
Class I Areas												
Arches NP	1	0	1	0	1	0	**0.079**	0.060	**0.079**	6	2.1	10
Black Canyon of the Gunnison WA	1	0	0	0	1	0	0.067	0.061	0.067	3	1.4	10
Bridger WA	1	0	0	0	3	0	0.070	0.061	0.070	4	1.5	10
Bryce Canyon NP	1	0	0	0	1	0	0.074	0.058	0.074	4	1.9	20
Canyonlands NP	1	0	0	0	1	0	**0.078**	0.065	**0.078**	6	1.9	10
Capitol Reef NP	1	0	0	0	1	0	0.075	0.068	0.075	5	1.9	10
Eagles Nest WA	3	1	0	0	2	0	0.070	0.062	0.070	4	1.6	10
Fitzpatrick WA	1	0	0	0	3	0	0.069	0.060	0.069	4	1.4	10
Flat Tops WA	1	0	0	0	1	0	0.072	0.063	0.072	3	1.5	10
La Garita WA	1	0	0	0	1	0	0.070	0.067	0.070	3	1.2	10
Maroon Bells-Snowmass WA	1	0	0	0	1	0	0.068	0.062	0.068	3	1.3	10
Mesa Verde NP	4	1	0	0	2	0	0.073	0.067	0.073	4	1.7	10
Mount Zirkel WA	2	0	0	0	2	0	0.071	0.069	0.071	4	1.6	10
Rawah WA	2	0	0	0	2	0	0.072	0.066	0.072	4	1.5	10
Rocky Mountain NP	2	0	1	0	4	0	**0.076**	0.067	**0.076**	4	1.6	20
Weminuche WA	1	0	0	0	1	0	0.070	0.070	0.070	3	1.2	10
West Elk WA	1	0	0	0	1	0	0.068	0.063	0.068	3	1.3	10

Table 3-17 Model-Predicted Ambient Air Quality Impacts Compared to NAAQS – 2021 Scenario 1

Receptor Site	NO_2 (ppb)		CO (ppm)		SO_2 (ppb)		O_3 (ppm) 8-hour			$PM_{2.5}$ (µg/m^3)		PM_{10} (µg/m^3)
	1-hour	Annual	1-hour	8-hour	1-hour	3-hour	Annual	Winter	Non-Winter	24-hour	Annual	24-hour
Class II Areas												
Dinosaur National Monument	2	0	1	0	1	0	**0.093**	**0.093**	0.073	8	2.4	20
Flaming Gorge National Recreation Area	3	1	1	0	4	0	0.073	0.071	0.073	7	2.2	20
Fort Hall IR	7	1	1	0	5	0	0.067	0.065	0.067	12	3.8	50
Goshute IR	0	0	0	0	0	0	0.070	0.058	0.070	3	1.2	10
High Uintas WA	1	0	0	0	1	0	0.073	0.071	0.073	4	1.8	10
Navajo IR	6	1	0	0	3	0	0.075	0.068	0.075	6	1.9	30
Paitute IR	2	0	1	0	1	0	0.072	0.072	0.072	5	2.0	10
Skull Valley IR	2	0	0	0	2	0	0.070	0.068	0.069	6	1.9	10
Southern Ute IR	16	3	1	0	1	0	0.072	0.069	0.072	4	1.7	40
Uintah and Ouray IR	27	2	3	1	2	0	**0.127**	**0.127**	**0.079**	15	3.3	50
Ute Mountain IR	7	1	1	0	3	0	0.072	0.067	0.072	6	2.0	20
Wind River IR	2	0	0	0	7	0	0.071	0.062	0.071	4	1.5	10

Note: Model-predicted concentrations that exceed the NAAQS are shown in **red bold** text.

Table 3-18 Change in Model-Predicted Ambient Air Quality Impacts Between 2021 Scenario 1 and 2010 Typical Year

Receptor Site	NO_2 (ppb)		CO (ppm)		SO_2 (ppb)		O_3 (ppm) 8-hour			$PM_{2.5}$ (µg/m^3)		PM_{10} (µg/m^3)
	1-hour	Annual	1-hour	8-hour	1-hour	3-hour	Annual	Winter	Non-Winter	24-hour	Annual	24-hour
Uinta Basin Study Area												
Uinta Basin Study Area	3	0	-2	-2	0	0	0.001	0.001	0.000	-1	-0.2	0
Dinosaur AQS Station	0	0	0	0	0	0	-0.002	-0.002	-0.005	-2	-0.3	0
Ouray AQS Station	11	3	0	1	0	0	-0.001	-0.001	-0.002	0	0.2	0
Rangely AQS Station	-10	-2	0	0	0	0	-0.002	0.002	-0.003	0	-0.2	0
Redwash AQS Station	11	4	0	0	0	0	0.000	0.001	-0.003	0	0.4	0
Class I Areas												
Arches NP	-1	-1	1	0	-1	0	-0.002	-0.007	-0.002	-3	-0.6	-10
Black Canyon of the Gunnison WA	-1	0	0	0	0	0	-0.006	-0.006	-0.006	-1	-0.3	0
Bridger WA	0	0	0	0	1	0	-0.004	-0.007	-0.004	0	0.0	0
Bryce Canyon NP	0	0	0	0	0	0	-0.006	-0.007	-0.006	-2	-0.4	0
Canyonlands NP	-1	0	0	0	-1	0	-0.002	-0.007	-0.002	-2	-0.5	-10
Capitol Reef NP	-1	0	0	0	-1	0	-0.005	-0.004	-0.005	-2	-0.4	-10
Eagles Nest WA	-3	0	0	0	0	0	-0.004	-0.005	-0.004	0	-0.2	0
Fitzpatrick WA	0	0	0	0	1	0	-0.004	-0.012	-0.003	0	-0.1	0
Flat Tops WA	0	0	0	0	0	0	0.001	-0.003	0.001	-1	-0.1	0
La Garita WA	-2	0	0	0	-1	0	-0.004	-0.002	-0.004	0	-0.1	0
Maroon Bells-Snowmass WA	-1	0	0	0	0	0	-0.004	-0.009	-0.004	0	-0.1	0
Mesa Verde NP	-5	0	0	0	-8	0	-0.005	-0.003	-0.005	-1	-0.2	0
Mount Zirkel WA	-2	-1	0	0	-1	0	-0.006	-0.002	-0.006	0	-0.2	0
Rawah WA	-1	-1	0	0	-1	0	-0.004	-0.004	-0.004	0	-0.2	0
Rocky Mountain NP	-2	-1	0	0	0	0	-0.011	-0.003	-0.011	0	-0.1	-10
Weminuche WA	-2	0	0	0	-1	0	-0.006	-0.006	-0.004	0	-0.1	0
West Elk WA	0	0	0	0	0	0	-0.006	-0.006	-0.006	0	-0.2	0

Table 3-18 Change in Model-Predicted Ambient Air Quality Impacts Between 2021 Scenario 1 and 2010 Typical Year

Receptor Site	NO_2 (ppb)		CO (ppm)		SO_2 (ppb)		O_3 (ppm) 8-hour			$PM_{2.5}$ (µg/m³)		PM_{10} (µg/m³)
	1-hour	Annual	1-hour	8-hour	1-hour	3-hour	Annual	Winter	Non-Winter	24-hour	Annual	24-hour
Class II Areas												
Dinosaur National Monument	0	-1	0	0	0	0	0.005	0.005	-0.002	-1	-0.3	0
Flaming Gorge National Recreation Area	-2	0	1	0	-3	0	-0.007	-0.009	-0.004	-1	-0.3	0
Fort Hall IR	-3	-1	0	0	1	0	-0.005	-0.006	-0.005	2	0.7	20
Goshute IR	0	0	0	0	-1	0	-0.006	-0.002	-0.006	0	-0.1	0
High Uintas WA	0	0	0	0	0	0	-0.008	-0.010	-0.003	-1	-0.2	0
Navajo IR	-5	0	0	0	-8	-100	-0.007	-0.004	-0.007	-1	-0.3	-10
Paitute IR	-3	-1	0	0	-1	0	-0.017	-0.017	-0.006	-1	-0.4	-10
Skull Valley IR	-1	0	0	0	1	0	-0.003	-0.003	-0.004	-1	-0.2	0
Southern Ute IR	-11	-1	0	0	-5	0	-0.006	-0.005	-0.006	-1	-0.2	0
Uintah and Ouray IR	6	0	0	0	-2	0	0.002	0.002	-0.001	0	-0.1	0
Ute Mountain IR	-8	-2	0	0	-12	0	-0.006	-0.006	-0.006	-1	-0.4	0
Wind River IR	-2	-1	0	0	-6	0	-0.004	-0.006	-0.004	-1	-0.2	0

Table 3-19 MATS-Estimated Ozone Impacts at Monitored Locations – 2021 Scenario 1

Receptor Site Name or City	Site ID	Latitude	Longitude	Annual (ppm)			Winter (ppm)			non-Winter (ppm)		
				Baseline Monitor O_3 Design Value	2021 Scenario 1 O_3 Design Value	Difference	Baseline Monitor O_3 Design Value	2021 Scenario 1 O_3 Design Value	Difference	Baseline Monitor O_3 Design Value	2021 Scenario 1 O_3 Design Value	Difference
Uinta Basin Study Area												
Dinosaur NM, Uintah County, Utah*	490471002	40.4300	-109.3000	0.071	0.069	-0.002	0.072	0.070	-0.002	0.065	0.062	-0.003
Ouray Site, Uintah County, Utah*	490472003	40.0500	-109.6800	**0.097**	**0.098**	0.001	**0.096**	**0.096**	0.000	0.063	0.060	-0.003
Rangely Site, Rio Blanco County, Colorado*	81030006	40.0800	-108.7600	0.064	0.064	0.000	0.046	0.047	0.001	0.064	0.061	-0.003
Red Wash Site, Uintah County, Utah*	490472002	40.2000	-109.3500	**0.086**	**0.083**	-0.003	**0.084**	**0.082**	-0.002	0.061	0.058	-0.003
Utah Stations Outside of Uinta Basin Study Area												
Bountiful Site, Davis County, Utah	490110004	40.9000	-111.8800	0.071	0.070	-0.001	NA	NA	NA	0.071	0.067	-0.004
Canyonlands NP Site, San Juan County, Utah	490370101	38.4500	-109.8100	0.069	0.065	-0.004	0.058	0.052	-0.006	0.067	0.064	-0.003
Cottonwood Site, Salt Lake County, Utah	490350003	40.6400	-111.8400	0.075	**0.077**	0.002	NA	NA	NA	0.074	0.073	-0.001
Escalante Site, Garfield County, Utah	490170004	37.7700	-111.6100	0.053	0.050	-0.003	0.045	0.042	-0.003	NA	NA	NA
Fruitland Site, Duchesne County, Utah	490131001	40.3000	-110.0000	0.067	0.065	-0.002	0.049	0.046	-0.003	0.065	0.062	-0.003
Harrisville Site, Weber County, Utah	490571003	41.3000	-111.9800	0.073	0.070	-0.003	NA	NA	NA	0.072	0.068	-0.004
Hawthorne Site, Salt Lake County, Utah	490353006	40.7300	-111.8700	0.075	**0.076**	0.001	0.049	0.055	0.006	0.075	0.072	-0.003
Highland Site, Utah County, Utah	490495008	40.4300	-111.8000	0.067	0.066	-0.001	NA	NA	NA	0.066	0.062	-0.004
Lakepoint Site, Salt Lake County, Utah	490352004	40.7300	-112.2100	0.074	0.068	-0.006	NA	NA	NA	0.072	0.066	-0.006
North Provo Site, Utah County, Utah	490490002	40.2500	-111.6600	0.069	0.066	-0.003	0.047	0.049	0.002	0.069	0.065	-0.004
Ogden Site, Weber County, Utah	490570002	41.2000	-111.9700	0.072	0.069	-0.003	0.046	0.044	-0.002	0.071	0.067	-0.004
Price Site, Carbon County, Utah	490071003	39.6000	-110.8000	0.070	0.064	-0.006	0.049	0.044	-0.005	0.068	0.064	-0.004
Spanish Fork Site, Utah County, Utah	490495010	40.1300	-111.6500	0.069	0.066	-0.003	NA	NA	NA	0.068	0.064	-0.004
St. George Site, Washington County, Utah	490530006	37.1200	-113.6300	0.067	0.060	-0.007	NA	NA	NA	0.066	0.059	-0.007
Tooele Site, Tooele County, Utah	490450003	40.5400	-112.2900	0.072	0.065	-0.007	NA	NA	NA	0.071	0.066	-0.005
Zion NP Site, Washington County, Utah	490530130	37.1900	-113.1500	0.071	0.063	-0.008	0.057	0.049	-0.008	0.070	0.063	-0.007
Colorado												
Cortez Site, Montezuma County, Colorado	80830006	37.3500	-108.5900	0.066	0.060	-0.006	0.053	0.049	-0.004	0.065	0.059	-0.006
Grand Junction Site, Mesa County, Colorado	80771001	39.1000	-108.7400	0.064	0.060	-0.004	0.062	0.056	-0.006	0.062	0.059	-0.003
Meeker Site, Rio Blanco County, Colorado	81030005	40.0300	-107.8400	0.064	0.060	-0.004	0.053	0.048	-0.005	0.064	0.060	-0.004
Mesa Verde NP Site, Montezuma County, Colorado	80830101	37.1900	-108.4900	0.068	0.062	-0.006	0.000	0.000	0.000	0.000	0.000	0.000
Wyoming												
Evanston Site, Uinta County, Wyoming	560410101	41.3700	-111.0400	0.060	0.054	-0.006	0.052	0.047	-0.005	0.062	0.055	-0.007
Wamsutter Southeast Site, Sweetwater County, Wyoming	560370200	41.6700	-108.0200	0.064	0.059	-0.005	0.055	0.051	-0.004	0.062	0.057	-0.005

Note: Model-predicted concentrations that exceed the NAAQS are shown in **red bold** text.

Table 3-20 MATS-Estimated Ozone and PM2.5 Impacts at Unmonitored Locations– 2021 Scenario 1

Receptor Site	Ozone Design Value (ppm)			Annual $PM_{2.5}$ Design Value ($\mu g/m^3$)		
	Baseline	2021 Scenario 1 Controls	Difference	Baseline	2021 Scenario 1 Controls	Difference
Uinta Basin Study Area						
Uinta Basin Study Area	0.102	0.104	0.002	14.9	17.1	2.2
Class I Areas						
Arches NP	0.068	0.065	-0.003	4.6	4.4	-0.2
Black Canyon of the Gunnison WA	0.066	0.061	-0.005	3.4	3.1	-0.3
Bridger WA	0.073	0.067	-0.006	5.3	5.5	0.2
Bryce Canyon NP	0.062	0.058	-0.004	2.7	2.6	-0.1
Canyonlands NP	0.068	0.065	-0.003	3.2	3.0	-0.2
Capitol Reef NP	0.063	0.060	-0.003	3.2	3.0	-0.2
Eagles Nest WA	0.067	0.063	-0.004	3.8	3.5	-0.3
Fitzpatrick WA	0.071	0.066	-0.005	3.9	4.1	0.2
Flat Tops WA	0.067	0.063	-0.004	2.7	2.6	-0.1
La Garita WA	0.068	0.064	-0.004	2.6	2.5	-0.1
Maroon Bells-Snowmass WA	0.067	0.062	-0.005	2.3	2.2	-0.1
Mesa Verde NP	0.067	0.061	-0.006	4.1	3.8	-0.3
Mount Zirkel WA	0.071	0.064	-0.007	2.3	2.3	0.0
Rawah WA	0.070	0.064	-0.006	2.7	2.6	-0.1
Rocky Mountain NP	0.076	0.067	-0.009	3.7	3.6	-0.1
Weminuche WA	0.070	0.064	-0.006	3.0	2.9	-0.1
West Elk WA	0.066	0.062	-0.004	2.8	2.6	-0.2

Table 3-20 MATS-Estimated Ozone and PM2.5 Impacts at Unmonitored Locations– 2021 Scenario 1

Receptor Site	Ozone Design Value (ppm)			Annual $PM_{2.5}$ Design Value ($\mu g/m^3$)		
	Baseline	2021 Scenario 1 Controls	Difference	Baseline	2021 Scenario 1 Controls	Difference
Class II Areas						
Dinosaur National Monument	**0.076**	0.075	-0.001	5.5	5.2	-0.3
Flaming Gorge National Recreation Area	0.061	0.057	-0.004	7.1	7.1	0.0
Fort Hall IR	0.070	0.065	-0.005	7.2	11.2	4.0
Goshute IR	0.067	0.061	-0.006	2.9	2.9	0.0
High Uintas WA	0.065	0.060	-0.005	3.9	3.6	-0.3
Navajo IR	0.072	0.067	-0.005	7.5	11.1	3.6
Paitute IR	**0.076**	0.064	-0.012	5.7	5.5	-0.2
Skull Valley IR	0.065	0.060	-0.005	3.4	3.3	-0.1
Southern Ute IR	0.070	0.064	-0.006	4.6	4.6	0.0
Uintah and Ouray IR	**0.102**	**0.101**	-0.001	**12.1**	**17.1**	5.0
Ute Mountain IR	0.072	0.066	-0.006	7.0	6.8	-0.2
Wind River IR	0.072	0.067	-0.005	11.0	10.0	-1.0

Note: Model-predicted concentrations that exceed the NAAQS are shown in red bold text.

Table 3-21 MATS-Estimated Winter and Non-Winter Ozone Impacts at Unmonitored Locations – 2021 Scenario 1

Receptor Site	Winter Ozone Design Value (ppm)			Non-Winter Ozone Design Value (ppm)		
	Baseline	2021 Scenario 1	Difference	Baseline	2021 Scenario 1	Difference
Uinta Basin Study Area						
Uinta Basin Study Area	**0.098**	**0.098**	0.000	0.067	0.066	-0.001
Class I Areas						
Arches NP	0.056	0.050	-0.006	0.066	0.063	-0.003
Bryce Canyon NP	0.051	0.047	-0.004	0.068	0.064	-0.004
Canyonlands NP	0.058	0.053	-0.005	0.068	0.065	-0.003
Capitol Reef NP	0.051	0.047	-0.004	0.068	0.064	-0.004
Mesa Verde NP	0.056	0.052	-0.004	0.066	0.060	-0.006
Class II Areas						
Dinosaur National Monument	0.075	0.073	-0.002	0.065	0.062	-0.003
Flaming Gorge National Recreation Area	0.053	0.049	-0.004	0.062	0.059	-0.003
Goshute IR	0.044	0.041	-0.003	0.066	0.060	-0.006
High Uintas WA	0.052	0.047	-0.005	0.066	0.061	-0.005
Paitute IR	0.070	0.057	-0.013	0.070	0.064	-0.006
Skull Valley IR	0.049	0.046	-0.003	0.064	0.060	-0.004
Uintah and Ouray IR	**0.098**	**0.098**	0.000	0.067	0.063	-0.004

Note: Model-predicted concentrations that exceed the NAAQS are shown in **red bold** text.

Table 3-22 MATS-Estimated $PM_{2.5}$ Impacts at Monitored Locations – 2021 Scenario 1

Receptor Site Name or City	Site ID	Latitude	Longitude	Annual $PM_{2.5}$ Design Value ($\mu g/m^3$)			Daily $PM_{2.5}$ Design Value ($\mu g/m^3$)		
				Baseline Monitor	2021 Scenario 1	Difference	Baseline Monitor	2021 Scenario 1	Difference
Bountiful Site, Davis County, Utah	490110004	40.9030	-111.8845	10.2	9.6	-0.60	**37.40**	32.8	-4.60
Cottonwood Site, Salt Lake County, Utah	490350003	40.6467	-111.8497	11.1	10.6	-0.50	**45.40**	**39.8**	-5.60
Harrisville Site, Weber County, Utah	490571003	41.3037	-111.9871	8.9	8.1	-0.80	**35.10**	27.3	-7.80
Highland Site, Utah County, Utah	490495008	40.4303	-111.8039	8.5	7.7	-0.80	31.70	25.6	-6.10
Lindon Site, Utah County, Utah	490494001	40.3414	-111.7136	10.3	9.3	-1.00	**37.90**	31.2	-6.70
Magna Salt Lake City Site, Salt Lake County, Utah	490351001	40.7086	-112.0947	8.6	8.5	-0.10	32.40	27.6	-4.80
Ogden Site, Weber County, Utah	490570002	41.2064	-111.9747	10.3	9.3	-1.00	**38.40**	31.1	-7.30
Provo Site, Utah County, Utah	490490002	40.2536	-111.6631	9.9	8.8	-1.10	33.30	26.1	-7.20
Rose Park Salt Lake City Site, Salt Lake County, Utah	490353010	40.7842	-111.9310	10.4	9.8	-0.60	**39.00**	33.3	-5.70
Spanish Fork Site, Utah County, Utah	490495010	40.1364	-111.6597	9.1	8.0	-1.10	**38.50**	30.8	-7.70
Tooele Site, Tooele County, Utah	490450003	40.5434	-112.2988	6.8	6.4	-0.40	25.40	20.9	-4.50

Note: Model-predicted concentrations that exceed the NAAQS are shown in **red bold** text.

Table 3-23 Change in Model-Predicted Ambient Air Quality Impacts Between 2021 Scenario 1 and OTB Controls

Receptor Site	NO_2 (ppb)		CO (ppm)		SO_2 (ppb)		O_3 (ppm) 8-hour			$PM_{2.5}$ (μg/m^3)		PM_{10} (μg/m^3)
	1-hour	Annual	1-hour	8-hour	1-hour	3-hour	Annual	Winter	Non-Winter	24-hour	Annual	24-hour
Uinta Basin Study Area												
Uinta Basin Study Area	-7	0	0	-1	0	0	0.010	0.010	0.001	-3	-0.3	-10
Dinosaur AQS Station	-1	0	0	0	0	0	-0.002	-0.002	-0.001	-2	-0.3	0
Ouray AQS Station	-6	-2	0	0	0	0	0.006	0.006	0.001	-3	-1.1	-10
Rangely AQS Station	-1	0	0	0	0	0	0.000	0.001	-0.001	0	-0.1	0
Redwash AQS Station	-4	0	-1	0	0	0	-0.001	-0.001	-0.001	-1	-0.4	0
Class I Areas												
Arches NP	0	0	0	0	0	0	0.000	0.000	0.000	0	-0.1	0
Black Canyon of the Gunnison WA	0	0	0	0	0	0	0.000	0.000	0.000	0	0.0	0
Bridger WA	0	0	0	0	0	0	0.000	-0.001	0.000	0	0.0	0
Bryce Canyon NP	0	0	0	0	0	0	0.000	-0.001	0.000	0	0.0	0
Canyonlands NP	0	0	0	0	0	0	0.000	0.001	0.000	0	-0.1	0
Capitol Reef NP	0	0	0	0	0	0	0.000	0.000	0.000	0	0.0	0
Eagles Nest WA	0	0	0	0	0	0	0.000	0.000	0.000	0	0.0	0
Fitzpatrick WA	0	0	0	0	0	0	0.000	-0.001	0.000	0	0.0	0
Flat Tops WA	0	0	0	0	0	0	0.000	0.000	0.000	0	0.0	0
La Garita WA	0	0	0	0	0	0	0.000	0.000	0.000	0	0.0	0
Maroon Bells-Snowmass WA	0	0	0	0	0	0	0.000	0.000	0.000	0	0.0	0
Mesa Verde NP	0	0	0	0	0	0	0.000	0.000	0.000	0	0.0	0
Mount Zirkel WA	0	0	0	0	0	0	0.000	0.000	0.000	0	0.0	0
Rawah WA	0	0	0	0	0	0	0.000	0.000	0.000	0	0.0	0
Rocky Mountain NP	0	0	0	0	0	0	0.000	0.000	0.000	0	0.0	0
Weminuche WA	0	0	0	0	0	0	0.000	0.000	0.000	0	0.0	0
West Elk WA	0	0	0	0	0	0	0.000	0.000	0.000	0	0.0	0

Table 3-23 Change in Model-Predicted Ambient Air Quality Impacts Between 2021 Scenario 1 and OTB Controls

Receptor Site	NO_2 (ppb)		CO (ppm)		SO_2 (ppb)		O_3 (ppm) 8-hour			$PM_{2.5}$ (µg/m^3)		PM_{10} (µg/m^3)
	1-hour	Annual	1-hour	8-hour	1-hour	3-hour	Annual	Winter	Non-Winter	24-hour	Annual	24-hour
Class II Areas												
Dinosaur National Monument	-1	-1	0	0	0	0	-0.001	-0.001	-0.001	-1	-0.1	0
Flaming Gorge National Recreation Area	0	0	0	0	0	0	-0.001	0.000	-0.001	-1	-0.1	0
Fort Hall IR	0	0	0	0	0	0	0.000	0.000	0.000	0	0.0	0
Goshute IR	0	0	0	0	0	0	0.000	0.000	0.000	0	0.0	0
High Uintas WA	0	0	0	0	0	0	0.000	0.000	0.000	0	0.0	0
Navajo IR	0	0	0	0	0	0	0.000	0.000	0.000	0	0.0	0
Paitute IR	0	0	0	0	0	0	0.000	0.000	0.000	0	0.0	0
Skull Valley IR	0	0	0	0	0	0	0.000	0.000	0.000	0	0.0	0
Southern Ute IR	0	0	0	0	0	0	0.000	0.000	0.000	0	0.0	0
Uintah and Ouray IR	-7	-1	0	-1	0	0	0.013	0.013	0.000	-3	-0.3	0
Ute Mountain IR	0	0	0	0	0	0	0.000	0.000	0.000	0	0.0	0
Wind River IR	0	0	0	0	0	0	0.000	0.000	0.000	0	0.0	0

Table 3-24 Change in MATS-Estimated Ozone Impacts Between 2021 OTB Control Scenario and Scenarios 1, 2, and 3 at Monitored Locations

Receptor Site Name or City	Site ID	Annual (ppm)			Winter (ppm)			Non-Winter (ppm)		
		Difference of Scenario 1 and OTB Control	Difference of Scenario 2 and OTB Control	Difference of Scenario 3 and OTB Control	Difference of Scenario 1 and OTB Control	Difference of Scenario 2 and OTB Control	Difference of Scenario 3 and OTB Control	Difference of Scenario 1 and OTB Control	Difference of Scenario 2 and OTB Control	Difference of Scenario 3 and OTB Control
Uinta Basin Study Area										
Dinosaur NM, Uintah County, Utah*	490471002	-0.002	-0.001	-0.003	-0.001	0.001	-0.002	-0.001	-0.001	-0.002
Ouray Site, Uintah County, Utah*	490472003	0.011	-0.003	0.008	0.010	0.010	0.007	0.000	0.000	0.000
Rangely Site, Rio Blanco County, Colorado*	81030006	0.000	-0.001	-0.001	0.001	0.000	0.000	0.000	0.000	-0.001
Red Wash Site, Uintah County, Utah*	490472002	0.007	-0.002	0.005	0.007	0.009	0.004	0.000	0.000	-0.001
Utah Stations Outside of Uinta Basin Study Area										
Bountiful Site, Davis County, Utah	490110004	0.000	0.000	0.000	NA	NA	NA	0.000	0.000	0.000
Canyonlands NP Site, San Juan County, Utah	490370101	0.000	0.000	0.000	0.000	0.006	0.000	-0.001	-0.001	-0.001
Cottonwood Site, Salt Lake County, Utah	490350003	0.000	0.000	0.000	NA	NA	NA	0.000	0.000	0.000
Escalante Site, Garfield County, Utah	490170004	0.000	0.000	0.000	0.000	0.003	0.000	NA	NA	NA
Fruitland Site, Duchesne County, Utah	490131001	0.000	-0.001	-0.001	-0.001	0.002	-0.002	-0.001	0.000	-0.002
Harrisville Site, Weber County, Utah	490571003	0.000	0.000	0.000	NA	NA	NA	0.000	0.000	0.000
Hawthorne Site, Salt Lake County, Utah	490353006	0.000	0.000	0.000	0.000	-0.006	0.000	0.000	0.000	0.000
Highland Site, Utah County, Utah	490495008	0.000	0.000	0.000	NA	NA	NA	0.000	0.000	0.000
Lakepoint Site, Salt Lake County, Utah	490352004	0.000	0.000	0.000	NA	NA	NA	0.000	0.000	0.000
North Provo Site, Utah County, Utah	490490002	0.000	0.000	0.000	0.000	-0.002	0.000	0.000	0.000	0.000
Ogden Site, Weber County, Utah	490570002	0.000	0.000	0.000	0.000	0.002	0.000	0.000	0.000	0.000
Price Site, Carbon County, Utah	490071003	0.000	0.000	-0.001	0.000	0.005	0.000	0.000	0.000	0.000
Spanish Fork Site, Utah County, Utah	490495010	0.000	0.000	0.000	NA	NA	NA	0.000	0.000	0.000
St. George Site, Washington County, Utah	490530006	0.000	0.000	0.000	NA	NA	NA	0.000	0.000	0.000
Tooele Site, Tooele County, Utah	490450003	0.000	0.000	0.000	NA	NA	NA	0.000	0.000	0.000
Zion NP Site, Washington County, Utah	490530130	0.000	0.000	0.000	0.000	0.008	0.000	0.000	0.000	0.000

Table 3-24 Change in MATS-Estimated Ozone Impacts Between 2021 OTB Control Scenario and Scenarios 1, 2, and 3 at Monitored Locations

Receptor Site Name or City	Site ID	Annual (ppm)			Winter (ppm)			Non-Winter (ppm)		
		Difference of Scenario 1 and OTB Control	Difference of Scenario 2 and OTB Control	Difference of Scenario 3 and OTB Control	Difference of Scenario 1 and OTB Control	Difference of Scenario 2 and OTB Control	Difference of Scenario 3 and OTB Control	Difference of Scenario 1 and OTB Control	Difference of Scenario 2 and OTB Control	Difference of Scenario 3 and OTB Control
Colorado										
Cortez Site, Montezuma County, Colorado	80830006	0.000	0.000	0.000	0.000	0.004	0.000	0.000	0.000	0.000
Grand Junction Site, Mesa County, Colorado	80771001	0.000	0.000	0.000	0.000	0.006	-0.001	0.000	0.000	0.000
Meeker Site, Rio Blanco County, Colorado	81030005	0.000	0.000	0.000	-0.001	0.004	-0.001	-0.001	0.000	-0.001
Mesa Verde NP Site, Montezuma County, Colorado	80830101	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Wyoming										
Evanston Site, Uinta County, Wyoming	560410101	0.000	0.000	0.000	0.000	0.005	0.000	0.000	0.000	0.000
Wamsutter Southeast Site, Sweetwater County, Wyoming	560370200	0.000	0.000	0.000	-0.001	0.003	-0.001	0.000	0.000	0.000

Table 3-25 Change in MATS-Estimated PM2.5 Impacts Between 2021 OTB Control Scenario and Scenarios 1, 2, and 3 at Monitored Locations

Receptor Site Name or City	Site ID	Annual $PM_{2.5}$ Design Value Difference from 2021 OTB Control ($\mu g/m^3$)			Daily $PM_{2.5}$ Design Value Difference from 2021 OTB Control ($\mu g/m^3$)		
		Scenario 1	Scenario 2	Scenario 3	Scenario 1	Scenario 2	Scenario 3
Bountiful Site, Davis County, Utah	490110004	0.000	0.100	0.000	0.000	0.000	0.000
Cottonwood Site, Salt Lake County, Utah	490350003	0.000	0.000	0.000	0.000	0.000	0.000
Harrisville Site, Weber County, Utah	490571003	0.000	0.000	0.000	0.000	0.000	0.000
Highland Site, Utah County, Utah	490495008	0.000	0.000	0.000	0.000	0.000	0.000
Lindon Site, Utah County, Utah	490494001	0.000	0.000	0.000	0.000	0.000	0.000
Magna Salt Lake City Site, Salt Lake County, Utah	490351001	0.000	0.000	0.000	0.000	0.000	0.000
Ogden Site, Weber County, Utah	490570002	0.000	0.100	0.000	0.000	0.000	0.000
Provo Site, Utah County, Utah	490490002	0.000	0.100	0.000	0.000	0.000	-0.100
Rose Park Salt Lake City Site, Salt Lake County, Utah	490353010	0.000	0.100	0.000	0.000	0.000	0.000
Spanish Fork Site, Utah County, Utah	490495010	0.000	0.100	0.000	-0.100	0.000	-0.100
Tooele Site, Tooele County, Utah	490450003	0.000	0.000	0.000	0.000	0.000	0.000

Table 3-26 Change in MATS-Estimated Impacts Between 2021 OTB Control Scenario and Scenarios 1, 2, and 3 at Unmonitored Locations

Receptor Site Name or City	Ozone Design Value Difference from 2021 OTB Control (ppm)			Annual $PM_{2.5}$ Design Value Difference from 2021 OTB Control (µg/m3)		
	Scenario 1	Scenario 2	Scenario 3	Scenario 1	Scenario 2	Scenario 3
Uinta Basin Study Area						
Uinta Basin Study Area	0.012	-0.003	0.009	-4.8	-0.1	-7.5
Class I Areas						
Arches NP	0.000	0.000	0.000	0.0	0.1	0.0
Black Canyon of the Gunnison WA	0.000	0.000	0.000	0.0	0.0	0.0
Bridger WA	0.000	0.000	0.000	0.0	0.0	0.0
Bryce Canyon NP	0.000	0.000	0.000	0.0	0.0	0.0
Canyonlands NP	0.000	0.000	0.000	0.0	0.0	0.0
Capitol Reef NP	0.000	0.000	0.000	0.0	0.0	0.0
Eagles Nest WA	0.000	0.000	0.000	0.0	0.0	0.0
Fitzpatrick WA	0.000	0.000	0.000	0.0	0.0	0.0
Flat Tops WA	0.000	0.000	0.000	0.0	0.0	0.0
La Garita WA	0.000	0.000	0.000	0.0	0.0	0.0
Maroon Bells-Snowmass WA	0.000	0.000	0.000	0.0	0.0	0.0
Mesa Verde NP	0.000	0.000	0.000	0.0	0.0	0.0
Mount Zirkel WA	0.000	0.000	0.000	0.0	0.0	-0.1
Rawah WA	0.000	0.000	0.000	0.0	0.0	0.0
Rocky Mountain NP	0.000	0.000	0.000	0.0	0.0	0.0
Weminuche WA	0.000	0.000	0.000	0.0	0.0	0.0
West Elk WA	0.000	0.000	0.000	0.0	0.0	0.0

Table 3-26 Change in MATS-Estimated Impacts Between 2021 OTB Control Scenario and Scenarios 1, 2, and 3 at Unmonitored Locations

Receptor Site Name or City	Ozone Design Value Difference from 2021 OTB Control (ppm)			Annual $PM_{2.5}$ Design Value Difference from 2021 OTB Control (µg/m3)		
	Scenario 1	Scenario 2	Scenario 3	Scenario 1	Scenario 2	Scenario 3
Class II Areas						
Dinosaur National Monument	0.002	-0.001	0.001	-0.3	0.0	-0.4
Flaming Gorge National Recreation Area	-0.001	0.000	-0.001	-0.1	0.0	-0.1
Fort Hall IR	0.000	0.000	0.000	0.0	0.0	0.0
Goshute IR	0.000	0.000	0.000	0.0	0.0	0.0
High Uintas WA	0.000	0.000	0.000	0.0	0.0	0.0
Navajo IR	0.000	0.000	0.000	0.0	0.0	0.0
Paitute IR	0.000	0.000	0.000	0.0	0.0	0.0
Skull Valley IR	0.000	0.000	0.000	0.0	0.0	0.0
Southern Ute IR	0.000	0.000	0.000	0.0	0.0	0.0
Uintah and Ouray IR	0.014	-0.003	0.011	-4.8	-0.1	-10.8
Ute Mountain IR	-0.001	0.000	-0.001	0.0	0.0	0.0
Wind River IR	0.000	0.000	0.000	0.0	0.0	0.0

Table 3-27 Change in MATS-Estimated Winter and Non-Winter Ozone Impacts Between 2021 OTB Control Scenario and Scenarios 1, 2, and 3 at Unmonitored Locations

Receptor Site Name or City	Winter Ozone Design Value Difference from 2021 OTB Control (ppm)			Non-Winter Ozone Design Value Difference from 2021 OTB Control (ppm)		
	Scenario 1	Scenario 2	Scenario 3	Scenario 1	Scenario 2	Scenario 3
Uinta Basin Study Area						
Uinta Basin Study Area	0.013	-0.004	0.010	0.001	-0.001	-0.001
Class I Areas						
Arches NP	0.000	0.000	0.000	0.000	0.000	0.000
Bryce Canyon NP	0.000	0.000	0.000	0.000	0.000	0.000
Canyonlands NP	0.000	0.000	0.000	0.000	0.000	0.000
Capitol Reef NP	-0.001	0.000	-0.001	0.000	0.000	0.000
Mesa Verde NP	0.000	0.000	0.000	0.000	0.000	0.000
Class II Areas						
Dinosaur National Monument	0.000	-0.002	-0.001	0.000	0.000	-0.001
Flaming Gorge National Recreation Area	-0.001	0.000	-0.001	0.000	0.000	0.000
Goshute IR	0.000	0.000	0.000	0.000	0.000	0.000
High Uintas WA	0.000	0.000	0.000	-0.001	0.000	-0.001
Paitute IR	0.000	0.000	0.000	0.000	0.000	0.000
Skull Valley IR	-0.001	0.000	-0.001	0.000	0.000	0.000
Uintah and Ouray IR	0.014	-0.004	0.011	0.000	0.000	0.000

Table 3-28 Model-Predicted PSD Increment Values – 2021 Scenario 1

Receptor Site	NO_2 (ppb)	SO_2 (ppb)			$PM_{2.5}$ (µg/m^3)		PM_{10} (µg/m^3)	
	Annual	3-hour	24-hour	Annual	24-hour	Annual	24-hour	Annual
Uinta Basin Study Area								
Uinta Basin Study Area	1.89	9.6	4.2	0.14	**42.1**	3.2	**42.5**	3.7
Dinosaur AQS Station	0.66	0.8	0.5	0.13	**16.9**	3.4	17.5	3.9
Ouray AQS Station	9.10	0.8	0.5	0.11	**31.2**	**7.0**	**31.6**	7.4
Rangely AQS Station	1.54	1.3	0.6	0.14	**10.3**	2.4	11.3	3.1
Redwash AQS Station	6.63	2.6	1.2	0.20	**18.4**	**4.2**	18.7	4.6
Class I Areas								
Arches NP	0.31	1.0	0.5	0.11	**10.4**	**2.1**	**10.7**	2.7
Black Canyon of the Gunnison WA	0.24	0.6	0.4	0.09	**4.6**	**1.4**	7.4	1.8
Bridger WA	0.21	4.1	**2.7**	0.24	**5.5**	**1.5**	8.0	1.9
Bryce Canyon NP	0.16	0.8	0.6	0.08	**12.0**	**1.9**	**15.8**	2.5
Canyonlands NP	0.22	3.5	1.0	0.11	**10.0**	**1.9**	**10.4**	2.4
Capitol Reef NP	0.18	2.1	0.7	0.10	**14.5**	**1.9**	**14.9**	2.4
Eagles Nest WA	0.63	3.5	1.3	0.12	**6.3**	**1.6**	**8.1**	1.9
Fitzpatrick WA	0.16	4.1	**2.5**	0.19	**4.6**	**1.4**	**8.4**	1.8
Flat Tops WA	0.24	2.2	0.8	0.12	**4.5**	**1.5**	**8.4**	1.8
La Garita WA	0.14	0.7	0.5	0.07	**3.8**	**1.2**	6.6	1.5
Maroon Bells-Snowmass WA	0.20	1.6	0.7	0.09	**4.1**	**1.3**	**8.1**	1.6
Mesa Verde NP	0.53	3.2	1.0	0.16	**6.3**	**1.7**	**8.6**	2.1
Mount Zirkel WA	0.46	2.6	1.4	0.23	**5.3**	**1.6**	7.5	2.0
Rawah WA	0.29	2.7	0.9	0.17	**6.8**	**1.5**	**8.1**	1.8

Table 3-28 Model-Predicted PSD Increment Values – 2021 Scenario 1

Receptor Site	NO_2 (ppb)	SO_2 (ppb)			$PM_{2.5}$ (µg/m^3)		PM_{10} (µg/m^3)	
	Annual	3-hour	24-hour	Annual	24-hour	Annual	24-hour	Annual
Rocky Mountain NP	0.38	6.1	**2.9**	0.17	**23.2**	**1.6**	**24.5**	1.9
Weminuche WA	0.25	1.4	0.7	0.08	**4.8**	**1.2**	**8.5**	1.6
West Elk WA	0.16	1.0	0.5	0.08	**7.6**	**1.3**	**8.9**	1.6
Class II Areas								
Dinosaur National Monument	0.45	1.6	0.7	0.14	**18.8**	2.4	19.2	2.8
Flaming Gorge National Recreation Area	0.51	21.4	6.1	0.19	**21.0**	2.2	21.7	2.7
Fort Hall IR	1.24	8.8	3.4	0.31	**28.4**	3.8	**45.0**	5.7
Goshute IR	0.10	0.6	0.3	0.06	5.2	1.2	11.5	1.8
High Uintas WA	0.15	2.1	0.7	0.10	7.5	1.8	11.6	2.2
Navajo IR	0.81	20.5	5.7	0.16	**25.6**	1.9	**30.7**	2.6
Paitute IR	0.41	2.2	0.6	0.10	**11.8**	2.0	14.7	2.8
Skull Valley IR	0.33	2.0	0.7	0.12	**12.3**	1.9	12.8	2.4
Southern Ute IR	2.53	4.8	1.0	0.12	**30.5**	1.7	**35.1**	2.1
Uintah and Ouray IR	2.15	9.7	4.7	0.14	**48.0**	3.3	**53.3**	3.8
Ute Mountain IR	1.07	9.4	3.7	0.22	**19.6**	2.0	20.3	2.6
Wind River IR	0.35	18.0	10.9	0.39	**9.9**	1.5	11.6	1.9

Note: Model-predicted concentrations that exceed the PSD Increments are shown in **red bold** text.

Table 3-29 Change in PSD Increment Values Between 2021 Scenario 1 and 2010 Typical Year

	NO_2 (ppb)	SO_2 (ppb)			$PM_{2.5}$ (µg/m^3)		PM_{10} (µg/m^3)	
Receptor Site	**Annual**	**3-hour**	**24-hour**	**Annual**	**24-hour**	**Annual**	**24-hour**	**Annual**
Uinta Basin Study Area								
Uinta Basin Study Area	-0.1	-3.3	-2.1	0.0	5.1	-0.2	-1.2	-0.2
Dinosaur AQS Station	-0.1	-0.6	-0.3	0.0	-0.7	-0.4	-0.8	-0.4
Ouray AQS Station	2.8	-0.7	-0.1	0.0	1.3	0.2	0.8	0.0
Rangely AQS Station	-2.0	-0.2	-0.3	-0.1	-0.6	-0.2	-0.7	-0.2
Redwash AQS Station	3.3	0.0	-0.1	0.0	-1.2	0.4	-1.4	0.4
Class I Areas								
Arches NP	-0.2	-2.6	-1.1	-0.1	-6.5	-0.5	-6.7	-0.6
Black Canyon of the Gunnison WA	-0.2	-1.1	-0.4	-0.1	-1.6	-0.2	-0.4	-0.3
Bridger WA	0.0	1.4	1.4	0.1	-0.4	0.0	0.1	0.0
Bryce Canyon NP	-0.1	-1.2	-0.5	-0.1	-1.5	-0.4	-1.8	-0.4
Canyonlands NP	-0.1	-10.3	-2.9	-0.1	-7.6	-0.5	-7.8	-0.5
Capitol Reef NP	-0.1	-0.3	-1.2	-0.1	-3.7	-0.4	-3.8	-0.4
Eagles Nest WA	-0.6	-0.1	-0.2	-0.1	-1.0	-0.2	-1.1	-0.2
Fitzpatrick WA	0.0	2.4	1.7	0.1	-0.7	0.0	0.1	0.0
Flat Tops WA	-0.2	-2.5	-0.6	-0.1	-1.1	-0.2	0.0	-0.2
La Garita WA	-0.1	-1.5	-0.5	-0.1	-0.2	-0.1	0.0	-0.1
Maroon Bells-Snowmass WA	-0.1	0.0	-0.2	-0.1	-0.2	-0.1	0.0	-0.2
Mesa Verde NP	-0.8	-12.3	-3.4	-0.3	-2.1	-0.3	-0.4	-0.3
Mount Zirkel WA	-0.5	-2.1	-1.2	-0.2	-1.8	-0.2	-0.2	-0.2
Rawah WA	-0.3	-0.8	-0.7	-0.1	-1.5	-0.2	-1.6	-0.2

Table 3-29 Change in PSD Increment Values Between 2021 Scenario 1 and 2010 Typical Year

Receptor Site	NO_2 (ppb)	SO_2 (ppb)			$PM_{2.5}$ (µg/m^3)		PM_{10} (µg/m^3)	
	Annual	3-hour	24-hour	Annual	24-hour	Annual	24-hour	Annual
Rocky Mountain NP	-0.4	0.2	0.0	-0.1	-1.1	-0.2	-1.1	-0.2
Weminuche WA	-0.2	-5.1	-1.3	-0.1	-0.2	-0.1	0.0	-0.1
West Elk WA	-0.1	-0.7	-0.4	-0.1	-0.2	-0.2	-0.2	-0.2
Class II Areas								
Dinosaur National Monument	-0.1	-1.0	-0.7	0.0	1.1	-0.3	0.8	-0.3
Flaming Gorge National Recreation Area	-0.3	-9.8	-2.3	-0.1	6.6	-0.2	1.7	-0.3
Fort Hall IR	-0.4	-0.6	-2.3	-0.1	7.4	0.7	18.8	1.3
Goshute IR	0.0	-0.9	-0.5	-0.1	-1.7	-0.1	-0.1	-0.1
High Uintas WA	-0.1	0.4	-0.3	0.0	-2.0	-0.3	0.0	-0.3
Navajo IR	-0.6	-79.3	-24.8	-0.2	-12.9	-0.3	-8.9	-0.3
Paitute IR	-0.4	-0.5	-0.6	-0.2	-3.0	-0.4	-3.0	-0.4
Skull Valley IR	-0.1	0.1	-0.2	0.0	-1.6	-0.2	-1.5	-0.1
Southern Ute IR	-1.7	-11.0	-3.4	-0.2	-0.6	-0.2	-0.6	-0.3
Uintah and Ouray IR	0.0	-4.5	-2.3	0.0	-1.0	-0.2	-1.0	-0.2
Ute Mountain IR	-1.5	-23.6	-10.3	-0.5	-2.5	-0.4	-3.2	-0.6
Wind River IR	-0.3	-16.1	-10.7	-0.1	-2.8	-0.1	-2.9	-0.1

Table 3-30 Change in PSD Increment Values Between 2021 Scenario 1 and 2021 OTB Controls

Receptor Site	NO_2 (ppb)	SO_2 (ppb)			$PM_{2.5}$ (µg/m^3)		PM_{10} (µg/m^3)	
	Annual	3-hour	24-hour	Annual	24-hour	Annual	24-hour	Annual
Uinta Basin Study Area								
Uinta Basin Study Area	-0.4	0.0	0.0	0.0	-6.6	-0.3	0.0	-0.3
Dinosaur AQS Station	-0.1	0.0	0.0	0.0	-3.0	-0.3	-3.0	-0.3
Ouray AQS Station	-2.1	0.0	0.0	0.0	-4.7	-1.2	-4.7	-1.2
Rangely AQS Station	-0.1	0.0	0.0	0.0	-0.3	0.0	-0.3	0.0
Redwash AQS Station	-0.7	0.0	0.0	0.0	-2.7	-0.4	-2.7	-0.4
Class I Areas								
Arches NP	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Black Canyon of the Gunnison WA	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0
Bridger WA	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Bryce Canyon NP	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Canyonlands NP	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Capitol Reef NP	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Eagles Nest WA	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Fitzpatrick WA	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Flat Tops WA	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
La Garita WA	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maroon Bells-Snowmass WA	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Mesa Verde NP	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Mount Zirkel WA	0.0	0.0	0.0	0.0	-0.4	0.0	0.0	0.0
Rawah WA	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 3-30 Change in PSD Increment Values Between 2021 Scenario 1 and 2021 OTB Controls

	NO_2 (ppb)	SO_2 (ppb)			$PM_{2.5}$ (µg/m^3)		PM_{10} (µg/m^3)	
Receptor Site	**Annual**	**3-hour**	**24-hour**	**Annual**	**24-hour**	**Annual**	**24-hour**	**Annual**
Rocky Mountain NP	0.0	0.0	0.0	0.0	-0.1	0.0	-0.1	0.0
Weminuche WA	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
West Elk WA	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Class II Areas								
Dinosaur National Monument	-0.1	0.0	0.0	0.0	-2.4	-0.1	-2.4	-0.1
Flaming Gorge National Recreation Area	0.0	0.0	0.0	0.0	-0.2	-0.1	-0.2	-0.1
Fort Hall IR	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Goshute IR	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0
High Uintas WA	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Navajo IR	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Paitute IR	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Skull Valley IR	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Southern Ute IR	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Uintah and Ouray IR	-0.4	0.0	0.0	0.0	-0.8	-0.3	0.0	-0.3
Ute Mountain IR	0.0	0.0	0.0	0.0	-0.1	0.0	-0.1	0.0
Wind River IR	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

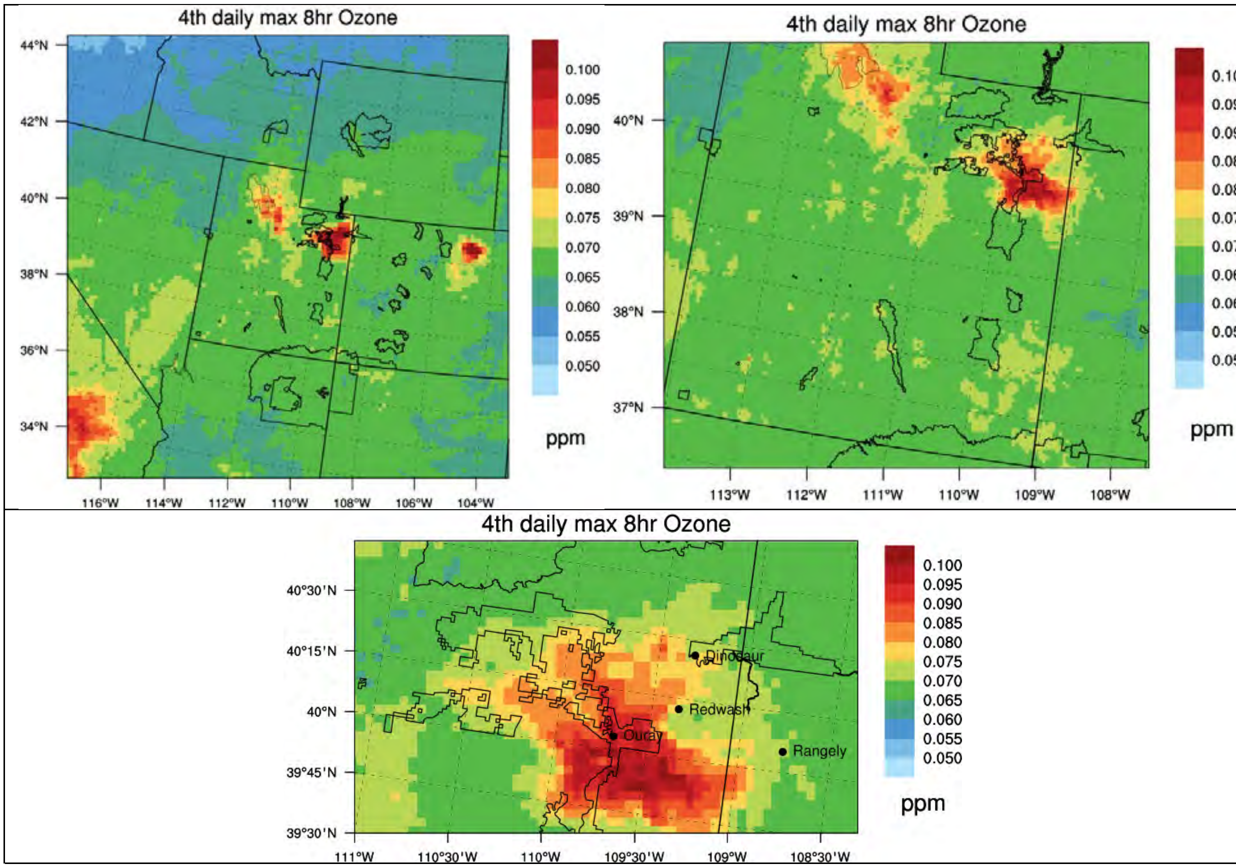

Figure 3-9 2021 Scenario 1 Model-Predicted 4th Highest Daily Maximum 8-hour Ozone Spatial Plots

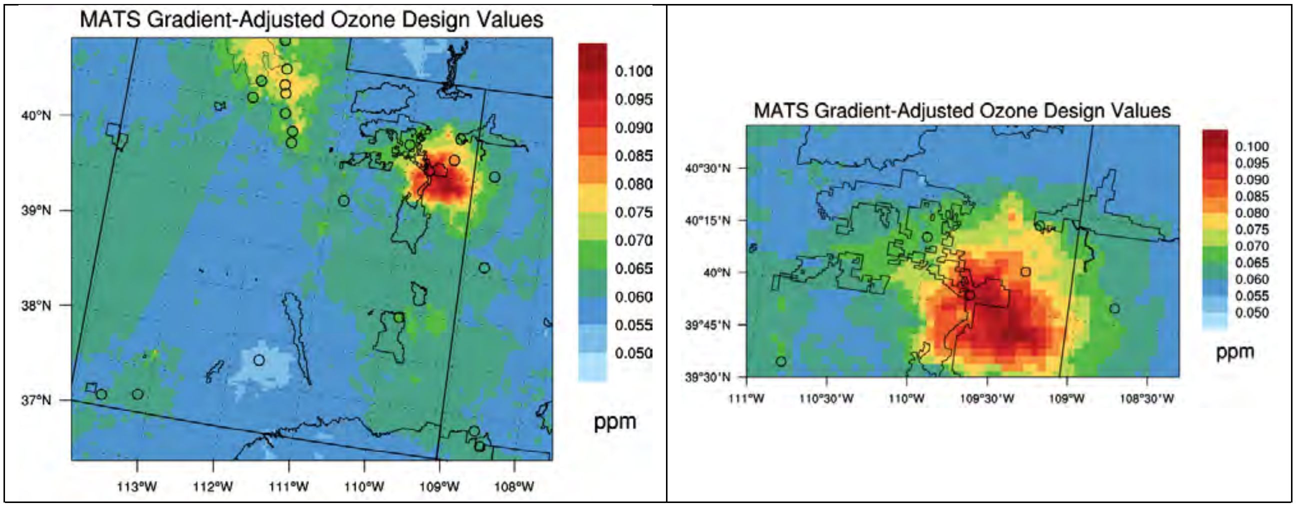

Figure 3-10 MATS Interpolated 2021 Scenario 1 Ozone Design Values

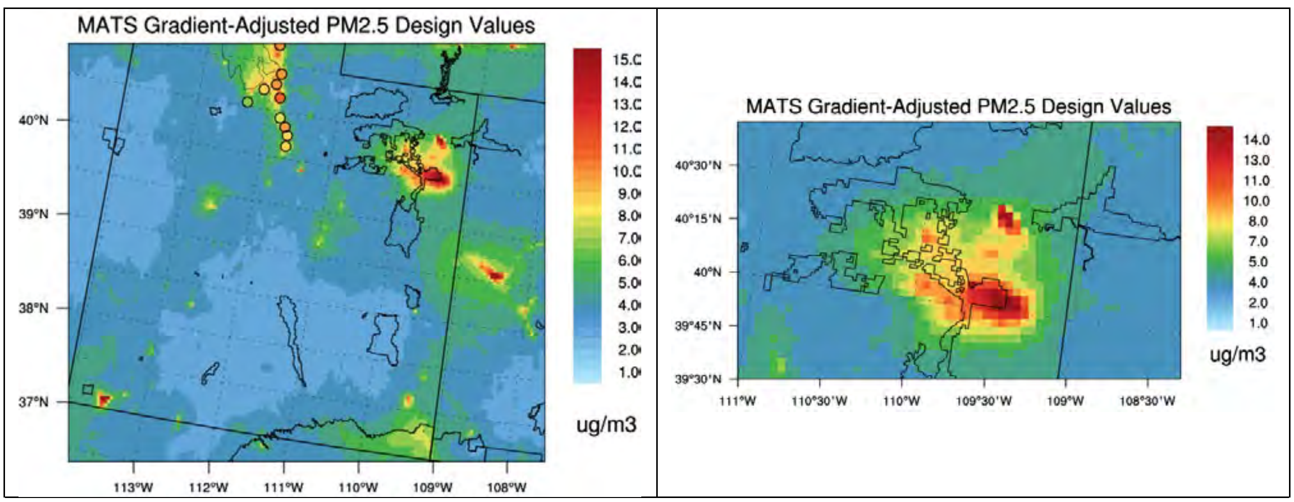

Figure 3-11 MATS Interpolated 2021 Scenario 1 Annual $PM_{2.5}$ Design Values

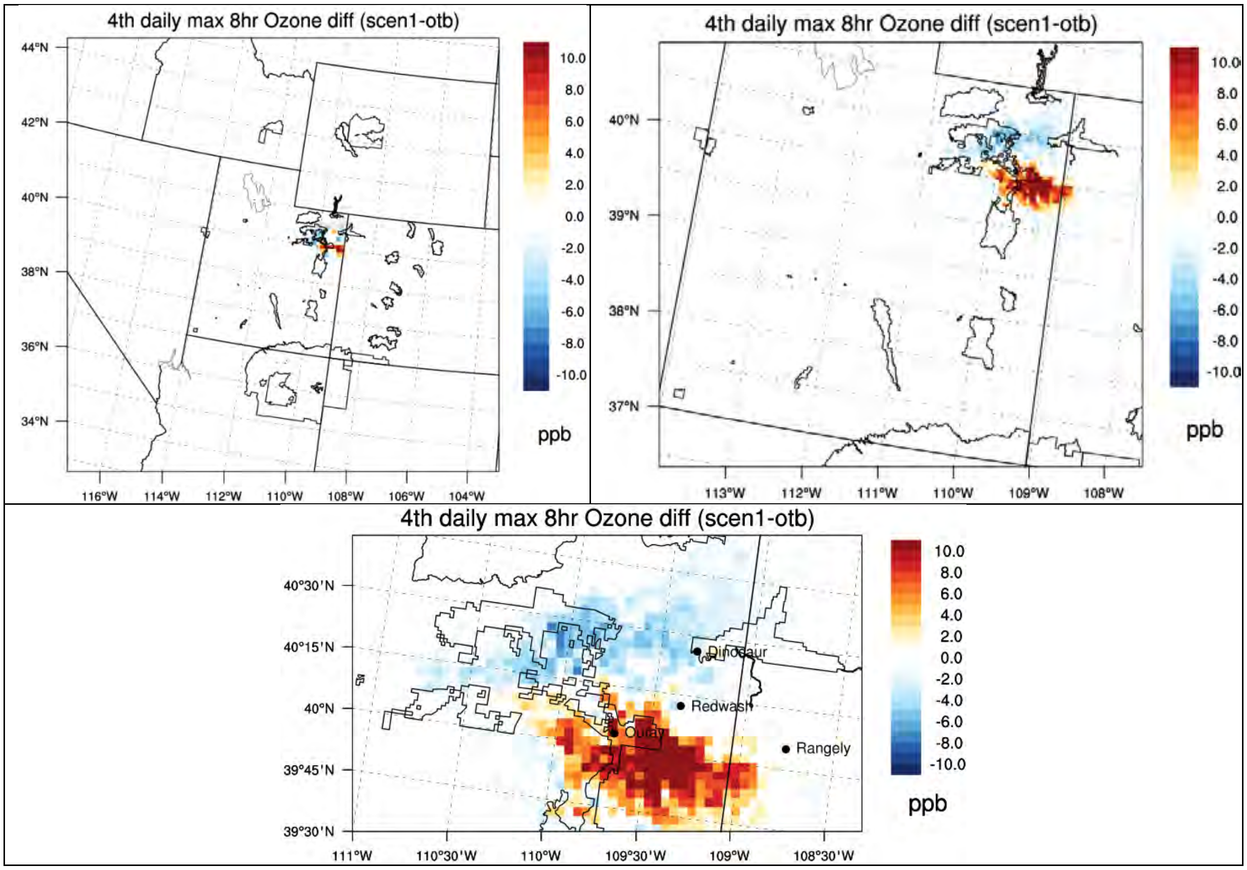

Figure 3-12 Absolute Difference between 2021 Scenario 1 and 2021 OTB Controls Model-Predicted 4th Highest Daily Maximum 8-hour Ozone Spatial Plots

3.7 2021 Control Scenario 2

For the purpose of this study, the results for the 2021 Scenario 2 are analyzed:

- Individually;
- Relative to the 2010 Typical Year; and
- Relative to 2021 OTB Controls.

An explanation of the differences between the three scenarios is found in Chapter 2. With the exception of the Uinta Basin study area, the emission inventories for the 2021 OTB Controls and Scenario 2 modeling scenarios are same. It is expected that 2021 Scenario 2 modeling results outside of the Uinta Basin study area are similar to the 2021 OTB Controls. Therefore, when comparing the 2021 Scenario 2 to the 2021 OTB Controls, the discussion of the modeling results is limited to new results not previously seen or discussed.

3.7.1 Model-Predicted Cumulative Criteria Pollutant Impacts

3.7.1.1 Absolute Model Impacts for all Pollutants

Table 3-31 presents the 2021 Scenario 2 modeled cumulative air quality impacts at all assessment areas. Similar to the previous model scenarios, only ozone is predicted to be above the NAAQS and state AAQS when evaluating the absolute model concentrations.[5] Three areas within the Uinta Basin study area, three Class I areas, and two Sensitive Class II areas are above the ozone standard. Of the assessment areas near or within the Uinta Basin study area, Rangely Station, Redwash Station, Flaming Gorge National Recreation Area, and High Uintas WA have ozone values below the NAAQS. Similar to the other modeling scenarios, the Uinta Basin study area has the highest modeled ozone concentrations.

The differences between the 2021 Scenario 2 and 2010 Typical Year are presented in **Table 3-32.** Areas removed from the Uinta Basin study area generally have lower concentrations in 2021 Scenario 2 than the 2010 Typical Year scenario. All assessment areas are predicted to have lower ozone values in the 2021 Scenario 2 relative to the Typical Year, except for Dinosaur NM. The areas near or within the Uinta Basin study area generally have higher modeled values in 2021 Scenario 2 relative to 2010 Typical Year for: 1-hour NO_2, annual NO_2, 24-hour $PM_{2.5}$, and annual $PM_{2.5}$. Only the Rangely station on the eastern side of the Uinta Basin study area has lower values of 1-hour NO_2, annual NO_2, and annual $PM_{2.5}$.

The 4th highest daily maximum 8-hour ozone concentrations spatial plots are shown in **Figure 3-13** for the 2021 Scenario 2. The figure shows the 12-km domain, 4-km domain, and the Uinta Basin study area, from left to right, top to bottom. Within the Uinta Basin study area, the areas with highest ozone values are south of Ouray. The spatial distribution is similar 2010 Typical Year modeling results (**Figure 3-3**). For Scenario 2, the spatial extent of the ozone NAAQS exceedances are more condensed. A more detailed analysis of the modeled ozone differences between the 2021 Scenario 2 and the 2021 OTB Scenario is available in Section 3.7.2 and **Appendix B**.

3.7.1.2 Relative Model Impacts for Ozone and $PM_{2.5}$

<u>Ozone</u>

Table 3-33 provides the MATS 8-hour annual, winter and non-winter ozone design values for baseline and 2021 Scenario 2 at available monitoring sites in the 4-km domain. **Figure 3-1** shows the location of the monitoring sites relative to the assessment areas. As discussed in Section 3.1 and **Appendix A**, the baseline year is 2010 for the MATS monitoring sites. As shown in **Table 3-33**, the baseline design value

[5] Note that in contrast to absolute model impacts, the MATS tool, which is used to calculate model-adjusted concentrations based on monitoring values, predicts potential exceedances of the NAAQS for $PM_{2.5}$.

exceed the ozone NAAQS for 2 of the 26 monitors.[6] Based on the model-predicted ozone changes between 2021 OTB Controls and the baseline, the design value is projected to decrease at most monitoring sites; however, there is an increase in the number of monitors that are projected to exceed the NAAQS from two monitoring sites in 2010 to three monitoring sites in 2021. One of the monitors is located within the Uinta Basin study area and the other two monitors are near the Salt Lake City metropolitan area. The highest predicted ozone design value in 2021 is 0.0847 ppm, which occurs at site 490472003, Ouray, Utah, within the Uinta Basin. Importantly, this is a 13 ppb decrease relative to the baseline. In the baseline, ozone design values at the Redwash monitor exceeded the NAAQS; however, in the 2021 Scenario 2 the Redwash monitor is predicted to have a 12 ppb decrease and be below the NAAQS.

For the UAA, the spatial interpolation of ozone design values are shown in **Figure 3-14** and the maximum ozone design value for assessment areas are presented in **Table 3-34.** For the spatial plots, the circles show the model-predicted design value at the monitoring sites as reported in **Table 3-33**. **Table 3-35** shows the winter and non-winter ozone design values at unmonitored locations within the 4-km domain. For the most part, the design values at monitoring sites correspond to the UAA. As shown in **Figure 3-14**, the 2021 predicted ozone design values near or exceeding the NAAQS in Uinta Basin and Salt Lake City metropolitan area. These areas correspond to the same areas predicted to have elevated 8-hour ozone concentrations from the absolute model results (shown in **Figure 3-13**).

As shown in **Table 3-34**, the assessment areas with the highest ozone design values for the 2021 Scenario 2 are within or near the Uinta Basin study area. For the 2021 Scenario 2, ozone design values are substantially lower than baseline values, with 13 ppb decreases in the Uinta Basin study area and 18 pb decreases in the Uintah and Ouray IR. The number of areas predicted to exceed the NAAQS decreases from 5 areas to 2 areas: the Uinta Basin study area and Uintah and Ouray IR. All other assessment areas have ozone design values below the NAAQS in 2021.

$\underline{PM_{2.5}}$

In addition to the ozone analysis, an analysis of the relative model impacts of annual and daily $PM_{2.5}$ was conducted using MATS. **Table 3-36** presents the MATS-estimated baseline and 2021 Scenario 2 $PM_{2.5}$ design values at monitor locations within the 4-km domain. All of the monitors have lower annual and daily $PM_{2.5}$ design values modeled in 2021 Scenario 2 relative to the baseline. All annual $PM_{2.5}$ monitors are below the NAAQS in 2021 Scenario 2 and baseline. Only one monitor is predicted to have daily $PM_{2.5}$ design values above the NAAQS, which is a decrease from seven monitors in 2010.

For the UAA, spatial plots of the spatially interpolated annual $PM_{2.5}$ design values are shown in **Figure -5**. Since MATS does not provided spatial interpolation of daily $PM_{2.5}$, only the annual $PM_{2.5}$ is used for the UAA. The maximum annual $PM_{2.5}$ design value for the assessment areas are shown in **Table 3-34**. Like the ozone deign value spatial plot, the circles show the model-predicted design value at the monitoring sites as reported in **Table 3-36**. In general the monitor values correspond to the spatial interpolation. However, there are large spatial gradients in the modeled concentrations, which can make it difficult to visually compare the monitoring values to the UAA spatial plot values. Throughout the 4-km domain, MATS spatial analysis show several small isolated areas with annual $PM_{2.5}$ design values close or exceeding the NAAQS. Areas of elevated annual $PM_{2.5}$ design values include the Uinta Basin study area, Salt Lake City area, and the southwest corner of Utah. For 2021 Scenario 2 the assessment areas within or near the Uinta Basin have the highest maximum annual $PM_{2.5}$ design values. The only assessment areas with annual $PM_{2.5}$ design values above the NAAQS are the Uinta Basin study area and Uintah and Ouray IR for both the baseline and 2021 Scenario 2, and both these areas are predicted to increase by 6.9 and 9.7 µg/m^3, respectively in 2021 relative to the baseline.

[6] It is important to note that currently there is insufficient data collected at regulatory monitors in the Uinta Basin study area to calculate a true ozone design value. All future year ozone design values reported for the Uinta Basin do not represent actual design values and are for informational purposes only.

3.7.2 Comparison of Control Scenario 2 to OTB Controls

In the following sections, the 2021 Scenario 2 modeling results are compared to the 2021 OTB Controls modeling results. The focus of the comparison is on the modeling results near and in the Uinta Basin study area. For completeness, the scenario differences for all assessment areas and domains are shown.

3.7.2.1 Differences in Absolute Model Impacts for all Pollutants

Table 3-27 shows the change in the model predicted ambient air quality impacts between 2021 Scenario 2 and OTB Controls. As expected, the largest differences occur near the Uinta Basin study area, where the differences in the emissions inventory occur. Relative to the 2021 OTB Controls, the VOC emissions for the 2021 Scenario 2 decrease approximately 13 percent, while all other emissions have small increases (as shown in **Table 2-10**). Correspondingly, annual NO_2 decreases slightly by 1 ppb for the Uinta Basin study area and 8-hour CO slightly decreases by1 ppm for the Uinta Basin study area and Uintah and Ouray IR. In addition, a few assessment areas near or within the Uinta Basin study area have small changes in the PM concentrations. Aside from the previous mentioned differences, there are minimal additional differences between the scenarios. For 2021 Scenario 2 ozone, six assessment areas, which are near or within the Uinta Basin study area, are modeled lower. The remaining assessment areas have no changes between the scenarios.

Spatial plots of the difference in the 4th maximum ozone concentrations between 2021 Scenario 2 and OTB Controls are shown in **Figure 3-16**. The only areas with measureable differences in the ozone concentrations are near or within the Uinta Basin study area. Within the Uinta Basin study area, there are very little differences in the spatial extent of the ozone concentrations relative to the 2021 OTB Controls. As discussed in **Appendix B**, the ozone is approximately 4-6 ppb lower between 2021 Scenario 2 and the OTB Controls and Scenario 2 shows enhanced ozone reduction without associated ozone disbenefits (i.e., ozone increases) apparent in other mitigation scenarios.

3.7.2.2 Differences in Relative Model Impacts for Ozone and $PM_{2.5}$

The change in the MATS-estimated ozone and $PM_{2.5}$ impacts between 2021 Scenario 2 and OTB Controls are shown in **Tables 3-24** and **3-25,** respectively, for all monitored locations.

Ozone

As shown in **Table 3-24**, Scenario 2 is the only mitigation scenario that demonstrates ozone reductions at all monitoring sites in the Uinta Basin study area. The predicted ozone reductions vary between 1 to 3 ppb relative to OTB Controls.

The change in UAA ozone design values are shown in **Table 3-26** for all assessment areas. The change in UAA winter and non-winter ozone design values for assessment areas within the 4-km domain are shown in **Table 3-27**. **Table 3-26** shows that under Scenario 2 the predicted ozone design values would decrease relative to the OTB Controls in: the Uinta Basin study area, Uintah and Ouray IR, and Dinosaur National Monument.

$PM_{2.5}$

As shown in **Table 3-25**, there are no predicted changes to the daily $PM_{2.5}$ design value for Scenario 2 relative to OTB Controls. As shown in **Table 3-26**, two assessment areas are predicted to have lower annual $PM_{2.5}$ design values than the OTB Controls. The Uinta Basin study area and Uintah and Ouray IR decrease by about 0.1 µg/m^3, while Archer NP increases by about 0.1 µg/m^3. Scenario 2 has the smallest effect on PM concentrations of all mitigation scenarios.

3.7.3 PSD Increment Assessment

Table 3-38 shows the PSD increments for the assessment areas for 2021 Scenario 2. If all model sources were increment consuming sources, model predicted impacts would exceed allowable increments for 24-hour $PM_{2.5}$ for most assessment areas. The 3-hour SO_2, annual SO_2, NO_2, and PM_{10} PSD increments are below the increment for all assessment areas, as seen with the previously discussed modeling scenarios. Within the Uinta Basin study area, the annual $PM_{2.5}$ increment is exceeded by the Ouray and Redwash stations, and the 24-hour PM_{10} value at the Ouray station and Uinta Basin study area is above the increment. All assessments areas within the Uinta Basin study area are above the 24-hour $PM_{2.5}$ PSD increment. The model results for the other increments and assessment areas are similar to those previously discussed scenarios.

Table 3-39 shows the changes between 2021 Scenario 2 and 2010 Typical Year. Outside of the Uinta Basin study area, the majority of the PSD increments are modeled lower for the 2021 Scenario 2 relative to 2010 Typical Year. The Uinta Basin study area, the Ouray, Dinosaur, and Redwash stations are predicted to be higher in the 2021 Scenario 2 for: annual NO_2, 24-hour $PM_{2.5}$, annual $PM_{2.5}$, and annual PM_{10} PSD increments. For all assessment areas, the SO_2 PSD increments are lower in the 2021 Scenario 2.

3.7.3.1 Comparison of Control Scenario 2 to OTB Controls

Changes in the PSD Increment values between 2021 Scenario 2 and OTB Controls are shown in **Table 3-40**. As expected, the only differences between the scenarios occur at assessment areas near or within the Uinta Basin study area. Although the Scenario 2 PM emissions increased relative to OTB Controls, the Scenario 2 PM modeling results for the PSD increments are generally lower than OTB Controls. However, these differences are typically small, ranging from 0.5-0.1 $\mu g/m^3$.

Table 3-31 Model-Predicted Ambient Air Quality Impacts Compared to NAAQS – 2021 Scenario 2

Receptor Site	NO_2 (ppb)		CO (ppm)		SO_2 (ppb)		O_3 (ppm) 8-hour			$PM_{2.5}$ (µg/m^3)		PM_{10} (µg/m^3)
	1-hour	Annual	1-hour	8-hour	1-hour	3-hour	Annual	Winter	Non-Winter	24-hour	Annual	24-hour
Uinta Basin Study Area												
Uinta Basin Study Area	28	2	2	1	2	0	**0.116**	**0.116**	**0.080**	16	3.5	50
Dinosaur AQS Station	4	1	0	0	1	0	**0.076**	**0.076**	0.069	14	3.7	20
Ouray AQS Station	46	11	1	1	1	0	**0.088**	**0.088**	0.071	28	8.0	40
Rangely AQS Station	6	2	0	0	1	0	0.070	0.065	0.069	7	2.5	10
Redwash AQS Station	28	7	1	0	2	0	0.074	0.074	0.070	14	4.6	20
Class I Areas												
Arches NP	1	0	1	0	1	0	**0.079**	0.060	**0.079**	6	2.2	10
Black Canyon of the Gunnison WA	1	0	0	0	1	0	0.067	0.061	0.067	3	1.4	10
Bridger WA	1	0	0	0	3	0	0.070	0.062	0.070	4	1.5	10
Bryce Canyon NP	1	0	0	0	1	0	0.074	0.059	0.074	4	1.9	20
Canyonlands NP	1	0	0	0	1	0	**0.078**	0.064	**0.078**	6	2.0	10
Capitol Reef NP	1	0	0	0	1	0	0.075	0.068	0.075	5	1.9	10
Eagles Nest WA	3	1	0	0	2	0	0.070	0.062	0.070	4	1.6	10
Fitzpatrick WA	1	0	0	0	3	0	0.069	0.061	0.069	4	1.5	10
Flat Tops WA	1	0	0	0	1	0	0.072	0.063	0.072	3	1.5	10
La Garita WA	1	0	0	0	1	0	0.070	0.067	0.070	3	1.2	10
Maroon Bells-Snowmass WA	1	0	0	0	1	0	0.068	0.062	0.068	3	1.3	10
Mesa Verde NP	4	1	0	0	2	0	0.073	0.067	0.073	4	1.7	10
Mount Zirkel WA	2	0	0	0	2	0	0.071	0.069	0.071	4	1.6	10
Rawah WA	2	0	0	0	2	0	0.072	0.066	0.072	4	1.5	10
Rocky Mountain NP	2	0	1	0	4	0	**0.076**	0.067	**0.076**	4	1.6	20
Weminuche WA	1	0	0	0	1	0	0.070	0.070	0.070	3	1.2	10
West Elk WA	1	0	0	0	1	0	0.068	0.063	0.068	3	1.3	10

Table 3-31 Model-Predicted Ambient Air Quality Impacts Compared to NAAQS – 2021 Scenario 2

Receptor Site	NO_2 (ppb)		CO (ppm)		SO_2 (ppb)		O_3 (ppm) 8-hour			$PM_{2.5}$ (µg/m^3)		PM_{10} (µg/m^3)
	1-hour	Annual	1-hour	8-hour	1-hour	3-hour	Annual	Winter	Non-Winter	24-hour	Annual	24-hour
Class II Areas												
Dinosaur National Monument	3	1	1	0	1	0	**0.092**	**0.092**	0.074	9	2.5	20
Flaming Gorge National Recreation Area	3	1	1	0	4	0	0.074	0.071	0.074	8	2.3	20
Fort Hall IR	7	1	1	0	5	0	0.067	0.065	0.067	12	3.8	50
Goshute IR	0	0	0	0	0	0	0.070	0.058	0.070	3	1.2	10
High Uintas WA	1	0	0	0	1	0	0.073	0.071	0.073	4	1.8	10
Navajo IR	6	1	0	0	3	0	0.075	0.068	0.075	5	1.9	30
Paitute IR	2	0	1	0	1	0	0.072	0.072	0.072	5	2.0	10
Skull Valley IR	2	0	0	0	2	0	0.070	0.068	0.069	6	1.9	10
Southern Ute IR	16	3	1	0	1	0	0.072	0.069	0.072	4	1.7	40
Uintah and Ouray IR	34	3	3	1	2	0	**0.111**	**0.111**	**0.078**	17	3.6	50
Ute Mountain IR	7	1	1	0	3	0	0.072	0.067	0.072	6	2.0	20
Wind River IR	2	0	0	0	7	0	0.071	0.062	0.071	4	1.5	10

Note: Model-predicted concentrations that exceed the NAAQS are shown in **red bold** text.

Table 3-32 Change in Model-Predicted Ambient Air Quality Impacts Between 2021 Scenario 2 and 2010 Typical Year

Receptor Site	NO_2 (ppb)		CO (ppm)		SO_2 (ppb)		O_3 (ppm) 8-hour			$PM_{2.5}$ (µg/m³)		PM_{10} (µg/m³)
	1-hour	Annual	1-hour	8-hour	1-hour	3-hour	Annual	Winter	Non-Winter	24-hour	Annual	24-hour
Uinta Basin Study Area												
Uinta Basin Study Area	9	0	-2	-2	0	0	-0.010	-0.010	-0.002	2	0.1	10
Dinosaur AQS Station	1	0	0	0	0	0	-0.001	-0.001	-0.004	0	0.0	0
Ouray AQS Station	17	5	0	1	0	0	-0.010	-0.010	-0.004	3	1.2	10
Rangely AQS Station	-9	-2	0	0	0	0	-0.002	0.001	-0.003	0	-0.1	0
Redwash AQS Station	15	4	1	0	0	0	0.000	0.001	-0.002	1	0.8	0
Class I Areas												
Arches NP	-1	-1	1	0	-1	0	-0.002	-0.007	-0.002	-3	-0.5	-10
Black Canyon of the Gunnison WA	-1	0	0	0	0	0	-0.006	-0.006	-0.006	-1	-0.3	0
Bridger WA	0	0	0	0	1	0	-0.004	-0.006	-0.004	0	0.0	0
Bryce Canyon NP	0	0	0	0	0	0	-0.006	-0.006	-0.006	-2	-0.4	0
Canyonlands NP	-1	0	0	0	-1	0	-0.002	-0.008	-0.002	-2	-0.4	-10
Capitol Reef NP	-1	0	0	0	-1	0	-0.005	-0.004	-0.005	-2	-0.4	-10
Eagles Nest WA	-3	0	0	0	0	0	-0.004	-0.005	-0.004	0	-0.2	0
Fitzpatrick WA	0	0	0	0	1	0	-0.004	-0.011	-0.003	0	0.0	0
Flat Tops WA	0	0	0	0	0	0	0.001	-0.003	0.001	-1	-0.1	0
La Garita WA	-2	0	0	0	-1	0	-0.004	-0.002	-0.004	0	-0.1	0
Maroon Bells-Snowmass WA	-1	0	0	0	0	0	-0.004	-0.009	-0.004	0	-0.1	0
Mesa Verde NP	-5	0	0	0	-8	0	-0.005	-0.003	-0.005	-1	-0.2	0
Mount Zirkel WA	-2	-1	0	0	-1	0	-0.006	-0.002	-0.006	0	-0.2	0
Rawah WA	-1	-1	0	0	-1	0	-0.004	-0.004	-0.004	0	-0.2	0
Rocky Mountain NP	-2	-1	0	0	0	0	-0.011	-0.003	-0.011	0	-0.1	-10
Weminuche WA	-2	0	0	0	-1	0	-0.006	-0.006	-0.004	0	-0.1	0
West Elk WA	0	0	0	0	0	0	-0.006	-0.006	-0.006	0	-0.2	0

Table 3-32 Change in Model-Predicted Ambient Air Quality Impacts Between 2021 Scenario 2 and 2010 Typical Year

Receptor Site	NO_2 (ppb)		CO (ppm)		SO_2 (ppb)		O_3 (ppm) 8-hour			$PM_{2.5}$ (µg/m^3)		PM_{10} (µg/m^3)
	1-hour	Annual	1-hour	8-hour	1-hour	3-hour	Annual	Winter	Non-Winter	24-hour	Annual	24-hour
Class II Areas												
Dinosaur National Monument	1	0	0	0	0	0	0.004	0.004	-0.001	0	-0.2	0
Flaming Gorge National Recreation Area	-2	0	1	0	-3	0	-0.006	-0.009	-0.003	0	-0.2	0
Fort Hall IR	-3	-1	0	0	1	0	-0.005	-0.006	-0.005	2	0.7	20
Goshute IR	0	0	0	0	-1	0	-0.006	-0.002	-0.006	0	-0.1	0
High Uintas WA	0	0	0	0	0	0	-0.008	-0.010	-0.003	-1	-0.2	0
Navajo IR	-5	0	0	0	-8	-100	-0.007	-0.004	-0.007	-2	-0.3	-10
Paitute IR	-3	-1	0	0	-1	0	-0.017	-0.017	-0.006	-1	-0.4	-10
Skull Valley IR	-1	0	0	0	1	0	-0.003	-0.003	-0.004	-1	-0.2	0
Southern Ute IR	-11	-1	0	0	-5	0	-0.006	-0.005	-0.006	-1	-0.2	0
Uintah and Ouray IR	13	1	0	0	-2	0	-0.014	-0.014	-0.002	2	0.2	0
Ute Mountain IR	-8	-2	0	0	-12	0	-0.006	-0.006	-0.006	-1	-0.4	0
Wind River IR	-2	-1	0	0	-6	0	-0.004	-0.006	-0.004	-1	-0.2	0

Table 3-33 MATS-Estimated Ozone Impacts at Monitored Locations – Scenario 2 Controls

Receptor Site Name or City	Site ID	Latitude	Longitude	Annual (ppm)			Winter (ppm)			non-Winter (ppm)		
				Baseline Monitor O_3 Design Value	2021 Scenario 2 O_3 Design Value	Difference	Baseline Monitor O_3 Design Value	2021 Scenario 2 O_3 Design Value	Difference	Baseline Monitor O_3 Design Value	2021 Scenario 2 O_3 Design Value	Difference
Uinta Basin Study Area												
Dinosaur NM, Uintah County, Utah*	490471002	40.4300	-109.3000	0.071	0.070	-0.001	0.072	0.070	-0.002	0.065	0.062	-0.003
Ouray Site, Uintah County, Utah*	490472003	40.0500	-109.6800	**0.097**	**0.084**	-0.013	**0.096**	**0.083**	-0.013	0.063	0.060	-0.003
Rangely Site, Rio Blanco County, Colorado*	81030006	40.0800	-108.7600	0.064	0.063	-0.001	0.046	0.045	-0.001	0.064	0.061	-0.003
Red Wash Site, Uintah County, Utah*	490472002	40.2000	-109.3500	**0.086**	0.074	-0.012	**0.084**	0.073	-0.011	0.061	0.058	-0.003
Utah Stations Outside of Uinta Basin Study Area												
Bountiful Site, Davis County, Utah	490110004	40.9000	-111.8800	0.071	0.070	-0.001	NA	NA	NA	0.071	0.067	-0.004
Canyonlands NP Site, San Juan County, Utah	490370101	38.4500	-109.8100	0.069	0.065	-0.004	0.058	0.052	-0.006	0.067	0.064	-0.003
Cottonwood Site, Salt Lake County, Utah	490350003	40.6400	-111.8400	0.075	**0.077**	0.002	NA	NA	NA	0.074	0.073	-0.001
Escalante Site, Garfield County, Utah	490170004	37.7700	-111.6100	0.053	0.050	-0.003	0.045	0.042	-0.003	NA	NA	NA
Fruitland Site, Duchesne County, Utah	490131001	40.3000	-110.0000	0.067	0.064	-0.003	0.049	0.046	-0.003	0.065	0.063	-0.002
Harrisville Site, Weber County, Utah	490571003	41.3000	-111.9800	0.073	0.070	-0.003	NA	NA	NA	0.072	0.068	-0.004
Hawthorne Site, Salt Lake County, Utah	490353006	40.7300	-111.8700	0.075	**0.076**	0.001	0.049	0.055	0.006	0.075	0.072	-0.003
Highland Site, Utah County, Utah	490495008	40.4300	-111.8000	0.067	0.066	-0.001	NA	NA	NA	0.066	0.062	-0.004
Lakepoint Site, Salt Lake County, Utah	490352004	40.7300	-112.2100	0.074	0.068	-0.006	NA	NA	NA	0.072	0.066	-0.006
North Provo Site, Utah County, Utah	490490002	40.2500	-111.6600	0.069	0.066	-0.003	0.047	0.049	0.002	0.069	0.065	-0.004
Ogden Site, Weber County, Utah	490570002	41.2000	-111.9700	0.072	0.069	-0.003	0.046	0.044	-0.002	0.071	0.067	-0.004
Price Site, Carbon County, Utah	490071003	39.6000	-110.8000	0.070	0.064	-0.006	0.049	0.044	-0.005	0.068	0.064	-0.004
Spanish Fork Site, Utah County, Utah	490495010	40.1300	-111.6500	0.069	0.066	-0.003	NA	NA	NA	0.068	0.064	-0.004
St. George Site, Washington County, Utah	490530006	37.1200	-113.6300	0.067	0.060	-0.007	NA	NA	NA	0.066	0.059	-0.007
Tooele Site, Tooele County, Utah	490450003	40.5400	-112.2900	0.072	0.065	-0.007	NA	NA	NA	0.071	0.066	-0.005
Zion NP Site, Washington County, Utah	490530130	37.1900	-113.1500	0.071	0.063	-0.008	0.057	0.049	-0.008	0.070	0.063	-0.007

Table 3-33 MATS-Estimated Ozone Impacts at Monitored Locations – Scenario 2 Controls

Receptor Site Name or City	Site ID	Latitude	Longitude	Annual (ppm)			Winter (ppm)			non-Winter (ppm)		
				Baseline Monitor O_3 Design Value	2021 Scenario 2 O_3 Design Value	Difference	Baseline Monitor O_3 Design Value	2021 Scenario 2 O_3 Design Value	Difference	Baseline Monitor O_3 Design Value	2021 Scenario 2 O_3 Design Value	Difference
Colorado												
Cortez Site, Montezuma County, Colorado	80830006	37.3500	-108.5900	0.066	0.060	-0.006	0.053	0.049	-0.004	0.065	0.059	-0.006
Grand Junction Site, Mesa County, Colorado	80771001	39.1000	-108.7400	0.064	0.060	-0.004	0.062	0.055	-0.007	0.062	0.059	-0.003
Meeker Site, Rio Blanco County, Colorado	81030005	40.0300	-107.8400	0.064	0.060	-0.004	0.053	0.048	-0.005	0.064	0.061	-0.003
Mesa Verde NP Site, Montezuma County, Colorado	80830101	37.1900	-108.4900	0.068	0.062	-0.006	0.000	0.000	0.000	0.000	0.000	0.000
Wyoming												
Evanston Site, Uinta County, Wyoming	560410101	41.3700	-111.0400	0.060	0.054	-0.006	0.052	0.047	-0.005	0.062	0.055	-0.007
Wamsutter Southeast Site, Sweetwater County, Wyoming	560370200	41.6700	-108.0200	0.064	0.059	-0.005	0.055	0.052	-0.003	0.062	0.057	-0.005

Note: Model-predicted concentrations that exceed the NAAQS are shown in **red bold** text.

Table 3-34 MATS-Estimated Ozone and $PM_{2.5}$ Impacts at Unmonitored Locations – 2021 Scenario 2

Receptor Site	Ozone Design Value (ppm)			Annual $PM_{2.5}$ Design Value ($\mu g/m^3$)		
	Baseline	2021 Scenario 2 Controls	Difference	Baseline	2021 Scenario 2 Controls	Difference
Uinta Basin Study Area						
Uinta Basin Study Area	0.102	0.089	-0.013	14.9	21.8	6.9
Class I Areas						
Arches NP	0.068	0.065	-0.003	4.6	4.5	-0.1
Black Canyon of the Gunnison WA	0.066	0.061	-0.005	3.4	3.1	-0.3
Bridger WA	0.073	0.067	-0.006	5.3	5.5	0.2
Bryce Canyon NP	0.062	0.058	-0.004	2.7	2.6	-0.1
Canyonlands NP	0.068	0.065	-0.003	3.2	3.0	-0.2
Capitol Reef NP	0.063	0.060	-0.003	3.2	3.0	-0.2
Eagles Nest WA	0.067	0.063	-0.004	3.8	3.5	-0.3
Fitzpatrick WA	0.071	0.066	-0.005	3.9	4.1	0.2
Flat Tops WA	0.067	0.063	-0.004	2.7	2.6	-0.1
La Garita WA	0.068	0.064	-0.004	2.6	2.5	-0.1
Maroon Bells-Snowmass WA	0.067	0.062	-0.005	2.3	2.2	-0.1
Mesa Verde NP	0.067	0.061	-0.006	4.1	3.8	-0.3
Mount Zirkel WA	0.071	0.064	-0.007	2.3	2.3	0.0
Rawah WA	0.070	0.064	-0.006	2.7	2.6	-0.1
Rocky Mountain NP	0.076	0.067	-0.009	3.7	3.6	-0.1
Weminuche WA	0.070	0.064	-0.006	3.0	2.9	-0.1
West Elk WA	0.066	0.062	-0.004	2.8	2.6	-0.2

Table 3-34 MATS-Estimated Ozone and $PM_{2.5}$ Impacts at Unmonitored Locations – 2021 Scenario 2

Receptor Site	Ozone Design Value (ppm)			Annual $PM_{2.5}$ Design Value ($\mu g/m^3$)		
	Baseline	2021 Scenario 2 Controls	Difference	Baseline	2021 Scenario 2 Controls	Difference
Class II Areas						
Dinosaur National Monument	**0.076**	0.072	-0.004	5.5	5.5	0.0
Flaming Gorge National Recreation Area	0.061	0.058	-0.003	7.1	7.2	0.1
Fort Hall IR	0.070	0.065	-0.005	7.2	11.2	4.0
Goshute IR	0.067	0.061	-0.006	2.9	2.9	0.0
High Uintas WA	0.065	0.060	-0.005	3.9	3.6	-0.3
Navajo IR	0.072	0.067	-0.005	7.5	11.1	3.6
Paitute IR	**0.076**	0.064	-0.012	5.7	5.5	-0.2
Skull Valley IR	0.065	0.060	-0.005	3.4	3.3	-0.1
Southern Ute IR	0.070	0.064	-0.006	4.6	4.6	0.0
Uintah and Ouray IR	**0.102**	**0.084**	-0.018	**12.1**	**21.8**	9.7
Ute Mountain IR	0.072	0.067	-0.005	7.0	6.8	-0.2
Wind River IR	0.072	0.067	-0.005	11.0	10.0	-1.0

Note: Model-predicted concentrations that exceed the NAAQS are shown in **red bold** text.

Table 3-35 MATS-Estimated Winter and Non-Winter Ozone Impacts at Unmonitored Locations – 2021 Scenario 2

Receptor Site	Winter Ozone Design Value (ppm)			Non-Winter Ozone Design Value (ppm)		
	Baseline	2021 Scenario 2	Difference	Baseline	2021 Scenario 2	Difference
Uinta Basin Study Area						
Uinta Basin Study Area	**0.098**	**0.081**	-0.017	0.067	0.064	-0.003
Class I Areas						
Arches NP	0.056	0.050	-0.006	0.066	0.063	-0.003
Bryce Canyon NP	0.051	0.047	-0.004	0.068	0.064	-0.004
Canyonlands NP	0.058	0.053	-0.005	0.068	0.065	-0.003
Capitol Reef NP	0.051	0.048	-0.003	0.068	0.064	-0.004
Mesa Verde NP	0.056	0.052	-0.004	0.066	0.060	-0.006
Class II Areas						
Dinosaur National Monument	0.075	0.071	-0.004	0.065	0.062	-0.003
Flaming Gorge National Recreation Area	0.053	0.050	-0.003	0.062	0.059	-0.003
Goshute IR	0.044	0.041	-0.003	0.066	0.060	-0.006
High Uintas WA	0.052	0.047	-0.005	0.066	0.062	-0.004
Paitute IR	0.070	0.057	-0.013	0.070	0.064	-0.006
Skull Valley IR	0.049	0.047	-0.002	0.064	0.060	-0.004
Uintah and Ouray IR	**0.098**	**0.080**	-0.018	0.067	0.063	-0.004

Note: Model-predicted concentrations that exceed the NAAQS are shown in **red bold** text.

Table 3-36 MATS-Estimated $PM_{2.5}$ Impacts at Monitored Locations within the 4-km Domain – 2021 Scenario 2

Receptor Site Name or City	Site ID	Latitude	Longitude	Annual $PM_{2.5}$ Design Value (µg/m^3)			Daily $PM_{2.5}$ Design Value (µg/m^3)		
				Baseline Monitor	2021 Scenario 2	Difference	Baseline Monitor	2021 Scenario 2	Difference
Bountiful Site, Davis County, Utah	490110004	40.9030	-111.8845	10.2	9.7	-0.50	**37.4**	32.8	-4.60
Cottonwood Site, Salt Lake County, Utah	490350003	40.6467	-111.8497	11.1	10.6	-0.50	**45.4**	**39.8**	-5.60
Harrisville Site, Weber County, Utah	490571003	41.3037	-111.9871	8.9	8.1	-0.80	**35.1**	27.3	-7.80
Highland Site, Utah County, Utah	490495008	40.4303	-111.8039	8.5	7.7	-0.80	31.7	25.6	-6.10
Lindon Site, Utah County, Utah	490494001	40.3414	-111.7136	10.3	9.3	-1.00	**37.9**	31.2	-6.70
Magna Salt Lake City Site, Salt Lake County, Utah	490351001	40.7086	-112.0947	8.6	8.5	-0.10	32.4	27.6	-4.80
Ogden Site, Weber County, Utah	490570002	41.2064	-111.9747	10.3	9.4	-0.90	**38.4**	31.1	-7.30
Provo Site, Utah County, Utah	490490002	40.2536	-111.6631	9.9	8.9	-1.00	33.3	26.1	-7.20
Rose Park Salt Lake City Site, Salt Lake County, Utah	490353010	40.7842	-111.9310	10.4	9.9	-0.50	**39.0**	33.3	-5.70
Spanish Fork Site, Utah County, Utah	490495010	40.1364	-111.6597	9.1	8.1	-1.00	**38.5**	30.9	-7.60
Tooele Site, Tooele County, Utah	490450003	40.5434	-112.2988	6.8	6.4	-0.40	25.4	20.9	-4.50

Note: Model-predicted concentrations that exceed the NAAQS are shown in **red bold** text.

Table 3-37 Change in Model-Predicted Ambient Air Quality Impacts Between 2021 Scenario 2 and OTB Controls

Receptor Site	NO_2 (ppb)		CO (ppm)		SO_2 (ppb)		O_3 (ppm) 8-hour			$PM_{2.5}$ (µg/m^3)		PM_{10} (µg/m^3)
	1-hour	Annual	1-hour	8-hour	1-hour	3-hour	Annual	Winter	Non-Winter	24-hour	Annual	24-hour
Uinta Basin Study Area												
Uinta Basin Study Area	-1	0	0	-1	0	0	-0.001	-0.001	-0.001	0	0.0	0
Dinosaur AQS Station	0	0	0	0	0	0	-0.001	-0.001	0.000	0	0.0	0
Ouray AQS Station	0	0	0	0	0	0	-0.003	-0.003	-0.001	0	-0.1	0
Rangely AQS Station	0	0	0	0	0	0	0.000	0.000	-0.001	0	0.0	0
Redwash AQS Station	0	0	0	0	0	0	-0.001	-0.001	0.000	0	0.0	0
Class I Areas												
Arches NP	0	0	0	0	0	0	0.000	0.000	0.000	0	0.0	0
Black Canyon of the Gunnison WA	0	0	0	0	0	0	0.000	0.000	0.000	0	0.0	0
Bridger WA	0	0	0	0	0	0	0.000	0.000	0.000	0	0.0	0
Bryce Canyon NP	0	0	0	0	0	0	0.000	0.000	0.000	0	0.0	0
Canyonlands NP	0	0	0	0	0	0	0.000	0.000	0.000	0	0.0	0
Capitol Reef NP	0	0	0	0	0	0	0.000	0.000	0.000	0	0.0	0
Eagles Nest WA	0	0	0	0	0	0	0.000	0.000	0.000	0	0.0	0
Fitzpatrick WA	0	0	0	0	0	0	0.000	0.000	0.000	0	0.1	0
Flat Tops WA	0	0	0	0	0	0	0.000	0.000	0.000	0	0.0	0
La Garita WA	0	0	0	0	0	0	0.000	0.000	0.000	0	0.0	0
Maroon Bells-Snowmass WA	0	0	0	0	0	0	0.000	0.000	0.000	0	0.0	0
Mesa Verde NP	0	0	0	0	0	0	0.000	0.000	0.000	0	0.0	0
Mount Zirkel WA	0	0	0	0	0	0	0.000	0.000	0.000	0	0.0	0
Rawah WA	0	0	0	0	0	0	0.000	0.000	0.000	0	0.0	0
Rocky Mountain NP	0	0	0	0	0	0	0.000	0.000	0.000	0	0.0	0
Weminuche WA	0	0	0	0	0	0	0.000	0.000	0.000	0	0.0	0
West Elk WA	0	0	0	0	0	0	0.000	0.000	0.000	0	0.0	0

Table 3-37 Change in Model-Predicted Ambient Air Quality Impacts Between 2021 Scenario 2 and OTB Controls

Receptor Site	NO_2 (ppb)		CO (ppm)		SO_2 (ppb)		O_3 (ppm) 8-hour			$PM_{2.5}$ (µg/m^3)		PM_{10} (µg/m^3)
	1-hour	Annual	1-hour	8-hour	1-hour	3-hour	Annual	Winter	Non-Winter	24-hour	Annual	24-hour
Class II Areas												
Dinosaur National Monument	0	0	0	0	0	0	-0.002	-0.002	0.000	0	0.0	0
Flaming Gorge National Recreation Area	0	0	0	0	0	0	0.000	0.000	0.000	0	0.0	0
Fort Hall IR	0	0	0	0	0	0	0.000	0.000	0.000	0	0.0	0
Goshute IR	0	0	0	0	0	0	0.000	0.000	0.000	0	0.0	0
High Uintas WA	0	0	0	0	0	0	0.000	0.000	0.000	0	0.0	0
Navajo IR	0	0	0	0	0	0	0.000	0.000	0.000	-1	0.0	0
Paitute IR	0	0	0	0	0	0	0.000	0.000	0.000	0	0.0	0
Skull Valley IR	0	0	0	0	0	0	0.000	0.000	0.000	0	0.0	0
Southern Ute IR	0	0	0	0	0	0	0.000	0.000	0.000	0	0.0	0
Uintah and Ouray IR	0	0	0	-1	0	0	-0.003	-0.003	-0.001	-1	0.0	0
Ute Mountain IR	0	0	0	0	0	0	0.000	0.000	0.000	0	0.0	0
Wind River IR	0	0	0	0	0	0	0.000	0.000	0.000	0	0.0	0

Table 3-38 Model-Predicted PSD Increment Values – 2021 Scenario 2 Year

Receptor Site	NO_2 (ppb)	SO_2 (ppb)			$PM_{2.5}$ (µg/m^3)		PM_{10} (µg/m^3)	
	Annual	3-hour	24-hour	Annual	24-hour	Annual	24-hour	Annual
Uinta Basin Study Area								
Uinta Basin Study Area	2.31	9.6	4.2	0.14	**48.3**	3.5	**48.6**	4.0
Dinosaur AQS Station	0.77	0.8	0.5	0.13	**20.0**	3.7	20.6	4.2
Ouray AQS Station	11.23	0.8	0.5	0.12	**35.4**	**8.0**	**35.9**	8.5
Rangely AQS Station	1.60	1.3	0.6	0.14	**10.6**	2.5	11.6	3.2
Redwash AQS Station	7.35	2.6	1.2	0.20	**21.1**	**4.6**	21.4	5.0
Class I Areas								
Arches NP	0.31	1.0	0.5	0.11	**10.5**	**2.2**	**10.7**	2.7
Black Canyon of the Gunnison WA	0.24	0.6	0.4	0.09	**4.8**	**1.4**	7.4	1.8
Bridger WA	0.21	4.1	**2.7**	0.24	**5.5**	**1.5**	8.0	1.9
Bryce Canyon NP	0.16	0.8	0.6	0.08	**12.0**	**1.9**	**15.8**	2.5
Canyonlands NP	0.22	3.5	1.0	0.11	**10.1**	**2.0**	**10.4**	2.4
Capitol Reef NP	0.18	2.1	0.7	0.10	**14.6**	**1.9**	**15.0**	2.4
Eagles Nest WA	0.63	3.5	1.3	0.12	**6.3**	**1.6**	**8.1**	1.9
Fitzpatrick WA	0.16	4.1	**2.5**	0.19	**4.6**	**1.4**	**8.4**	1.8
Flat Tops WA	0.24	2.2	0.8	0.12	**4.5**	**1.5**	**8.4**	1.8
La Garita WA	0.14	0.7	0.5	0.07	**3.8**	**1.2**	6.6	1.5
Maroon Bells-Snowmass WA	0.20	1.6	0.7	0.09	**4.1**	**1.3**	**8.1**	1.6
Mesa Verde NP	0.53	3.2	1.0	0.16	**6.3**	**1.7**	**8.6**	2.1
Mount Zirkel WA	0.46	2.6	1.4	0.23	**5.7**	**1.6**	7.5	2.0
Rawah WA	0.30	2.7	0.9	0.17	**6.8**	**1.5**	**8.1**	1.8

Table 3-38 Model-Predicted PSD Increment Values – 2021 Scenario 2 Year

Receptor Site	NO_2 (ppb)	SO_2 (ppb)			$PM_{2.5}$ (µg/m^3)		PM_{10} (µg/m^3)	
	Annual	3-hour	24-hour	Annual	24-hour	Annual	24-hour	Annual
Rocky Mountain NP	0.38	6.1	**2.9**	0.17	**23.2**	**1.6**	**24.5**	1.9
Weminuche WA	0.25	1.4	0.7	0.08	**4.8**	**1.2**	**8.5**	1.6
West Elk WA	0.16	1.0	0.5	0.08	**7.6**	**1.3**	**8.9**	1.7
Class II Areas								
Dinosaur National Monument	0.51	1.6	0.7	0.14	**21.2**	2.5	21.6	2.9
Flaming Gorge National Recreation Area	0.52	21.4	6.1	0.19	**21.2**	2.3	21.8	2.7
Fort Hall IR	1.24	8.8	3.4	0.31	**28.4**	3.8	**45.0**	5.7
Goshute IR	0.10	0.6	0.3	0.06	5.3	1.2	11.5	1.8
High Uintas WA	0.16	2.1	0.7	0.10	7.5	1.8	11.6	2.2
Navajo IR	0.81	20.5	5.7	0.16	**25.6**	1.9	**30.7**	2.6
Paitute IR	0.41	2.2	0.6	0.10	**11.8**	2.0	14.7	2.8
Skull Valley IR	0.33	2.0	0.7	0.12	**12.3**	1.9	12.8	2.4
Southern Ute IR	2.53	4.8	1.0	0.12	**30.5**	1.7	**35.1**	2.1
Uintah and Ouray IR	2.56	9.7	4.7	0.14	**48.3**	3.6	**53.3**	4.1
Ute Mountain IR	1.07	9.4	3.7	0.22	**19.6**	2.0	20.4	2.6
Wind River IR	0.35	18.0	10.9	0.39	**9.9**	1.5	11.6	1.9

Note: Model-predicted concentrations that exceed the PSD Increments are shown in **red bold** text.

Table 3-39 Change in PSD Increment Values Between 2021 Scenario 2 and 2010 Year

Receptor Site	NO_2 (ppb)	SO_2 (ppb)			$PM_{2.5}$ (µg/m^3)		PM_{10} (µg/m^3)	
	Annual	3-hour	24-hour	Annual	24-hour	Annual	24-hour	Annual
Uinta Basin Study Area								
Uinta Basin Study Area	0.3	-3.3	-2.1	0.0	11.3	0.1	5.0	0.1
Dinosaur AQS Station	0.0	-0.6	-0.3	0.0	2.4	0.0	2.3	-0.1
Ouray AQS Station	4.9	-0.7	-0.1	0.0	5.6	1.3	5.0	1.1
Rangely AQS Station	-2.0	-0.2	-0.3	-0.1	-0.3	-0.1	-0.5	-0.2
Redwash AQS Station	4.1	0.0	-0.1	0.0	1.5	0.8	1.3	0.8
Class I Areas								
Arches NP	-0.2	-2.6	-1.1	-0.1	-6.5	-0.5	-6.7	-0.5
Black Canyon of the Gunnison WA	-0.2	-1.1	-0.4	-0.1	-1.5	-0.2	-0.4	-0.3
Bridger WA	0.0	1.4	1.4	0.1	-0.4	0.0	0.1	0.0
Bryce Canyon NP	-0.1	-1.2	-0.5	-0.1	-1.5	-0.4	-1.8	-0.4
Canyonlands NP	-0.1	-10.3	-2.9	-0.1	-7.6	-0.5	-7.8	-0.5
Capitol Reef NP	-0.1	-0.3	-1.2	-0.1	-3.7	-0.4	-3.8	-0.4
Eagles Nest WA	-0.6	-0.1	-0.2	-0.1	-1.0	-0.2	-1.1	-0.2
Fitzpatrick WA	0.0	2.4	1.7	0.1	-0.7	0.0	0.1	0.0
Flat Tops WA	-0.2	-2.5	-0.6	-0.1	-1.1	-0.2	0.0	-0.2
La Garita WA	-0.1	-1.5	-0.5	-0.1	-0.2	-0.1	0.0	-0.1
Maroon Bells-Snowmass WA	-0.1	0.0	-0.2	-0.1	-0.2	-0.1	0.0	-0.1
Mesa Verde NP	-0.8	-12.3	-3.4	-0.3	-2.1	-0.3	-0.4	-0.3
Mount Zirkel WA	-0.5	-2.1	-1.2	-0.2	-1.4	-0.2	-0.2	-0.2
Rawah WA	-0.3	-0.8	-0.7	-0.1	-1.5	-0.2	-1.6	-0.2

Table 3-39 Change in PSD Increment Values Between 2021 Scenario 2 and 2010 Year

Receptor Site	NO_2 (ppb)	SO_2 (ppb)			$PM_{2.5}$ (µg/m^3)		PM_{10} (µg/m^3)	
	Annual	3-hour	24-hour	Annual	24-hour	Annual	24-hour	Annual
Rocky Mountain NP	-0.4	0.2	0.0	-0.1	-1.0	-0.2	-1.1	-0.2
Weminuche WA	-0.2	-5.1	-1.3	-0.1	-0.2	-0.1	0.0	-0.1
West Elk WA	-0.1	-0.7	-0.4	-0.1	-0.2	-0.2	-0.2	-0.2
Class II Areas								
Dinosaur National Monument	0.0	-1.0	-0.7	0.0	3.5	-0.1	3.2	-0.2
Flaming Gorge National Recreation Area	-0.3	-9.8	-2.3	-0.1	6.8	-0.2	1.9	-0.3
Fort Hall IR	-0.4	-0.6	-2.3	-0.1	7.4	0.7	18.8	1.3
Goshute IR	0.0	-0.9	-0.5	-0.1	-1.6	-0.1	-0.1	-0.1
High Uintas WA	-0.1	0.4	-0.3	0.0	-2.0	-0.2	0.0	-0.2
Navajo IR	-0.6	-79.3	-24.8	-0.2	-12.9	-0.3	-8.9	-0.3
Paitute IR	-0.4	-0.5	-0.6	-0.2	-3.0	-0.4	-2.9	-0.4
Skull Valley IR	-0.1	0.1	-0.2	0.0	-1.6	-0.2	-1.5	-0.1
Southern Ute IR	-1.7	-11.0	-3.4	-0.2	-0.6	-0.2	-0.6	-0.3
Uintah and Ouray IR	0.4	-4.5	-2.3	0.0	-0.7	0.1	-1.0	0.1
Ute Mountain IR	-1.5	-23.6	-10.3	-0.5	-2.5	-0.4	-3.2	-0.6
Wind River IR	-0.3	-16.1	-10.7	-0.1	-2.8	-0.1	-2.9	-0.1

Table 3-40 Change in PSD Increment Values Between 2021 Scenario 2 and 2021 OTB Controls

	NO_2 (ppb)	SO_2 (ppb)			$PM_{2.5}$ (µg/m^3)		PM_{10} (µg/m^3)	
Receptor Site	**Annual**	**3-hour**	**24-hour**	**Annual**	**24-hour**	**Annual**	**24-hour**	**Annual**
Uinta Basin Study Area								
Uinta Basin Study Area	0.0	0.0	0.0	0.0	-0.5	0.0	-0.5	0.0
Dinosaur AQS Station	0.0	0.0	0.0	0.0	0.1	0.0	0.1	0.0
Ouray AQS Station	0.0	0.0	0.0	0.0	-0.4	-0.1	-0.4	-0.1
Rangely AQS Station	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Redwash AQS Station	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Class I Areas								
Arches NP	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Black Canyon of the Gunnison WA	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Bridger WA	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Bryce Canyon NP	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Canyonlands NP	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Capitol Reef NP	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Eagles Nest WA	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Fitzpatrick WA	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Flat Tops WA	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
La Garita WA	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maroon Bells-Snowmass WA	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Mesa Verde NP	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Mount Zirkel WA	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rawah WA	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 3-40 Change in PSD Increment Values Between 2021 Scenario 2 and 2021 OTB Controls

	NO_2 (ppb)	SO_2 (ppb)			$PM_{2.5}$ (µg/m^3)		PM_{10} (µg/m^3)	
Receptor Site	**Annual**	**3-hour**	**24-hour**	**Annual**	**24-hour**	**Annual**	**24-hour**	**Annual**
Rocky Mountain NP	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Weminuche WA	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
West Elk WA	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Class II Areas								
Dinosaur National Monument	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Flaming Gorge National Recreation Area	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Fort Hall IR	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Goshute IR	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
High Uintas WA	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Navajo IR	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Paitute IR	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Skull Valley IR	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Southern Ute IR	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Uintah and Ouray IR	0.0	0.0	0.0	0.0	-0.5	0.0	0.0	0.0
Ute Mountain IR	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Wind River IR	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

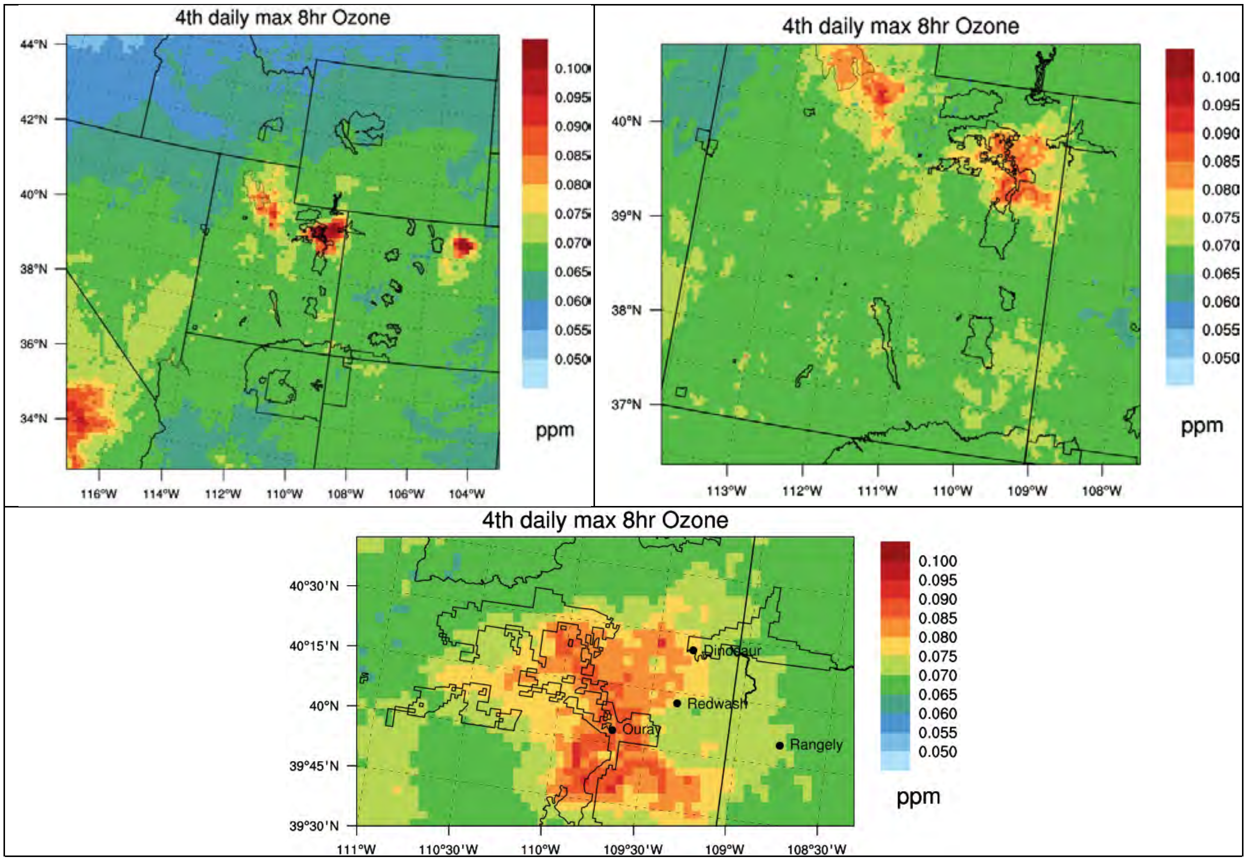

Figure 3-13 2021 Scenario 2 Model-Predicted 4th Highest Daily Maximum 8-hour Ozone Spatial Plots

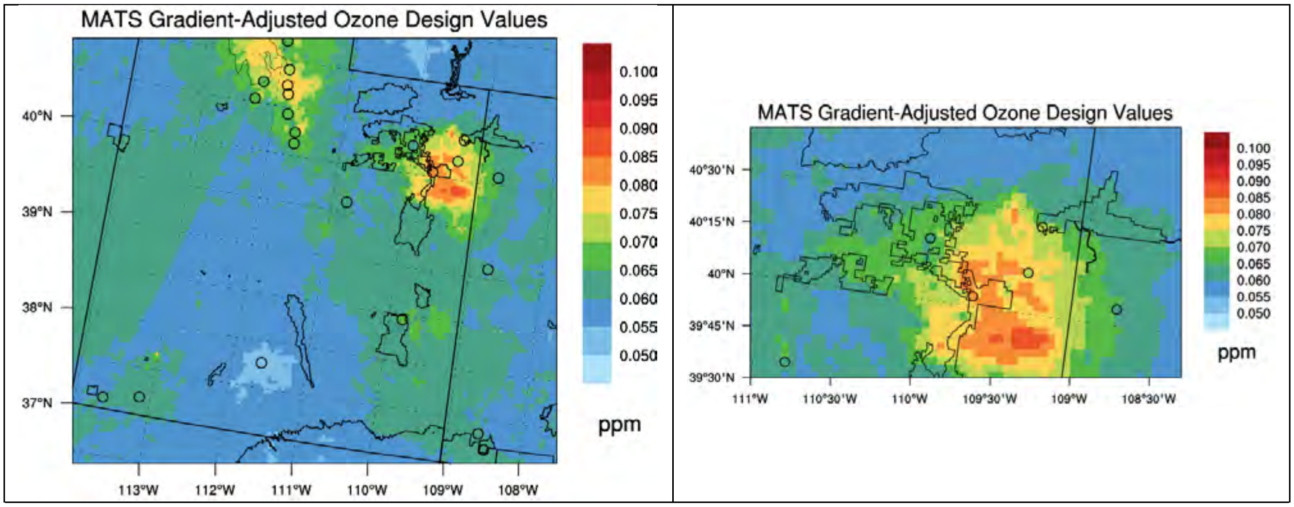

Figure 3-14 MATS Interpolated 2021 Scenario 2 Ozone Design Values

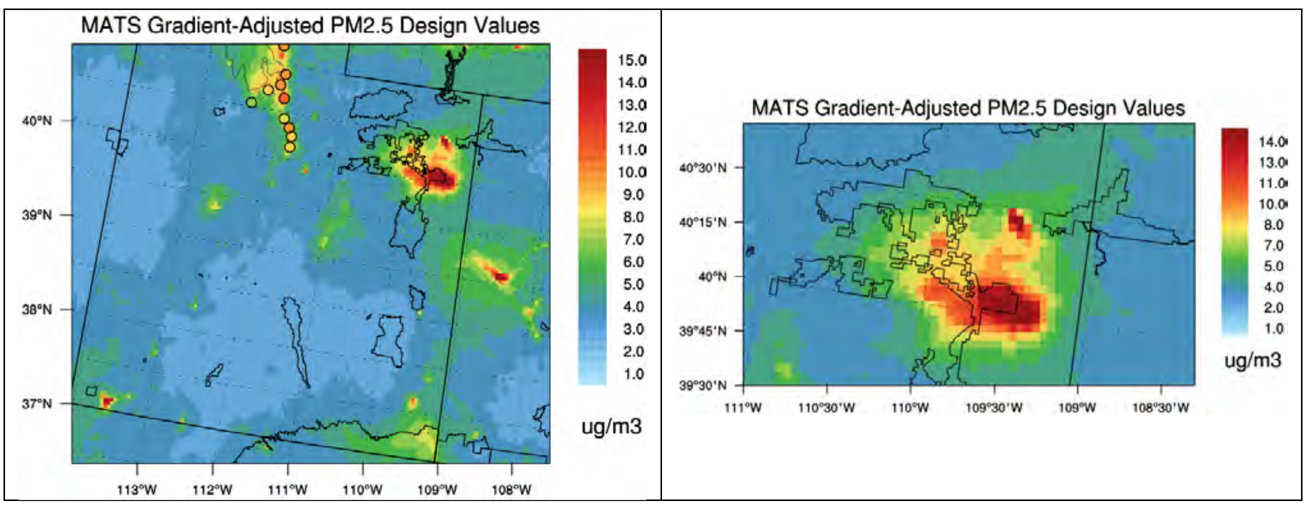

Figure 3-15 MATS Interpolated 2021 Scenario 2 Annual $PM_{2.5}$ Design Values

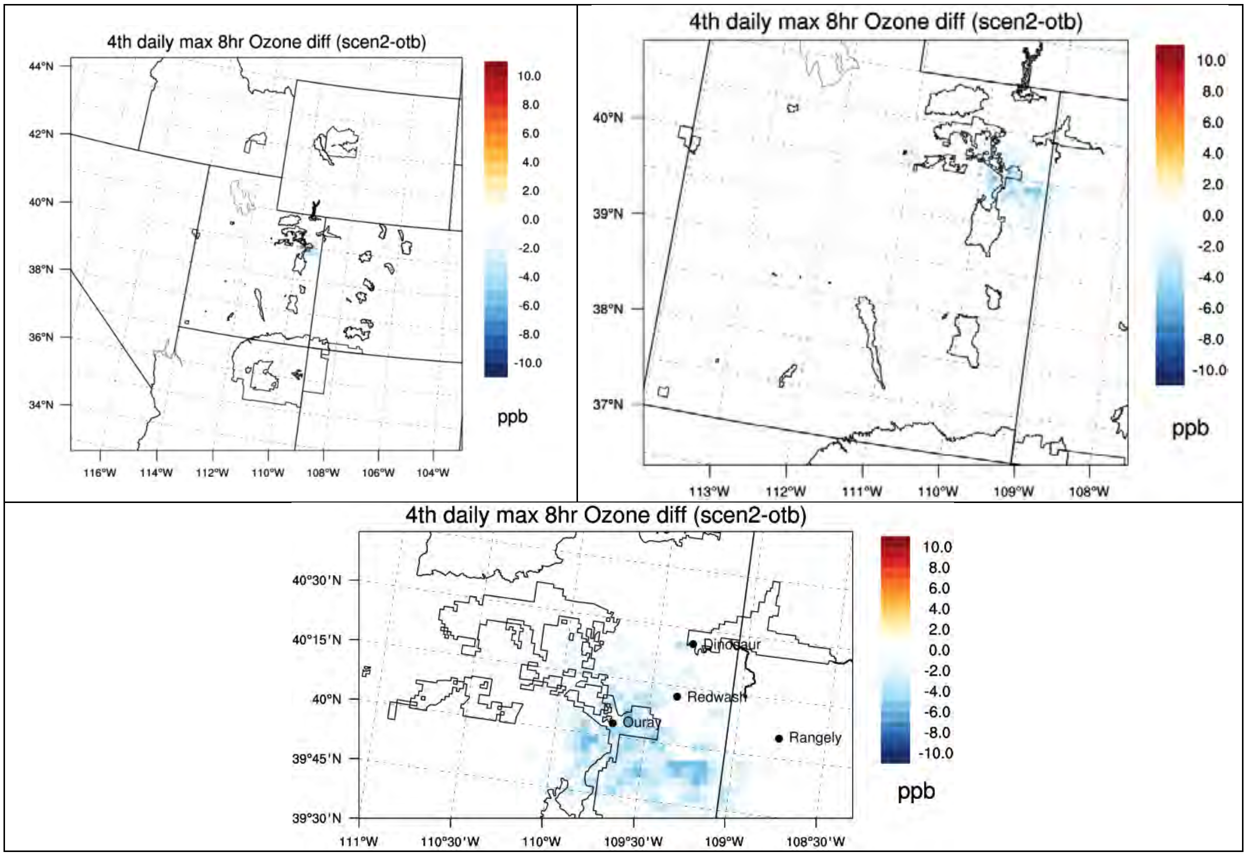

Figure 3-16 Absolute Difference between 2021 Scenario 2 and 2021 OTB Controls Model-Predicted 4th Highest Daily Maximum 8-hour Ozone Spatial Plots

3.8 2021 Control Scenario 3

For the purpose of this study, the results for the 2021 Scenario 3 are analyzed:

- Individually;
- Relative to the 2010 Typical Year; and
- Relative to 2021 OTB Controls.

An explanation of the differences between the three scenarios is found in Chapter 2. With the exception of the Uinta Basin study area, the emission inventories for the 2021 OTB Controls and Scenario 3 modeling scenarios are same. It is expected that 2021 Scenario 3 modeling results outside of the Uinta Basin study area are similar to the 2021 OTB Controls. Therefore, when comparing the 2021 Scenario 3 to the 2021 OTB Controls, the discussion of the modeling results is limited to new results not previously seen or discussed.

3.8.1 Model-Predicted Cumulative Criteria Pollutant Impacts

3.8.1.1 Absolute Model Impacts for all Pollutants

Table 3-41 presents the 2021 Scenario 3 modeled cumulative air quality impacts at all assessment areas. Similar to the previous model scenarios, only ozone is predicted to be above the NAAQS and state AAQS when evaluating the absolute model concentrations.[7] Two areas within the Uinta Basin study area, three Class I areas, and two Sensitive Class II areas above the ozone standard. Of the assessment areas near or within the Uinta Basin study area, Rangely Station, Redwash Station, Flaming Gorge National Recreation Area, and High Uintas WA have ozone values below the NAAQS. Similar to the other modeling scenarios, the Uinta Basin study area has the highest modeled ozone concentrations.

The differences between the 2021 Scenario 3 and 2010 Typical Year are presented in **Table 3-42.** Areas removed from the Uinta Basin study area generally have lower concentrations in 2021 Scenario 3 than the 2010 Typical Year scenario. All assessment areas are predicted to have lower ozone values in the 2021 Scenario 3 relative to the Typical Year, except for Dinosaur NM. The areas near or within the Uinta Basin study area generally have higher modeled values in 2021 Scenario 3 relative to 2010 Typical Year for 1-hour and annual NO_2. Only the Rangely station on the eastern side of the Uinta Basin study area has lower values of 1-hour and annual NO_2.

The 4th highest daily maximum 8-hour ozone concentrations spatial plots are shown in **Figure 3-17** for the 2021 Scenario 3. The figure shows the 12-km domain, 4-km domain, and the Uinta Basin study area, from left to right, top to bottom. Within the Uinta Basin study area, the areas with highest ozone values are south of Ouray. The spatial distribution is similar 2010 Typical Year modeling results (**Figure 3-3**), whereby a majority of the area is below the NAAQS except for Salt Lake City area and the Uinta Basin study area. The spatial extent of ozone exceedences around Salt Lake City appears to be smaller in Scenario 3 relative to the 2010 Typical Year (**Figure 3-3**). As seen in **Table 3-42,** Dinosaur, Redwash, and Rangely sites are predicted to be below the NAAQS, so the higher ozone concentrations are not at the monitoring site locations. A more detailed analysis of the modeled ozone differences between the 2021 Scenario 3 and the 2021 OTB Controls is available in Section 3.8.2 and **Appendix B**.

3.8.1.2 Relative Model Impacts for Ozone and $PM_{2.5}$

<u>Ozone</u>

Table 3-43 provides the MATS 8-hour annual, winter, and non-winter ozone design values for baseline and 2021 Scenario 3 at available monitoring sites in the 4-km domain. **Figure 3-1** shows the location of

[7] Note that in contrast to absolute model impacts, the MATS tool, which is used to calculate model-adjusted concentrations based on monitoring values, predicts potential exceedances of the NAAQS for $PM_{2.5}$.

the monitoring sites relative to the assessment areas. As discussed in Section 3.1 and **Appendix A**, the baseline year is 2010 for the MATS monitoring sites. As shown in **Table 3-43**, the baseline design value exceed the ozone NAAQS for 2 of the 26 monitors.[8] Based on the model-predicted ozone changes between 2021 Scenario 3 and the baseline, the design value is projected to decrease at most monitoring sites; however, there is an increase in the number of monitors that are projected to exceed the NAAQS from two monitoring sites in 2010 to four monitoring sites in 2021. The highest predicted ozone design value in 2021 is 0.095 ppm, which occurs at site 490472003, Ouray, Utah, within the Uinta Basin. Importantly, this is a 10 ppb decrease relative to the baseline. Within the Uinta Basin, 2 of the 4 monitors are projected to have ozone design values that exceeding the NAAQS both in 2010 and in 2021.

For the UAA, the spatial interpolation of ozone design values are shown in **Figure 3-18** and the maximum ozone design value for assessment areas are presented in **Table 3-44**. **Table 3-45** shows the winter and non-winter ozone design values at unmonitored locations within the 4-km domain. For the spatial plots, the circles show the model-predicted design value at the monitoring sites as reported in **Table 3-43**. For the most part, the design values at monitoring sites correspond to the UAA. As shown in **Figure 3-18**, the 2021 predicted ozone design values that are close or exceeding the NAAQS are located in Uinta Basin and Salt Lake City metropolitan area. These areas correspond to the same areas predicted to have elevated 8-hour ozone concentrations from the absolute model results (shown in **Figure 3-17**).

As shown in **Table 3-44**, the assessment areas with the highest ozone design values for the 2021 Scenario 3 are within or near the Uinta Basin study area. For the 2021 Scenario 3, ozone design values are lower than baseline values and the number of areas predicted to exceed the NAAQS decreases from 5 areas to 2 areas: the Uinta Basin study area and Uintah and Ouray IR. All other assessment areas have ozone design values below the NAAQS in 2021.

$PM_{2.5}$

In addition to the ozone analysis, an analysis of the relative model impacts of annual and daily $PM_{2.5}$ was conducted using MATS. **Table 3-46** presents the MATS-estimated baseline and 2021 Scenario 3 $PM_{2.5}$ design values at monitor locations within the 4-km domain. Due to the limited number $PM_{2.5}$ monitors, the closest monitors to the Uinta Basin study area are near Salt Lake City. All annual $PM_{2.5}$ monitors are below the NAAQS in 2021. For daily $PM_{2.5}$, only one monitor has design values above the NAAQS.

For the UAA, spatial plots of the spatially interpolated annual $PM_{2.5}$ design values are shown in **Figure 3-19**. Since MATS does not provided spatial interpolation of daily $PM_{2.5}$, only the annual $PM_{2.5}$ is used for the UAA. The maximum annual $PM_{2.5}$ design value for the assessment areas are shown in **Table 3-44**. Like the ozone deign value spatial plot, the circles show the model-predicted design value at the monitoring sites as reported in **Table 3-46**. In general the monitor values correspond to the spatial interpolation. However, there are large spatial gradients in the modeled concentrations, which can make it difficult to visually compare the monitoring values to the UAA spatial plot values. Within the Uinta Basin study area, the highest annual $PM_{2.5}$ design values are found in the northern portions of the Uintah and Ouray IR. For the assessment areas (**Table 3-44**), only the Uinta Basin study area has modeled annual $PM_{2.5}$ design values above the NAAQS. Areas near and within the Uinta Basin study area have lower annual $PM_{2.5}$ design values in 2021 than in the baseline.

3.8.2 Comparison of Control Scenario 3 to OTB Controls

In the following sections, the 2021 Scenario 3 modeling results are compared to the 2021 OTB Controls modeling results. The differences for all assessment areas and domains are shown. However, the focus of the comparison is modeling results near and in the Uinta Basin study area.

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[8] It is important to note that currently there is insufficient data collected at regulatory monitors in the Uinta Basin study area to calculate a true ozone design value. All future year ozone design values reported for the Uinta Basin do not represent actual design values and are for informational purposes only.

3.8.2.1 Differences in Absolute Model Impacts for all Pollutants

Table 3-47 shows the change in the model predicted ambient air quality impacts between 2021 Scenario 3 and 2021 OTB Controls. As expected, the largest differences occur near the Uinta Basin study area. Relative to the 2021 OTB Controls, the NO_2, PM_{10},$PM_{2.5}$, SO_2, CO, and VOC emissions for the 2021 Scenario 3 decrease (**Table 2-10**). The differences in modeled impacts of associated criteria pollutants (shown in **Table 3-47**) are consistent with the changes in the emissions inventory. The 1-hour and annual NO_2, 24-hour and annual $PM_{2.5}$, and annual PM_{10} values for areas near or within the Uinta Basin study area are lower for 2021 Scenario 3 than the 2021 OTB Controls. Small differences are shown with 1-hour and 8-hour CO. For 1-hour and 3-hour SO_2, model impacts are unchanged relative to the OTB Controls. For 8-hour ozone impacts, four assessment areas have slightly lower concentrations, 3 assessment areas have impacts 5-7 ppb higher, and the remaining assessment areas are unchanged. Overall, the Scenario 3 impacts are most similar to the Scenario 1 impacts.

Spatial plots of the difference of the 4^{th} maximum ozone concentrations between 2021 Scenario 3 and OTB Controls are shown in **Figure 3-20**. The only areas with predicted differences are within or near the Uinta Basin study area. Within the Uinta Basin study area, it appears that the area with highest ozone values have shifted slightly south and east and the spatial extent is smaller. Relative to the 2021 OTB Controls, the 2021 Scenario 3 ozone values are approximately 10 ppb less in northern half of the study area and 10 ppb higher in the southern area. The largest increase is shown southeast of Ouray where the modeled impacts are already the highest. More details are provided in **Appendix B**.

3.8.2.2 Differences in Relative Model Impacts for Ozone and $PM_{2.5}$

The change in the MATS-estimated ozone and $PM_{2.5}$ impacts between 2021 Scenario 2 and OTB Controls are shown in **Tables 3-24** and **3-25,** respectively, for all monitored locations.

<u>Ozone</u>

As shown in **Table 3-24**, Scenario 3 indicates a small 1 ppb ozone reduction at Rangely, but increased ozone concentrations at all other monitoring sites in the Uinta Basin study area. For the Ouray Site, both the absolute model impacts and MATS analysis establishes an increase of ozone in Scenario 3 relative to OTB Controls. However at the Redwash Site, the analysis of the absolute model impacts shows a decrease of ozone by 2 ppb, whereas the MATS analysis shows a 5 ppb increase of ozone. Similar to Scenario 1 this difference in the absolute versus relative model results indicates larger ozone impacts in the vicinity of the Redwash monitor that are incorporated into the results as part of the relative modeling analysis.

The change in UAA ozone design values are shown in **Table 3-26** for all assessment areas. **Table 3-27** shows the change in winter and non-winter ozone design values at unmonitored locations within the 4-km domain. **Table 3-26** shows that under Scenario 3 the predicted ozone design values would increase relative to the OTB Controls in: the Uinta Basin study area, Uintah and Ouray IR, and Dinosaur National Monument. The increases range from 1 ppb to 11 ppb.

<u>$PM_{2.5}$</u>

As shown in **Table 3-25**, two monitors near Salt Lake City have a lower daily $PM_{2.5}$ design value for Scenario 3 relative to OTB Controls. As shown in **Table 3-26**, five assessment areas are predicted to have lower annual $PM_{2.5}$ design values than the OTB Controls. These areas are: Uinta Basin study area, Uintah and Ouray IR, Dinosaur National Monument, Flaming Gorge National Recreation Area, and Mount Zirkel WA. The largest decrease of annual $PM_{2.5}$ design values is modeled for Uintah and Ouray IR.

3.8.3 PSD Increment Assessment

The PSD increments for the assessment areas for 2021 Scenario 3 are shown in **Table 3-48**. If all model sources were increment consuming sources, model predicted impacts would exceed allowable increments for 24-hour $PM_{2.5}$ at most assessment areas. As seen with the previously discussed scenarios, the following pollutants and averaging periods are below the PSD increment for all assessment areas: 3-hour SO_2, annual SO_2, NO_2, and PM_{10}. Within the Uinta Basin study area all sites exceed the 24-hour $PM_{2.5}$ increment. In addition, the annual $PM_{2.5}$ increment is exceeded at the Ouray station, while the 24-hour PM_{10} is above the increment at Uinta Basin study area. The model results for the other increments and assessment areas are similar to the previously discussed scenarios.

The PSD increments changes between 2021 Scenario 3 and 2010 Typical Year are shown in **Table 3-49**. Relative to the 2010 Typical Year, the almost all of pollutants are predicted to be lower for the 2021 Scenario 3. Near and within the Uinta Basin study area, the following PSD increments are predicted to be higher in Scenario 3 for their respective assessment areas: annual NO_2 at the Ouray stations, 24-hour $PM_{2.5}$ at Dinosaur National Monument and Flaming Gorge Recreation Area, and 24-hour PM_{10} at Flaming Gorge Recreation. With the exception of the PM differences shown at Fort Hall IR, the majority of the modeled differences for all assessment areas are relatively small.

3.8.3.1 Comparison of Control Scenario 3 to OTB Controls

Changes in the modeled impacts between 2021 Scenario 3 and OTB Controls are shown in **Table 3-50** relative to applicable PSD increments. The largest differences between occur at assessment areas near or within the Uinta Basin study area. The annual NO_2 and all PM increments are lower in Scenario 3 corresponding to the NO_x, $PM_{2.5}$, and PM_{10} emissions reductions (**Table 2-10**). Overall, the results are similar to Scenario 1 (Section 3.6.3.1), except the magnitude of the difference is larger in Scenario 3.

Table 3-41 Model-Predicted Ambient Air Quality Impacts Compared to NAAQS – 2021 Scenario 3

Receptor Site	NO_2 (ppb)		CO (ppm)		SO_2 (ppb)		O_3 (ppm) 8-hour			$PM_{2.5}$ (µg/m^3)		PM_{10} (µg/m^3)
	1-hour	Annual	1-hour	8-hour	1-hour	3-hour	Annual	Winter	Non-Winter	24-hour	Annual	24-hour
Uinta Basin Study Area												
Uinta Basin Study Area	21	2	2	1	2	0	**0.122**	**0.122**	**0.080**	12	2.9	40
Dinosaur AQS Station	3	1	0	0	1	0	0.074	0.074	0.068	12	3.3	20
Ouray AQS Station	38	9	1	0	1	0	**0.095**	**0.095**	0.072	22	5.4	30
Rangely AQS Station	5	2	0	0	1	0	0.069	0.064	0.069	6	2.4	10
Redwash AQS Station	24	6	0	0	2	0	0.073	0.073	0.069	12	3.6	20
Class I Areas												
Arches NP	1	0	1	0	1	0	**0.079**	0.060	**0.079**	6	2.1	10
Black Canyon of the Gunnison WA	1	0	0	0	1	0	0.067	0.061	0.067	3	1.4	10
Bridger WA	1	0	0	0	3	0	0.070	0.061	0.070	4	1.5	10
Bryce Canyon NP	1	0	0	0	1	0	0.074	0.058	0.074	4	1.9	20
Canyonlands NP	1	0	0	0	1	0	**0.078**	0.064	**0.078**	6	1.9	10
Capitol Reef NP	1	0	0	0	1	0	0.075	0.068	0.075	5	1.9	10
Eagles Nest WA	3	1	0	0	2	0	0.070	0.062	0.070	4	1.6	10
Fitzpatrick WA	1	0	0	0	3	0	0.069	0.060	0.069	4	1.4	10
Flat Tops WA	1	0	0	0	1	0	0.072	0.063	0.072	3	1.5	10
La Garita WA	1	0	0	0	1	0	0.070	0.067	0.070	3	1.2	10
Maroon Bells-Snowmass WA	1	0	0	0	1	0	0.068	0.062	0.068	3	1.3	10
Mesa Verde NP	4	1	0	0	2	0	0.073	0.067	0.073	4	1.7	10
Mount Zirkel WA	2	0	0	0	2	0	0.071	0.068	0.071	4	1.6	10
Rawah WA	2	0	0	0	2	0	0.072	0.066	0.072	4	1.5	10
Rocky Mountain NP	2	0	1	0	4	0	**0.076**	0.067	**0.076**	4	1.6	20
Weminuche WA	1	0	0	0	1	0	0.070	0.070	0.070	3	1.2	10
West Elk WA	1	0	0	0	1	0	0.068	0.063	0.068	3	1.3	10

Table 3-41 Model-Predicted Ambient Air Quality Impacts Compared to NAAQS – 2021 Scenario 3

Receptor Site	NO_2 (ppb)		CO (ppm)		SO_2 (ppb)		O_3 (ppm) 8-hour			$PM_{2.5}$ (µg/m^3)		PM_{10} (µg/m^3)
	1-hour	Annual	1-hour	8-hour	1-hour	3-hour	Annual	Winter	Non-Winter	24-hour	Annual	24-hour
Class II Areas												
Dinosaur National Monument	2	0	1	0	1	0	**0.091**	**0.091**	0.072	8	2.3	20
Flaming Gorge National Recreation Area	3	1	1	0	4	0	0.073	0.071	0.073	7	2.2	20
Fort Hall IR	7	1	1	0	5	0	0.067	0.065	0.067	12	3.8	50
Goshute IR	0	0	0	0	0	0	0.070	0.058	0.070	3	1.2	10
High Uintas WA	1	0	0	0	1	0	0.073	0.071	0.073	4	1.8	10
Navajo IR	6	1	0	0	3	0	0.075	0.067	0.074	6	1.9	30
Paitute IR	2	0	1	0	1	0	0.072	0.072	0.072	5	2.0	10
Skull Valley IR	2	0	0	0	2	0	0.070	0.068	0.069	6	1.9	10
Southern Ute IR	16	3	1	0	1	0	0.072	0.069	0.072	4	1.7	40
Uintah and Ouray IR	26	2	3	1	2	0	**0.121**	**0.121**	**0.077**	12	2.9	50
Ute Mountain IR	7	1	1	0	3	0	0.072	0.067	0.072	6	2.0	20
Wind River IR	2	0	0	0	7	0	0.071	0.062	0.071	4	1.5	10

Note: Model-predicted concentrations that exceed the NAAQS are shown in **red bold** text.

Table 3-42 Change in Model-Predicted Ambient Air Quality Impacts Between 2021 Scenario 3 and 2010 Typical Year

Receptor Site	NO_2 (ppb)		CO (ppm)		SO_2 (ppb)		O_3 (ppm) 8-hour			$PM_{2.5}$ (µg/m^3)		PM_{10} (µg/m^3)
	1-hour	Annual	1-hour	8-hour	1-hour	3-hour	Annual	Winter	Non-Winter	24-hour	Annual	24-hour
Uinta Basin Study Area												
Uinta Basin Study Area	2	0	-2	-2	0	0	-0.004	-0.004	-0.002	-2	-0.5	0
Dinosaur AQS Station	0	0	0	0	0	0	-0.003	-0.003	-0.005	-2	-0.4	0
Ouray AQS Station	9	3	0	0	0	0	-0.003	-0.003	-0.003	-3	-1.4	0
Rangely AQS Station	-10	-2	0	0	0	0	-0.003	0.000	-0.003	-1	-0.2	0
Redwash AQS Station	11	3	0	0	0	0	-0.001	0.000	-0.003	-1	-0.2	0
Class I Areas												
Arches NP	-1	-1	1	0	-1	0	-0.002	-0.007	-0.002	-3	-0.6	-10
Black Canyon of the Gunnison WA	-1	0	0	0	0	0	-0.006	-0.006	-0.006	-1	-0.3	0
Bridger WA	0	0	0	0	1	0	-0.004	-0.007	-0.004	0	0.0	0
Bryce Canyon NP	0	0	0	0	0	0	-0.006	-0.007	-0.006	-2	-0.4	0
Canyonlands NP	-1	0	0	0	-1	0	-0.002	-0.008	-0.002	-2	-0.5	-10
Capitol Reef NP	-1	0	0	0	-1	0	-0.005	-0.004	-0.005	-2	-0.4	-10
Eagles Nest WA	-3	0	0	0	0	0	-0.004	-0.005	-0.004	0	-0.2	0
Fitzpatrick WA	0	0	0	0	1	0	-0.004	-0.012	-0.003	0	-0.1	0
Flat Tops WA	0	0	0	0	0	0	0.001	-0.003	0.001	-1	-0.1	0
La Garita WA	-2	0	0	0	-1	0	-0.004	-0.002	-0.004	0	-0.1	0
Maroon Bells-Snowmass WA	-1	0	0	0	0	0	-0.004	-0.009	-0.004	0	-0.1	0
Mesa Verde NP	-5	0	0	0	-8	0	-0.005	-0.003	-0.005	-1	-0.2	0
Mount Zirkel WA	-2	-1	0	0	-1	0	-0.006	-0.003	-0.006	0	-0.2	0
Rawah WA	-1	-1	0	0	-1	0	-0.004	-0.004	-0.004	0	-0.2	0
Rocky Mountain NP	-2	-1	0	0	0	0	-0.011	-0.003	-0.011	0	-0.1	-10
Weminuche WA	-2	0	0	0	-1	0	-0.006	-0.006	-0.004	0	-0.1	0
West Elk WA	0	0	0	0	0	0	-0.006	-0.006	-0.006	0	-0.2	0

Table 3-42 Change in Model-Predicted Ambient Air Quality Impacts Between 2021 Scenario 3 and 2010 Typical Year

Receptor Site	NO_2 (ppb)		CO (ppm)		SO_2 (ppb)		O_3 (ppm) 8-hour			$PM_{2.5}$ (µg/m^3)		PM_{10} (µg/m^3)
	1-hour	Annual	1-hour	8-hour	1-hour	3-hour	Annual	Winter	Non-Winter	24-hour	Annual	24-hour
Class II Areas												
Dinosaur National Monument	0	-1	0	0	0	0	0.003	0.003	-0.003	-1	-0.4	0
Flaming Gorge National Recreation Area	-2	0	1	0	-3	0	-0.007	-0.009	-0.004	-1	-0.3	0
Fort Hall IR	-3	-1	0	0	1	0	-0.005	-0.006	-0.005	2	0.7	20
Goshute IR	0	0	0	0	-1	0	-0.006	-0.002	-0.006	0	-0.1	0
High Uintas WA	0	0	0	0	0	0	-0.008	-0.010	-0.003	-1	-0.2	0
Navajo IR	-5	0	0	0	-8	-100	-0.007	-0.005	-0.008	-1	-0.3	-10
Paitute IR	-3	-1	0	0	-1	0	-0.017	-0.017	-0.006	-1	-0.4	-10
Skull Valley IR	-1	0	0	0	1	0	-0.003	-0.003	-0.004	-1	-0.2	0
Southern Ute IR	-11	-1	0	0	-5	0	-0.006	-0.005	-0.006	-1	-0.2	0
Uintah and Ouray IR	5	0	0	0	-2	0	-0.004	-0.004	-0.003	-3	-0.5	0
Ute Mountain IR	-8	-2	0	0	-12	0	-0.006	-0.006	-0.006	-1	-0.4	0
Wind River IR	-2	-1	0	0	-6	0	-0.004	-0.006	-0.004	-1	-0.2	0

Table 3-43 MATS-Estimated Ozone Impacts at Monitored Locations – 2021 Scenario 3 Controls

Receptor Site Name or City	Site ID	Latitude	Longitude	Annual (ppm)			Winter (ppm)			non-Winter (ppm)		
				Baseline Monitor O_3 Design Value	2021 Scenario 3 O_3 Design Value	Difference	Baseline Monitor O_3 Design Value	2021 Scenario 3 O_3 Design Value	Difference	Baseline Monitor O_3 Design Value	2021 Scenario 3 O_3 Design Value	Difference
Uinta Basin Study Area												
Dinosaur NM, Uintah County, Utah*	490471002	40.4300	-109.3000	0.071	0.068	-0.003	0.072	0.069	-0.003	0.065	0.061	-0.004
Ouray Site, Uintah County, Utah*	490472003	40.0500	-109.6800	**0.097**	**0.095**	-0.002	**0.096**	**0.093**	-0.003	0.063	0.060	-0.003
Rangely Site, Rio Blanco County, Colorado*	81030006	40.0800	-108.7600	0.064	0.063	-0.001	0.046	0.046	0.000	0.064	0.060	-0.004
Red Wash Site, Uintah County, Utah*	490472002	40.2000	-109.3500	**0.086**	**0.081**	-0.005	**0.084**	**0.079**	-0.005	0.061	0.057	-0.004
Utah Stations Outside of Uinta Basin Study Area												
Bountiful Site, Davis County, Utah	490110004	40.9000	-111.8800	0.071	0.070	-0.001	NA	NA	NA	0.071	0.067	-0.004
Canyonlands NP Site, San Juan County, Utah	490370101	38.4500	-109.8100	0.069	0.065	-0.004	0.058	0.052	-0.006	0.067	0.064	-0.003
Cottonwood Site, Salt Lake County, Utah	490350003	40.6400	-111.8400	0.075	**0.077**	0.002	NA	NA	NA	0.074	0.073	-0.001
Escalante Site, Garfield County, Utah	490170004	37.7700	-111.6100	0.053	0.050	-0.003	0.045	0.042	-0.003	NA	NA	NA
Fruitland Site, Duchesne County, Utah	490131001	40.3000	-110.0000	0.067	0.064	-0.003	0.049	0.045	-0.004	0.065	0.061	-0.004
Harrisville Site, Weber County, Utah	490571003	41.3000	-111.9800	0.073	0.070	-0.003	NA	NA	NA	0.072	0.068	-0.004
Hawthorne Site, Salt Lake County, Utah	490353006	40.7300	-111.8700	0.075	**0.076**	0.001	0.049	0.055	0.006	0.075	0.072	-0.003
Highland Site, Utah County, Utah	490495008	40.4300	-111.8000	0.067	0.066	-0.001	NA	NA	NA	0.066	0.062	-0.004
Lakepoint Site, Salt Lake County, Utah	490352004	40.7300	-112.2100	0.074	0.068	-0.006	NA	NA	NA	0.072	0.066	-0.006
North Provo Site, Utah County, Utah	490490002	40.2500	-111.6600	0.069	0.066	-0.003	0.047	0.049	0.002	0.069	0.065	-0.004
Ogden Site, Weber County, Utah	490570002	41.2000	-111.9700	0.072	0.069	-0.003	0.046	0.044	-0.002	0.071	0.067	-0.004
Price Site, Carbon County, Utah	490071003	39.6000	-110.8000	0.070	0.063	-0.007	0.049	0.044	-0.005	0.068	0.064	-0.004
Spanish Fork Site, Utah County, Utah	490495010	40.1300	-111.6500	0.069	0.066	-0.003	NA	NA	NA	0.068	0.064	-0.004
St. George Site, Washington County, Utah	490530006	37.1200	-113.6300	0.067	0.060	-0.007	NA	NA	NA	0.066	0.059	-0.007
Tooele Site, Tooele County, Utah	490450003	40.5400	-112.2900	0.072	0.065	-0.007	NA	NA	NA	0.071	0.066	-0.005
Zion NP Site, Washington County, Utah	490530130	37.1900	-113.1500	0.071	0.063	-0.008	0.057	0.049	-0.008	0.070	0.063	-0.007

Table 3-43 MATS-Estimated Ozone Impacts at Monitored Locations – 2021 Scenario 3 Controls

Receptor Site Name or City	Site ID	Latitude	Longitude	Annual (ppm)			Winter (ppm)			non-Winter (ppm)		
				Baseline Monitor O_3 Design Value	2021 Scenario 3 O_3 Design Value	Difference	Baseline Monitor O_3 Design Value	2021 Scenario 3 O_3 Design Value	Difference	Baseline Monitor O_3 Design Value	2021 Scenario 3 O_3 Design Value	Difference
Colorado												
Cortez Site, Montezuma County, Colorado	80830006	37.3500	-108.5900	0.066	0.060	-0.006	0.053	0.049	-0.004	0.065	0.059	-0.006
Grand Junction Site, Mesa County, Colorado	80771001	39.1000	-108.7400	0.064	0.060	-0.004	0.062	0.055	-0.007	0.062	0.059	-0.003
Meeker Site, Rio Blanco County, Colorado	81030005	40.0300	-107.8400	0.064	0.060	-0.004	0.053	0.048	-0.005	0.064	0.060	-0.004
Mesa Verde NP Site, Montezuma County, Colorado	80830101	37.1900	-108.4900	0.068	0.062	-0.006	0.000	0.000	0.000	0.000	0.000	0.000
Wyoming												
Evanston Site, Uinta County, Wyoming	560410101	41.3700	-111.0400	0.060	0.054	-0.006	0.052	0.047	-0.005	0.062	0.055	-0.007
Wamsutter Southeast Site, Sweetwater County, Wyoming	560370200	41.6700	-108.0200	0.064	0.059	-0.005	0.055	0.051	-0.004	0.062	0.057	-0.005

Note: Model-predicted concentrations that exceed the NAAQS are shown in **red bold** text.

Table 3-44 MATS-Estimated Ozone and $PM_{2.5}$ Impacts at Unmonitored Locations– 2021 Scenario 3

Receptor Site	Ozone Design Value (ppm)			Annual $PM_{2.5}$ Design Value (µg/m^3)		
	Baseline	2021 Scenario 3 Controls	Difference	Baseline	2021 Scenario 3 Controls	Difference
Uinta Basin Study Area						
Uinta Basin Study Area	0.102	0.101	-0.001	14.9	14.4	-0.5
Class I Areas						
Arches NP	0.068	0.065	-0.003	4.6	4.4	-0.2
Black Canyon of the Gunnison WA	0.066	0.061	-0.005	3.4	3.1	-0.3
Bridger WA	0.073	0.067	-0.006	5.3	5.5	0.2
Bryce Canyon NP	0.062	0.058	-0.004	2.7	2.6	-0.1
Canyonlands NP	0.068	0.065	-0.003	3.2	3.0	-0.2
Capitol Reef NP	0.063	0.060	-0.003	3.2	3.0	-0.2
Eagles Nest WA	0.067	0.063	-0.004	3.8	3.5	-0.3
Fitzpatrick WA	0.071	0.066	-0.005	3.9	4.1	0.2
Flat Tops WA	0.067	0.063	-0.004	2.7	2.6	-0.1
La Garita WA	0.068	0.064	-0.004	2.6	2.5	-0.1
Maroon Bells-Snowmass WA	0.067	0.062	-0.005	2.3	2.2	-0.1
Mesa Verde NP	0.067	0.061	-0.006	4.1	3.8	-0.3
Mount Zirkel WA	0.071	0.064	-0.007	2.3	2.2	-0.1
Rawah WA	0.070	0.064	-0.006	2.7	2.6	-0.1
Rocky Mountain NP	0.076	0.067	-0.009	3.7	3.6	-0.1
Weminuche WA	0.070	0.064	-0.006	3.0	2.9	-0.1
West Elk WA	0.066	0.062	-0.004	2.8	2.6	-0.2

Table 3-44 MATS-Estimated Ozone and $PM_{2.5}$ Impacts at Unmonitored Locations– 2021 Scenario 3

Receptor Site	Ozone Design Value (ppm)			Annual $PM_{2.5}$ Design Value ($\mu g/m^3$)		
	Baseline	2021 Scenario 3 Controls	Difference	Baseline	2021 Scenario 3 Controls	Difference
Class II Areas						
Dinosaur National Monument	**0.076**	0.074	-0.002	5.5	5.1	-0.4
Flaming Gorge National Recreation Area	0.061	0.057	-0.004	7.1	7.1	0.0
Fort Hall IR	0.070	0.065	-0.005	7.2	11.2	4.0
Goshute IR	0.067	0.061	-0.006	2.9	2.9	0.0
High Uintas WA	0.065	0.060	-0.005	3.9	3.6	-0.3
Navajo IR	0.072	0.067	-0.005	7.5	11.1	3.6
Paitute IR	**0.076**	0.064	-0.012	5.7	5.5	-0.2
Skull Valley IR	0.065	0.060	-0.005	3.4	3.3	-0.1
Southern Ute IR	0.070	0.064	-0.006	4.6	4.6	0.0
Uintah and Ouray IR	**0.102**	**0.098**	-0.004	**12.1**	11.1	-1.0
Ute Mountain IR	0.072	0.066	-0.006	7.0	6.8	-0.2
Wind River IR	0.072	0.067	-0.005	11.0	10.0	-1.0

Note: Model-predicted concentrations that exceed the NAAQS are shown in red bold text.

Table 3-45 MATS-Estimated Winter and Non-Winter Ozone Impacts at Unmonitored Locations – 2021 Scenario 3

Receptor Site	Winter Ozone Design Value (ppm)			Non-Winter Ozone Design Value (ppm)		
	Baseline	2021 Scenario 3	Difference	Baseline	2021 Scenario 3	Difference
Uinta Basin Study Area						
Uinta Basin Study Area	**0.098**	**0.095**	-0.003	0.067	0.064	-0.003
Class I Areas						
Arches NP	0.056	0.050	-0.006	0.066	0.063	-0.003
Bryce Canyon NP	0.051	0.047	-0.004	0.068	0.064	-0.004
Canyonlands NP	0.058	0.053	-0.005	0.068	0.065	-0.003
Capitol Reef NP	0.051	0.047	-0.004	0.068	0.064	-0.004
Mesa Verde NP	0.056	0.052	-0.004	0.066	0.060	-0.006
Class II Areas						
Dinosaur National Monument	0.075	0.072	-0.003	0.065	0.061	-0.004
Flaming Gorge National Recreation Area	0.053	0.049	-0.004	0.062	0.059	-0.003
Goshute IR	0.044	0.041	-0.003	0.066	0.060	-0.006
High Uintas WA	0.052	0.047	-0.005	0.066	0.061	-0.005
Paitute IR	0.070	0.057	-0.013	0.070	0.064	-0.006
Skull Valley IR	0.049	0.046	-0.003	0.064	0.060	-0.004
Uintah and Ouray IR	**0.098**	**0.095**	-0.003	0.067	0.063	-0.004

Note: Model-predicted concentrations that exceed the NAAQS are shown in **red bold** text.

Table 3-46 MATS-Estimated $PM_{2.5}$ Impacts at Monitored Locations – 2021 Scenario 3

Receptor Site Name or City	Site ID	Latitude	Longitude	Annual $PM_{2.5}$ Design Value (µg/m^3)			Daily $PM_{2.5}$ Design Value (µg/m^3)		
				Baseline Monitor	2021 Scenario 3	Difference	Baseline Monitor	2021 Scenario 3	Difference
Bountiful Site, Davis County, Utah	490110004	40.9030	-111.8845	10.2	9.6	-0.60	**37.4**	32.8	-4.60
Cottonwood Site, Salt Lake County, Utah	490350003	40.6467	-111.8497	11.1	10.6	-0.50	**45.4**	**39.8**	-5.60
Harrisville Site, Weber County, Utah	490571003	41.3037	-111.9871	8.9	8.1	-0.80	**35.1**	27.3	-7.80
Highland Site, Utah County, Utah	490495008	40.4303	-111.8039	8.5	7.7	-0.80	31.7	25.6	-6.10
Lindon Site, Utah County, Utah	490494001	40.3414	-111.7136	10.3	9.3	-1.00	**37.9**	31.2	-6.70
Magna Salt Lake City Site, Salt Lake County, Utah	490351001	40.7086	-112.0947	8.6	8.5	-0.10	32.4	27.6	-4.80
Ogden Site, Weber County, Utah	490570002	41.2064	-111.9747	10.3	9.3	-1.00	**38.4**	31.1	-7.30
Provo Site, Utah County, Utah	490490002	40.2536	-111.6631	9.9	8.8	-1.10	33.3	26.0	-7.30
Rose Park Salt Lake City Site, Salt Lake County, Utah	490353010	40.7842	-111.9310	10.4	9.8	-0.60	**39.0**	33.3	-5.70
Spanish Fork Site, Utah County, Utah	490495010	40.1364	-111.6597	9.1	8.0	-1.10	**38.5**	30.8	-7.70
Tooele Site, Tooele County, Utah	490450003	40.5434	-112.2988	6.8	6.4	-0.40	25.4	20.9	-4.50

Note: Model-predicted concentrations that exceed the NAAQS are shown in **red bold** text.

Table 3-47 Change in Model-Predicted Ambient Air Quality Impacts Between 2021 Scenario 3 and OTB Controls

Receptor Site	NO_2 (ppb)		CO (ppm)		SO_2 (ppb)		O_3 (ppm) 8-hour			$PM_{2.5}$ (µg/m^3)		PM_{10} (µg/m^3)
	1-hour	Annual	1-hour	8-hour	1-hour	3-hour	Annual	Winter	Non-Winter	24-hour	Annual	24-hour
Uinta Basin Study Area												
Uinta Basin Study Area	-8	0	0	-1	0	0	0.005	0.005	-0.001	-4	-0.6	-10
Dinosaur AQS Station	-1	0	0	0	0	0	-0.003	-0.003	-0.001	-2	-0.4	0
Ouray AQS Station	-8	-2	0	-1	0	0	0.004	0.004	0.000	-6	-2.7	-10
Rangely AQS Station	-1	0	0	0	0	0	-0.001	-0.001	-0.001	-1	-0.1	0
Redwash AQS Station	-4	-1	-1	0	0	0	-0.002	-0.002	-0.001	-2	-1.0	0
Class I Areas												
Arches NP	0	0	0	0	0	0	0.000	0.000	0.000	0	-0.1	0
Black Canyon of the Gunnison WA	0	0	0	0	0	0	0.000	0.000	0.000	0	0.0	0
Bridger WA	0	0	0	0	0	0	0.000	-0.001	0.000	0	0.0	0
Bryce Canyon NP	0	0	0	0	0	0	0.000	-0.001	0.000	0	0.0	0
Canyonlands NP	0	0	0	0	0	0	0.000	0.000	0.000	0	-0.1	0
Capitol Reef NP	0	0	0	0	0	0	0.000	0.000	0.000	0	0.0	0
Eagles Nest WA	0	0	0	0	0	0	0.000	0.000	0.000	0	0.0	0
Fitzpatrick WA	0	0	0	0	0	0	0.000	-0.001	0.000	0	0.0	0
Flat Tops WA	0	0	0	0	0	0	0.000	0.000	0.000	0	0.0	0
La Garita WA	0	0	0	0	0	0	0.000	0.000	0.000	0	0.0	0
Maroon Bells-Snowmass WA	0	0	0	0	0	0	0.000	0.000	0.000	0	0.0	0
Mesa Verde NP	0	0	0	0	0	0	0.000	0.000	0.000	0	0.0	0
Mount Zirkel WA	0	0	0	0	0	0	0.000	-0.001	0.000	0	0.0	0
Rawah WA	0	0	0	0	0	0	0.000	0.000	0.000	0	0.0	0
Rocky Mountain NP	0	0	0	0	0	0	0.000	0.000	0.000	0	0.0	0
Weminuche WA	0	0	0	0	0	0	0.000	0.000	0.000	0	0.0	0
West Elk WA	0	0	0	0	0	0	0.000	0.000	0.000	0	0.0	0

Table 3-47 Change in Model-Predicted Ambient Air Quality Impacts Between 2021 Scenario 3 and OTB Controls

Receptor Site	NO_2 (ppb)		CO (ppm)		SO_2 (ppb)		O_3 (ppm) 8-hour			$PM_{2.5}$ (µg/m³)		PM_{10} (µg/m³)
	1-hour	Annual	1-hour	8-hour	1-hour	3-hour	Annual	Winter	Non-Winter	24-hour	Annual	24-hour
Class II Areas												
Dinosaur National Monument	-1	-1	0	0	0	0	-0.003	-0.003	-0.002	-1	-0.2	0
Flaming Gorge National Recreation Area	0	0	0	0	0	0	-0.001	0.000	-0.001	-1	-0.1	0
Fort Hall IR	0	0	0	0	0	0	0.000	0.000	0.000	0	0.0	0
Goshute IR	0	0	0	0	0	0	0.000	0.000	0.000	0	0.0	0
High Uintas WA	0	0	0	0	0	0	0.000	0.000	0.000	0	0.0	0
Navajo IR	0	0	0	0	0	0	0.000	-0.001	-0.001	0	0.0	0
Paitute IR	0	0	0	0	0	0	0.000	0.000	0.000	0	0.0	0
Skull Valley IR	0	0	0	0	0	0	0.000	0.000	0.000	0	0.0	0
Southern Ute IR	0	0	0	0	0	0	0.000	0.000	0.000	0	0.0	0
Uintah and Ouray IR	-8	-1	0	-1	0	0	0.007	0.007	-0.002	-6	-0.7	0
Ute Mountain IR	0	0	0	0	0	0	0.000	0.000	0.000	0	0.0	0
Wind River IR	0	0	0	0	0	0	0.000	0.000	0.000	0	0.0	0

Table 3-48 Model-Predicted PSD Increment Values – 2021 Scenario 3 Typical Year

Receptor Site	NO_2 (ppb)	SO_2 (ppb)			$PM_{2.5}$ (μg/m^3)		PM_{10} (μg/m^3)	
	Annual	3-hour	24-hour	Annual	24-hour	Annual	24-hour	Annual
Uinta Basin Study Area								
Uinta Basin Study Area	1.82	9.6	4.2	0.14	**35.1**	2.9	**38.6**	3.4
Dinosaur AQS Station	0.65	0.7	0.5	0.13	**16.0**	3.3	16.6	3.8
Ouray AQS Station	8.56	0.8	0.5	0.11	**26.0**	**5.4**	26.3	5.9
Rangely AQS Station	1.53	1.3	0.6	0.14	**10.1**	2.4	11.0	3.1
Redwash AQS Station	6.42	2.6	1.2	0.20	**17.0**	3.6	17.3	4.0
Class I Areas								
Arches NP	0.31	1.0	0.5	0.11	**10.4**	**2.1**	**10.7**	2.7
Black Canyon of the Gunnison WA	0.24	0.6	0.4	0.09	**4.6**	**1.4**	7.4	1.8
Bridger WA	0.21	4.1	**2.7**	0.24	**5.5**	**1.5**	8.0	1.9
Bryce Canyon NP	0.16	0.8	0.6	0.08	**12.0**	**1.9**	**15.8**	2.5
Canyonlands NP	0.22	3.5	1.0	0.11	**10.0**	**1.9**	**10.4**	2.4
Capitol Reef NP	0.18	2.1	0.7	0.10	**14.5**	**1.9**	**14.9**	2.4
Eagles Nest WA	0.63	3.5	1.3	0.12	**6.3**	**1.6**	**8.1**	1.9
Fitzpatrick WA	0.16	4.1	**2.5**	0.19	**4.6**	**1.4**	**8.4**	1.8
Flat Tops WA	0.24	2.2	0.8	0.12	**4.4**	**1.5**	**8.4**	1.8
La Garita WA	0.14	0.7	0.5	0.07	**3.8**	**1.2**	6.6	1.5
Maroon Bells-Snowmass WA	0.20	1.6	0.7	0.09	**4.1**	**1.3**	**8.1**	1.6
Mesa Verde NP	0.53	3.2	1.0	0.16	**6.3**	**1.7**	**8.6**	2.1
Mount Zirkel WA	0.46	2.6	1.4	0.23	**5.2**	**1.6**	7.5	1.9
Rawah WA	0.29	2.7	0.9	0.17	**6.8**	**1.5**	**8.1**	1.8

Table 3-48 Model-Predicted PSD Increment Values – 2021 Scenario 3 Typical Year

Receptor Site	NO_2 (ppb)	SO_2 (ppb)			$PM_{2.5}$ (µg/m^3)		PM_{10} (µg/m^3)	
	Annual	3-hour	24-hour	Annual	24-hour	Annual	24-hour	Annual
Rocky Mountain NP	0.38	6.1	**2.9**	0.17	**23.2**	**1.6**	**24.5**	1.9
Weminuche WA	0.25	1.4	0.7	0.08	**4.8**	**1.2**	**8.5**	1.6
West Elk WA	0.16	1.0	0.5	0.08	**7.6**	**1.3**	**8.9**	1.6
Class II Areas								
Dinosaur National Monument	0.44	1.6	0.7	0.14	**17.9**	2.3	18.3	2.7
Flaming Gorge National Recreation Area	0.51	21.4	6.1	0.19	**20.8**	2.2	21.5	2.7
Fort Hall IR	1.24	8.8	3.4	0.31	**28.4**	3.8	**45.0**	5.7
Goshute IR	0.10	0.6	0.3	0.06	5.2	1.2	11.5	1.8
High Uintas WA	0.15	2.1	0.7	0.10	7.5	1.8	11.6	2.2
Navajo IR	0.81	20.5	5.7	0.16	**25.6**	1.9	**30.7**	2.6
Paitute IR	0.41	2.2	0.6	0.10	**11.8**	2.0	14.7	2.8
Skull Valley IR	0.33	2.0	0.7	0.12	**12.3**	1.9	12.8	2.4
Southern Ute IR	2.53	4.8	1.0	0.12	**30.5**	1.7	**35.1**	2.1
Uintah and Ouray IR	2.08	9.7	4.7	0.14	**47.9**	2.9	**53.3**	3.5
Ute Mountain IR	1.07	9.4	3.7	0.22	**19.6**	2.0	20.3	2.6
Wind River IR	0.35	18.0	10.9	0.39	**9.9**	1.5	11.6	1.9

Note: Model-predicted concentrations that exceed the PSD Increments are shown in **red bold** text.

Table 3-49 Change in PSD Increment Values Between 2021 Scenario 3 and 2010 Typical Year

Receptor Site	NO_2 (ppb)	SO_2 (ppb)			$PM_{2.5}$ (µg/m^3)		PM_{10} (µg/m^3)	
	Annual	3-hour	24-hour	Annual	24-hour	Annual	24-hour	Annual
Uinta Basin Study Area								
Uinta Basin Study Area	-0.2	-3.3	-2.1	0.0	-1.9	-0.4	-5.1	-0.5
Dinosaur AQS Station	-0.1	-0.6	-0.3	0.0	-1.6	-0.5	-1.8	-0.5
Ouray AQS Station	2.2	-0.7	-0.1	0.0	-3.9	-1.3	-4.6	-1.5
Rangely AQS Station	-2.0	-0.2	-0.3	-0.1	-0.9	-0.2	-1.0	-0.3
Redwash AQS Station	3.1	0.0	-0.1	0.0	-2.6	-0.1	-2.8	-0.2
Class I Areas								
Arches NP	-0.2	-2.6	-1.1	-0.1	-6.5	-0.6	-6.7	-0.6
Black Canyon of the Gunnison WA	-0.2	-1.1	-0.4	-0.1	-1.6	-0.2	-0.4	-0.3
Bridger WA	0.0	1.4	1.4	0.1	-0.4	0.0	0.1	0.0
Bryce Canyon NP	-0.1	-1.2	-0.5	-0.1	-1.5	-0.4	-1.8	-0.4
Canyonlands NP	-0.1	-10.3	-2.9	-0.1	-7.6	-0.5	-7.8	-0.5
Capitol Reef NP	-0.1	-0.3	-1.2	-0.1	-3.8	-0.4	-3.8	-0.4
Eagles Nest WA	-0.6	-0.1	-0.2	-0.1	-1.0	-0.2	-1.1	-0.2
Fitzpatrick WA	0.0	2.4	1.7	0.1	-0.7	0.0	0.1	0.0
Flat Tops WA	-0.2	-2.5	-0.6	-0.1	-1.1	-0.2	-0.1	-0.2
La Garita WA	-0.1	-1.5	-0.5	-0.1	-0.2	-0.1	0.0	-0.1
Maroon Bells-Snowmass WA	-0.1	0.0	-0.2	-0.1	-0.2	-0.1	0.0	-0.2
Mesa Verde NP	-0.8	-12.3	-3.4	-0.3	-2.1	-0.3	-0.4	-0.3
Mount Zirkel WA	-0.5	-2.1	-1.2	-0.2	-1.9	-0.2	-0.2	-0.2
Rawah WA	-0.3	-0.8	-0.7	-0.1	-1.5	-0.2	-1.6	-0.2

Table 3-49 Change in PSD Increment Values Between 2021 Scenario 3 and 2010 Typical Year

Receptor Site	NO_2 (ppb)	SO_2 (ppb)			$PM_{2.5}$ (µg/m^3)		PM_{10} (µg/m^3)	
	Annual	3-hour	24-hour	Annual	24-hour	Annual	24-hour	Annual
Rocky Mountain NP	-0.4	0.2	0.0	-0.1	-1.1	-0.2	-1.1	-0.2
Weminuche WA	-0.2	-5.1	-1.3	-0.1	-0.2	-0.1	0.0	-0.1
West Elk WA	-0.1	-0.7	-0.4	-0.1	-0.2	-0.2	-0.2	-0.2
Class II Areas								
Dinosaur National Monument	-0.1	-1.0	-0.7	0.0	0.2	-0.3	-0.1	-0.4
Flaming Gorge National Recreation Area	-0.3	-9.8	-2.3	-0.1	6.5	-0.3	1.5	-0.4
Fort Hall IR	-0.4	-0.6	-2.3	-0.1	7.4	0.7	18.8	1.3
Goshute IR	0.0	-0.9	-0.5	-0.1	-1.7	-0.1	-0.1	-0.1
High Uintas WA	-0.1	0.4	-0.3	0.0	-2.0	-0.3	0.0	-0.3
Navajo IR	-0.6	-79.3	-24.8	-0.2	-12.9	-0.3	-8.9	-0.3
Paitute IR	-0.4	-0.5	-0.6	-0.2	-3.0	-0.4	-3.0	-0.4
Skull Valley IR	-0.1	0.1	-0.2	0.0	-1.6	-0.2	-1.5	-0.1
Southern Ute IR	-1.7	-11.0	-3.4	-0.2	-0.6	-0.2	-0.6	-0.3
Uintah and Ouray IR	0.0	-4.5	-2.3	0.0	-1.0	-0.5	-1.0	-0.5
Ute Mountain IR	-1.5	-23.6	-10.3	-0.5	-2.5	-0.4	-3.2	-0.6
Wind River IR	-0.3	-16.1	-10.7	-0.1	-2.8	-0.1	-2.9	-0.1

Table 3-50 Change in PSD Increment Values Between 2021 Scenario 3 and 2021 OTB Controls

Receptor Site	NO_2 (ppb)	SO_2 (ppb)			$PM_{2.5}$ (µg/m^3)		PM_{10} (µg/m^3)	
	Annual	3-hour	24-hour	Annual	24-hour	Annual	24-hour	Annual
Uinta Basin Study Area								
Uinta Basin Study Area	-0.5	0.0	0.0	0.0	-13.7	-0.6	-10.5	-0.6
Dinosaur AQS Station	-0.1	0.0	0.0	0.0	-4.0	-0.4	-4.0	-0.4
Ouray AQS Station	-2.7	0.0	0.0	0.0	-9.9	-2.7	-10.0	-2.7
Rangely AQS Station	-0.1	0.0	0.0	0.0	-0.5	-0.1	-0.5	-0.1
Redwash AQS Station	-0.9	0.0	0.0	0.0	-4.1	-1.0	-4.1	-1.0
Class I Areas								
Arches NP	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Black Canyon of the Gunnison WA	0.0	0.0	0.0	0.0	-0.2	0.0	0.0	0.0
Bridger WA	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Bryce Canyon NP	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Canyonlands NP	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Capitol Reef NP	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Eagles Nest WA	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Fitzpatrick WA	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Flat Tops WA	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
La Garita WA	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maroon Bells-Snowmass WA	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Mesa Verde NP	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Mount Zirkel WA	0.0	0.0	0.0	0.0	-0.5	0.0	0.0	0.0
Rawah WA	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 3-50 Change in PSD Increment Values Between 2021 Scenario 3 and 2021 OTB Controls

Receptor Site	NO_2 (ppb)	SO_2 (ppb)			$PM_{2.5}$ (µg/m^3)		PM_{10} (µg/m^3)	
	Annual	3-hour	24-hour	Annual	24-hour	Annual	24-hour	Annual
Rocky Mountain NP	0.0	0.0	0.0	0.0	-0.1	0.0	-0.1	0.0
Weminuche WA	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
West Elk WA	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Class II Areas								
Dinosaur National Monument	-0.1	0.0	0.0	0.0	-3.3	-0.2	-3.3	-0.2
Flaming Gorge National Recreation Area	0.0	0.0	0.0	0.0	-0.3	-0.1	-0.3	-0.1
Fort Hall IR	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Goshute IR	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0
High Uintas WA	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Navajo IR	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0
Paitute IR	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Skull Valley IR	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Southern Ute IR	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Uintah and Ouray IR	-0.5	0.0	0.0	0.0	-0.8	-0.6	-0.1	-0.6
Ute Mountain IR	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Wind River IR	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

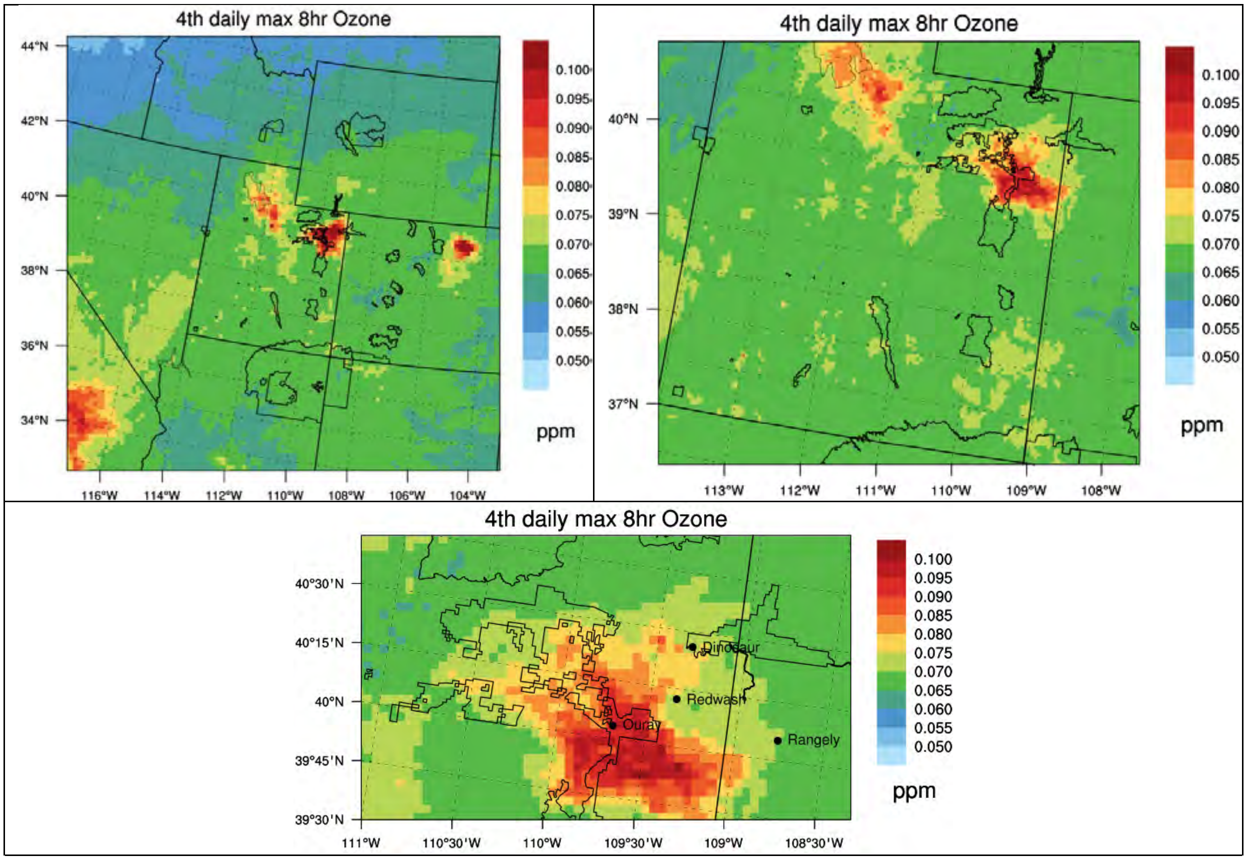


Figure 3-17 2021 Scenario 3 Model-Predicted 4th Highest Daily Maximum 8-hour Ozone Spatial Plots

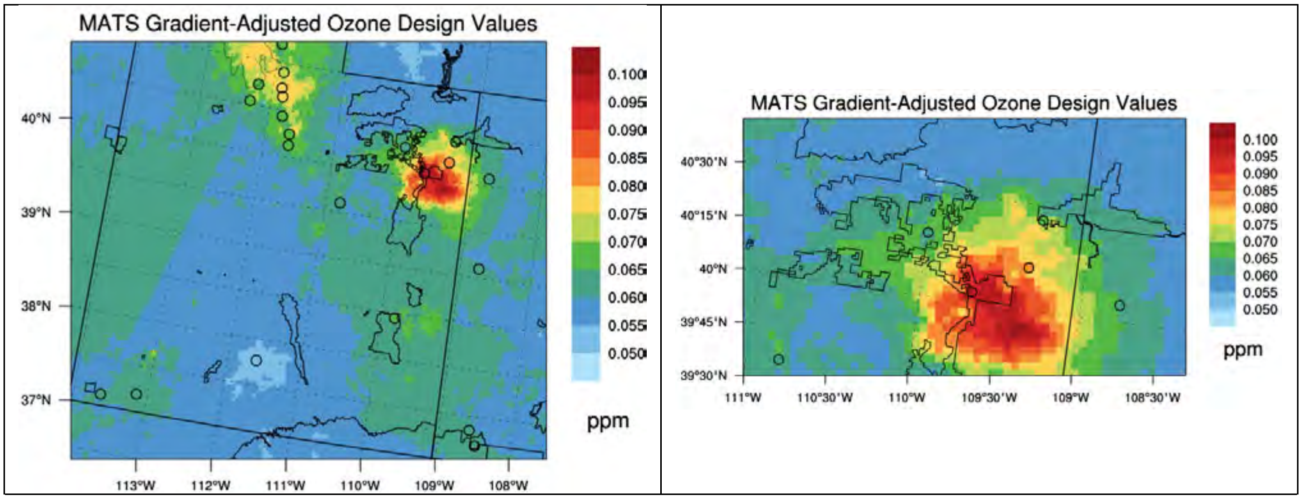


Figure 3-18 MATS Interpolated 2021 Scenario 3 Ozone Design Values

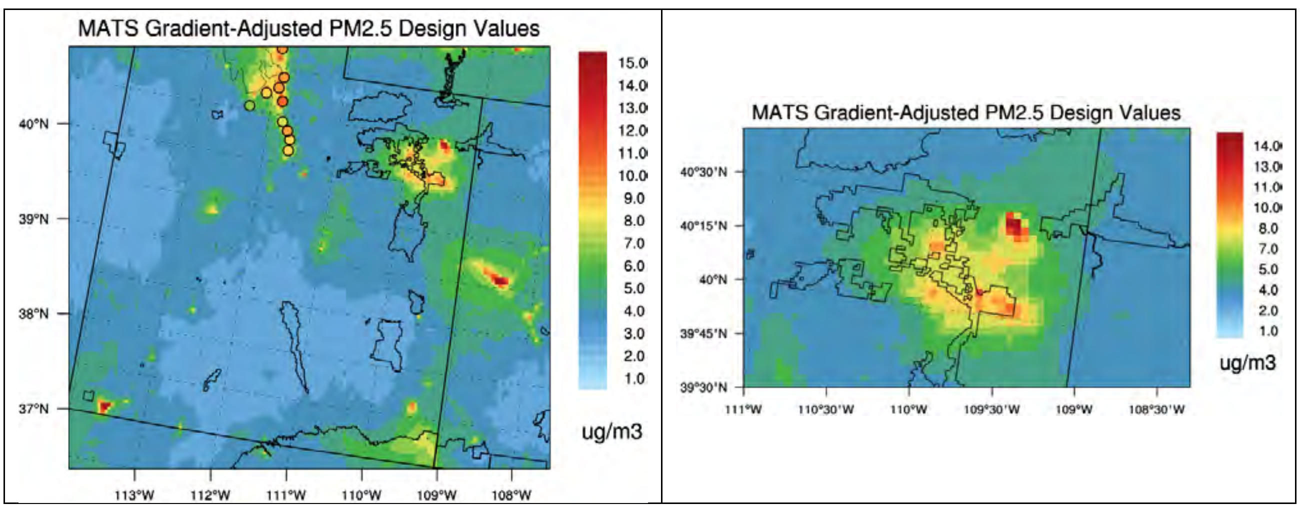


Figure 3-19 MATS Interpolated 2021 Scenario 3 Annual $PM_{2.5}$ Design Values

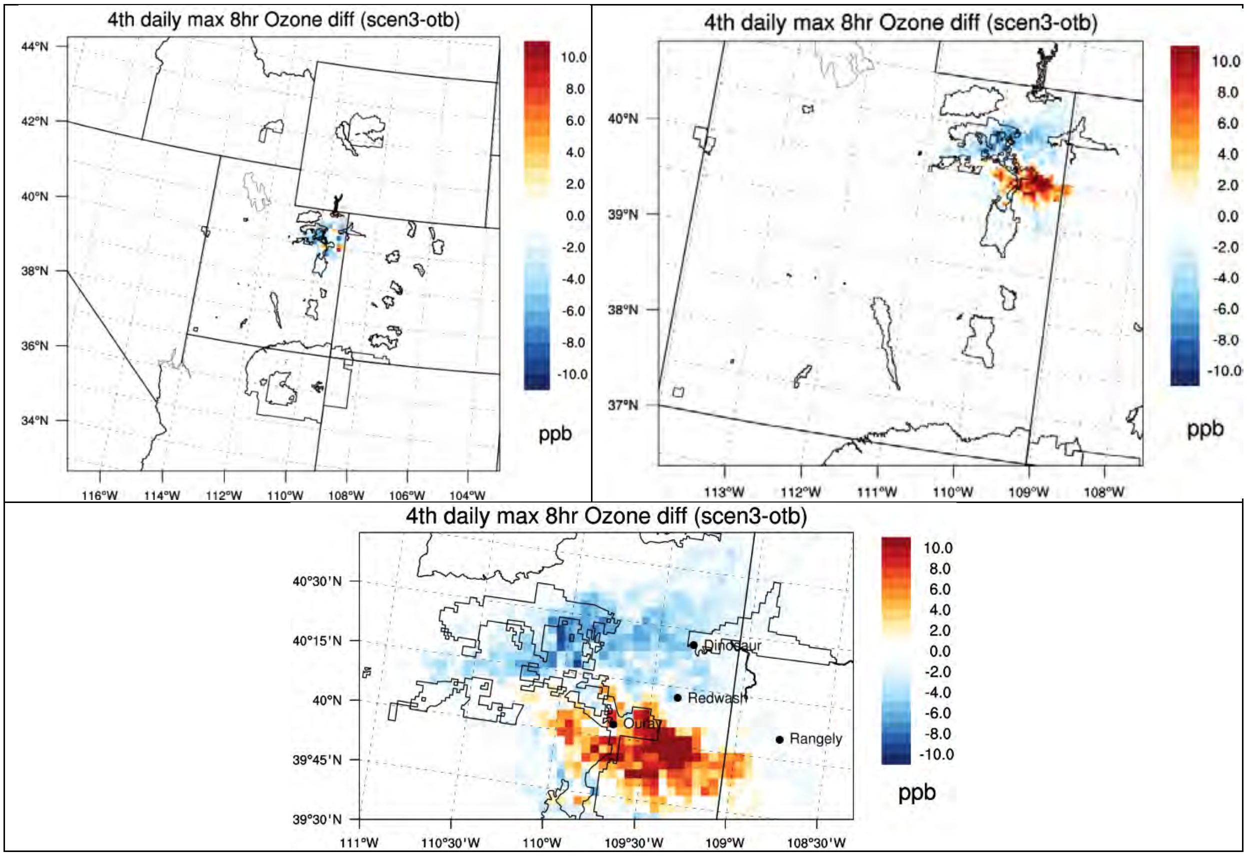


Figure 3-20 Absolute Difference between 2021 Scenario 3 and 2021 OTB Controls Model-Predicted 4th Highest Daily Maximum 8-hour Ozone Spatial Plots

4.0 Impacts on Visibility

Under the CAA, visibility has been established as a critical resource for mandatory Class I areas. Particulate matter in the atmosphere contributes to visibility degradation by both scattering and absorption of visible light. The combined effect of scattered and absorbed light is called light extinction. Modeled visibility impacts in terms of light extinction for the 2010 Base Year, 2010 Typical Year, 2021 OTB Controls Scenario, 2021 Scenario 1, 2021 Scenario 2, and 2021 Scenario 3 are analyzed in this Chapter for selected Class I and sensitive Class II areas.

4.1 Assessment Methods and Thresholds

Visibility impacts were assessed using both the absolute model impacts and model-adjusted impacts using the Impact Assessment Suite (IAS) and MATS, respectively. The IAS presents estimated visibility impacts based on the modeled concentrations of key pollutants; MATS was used to adjust the modeled values based on measured concentrations to account for model bias. Visibility impacts are expressed in terms of deciviews (dv), a measure for describing perceived changes in visibility. The deciview values were calculated from either measured or estimated light extinction values in units of inverse megameters (Mm^{-1}). Model-predicted concentrations of chemical compounds that scatter or absorb light are converted into estimates of light extinction using the IMPROVE equation (Hand and Malm 2006). Currently, there are no established thresholds for evaluating cumulative visibility impacts.

4.1.1 Visibility Impact Assessment

The IAS uses the IMPROVE equation to calculate 20 percent best and 20 percent worst visibility impacts. The IMPROVE equation calculates light extinction as a function of relative humidity for large particles, small particles, and sea salt particles. Relative humidity adjustment factors, f(RH), are required to calculate visibility impacts because some particles (e.g., ammonium sulfate and NO_3) can absorb water, thereby increasing their size and light scattering. Site-specific monthly relative humidity factors are available from FLAG (2010).

In the IAS, four steps used to determine and report 20 percent best and 20 percent worst visibility for each assessment area.

1. The IAS extracts model predicted concentrations of key components and estimates the fully neutralized mass.
2. The IAS apportions total ammonium sulfate, ammonium nitrate, and organic mass concentrations into the large & small size fractions as follows:

   $f_s(RH)$= relative humidity adjustment factor for small SO_4 and NO_3

   $f_L(RH)$ = relative humidity adjustment factor for large SO_4 and NO_3

   $f_{ss}(RH)$ = relative humidity adjustment factor for Sea Salt
3. The IAS calculates hourly light extinction for each assessment area as shown in **Equation 4-1** and using the f(RH) values from FLAG (2010).

Equation 4-1 $$b_{ext} = 2.2 + f_S(RH) \times [Small\ SO_4] + 4.8 \times f_L(RH) \times [Large\ SO_4] + 2.4 \times f_S(RH) \times [Small\ NO_3] + 5.1 \times f_L(RH) \times [Large\ NO_3] + 2.8 \times [Small\ OC] + 6.1 \times [Large\ OC] + 10 \times [EC] + 1 \times [SOIL] + 1.7 \times f_{SS}(RH) \times [SS] + 0.6 \times [CM] + [Rayleigh\ Scattering_{Site\ Specific}] + 0.33 \times [NO_2(ppb)]$$

4. The hourly light extinction is then ranked for each assessment area, and the 20 percent best and 20 percent worst visibility values are selected for each area. Light extinction is also converted into deciviews as shown in **Equation 4-2**.

Equation 4-2 $$deciview = 10 \times \ln\left(\frac{b_{ext}}{10\ Mm^{-1}}\right)$$

4.1.2 Visibility Modeled Attainment Test Analysis at Monitored Locations

The MATS version 2.5.1 (Abt Associates, Inc. 2009) tool was used to perform the USEPA recommended modeled test to assess visibility impacts (2007). A complete description of the methodology and MATS configuration used to estimate visibility impacts can be found in **Appendix A**. The MATS tool limits the visibility estimates to Class I areas only. The monitors at Class I areas used by MATS are shown in **Figure 4-1**.

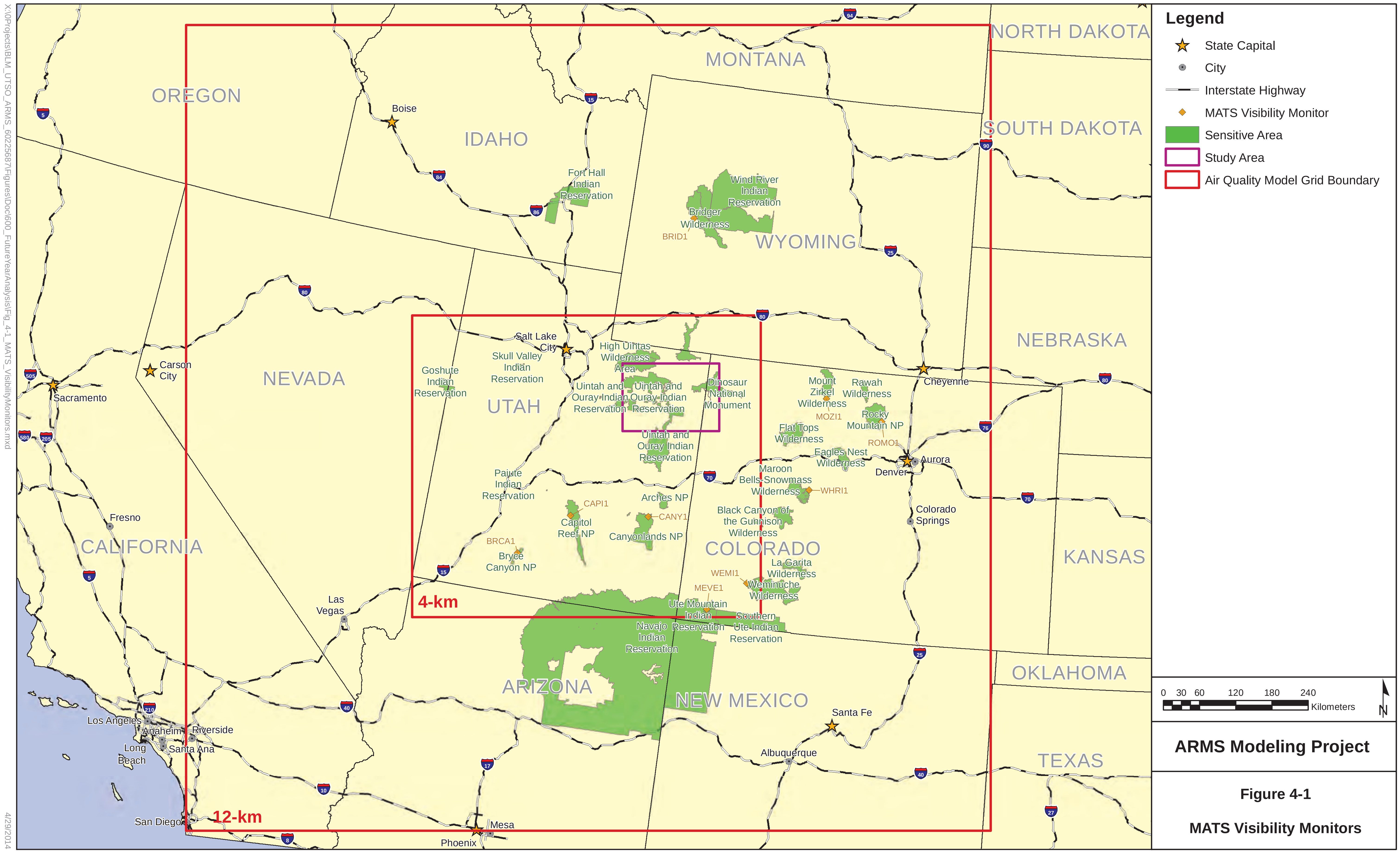
4.2 Summary of Visibility Impacts

A summary of model-predicted visibility impacts at Class I and sensitive Class II areas is presented in terms of the 20th percentile best and worst visibility days in **Table 4-1**. Visibility conditions in Class I and sensitive Class II areas generally show improvement in the 2021 future year scenarios relative to the 2010 Base Year and 2010 Typical Year using both the IAS and MATS to assess impacts. There are no significant differences in the 20th percentile best and worst visibility days between the 2010 Base Year and 2010 Typical Year. There also are no significant differences in the 20th percentile best and worst visibility days between the four future year scenarios.

In general, the IAS results show that the greatest improvement in visibility for the 20th percentile worst visibility days occurs for the 2021 Scenario 3 relative to the 2010 Typical Year. As shown in Chapter 2.0, 2021 Scenario 3 also has the lowest oil and gas emissions of the four future year scenarios considered, especially for particulate matter.

The IAS results show that the greatest improvement in visibility between the 2010 Typical Year and 2021 Scenario 3 occurs at Arches NP, with light extinction values changing from 30.3 Mm^{-1} (11.1 dv) in the 2010 Typical Year to 23.9 Mm^{-1} (8.7 dv) in the 2021 Scenario 3. The second most significant improvement occurs at the Uintah and Ouray IR, with light extinction values changing from 33.3 Mm^{-1} (12.0 dv) in the 2010 Typical Year to 28.0 Mm^{-1} (10.3 dv) in the 2021 Scenario 3. Across all future year scenarios, the largest improvement in visibility occurs at Arches NP, Canyonlands NP, Capitol Reef NP, Dinosaur National Monument, Flaming Gorge National Recreation Area, Uintah and Ouray IR, and Ute Mountain IR. Areas that do not have a noteworthy change in visibility impacts for any of the future year scenarios include Fitzpatrick WA and Goshute IR. The assessment area with the largest light extinction values, indicative of greater visibility impairment, is Fort Hall IR for the 2010 Base Year, 2010 Typical Year, and 2021 future year scenarios. The assessment areas with the lowest light extinction values, indicative of the best visibility, are Goshute IR in the 2010 Base Year and 2010 Typical Year and West Elk WA in the 2021 future year scenarios.

IAS results indicate that most Class I and sensitive Class II areas show improvement in the 20th percentile best visibility days, though the magnitude of the improvement tends to be less than the 20th percentile worst visibility days. The 20th percentile best visibility light extinction values increase, indicative of greater visibility impairment, for Bridger WA, Fitzpatrick WA, and Fort Hall IR across all four 2021 future year scenarios.



ARMS Modeling Project

Figure 4-1

MATS Visibility Monitors

Table 4-1 Summary of Modeled Visibility Air Quality Impacts

Model Scenario	Assessment Method	Area	Range of Modeled Visibility Values	
			Best Visibility	**Worst Visibility**
2010 Base Year	IAS	Class I	11.8 Mm^{-1} (1.7 dv) West Elk WA	30.2 Mm^{-1} (11.1 dv) Arches NP
		Class II	11.6 Mm^{-1} (1.5 dv) Goshute IR	37.8 Mm^{-1} (13.3 dv) Fort Hall IR
2010 Typical Year	IAS	Class I	11.8 Mm^{-1} (1.7 dv) West Elk WA	30.3 Mm^{-1} (11.1 dv) Arches NP
		Class II	11.6 Mm^{-1} (1.5 dv) Goshute IR	37.7 Mm^{-1} (13.3 dv) Fort Hall IR
2021 OTB Controls Scenario	IAS	Class I	11.2 Mm^{-1} (1.2 dv) West Elk WA	24.1 Mm^{-1} (8.8 dv) Arches NP
		Class II	11.5 Mm^{-1} (1.4 dv) Goshute IR	36.2 Mm^{-1} (12.9 dv) Fort Hall IR
	MATS	Class I	10.4 Mm^{-1} (0.43 dv) Eagles Nest WA, Flat Tops WA, Maroon Bells-Snowmass WA, West Elk WA	30.8 Mm^{-1} (11.3 dv) Rocky Mountain NP
2021 Scenario 1	IAS	Class I	11.2 Mm^{-1} (1.2 dv) West Elk WA	23.9 Mm^{-1} (8.7 dv) Arches NP
		Class II	11.5 Mm^{-1} (1.4 dv) Goshute IR	36.2 Mm^{-1} (12.9 dv) Fort Hall IR
	MATS	Class I	10.4 Mm^{-1} (0.43 dv) Eagles Nest WA, Flat Tops WA, Maroon Bells-Snowmass WA, West Elk WA	30.8 Mm^{-1} (11.3 dv) Rocky Mountain NP
2021 Scenario 2	IAS	Class I	11.2 Mm^{-1} (1.2 dv) West Elk WA	24.1 Mm^{-1} (8.8 dv) Arches NP
		Class II	11.5 Mm^{-1} (1.4 dv) Goshute IR	36.2 Mm^{-1} (12.9 dv) Fort Hall IR
	MATS	Class I	10.4 Mm^{-1} (0.43 dv) Eagles Nest WA, Flat Tops WA, Maroon Bells-Snowmass WA, West Elk WA	30.8 Mm^{-1} (11.3 dv) Rocky Mountain NP

Table 4-1 Summary of Modeled Visibility Air Quality Impacts

Model Scenario	Assessment Method	Area	Range of Modeled Visibility Values	
			Best Visibility	Worst Visibility
2021 Scenario 3	IAS	Class I	11.2 Mm^{-1} (1.2 dv) West Elk WA	23.9 Mm^{-1} (8.7 dv) Arches NP
		Class II	11.5 Mm^{-1} (1.4 dv) Goshute IR	36.2 Mm^{-1} (12.9 dv) Fort Hall IR
	MATS	Class I	10.4 Mm^{-1} (0.43 dv) Eagles Nest WA, Flat Tops WA, Maroon Bells-Snowmass WA, West Elk WA	30.8 Mm^{-1} (11.3 dv) Rocky Mountain NP

MATS estimates show that there is a general improvement between the baseline year and 2021 future year scenarios, similar to the IAS results; however, there are no significant differences in visibility impacts between the four future year scenarios at any Class I area. This is likely because all Class I assessment areas are not in proximity to the Uinta Basin study area where the different emission control scenarios are implemented.

Unlike the IAS results, the MATS visibility analysis indicates that two Class I areas, Bridger WA and Fitzpatrick WA, show a deterioration in visibility in terms of the 20 percent worst visibility days between the baseline year and 2021 future year scenarios; all other Class I areas show an improvement between the baseline year and 2021 future year scenarios. The greatest improvement in visibility between the baseline year and 2021 future year scenarios occurs at Mesa Verde NP: light extinction values changing from 30.6 Mm^{-1} (11.2 dv) in the baseline year to 28.0 Mm^{-1} (10.3 dv) in the 2021 future year scenarios. The assessment area with the highest light extinction values, indicative of greater visibility impairment, is Rocky Mountain NP for both the baseline and 2021 future year scenarios.

4.3 2010 Base Year

Table 4-2 presents the modeled light extinction and corresponding deciviews for the 20th percentile best and 20th percentile worst visibility days for the 2010 Base Year. The assessment areas with the lowest light extinction, indicative of the best visibility, include the Goshute IR and West Elk WA, with extinction values of 11.6 Mm^{-1} (1.5 dv) and 11.8 Mm^{-1} (1.7 dv), respectively. The assessment areas with the highest light extinction, and therefore greater visibility impairment, include Fort Hall IR and Uintah and Ouray IR, with extinction values of 37.8 Mm^{-1} (13.3 dv) and 33.2 Mm^{-1} (12.0 dv), respectively.

Model performance for visibility was presented in the ARMS Air Quality MPE for the 2010 Base Year (AECOM and STI 2014). Overall, the model performed well for total light extinction in both the 12-km and 4-km domains and was deemed suitable for assessing impacts on regional haze. Model-predicted annual average total light extinction values were fairly consistent with the reconstructed annual average total light extinction from the IMPROVE monitoring network in 2010. Modeled light extinction tended to be over-predicted during the winter and under-predicted during all other seasons; therefore, the model generally under-predicts visibility impairment during most seasons, except winter. The model also is not able to fully capture unique fire and windblown dust events impacting visibility at monitoring sites. The overall model performance for visibility is influenced by the contributions from individual PM species. The largest errors in the total light extinction due to individual species are due to sea salt (SS), followed by nitrate (NO_3), coarse mass (CM), organic carbon (OC), SOIL, elemental carbon (EC), and sulfate (SO_4) in decreasing order. The contribution of individual PM species to total light extinction varies significantly site by site. Since the model tends to predict less annual average visibility impairment than observed, absolute modeled visibility values (as shown in **Table 4-2** and for other scenarios) also may be under-predicted; however, model bias is minimized when using the MATS tool.

Table 4-2 2010 Base Year Model-Predicted Visibility Impacts for Class I and Sensitive Class II Areas

Receptor Site	20th Percentile Best Visibility (dv)	20th Percentile Worst Visibility (dv)	20th Percentile Best Visibility (Mm^{-1})	20th Percentile Worst Visibility (Mm^{-1})
Class I Areas				
Arches NP	3.0	11.1	13.5	30.2
Black Canyon of the Gunnison WA/NP	2.0	6.0	12.2	18.2
Bridger WA	2.1	6.7	12.4	19.5
Bryce Canyon NP	3.3	8.6	13.9	23.5
Canyonlands NP	2.8	9.6	13.2	26.2
Capitol Reef NP	2.9	9.2	13.4	25.1
Eagles Nest WA	2.6	6.2	13.0	18.7
Fitzpatrick WA	2.0	6.5	12.2	19.1
Flat Tops WA	2.1	5.9	12.3	18.1
La Garita WA	2.2	5.2	12.4	16.9
Maroon Bells-Snowmass WA	1.7	5.0	11.9	16.5
Mesa Verde NP	3.4	7.8	14.1	21.8
Mount Zirkel WA	2.4	6.8	12.7	19.8
Rawah WA	1.9	6.5	12.1	19.1
Rocky Mountain NP	3.0	7.0	13.4	20.2
Weminuche WA	2.3	5.3	12.6	17.0
West Elk WA	1.7	5.2	11.8	16.8
Class II Areas				
Dinosaur National Monument	2.6	11.0	12.9	29.9
Flaming Gorge National Recreation Area	2.5	9.5	12.8	25.9
Fort Hall IR	4.4	13.3	15.5	37.8
Goshute IR	1.5	4.8	11.6	16.1
High Uintas WA	2.8	8.3	13.3	23.0
Navajo IR	3.2	7.4	13.7	21.0
Paitute IR	4.0	8.4	14.9	23.2

Table 4-2 2010 Base Year Model-Predicted Visibility Impacts for Class I and Sensitive Class II Areas

Receptor Site	20th Percentile Best Visibility (dv)	20th Percentile Worst Visibility (dv)	20th Percentile Best Visibility (Mm^{-1})	20th Percentile Worst Visibility (Mm^{-1})
Skull Valley IR	2.1	7.9	12.4	22.0
Southern Ute IR	3.7	8.1	14.5	22.5
Uintah and Ouray IR	3.2	12.0	13.7	33.2
Ute Mountain IR	3.9	9.1	14.8	24.8
Wind River IR	2.1	7.1	12.3	20.3

4.4 2010 Typical Year

Table 4-3 presents a comparison of the modeled light extinction for the 20th percentile best and 20th percentile worst visibility days for both the 2010 Base Year and 2010 Typical Year. The modeled lowest and highest light extinction values are identical in the 2010 Base year and 2010 Typical Year, though some values vary slightly at a few assessment areas. Overall, the difference in modeled light extinction values between the 2010 Base Year and 2010 Typical Year is almost negligible. The largest difference between the 2010 Base Year and 2010 Typical Year light extinction values is 0.3 Mm^{-1} which occurs for the 20th percentile worst visibility in Paitute IR and Mesa Verde NP.

Table 4-3 2010 Typical Year and 2010 Base Year Model-Predicted Visibility Impacts for Class I and Sensitive Class II Areas

Receptor Site	20th Percentile Best Visibility (dv)		20th Percentile Worst Visibility (dv)		20th Percentile Best Visibility (Mm^{-1})		20th Percentile Worst Visibility (Mm^{-1})	
	Base10	Typ10	Base10	Typ10	Base10	Typ10	Base10	Typ10
Class I Areas								
Arches NP	3.0	3.0	11.1	11.1	13.5	13.5	30.2	30.3
Black Canyon of the Gunnison WA/NP	2.0	2.0	6.0	6.0	12.2	12.2	18.2	18.2
Bridger WA	2.1	2.1	6.7	6.7	12.4	12.3	19.5	19.5
Bryce Canyon NP	3.3	3.3	8.6	8.5	13.9	13.9	23.5	23.5
Canyonlands NP	2.8	2.7	9.6	9.7	13.2	13.2	26.2	26.3
Capitol Reef NP	2.9	2.9	9.2	9.2	13.4	13.3	25.1	25.0
Eagles Nest WA	2.6	2.6	6.2	6.2	13.0	13.0	18.7	18.7
Fitzpatrick WA	2.0	2.0	6.5	6.5	12.2	12.2	19.1	19.1
Flat Tops WA	2.1	2.1	5.9	5.9	12.3	12.3	18.1	18.1
La Garita WA	2.2	2.2	5.2	5.2	12.4	12.4	16.9	16.8
Maroon Bells-Snowmass WA	1.7	1.7	5.0	5.0	11.9	11.8	16.5	16.4
Mesa Verde NP	3.4	3.4	7.8	7.7	14.1	14.0	21.8	21.5
Mount Zirkel WA	2.4	2.3	6.8	6.8	12.7	12.6	19.8	19.8
Rawah WA	1.9	1.9	6.5	6.5	12.1	12.1	19.1	19.1
Rocky Mountain NP	3.0	3.0	7.0	7.0	13.4	13.4	20.2	20.2
Weminuche WA	2.3	2.3	5.3	5.3	12.6	12.6	17.0	17.0
West Elk WA	1.7	1.7	5.2	5.2	11.8	11.8	16.8	16.8

Table 4-3 2010 Typical Year and 2010 Base Year Model-Predicted Visibility Impacts for Class I and Sensitive Class II Areas

Receptor Site	20th Percentile Best Visibility (dv)		20th Percentile Worst Visibility (dv)		20th Percentile Best Visibility (Mm^{-1})		20th Percentile Worst Visibility (Mm^{-1})	
	Base10	Typ10	Base10	Typ10	Base10	Typ10	Base10	Typ10
Class II Areas								
Dinosaur National Monument	2.6	2.6	11.0	11.0	12.9	12.9	29.9	29.9
Flaming Gorge National Recreation Area	2.5	2.5	9.5	9.5	12.8	12.8	25.9	25.9
Fort Hall IR	4.4	4.3	13.3	13.3	15.5	15.4	37.8	37.7
Goshute IR	1.5	1.5	4.8	4.8	11.6	11.6	16.1	16.1
High Uintas WA	2.8	2.8	8.3	8.3	13.3	13.2	23.0	23.0
Navajo IR	3.2	3.1	7.4	7.4	13.7	13.7	21.0	20.9
Paitute IR	4.0	3.9	8.4	8.3	14.9	14.8	23.2	23.0
Skull Valley IR	2.1	2.1	7.9	7.9	12.4	12.4	22.0	22.0
Southern Ute IR	3.7	3.7	8.1	8.1	14.5	14.5	22.5	22.4
Uintah and Ouray IR	3.2	3.1	12.0	12.0	13.7	13.7	33.2	33.3
Ute Mountain IR	3.9	3.9	9.1	9.1	14.8	14.8	24.8	24.7
Wind River IR	2.1	2.1	7.1	7.1	12.3	12.3	20.3	20.3

4.5 2021 OTB Controls Scenario

Table 4-4 presents the modeled light extinction values for the 20th percentile best and 20th percentile worst visibility days for the 2010 Typical Year and 2021 OTB Controls Scenario. Based on the modeled 2021 OTB Controls Scenario data**,** the assessment areas with the lowest light extinction, indicative of the best visibility, include the West Elk WA and Maroon Bells-Snowmass WA, with extinction values of 11.2 Mm^{-1} (1.2 dv) and 11.3 Mm^{-1} (1.2 dv), respectively. The assessment areas with the highest light extinction, and therefore greater visibility impairment, include Fort Hall IR and Uintah and Ouray IR, with extinction values of 36.2 Mm^{-1} (12.9 dv) and 31.2 Mm^{-1} (11.4 dv), respectively.

Table 4-5 presents the MATS-estimated visibility impacts at Class I areas for the baseline year 2008 and 2021 OTB Controls Scenario. Based on the MATS-estimated 2021 OTB Controls Scenario data**,** the assessment areas with the lowest light extinction, indicative of the best visibility, include Eagles Nest WA, Flat Tops WA, Maroon Bells-Snowmass WA, and West Elk WA, with extinction values of 10.4 Mm^{-1} (0.4 dv). The assessment area with the highest light extinction, and therefore greater visibility impairment, is Rocky Mountain NP, with an extinction value of 30.8 Mm^{-1} (11.3 dv).

4.5.1 Comparison to Typical Year and Baseline

Model-predicted light extinction for 2021 OTB Controls Scenario is compared to the 2010 Typical Year in **Table 4-4**. The predicted 2021 visibility impacts generally are reduced relative to the 2010 Typical Year for both the 20th percentile best and 20th percentile worst days for most Class I and sensitive Class II assessment areas, with some exceptions. Bridger WA, Fitzpatrick WA, and Fort Hall IR all indicate greater visibility impairment with the 20th percentile best visibility days but an improvement in the 20th percentile worst visibility days relative to the 2010 Typical Year. All Class I and sensitive Class II areas indicate improvement in the 20th percentile worst days relative to the 2010 Typical Year. Arches NP and Canyonlands NP show the greatest improvement in the 20th percentile worst visibility days between the 2010 Typical Year and 2021 OTB Controls Scenario. The 20th percentile worst visibility in Arches NP improves from 30.3 Mm^{-1} (11.1 dv) in the 2010 Typical Year to 24.1 Mm^{-1} (8.8 dv) in the 2021 OTB Controls Scenario; the 20th percentile worst visibility in Canyonlands NP improves from 26.3 Mm^{-1} (9.7 dv) in the 2010 Typical Year to 21.8 Mm^{-1} (7.8 dv) in the 2021 OTB Controls Scenario.

MATS-predicted visibility estimates at Class I areas for the 2021 OTB Controls Scenario is compared to the baseline year in **Table 4-5**. Similar to the estimates presented above, the MATS-predicted 2021 visibility impacts are smaller relative to the 2010 Typical Year for both the 20 percent best and 20 percent worst days for most Class I assessment areas, with some exceptions. Bridger WA and Fitzpatrick WA both show increased visibility impairment with both the 20 percent best and worst days relative to the 2010 Typical Year. The 20 percent worst visibility at Bridger WA and Fitzpatrick WA deteriorates from 28.2 Mm^{-1} (10.6 dv) in the baseline year to 29.9 Mm^{-1} (10.9 dv) in the 2021 OTB Controls Scenario. Mesa Verde NP and Rocky Mountain NP show the greatest improvement in the 20 percent worst visibility days between the baseline year and 2021 OTB Controls Scenario. The 20 percent worst visibility in Mesa Verde NP improves from 30.6 Mm^{-1} (11.2 dv) in the 2010 Typical Year to 28.0 Mm^{-1} (10.3 dv) in the 2021 OTB Controls Scenario; the 20 percent worst visibility in Rocky Mountain NP improves from 33.3 Mm^{-1} (12.0 dv) in the 2010 Typical Year to 30.8 Mm^{-1} (11.3 dv) in the 2021 OTB Controls Scenario.

Table 4-4 2021 OTB Controls Scenario and 2010 Typical Year Model-Predicted Visibility Impacts for Class I and Sensitive Class II Areas

Receptor Site	20th Percentile Best Visibility (dv)		20th Percentile Worst Visibility (dv)		20th Percentile Best Visibility (Mm^{-1})		20th Percentile Worst Visibility (Mm^{-1})	
	OTB	Typ10	OTB	Typ10	OTB	Typ10	OTB	Typ10
Class I Areas								
Arches NP	2.5	3.0	8.8	11.1	12.8	13.5	24.1	30.3
Black Canyon of the Gunnison WA/NP	1.3	2.0	4.8	6.0	11.4	12.2	16.1	18.2
Bridger WA	2.3	2.1	6.1	6.7	12.6	12.3	18.5	19.5
Bryce Canyon NP	2.7	3.3	7.2	8.5	13.1	13.9	20.6	23.5
Canyonlands NP	2.2	2.7	7.8	9.7	12.5	13.2	21.8	26.3
Capitol Reef NP	2.4	2.9	7.8	9.2	12.7	13.3	21.8	25.0
Eagles Nest WA	1.8	2.6	5.3	6.2	12.0	13.0	17.0	18.7
Fitzpatrick WA	2.1	2.0	6.0	6.5	12.4	12.2	18.3	19.1
Flat Tops WA	1.5	2.1	5.2	5.9	11.6	12.3	16.7	18.1
La Garita WA	1.7	2.2	4.6	5.2	11.9	12.4	15.8	16.8
Maroon Bells-Snowmass WA	1.2	1.7	4.3	5.0	11.3	11.8	15.4	16.4
Mesa Verde NP	2.6	3.4	6.3	7.7	12.9	14.0	18.7	21.5
Mount Zirkel WA	1.7	2.3	5.8	6.8	11.9	12.6	17.9	19.8
Rawah WA	1.4	1.9	5.4	6.5	11.5	12.1	17.2	19.1
Rocky Mountain NP	2.4	3.0	6.3	7.0	12.7	13.4	18.7	20.2
Weminuche WA	1.8	2.3	4.6	5.3	12.0	12.6	15.8	17.0
West Elk WA	1.2	1.7	4.4	5.2	11.2	11.8	15.5	16.8

Table 4-4 2021 OTB Controls Scenario and 2010 Typical Year Model-Predicted Visibility Impacts for Class I and Sensitive Class II Areas

Receptor Site	20th Percentile Best Visibility (dv)		20th Percentile Worst Visibility (dv)		20th Percentile Best Visibility (Mm^{-1})		20th Percentile Worst Visibility (Mm^{-1})	
	OTB	Typ10	OTB	Typ10	OTB	Typ10	OTB	Typ10
Class II Areas								
Dinosaur National Monument	2.2	2.6	10.1	11.0	12.5	12.9	27.5	29.9
Flaming Gorge National Recreation Area	2.1	2.5	8.2	9.5	12.3	12.8	22.6	25.9
Fort Hall IR	4.9	4.3	12.9	13.3	16.4	15.4	36.2	37.7
Goshute IR	1.4	1.5	4.3	4.8	11.5	11.6	15.4	16.1
High Uintas WA	2.4	2.8	7.2	8.3	12.7	13.2	20.5	23.0
Navajo IR	2.6	3.1	6.3	7.4	13.0	13.7	18.8	20.9
Paitute IR	3.4	3.9	6.9	8.3	14.0	14.8	19.9	23.0
Skull Valley IR	2.0	2.1	6.9	7.9	12.2	12.4	20.0	22.0
Southern Ute IR	2.9	3.7	6.7	8.1	13.4	14.5	19.6	22.4
Uintah and Ouray IR	2.8	3.1	11.4	12.0	13.3	13.7	31.2	33.3
Ute Mountain IR	3.0	3.9	7.3	9.1	13.4	14.8	20.7	24.7
Wind River IR	2.1	2.1	6.2	7.1	12.3	12.3	18.7	20.3

Table 4-5 2021 OTB Controls Scenario and Baseline MATS-Estimated Visibility Impacts for Class I and Sensitive Class II Areas

Receptor Site	20th Percent Best Visibility (dv)		20th Percent Worst Visibility (dv)		20th Percent Best Visibility (Mm^{-1})		20th Percent Worst Visibility (Mm^{-1})	
	OTB	Baseline	OTB	Baseline	OTB	Baseline	OTB	Baseline
Class I Areas								
Arches NP	2.4	2.9	10.4	11.0	12.7	13.3	28.2	30.1
Black Canyon of the Gunnison WA/NP	2.2	2.3	9.3	10.0	12.4	12.5	25.3	27.0
Bridger WA	1.6	1.4	10.9	10.6	11.8	11.5	29.9	28.8
Bryce Canyon NP	1.7	2.0	10.6	11.4	11.8	12.2	28.9	31.2
Canyonlands NP	2.4	2.9	10.4	11.0	12.7	13.3	28.2	30.1
Capitol Reef NP	2.3	2.6	10.0	10.7	12.6	12.9	27.3	29.2
Eagles Nest WA	0.4	0.7	8.2	8.7	10.4	10.7	22.6	23.8
Fitzpatrick WA	1.6	1.4	10.9	10.6	11.8	11.5	29.9	28.8
Flat Tops WA	0.4	0.7	8.2	8.7	10.4	10.7	22.6	23.8
La Garita WA	2.2	2.3	9.3	10.0	12.4	12.5	25.3	27.0
Maroon Bells-Snowmass WA	0.4	0.7	8.2	8.7	10.4	10.7	22.6	23.8
Mesa Verde NP	2.4	3.1	10.3	11.2	12.8	13.7	28.0	30.6
Mount Zirkel WA	0.7	1.0	8.7	9.4	10.7	11.0	23.9	25.5
Rawah WA	0.7	1.0	8.7	9.4	10.7	11.0	23.9	25.5
Rocky Mountain NP	1.7	1.9	11.3	12.0	11.9	12.1	30.8	33.3
Weminuche WA	2.1	2.3	9.3	10.0	12.4	12.5	25.4	27.0
West Elk WA	0.4	0.7	8.2	8.7	10.4	10.7	22.6	23.8

4.6 2021 Control Scenario 1

Table 4-6 presents the modeled light extinction values for the 20th percentile best and 20th percentile worst visibility days for the future year 2021 Scenario 1 and 2010 Typical Year. **Table 4-7** presents the MATS-estimated visibility impacts at Class I areas for the future year 2021 Scenario 1 and baseline year. **Table 4-8** presents the modeled visibility impacts for the 20th percentile best and 20th percentile worst visibility days for the future year 2021 Scenario 1 and 2021 OTB Controls Scenario. **Table 4-9** presents the MATS-estimated visibility impacts at Class I areas for the future year 2021 Scenario 1 and 2021 OTB Controls Scenario.

Based on the modeled 2021 Scenario 1 data**,** the assessment areas with the lowest and highest light extinction values are identical to those analyzed for the 2021 OTB Controls Scenario.

4.6.1 Comparison to Typical Year and Baseline

Model-predicted light extinction for 2021 Scenario 1 is compared to the 2010 Typical Year in **Table 4-6**. The predicted 2021 visibility generally improves relative to the 2010 Typical Year for both the 20th percentile best and 20th percentile worst days for most Class I and sensitive Class II assessment areas. Results for Controls Scenario 1 are identical to the OTB Controls Scenario and a description can be found in Section 4.5.1 comparing the 2010 Typical Year to the 2021 OTB Controls Scenario.

MATS-predicted light extinction at Class I areas for 2021 Scenario 1 is compared to the baseline year in **Table 4-7**. Similar to model-predicted comparisons, the MATS-predicted 2021 visibility impacts generally show improvement relative to the 2010 Typical Year for both the 20 percent best and 20 percent worst days for most Class I assessment areas. Results are similar to comparisons of the baseline year and 2021 OTB Controls Scenario described in Section 4.5.1.

4.6.2 Comparison to OTB Controls Scenario

Model-predicted light extinction for 2021 Scenario 1 is compared to the 2021 OTB Controls Scenario in **Table 4-8**. In general, light extinction values remain the same or show some improvement in the 2021 Scenario 1 results compared to the 2021 OTB Controls Scenario. The largest improvement in model-predicted visibility impacts occurs at the Uintah and Ouray IR, the 20 percent worst visibility values decreasing from 31.2 Mm^{-1} (11.4 dv) for the 2021 OTB Controls Scenario to 29.4 Mm^{-1} (10.8 dv) for the 2021 Scenario 1. Significant improvement is also modeled at Dinosaur National Monument, the 20 percent worst visibility decreasing from 27.5 Mm^{-1} (10.1 dv) in the 2021 OTB Controls Scenario to 26.4 Mm^{-1} (9.7 dv) in the 2021 Scenario 1.

MATS-predicted light extinction at Class I areas in the 2021 OTB Controls Scenario and 2021 Scenario 1 are compared using **Table 4-9**. Light extinction values for all Class I areas remain the same or show a slight improvement in the 2021 Scenario 1 compared to the 2021 OTB Controls Scenario. Though small in magnitude, the greatest improvement in the 20 percent worst visibility occurs in Rocky Mountain NP, Bridger WA, and Fitzpatrick WA.

Table 4-6 2021 Scenario 1 and 2010 Typical Year Model-Predicted Visibility Impacts for Class I and Sensitive Class II Areas

Receptor Site	20th Percentile Best Visibility (dv)		20th Percentile Worst Visibility (dv)		20th Percentile Best Visibility (Mm^{-1})		20th Percentile Worst Visibility (Mm^{-1})	
	Scen1	Typ10	Scen1	Typ10	Scen1	Typ10	Scen1	Typ10
Class I Areas								
Arches NP	2.5	3.0	8.7	11.1	12.8	13.5	23.9	30.3
Black Canyon of the Gunnison WA/NP	1.3	2.0	4.8	6.0	11.4	12.2	16.1	18.2
Bridger WA	2.3	2.1	6.1	6.7	12.6	12.3	18.5	19.5
Bryce Canyon NP	2.7	3.3	7.2	8.5	13.1	13.9	20.6	23.5
Canyonlands NP	2.2	2.7	7.8	9.7	12.5	13.2	21.7	26.3
Capitol Reef NP	2.4	2.9	7.8	9.2	12.7	13.3	21.7	25.0
Eagles Nest WA	1.8	2.6	5.3	6.2	12.0	13.0	17.0	18.7
Fitzpatrick WA	2.1	2.0	6.0	6.5	12.4	12.2	18.3	19.1
Flat Tops WA	1.5	2.1	5.1	5.9	11.6	12.3	16.7	18.1
La Garita WA	1.7	2.2	4.6	5.2	11.9	12.4	15.8	16.8
Maroon Bells-Snowmass WA	1.2	1.7	4.3	5.0	11.3	11.8	15.3	16.4
Mesa Verde NP	2.6	3.4	6.3	7.7	12.9	14.0	18.7	21.5
Mount Zirkel WA	1.7	2.3	5.7	6.8	11.9	12.6	17.7	19.8
Rawah WA	1.4	1.9	5.4	6.5	11.4	12.1	17.1	19.1
Rocky Mountain NP	2.4	3.0	6.2	7.0	12.7	13.4	18.6	20.2
Weminuche WA	1.8	2.3	4.6	5.3	12.0	12.6	15.8	17.0
West Elk WA	1.2	1.7	4.3	5.2	11.2	11.8	15.4	16.8

Table 4-6 2021 Scenario 1 and 2010 Typical Year Model-Predicted Visibility Impacts for Class I and Sensitive Class II Areas

Receptor Site	20th Percentile Best Visibility (dv)		20th Percentile Worst Visibility (dv)		20th Percentile Best Visibility (Mm^{-1})		20th Percentile Worst Visibility (Mm^{-1})	
	Scen1	Typ10	Scen1	Typ10	Scen1	Typ10	Scen1	Typ10
Class II Areas								
Dinosaur National Monument	2.1	2.6	9.7	11.0	12.4	12.9	26.4	29.9
Flaming Gorge National Recreation Area	2.1	2.5	8.0	9.5	12.3	12.8	22.3	25.9
Fort Hall IR	4.9	4.3	12.9	13.3	16.4	15.4	36.2	37.7
Goshute IR	1.4	1.5	4.3	4.8	11.5	11.6	15.4	16.1
High Uintas WA	2.4	2.8	7.1	8.3	12.7	13.2	20.3	23.0
Navajo IR	2.6	3.1	6.3	7.4	12.9	13.7	18.8	20.9
Paitute IR	3.4	3.9	6.9	8.3	14.0	14.8	19.9	23.0
Skull Valley IR	2.0	2.1	6.9	7.9	12.2	12.4	20.0	22.0
Southern Ute IR	2.9	3.7	6.7	8.1	13.4	14.5	19.6	22.4
Uintah and Ouray IR	2.8	3.1	10.8	12.0	13.2	13.7	29.4	33.3
Ute Mountain IR	3.0	3.9	7.3	9.1	13.4	14.8	20.7	24.7
Wind River IR	2.1	2.1	6.2	7.1	12.3	12.3	18.7	20.3

Table 4-7 2021 Scenario 1 and Baseline MATS-Estimated Visibility Impacts for Class I and Sensitive Class II Areas

Receptor Site	20th Percent Best Visibility (dv)		20th Percent Worst Visibility (dv)		20th Percent Best Visibility (Mm^{-1})		20th Percent Worst Visibility (Mm^{-1})	
	Scen1	Baseline	Scen1	Baseline	Scen1	Baseline	Scen1	Baseline
Class I Areas								
Arches NP	2.4	2.9	10.3	11.0	12.7	13.3	28.1	30.1
Black Canyon of the Gunnison WA/NP	2.2	2.3	9.3	10.0	12.4	12.5	25.3	27.0
Bridger WA	1.6	1.4	10.9	10.6	11.8	11.5	29.8	28.8
Bryce Canyon NP	1.7	2.0	10.6	11.4	11.8	12.2	28.9	31.2
Canyonlands NP	2.4	2.9	10.3	11.0	12.7	13.3	28.1	30.1
Capitol Reef NP	2.3	2.6	10.0	10.7	12.6	12.9	27.3	29.2
Eagles Nest WA	0.4	0.7	8.1	8.7	10.4	10.7	22.6	23.8
Fitzpatrick WA	1.6	1.4	10.9	10.6	11.8	11.5	29.8	28.8
Flat Tops WA	0.4	0.7	8.1	8.7	10.4	10.7	22.6	23.8
La Garita WA	2.2	2.3	9.3	10.0	12.4	12.5	25.3	27.0
Maroon Bells-Snowmass WA	0.4	0.7	8.1	8.7	10.4	10.7	22.6	23.8
Mesa Verde NP	2.4	3.1	10.3	11.2	12.8	13.7	28.0	30.6
Mount Zirkel WA	0.7	1.0	8.7	9.4	10.7	11.0	23.8	25.5
Rawah WA	0.7	1.0	8.7	9.4	10.7	11.0	23.8	25.5
Rocky Mountain NP	1.7	1.9	11.3	12.0	11.8	12.1	30.8	33.3
Weminuche WA	2.1	2.3	9.3	10.0	12.4	12.5	25.4	27.0
West Elk WA	0.4	0.7	8.1	8.7	10.4	10.7	22.6	23.8

Table 4-8 2021 Scenario 1 and OTB Controls Scenario Model-Predicted Visibility Impacts for Class I and Sensitive Class II Areas

Receptor Site	20th Percentile Best Visibility (dv)		20th Percentile Worst Visibility (dv)		20th Percentile Best Visibility (Mm^{-1})		20th Percentile Worst Visibility (Mm^{-1})	
	Scen1	OTB	Scen1	OTB	Scen1	OTB	Scen1	OTB
Class I Areas								
Arches NP	2.5	2.5	8.7	8.8	12.8	12.8	23.9	24.1
Black Canyon of the Gunnison WA/NP	1.3	1.3	4.8	4.8	11.4	11.4	16.1	16.1
Bridger WA	2.3	2.3	6.1	6.1	12.6	12.6	18.5	18.5
Bryce Canyon NP	2.7	2.7	7.2	7.2	13.1	13.1	20.6	20.6
Canyonlands NP	2.2	2.2	7.8	7.8	12.5	12.5	21.7	21.8
Capitol Reef NP	2.4	2.4	7.8	7.8	12.7	12.7	21.7	21.8
Eagles Nest WA	1.8	1.8	5.3	5.3	12.0	12.0	17.0	17.0
Fitzpatrick WA	2.1	2.1	6.0	6.0	12.4	12.4	18.3	18.3
Flat Tops WA	1.5	1.5	5.1	5.2	11.6	11.6	16.7	16.7
La Garita WA	1.7	1.7	4.6	4.6	11.9	11.9	15.8	15.8
Maroon Bells-Snowmass WA	1.2	1.2	4.3	4.3	11.3	11.3	15.3	15.4
Mesa Verde NP	2.6	2.6	6.3	6.3	12.9	12.9	18.7	18.7
Mount Zirkel WA	1.7	1.7	5.7	5.8	11.9	11.9	17.7	17.9
Rawah WA	1.4	1.4	5.4	5.4	11.4	11.5	17.1	17.2
Rocky Mountain NP	2.4	2.4	6.2	6.3	12.7	12.7	18.6	18.7
Weminuche WA	1.8	1.8	4.6	4.6	12.0	12.0	15.8	15.8
West Elk WA	1.2	1.2	4.3	4.4	11.2	11.2	15.4	15.5

Table 4-8 2021 Scenario 1 and OTB Controls Scenario Model-Predicted Visibility Impacts for Class I and Sensitive Class II Areas

Receptor Site	20th Percentile Best Visibility (dv)		20th Percentile Worst Visibility (dv)		20th Percentile Best Visibility (Mm^{-1})		20th Percentile Worst Visibility (Mm^{-1})	
	Scen1	OTB	Scen1	OTB	Scen1	OTB	Scen1	OTB
Class II Areas								
Dinosaur National Monument	2.1	2.2	9.7	10.1	12.4	12.5	26.4	27.5
Flaming Gorge National Recreation Area	2.1	2.1	8.0	8.2	12.3	12.3	22.3	22.6
Fort Hall IR	4.9	4.9	12.9	12.9	16.4	16.4	36.2	36.2
Goshute IR	1.4	1.4	4.3	4.3	11.5	11.5	15.4	15.4
High Uintas WA	2.4	2.4	7.1	7.2	12.7	12.7	20.3	20.5
Navajo IR	2.6	2.6	6.3	6.3	12.9	13.0	18.8	18.8
Paitute IR	3.4	3.4	6.9	6.9	14.0	14.0	19.9	19.9
Skull Valley IR	2.0	2.0	6.9	6.9	12.2	12.2	20.0	20.0
Southern Ute IR	2.9	2.9	6.7	6.7	13.4	13.4	19.6	19.6
Uintah and Ouray IR	2.8	2.8	10.8	11.4	13.2	13.3	29.4	31.2
Ute Mountain IR	3.0	3.0	7.3	7.3	13.4	13.4	20.7	20.7
Wind River IR	2.1	2.1	6.2	6.2	12.3	12.3	18.7	18.7

Table 4-9 2021 Scenario 1 and OTB Controls Scenario MATS-Estimated Visibility Impacts for Class I and Sensitive Class II Areas

Receptor Site	20th Percent Best Visibility (dv)		20th Percent Worst Visibility (dv)		20th Percent Best Visibility (Mm^{-1})		20th Percent Worst Visibility (Mm^{-1})	
	Scen1	OTB	Scen1	OTB	Scen1	OTB	Scen1	OTB
Class I Areas								
Arches NP	2.4	2.4	10.3	10.4	12.7	12.7	28.1	28.2
Black Canyon of the Gunnison WA/NP	2.2	2.2	9.3	9.3	12.4	12.4	25.3	25.3
Bridger WA	1.6	1.6	10.9	10.9	11.8	11.8	29.8	29.9
Bryce Canyon NP	1.7	1.7	10.6	10.6	11.8	11.8	28.9	28.9
Canyonlands NP	2.4	2.4	10.3	10.4	12.7	12.7	28.1	28.2
Capitol Reef NP	2.3	2.3	10.0	10.0	12.6	12.6	27.3	27.3
Eagles Nest WA	0.4	0.4	8.1	8.2	10.4	10.4	22.6	22.6
Fitzpatrick WA	1.6	1.6	10.9	10.9	11.8	11.8	29.8	29.9
Flat Tops WA	0.4	0.4	8.1	8.2	10.4	10.4	22.6	22.6
La Garita WA	2.2	2.2	9.3	9.3	12.4	12.4	25.3	25.3
Maroon Bells-Snowmass WA	0.4	0.4	8.1	8.2	10.4	10.4	22.6	22.6
Mesa Verde NP	2.4	2.4	10.3	10.3	12.8	12.8	28.0	28.0
Mount Zirkel WA	0.7	0.7	8.7	8.7	10.7	10.7	23.8	23.9
Rawah WA	0.7	0.7	8.7	8.7	10.7	10.7	23.8	23.9
Rocky Mountain NP	1.7	1.7	11.3	11.3	11.8	11.9	30.8	30.8
Weminuche WA	2.1	2.1	9.3	9.3	12.4	12.4	25.4	25.4
West Elk WA	0.4	0.4	8.1	8.2	10.4	10.4	22.6	22.6

4.7 2021 Control Scenario 2

Table 4-10 presents the modeled light extinction values for the 20th percentile best and 20th percentile worst visibility days for the future year 2021 Scenario 2 and 2010 Typical Year. **Table 4-11** presents the MATS-estimated visibility impacts at Class I areas for the future year 2021 Scenario 2 and baseline year. **Table 4-12** presents the modeled visibility impacts for the 20th percentile best and 20th percentile worst visibility days for the future year 2021 Scenario 2 and 2021 OTB Controls Scenario. **Table 4-13** presents the MATS-estimated visibility impacts at Class I areas for the future year 2021 Scenario 2 and 2021 OTB Controls Scenario.

Based on the modeled 2021 Scenario 2 data**,** the assessment areas with the lowest and highest light extinction values are identical to those analyzed for the 2021 OTB Controls Scenario and 2021 Scenario 1.

4.7.1 Comparison to Typical Year and Baseline

Model-predicted light extinction for 2021 Scenario 2 is compared to the 2010 Typical Year in **Table 4-10**. The predicted 2021 visibility generally improves relative to the 2010 Typical Year for both the 20th percentile best and 20th percentile worst days for most Class I and sensitive Class II assessment areas. Results for Controls Scenario 2 are identical to the OTB Controls Scenario and a description can be found in in Section 4.5.1 comparing the 2021 OTB Controls Scenario to the 2010 Typical Year.

MATS-predicted light extinction at Class I areas for 2021 Scenario 2 is compared to the 2010 typical year in **Table 4-11**. Similar to model-predicted comparisons, the MATS-predicted 2021 visibility impacts generally show improvement relative to the 2010 Typical Year for both the 20 percent best and 20 percent worst days for most Class I assessment areas. Results are similar to comparisons of the 2021 OTB Controls Scenario to the 2010 Typical Year described in Section 4.5.1.

4.7.2 Comparison to OTB Controls Scenario

Model-predicted light extinction in the 2021 Scenario 2 is compared to the 2021 OTB Controls Scenario in **Table 4-12**. In general, light extinction values remain the approximately the same in the 2021 Scenario 2 results compared to the 2021 OTB Controls Scenario. The largest improvements in model-predicted visibility impacts occur at the Uintah and Ouray IR and High Uintas WA; however, the 20 percent worst visibility values decrease only slightly from the 2021 OTB Controls Scenario.

MATS-predicted light extinction at Class I areas for 2021 Scenario 2 is compared to the 2021 OTB Controls Scenario in **Table 4-13**. Light extinction values for all Class I areas are unchanged in the 2021 Scenario 2 from the 2021 OTB Controls Scenario.

Table 4-10 2021 Scenario 2 and 2010 Typical Year Model-Predicted Visibility Impacts for Class I and Sensitive Class II Areas

Receptor Site	20th Percentile Best Visibility (dv)		20th Percentile Worst Visibility (dv)		20th Percentile Best Visibility (Mm^{-1})		20th Percentile Worst Visibility (Mm^{-1})	
	Scen2	Typ10	Scen2	Typ10	Scen2	Typ10	Scen2	Typ10
Class I Areas								
Arches NP	2.5	3.0	8.8	11.1	12.8	13.5	24.1	30.3
Black Canyon of the Gunnison WA/NP	1.3	2.0	4.8	6.0	11.4	12.2	16.1	18.2
Bridger WA	2.3	2.1	6.1	6.7	12.6	12.3	18.5	19.5
Bryce Canyon NP	2.7	3.3	7.2	8.5	13.1	13.9	20.6	23.5
Canyonlands NP	2.2	2.7	7.8	9.7	12.5	13.2	21.8	26.3
Capitol Reef NP	2.4	2.9	7.8	9.2	12.7	13.3	21.8	25.0
Eagles Nest WA	1.8	2.6	5.3	6.2	12.0	13.0	17.0	18.7
Fitzpatrick WA	2.1	2.0	6.0	6.5	12.4	12.2	18.3	19.1
Flat Tops WA	1.5	2.1	5.2	5.9	11.6	12.3	16.7	18.1
La Garita WA	1.7	2.2	4.6	5.2	11.9	12.4	15.8	16.8
Maroon Bells-Snowmass WA	1.2	1.7	4.3	5.0	11.3	11.8	15.4	16.4
Mesa Verde NP	2.6	3.4	6.3	7.7	12.9	14.0	18.7	21.5
Mount Zirkel WA	1.7	2.3	5.8	6.8	11.9	12.6	17.9	19.8
Rawah WA	1.4	1.9	5.4	6.5	11.5	12.1	17.2	19.1
Rocky Mountain NP	2.4	3.0	6.3	7.0	12.7	13.4	18.7	20.2
Weminuche WA	1.8	2.3	4.6	5.3	12.0	12.6	15.8	17.0
West Elk WA	1.2	1.7	4.4	5.2	11.2	11.8	15.5	16.8

Table 4-10 2021 Scenario 2 and 2010 Typical Year Model-Predicted Visibility Impacts for Class I and Sensitive Class II Areas

	20th Percentile Best Visibility (dv)		20th Percentile Worst Visibility (dv)		20th Percentile Best Visibility (Mm^{-1})		20th Percentile Worst Visibility (Mm^{-1})	
Receptor Site	**Scen2**	**Typ10**	**Scen2**	**Typ10**	**Scen2**	**Typ10**	**Scen2**	**Typ10**
Class II Areas								
Dinosaur National Monument	2.2	2.6	10.1	11.0	12.4	12.9	27.5	29.9
Flaming Gorge National Recreation Area	2.1	2.5	8.2	9.5	12.3	12.8	22.6	25.9
Fort Hall IR	4.9	4.3	12.9	13.3	16.4	15.4	36.2	37.7
Goshute IR	1.4	1.5	4.3	4.8	11.5	11.6	15.4	16.1
High Uintas WA	2.4	2.8	7.2	8.3	12.7	13.2	20.5	23.0
Navajo IR	2.6	3.1	6.3	7.4	13.0	13.7	18.8	20.9
Paitute IR	3.4	3.9	6.9	8.3	14.0	14.8	19.9	23.0
Skull Valley IR	2.0	2.1	6.9	7.9	12.2	12.4	20.0	22.0
Southern Ute IR	2.9	3.7	6.7	8.1	13.4	14.5	19.6	22.4
Uintah and Ouray IR	2.8	3.1	11.4	12.0	13.3	13.7	31.2	33.3
Ute Mountain IR	3.0	3.9	7.3	9.1	13.4	14.8	20.7	24.7
Wind River IR	2.1	2.1	6.3	7.1	12.3	12.3	18.7	20.3

Table 4-11 2021 Scenario 2 and Baseline MATS-Estimated Visibility Impacts for Class I and Sensitive Class II Areas

Receptor Site	20th Percent Best Visibility (dv)		20th Percent Worst Visibility (dv)		20th Percent Best Visibility (Mm^{-1})		20th Percent Worst Visibility (Mm^{-1})	
	Scen2	Baseline	Scen2	Baseline	Scen2	Baseline	Scen2	Baseline
Class I Areas								
Arches NP	2.4	2.9	10.4	11.0	12.7	13.3	28.2	30.1
Black Canyon of the Gunnison WA/NP	2.2	2.3	9.3	10.0	12.4	12.5	25.3	27.0
Bridger WA	1.6	1.4	10.9	10.6	11.8	11.5	29.9	28.8
Bryce Canyon NP	1.7	2.0	10.6	11.4	11.8	12.2	28.9	31.2
Canyonlands NP	2.4	2.9	10.4	11.0	12.7	13.3	28.2	30.1
Capitol Reef NP	2.3	2.6	10.0	10.7	12.6	12.9	27.3	29.2
Eagles Nest WA	0.4	0.7	8.2	8.7	10.4	10.7	22.6	23.8
Fitzpatrick WA	1.6	1.4	10.9	10.6	11.8	11.5	29.9	28.8
Flat Tops WA	0.4	0.7	8.2	8.7	10.4	10.7	22.6	23.8
La Garita WA	2.2	2.3	9.3	10.0	12.4	12.5	25.3	27.0
Maroon Bells-Snowmass WA	0.4	0.7	8.2	8.7	10.4	10.7	22.6	23.8
Mesa Verde NP	2.4	3.1	10.3	11.2	12.8	13.7	28.0	30.6
Mount Zirkel WA	0.7	1.0	8.7	9.4	10.8	11.0	23.9	25.5
Rawah WA	0.7	1.0	8.7	9.4	10.8	11.0	23.9	25.5
Rocky Mountain NP	1.7	1.9	11.3	12.0	11.9	12.1	30.8	33.3
Weminuche WA	2.1	2.3	9.3	10.0	12.4	12.5	25.4	27.0
West Elk WA	0.4	0.7	8.2	8.7	10.4	10.7	22.6	23.8

Table 4-12 2021 Scenario 2 and OTB Controls Scenario Model-Predicted Visibility Impacts for Class I and Sensitive Class II Areas

Receptor Site	20th Percentile Best Visibility (dv)		20th Percentile Worst Visibility (dv)		20th Percentile Best Visibility (Mm^{-1})		20th Percentile Worst Visibility (Mm^{-1})	
	Scen2	OTB	Scen2	OTB	Scen2	OTB	Scen2	OTB
Class I Areas								
Arches NP	2.5	2.5	8.8	8.8	12.8	12.8	24.1	24.1
Black Canyon of the Gunnison WA/NP	1.3	1.3	4.8	4.8	11.4	11.4	16.1	16.1
Bridger WA	2.3	2.3	6.1	6.1	12.6	12.6	18.5	18.5
Bryce Canyon NP	2.7	2.7	7.2	7.2	13.1	13.1	20.6	20.6
Canyonlands NP	2.2	2.2	7.8	7.8	12.5	12.5	21.8	21.8
Capitol Reef NP	2.4	2.4	7.8	7.8	12.7	12.7	21.8	21.8
Eagles Nest WA	1.8	1.8	5.3	5.3	12.0	12.0	17.0	17.0
Fitzpatrick WA	2.1	2.1	6.0	6.0	12.4	12.4	18.3	18.3
Flat Tops WA	1.5	1.5	5.2	5.2	11.6	11.6	16.7	16.7
La Garita WA	1.7	1.7	4.6	4.6	11.9	11.9	15.8	15.8
Maroon Bells-Snowmass WA	1.2	1.2	4.3	4.3	11.3	11.3	15.4	15.4
Mesa Verde NP	2.6	2.6	6.3	6.3	12.9	12.9	18.7	18.7
Mount Zirkel WA	1.7	1.7	5.8	5.8	11.9	11.9	17.9	17.9
Rawah WA	1.4	1.4	5.4	5.4	11.5	11.5	17.2	17.2
Rocky Mountain NP	2.4	2.4	6.3	6.3	12.7	12.7	18.7	18.7
Weminuche WA	1.8	1.8	4.6	4.6	12.0	12.0	15.8	15.8
West Elk WA	1.2	1.2	4.4	4.4	11.2	11.2	15.5	15.5

Table 4-12 2021 Scenario 2 and OTB Controls Scenario Model-Predicted Visibility Impacts for Class I and Sensitive Class II Areas

	20th Percentile Best Visibility (dv)		20th Percentile Worst Visibility (dv)		20th Percentile Best Visibility (Mm^{-1})		20th Percentile Worst Visibility (Mm^{-1})	
Receptor Site	**Scen2**	**OTB**	**Scen2**	**OTB**	**Scen2**	**OTB**	**Scen2**	**OTB**
Class II Areas								
Dinosaur National Monument	2.2	2.2	10.1	10.1	12.4	12.5	27.5	27.5
Flaming Gorge National Recreation Area	2.1	2.1	8.2	8.2	12.3	12.3	22.6	22.6
Fort Hall IR	4.9	4.9	12.9	12.9	16.4	16.4	36.2	36.2
Goshute IR	1.4	1.4	4.3	4.3	11.5	11.5	15.4	15.4
High Uintas WA	2.4	2.4	7.2	7.2	12.7	12.7	20.5	20.5
Navajo IR	2.6	2.6	6.3	6.3	13.0	13.0	18.8	18.8
Paitute IR	3.4	3.4	6.9	6.9	14.0	14.0	19.9	19.9
Skull Valley IR	2.0	2.0	6.9	6.9	12.2	12.2	20.0	20.0
Southern Ute IR	2.9	2.9	6.7	6.7	13.4	13.4	19.6	19.6
Uintah and Ouray IR	2.8	2.8	11.4	11.4	13.3	13.3	31.2	31.2
Ute Mountain IR	3.0	3.0	7.3	7.3	13.4	13.4	20.7	20.7
Wind River IR	2.1	2.1	6.3	6.2	12.3	12.3	18.7	18.7

Table 4-13 2021 Scenario 2 and OTB Controls Scenario MATS-Estimated Visibility Impacts for Class I and Sensitive Class II Areas

Receptor Site	20th Percent Best Visibility (dv)		20th Percent Worst Visibility (dv)		20th Percent Best Visibility (Mm^{-1})		20th Percent Worst Visibility (Mm^{-1})	
	Scen2	OTB	Scen2	OTB	Scen2	OTB	Scen2	OTB
Class I Areas								
Arches NP	2.4	2.4	10.4	10.4	12.7	12.7	28.2	28.2
Black Canyon of the Gunnison WA/NP	2.2	2.2	9.3	9.3	12.4	12.4	25.3	25.3
Bridger WA	1.6	1.6	10.9	10.9	11.8	11.8	29.9	29.9
Bryce Canyon NP	1.7	1.7	10.6	10.6	11.8	11.8	28.9	28.9
Canyonlands NP	2.4	2.4	10.4	10.4	12.7	12.7	28.2	28.2
Capitol Reef NP	2.3	2.3	10.0	10.0	12.6	12.6	27.3	27.3
Eagles Nest WA	0.4	0.4	8.2	8.2	10.4	10.4	22.6	22.6
Fitzpatrick WA	1.6	1.6	10.9	10.9	11.8	11.8	29.9	29.9
Flat Tops WA	0.4	0.4	8.2	8.2	10.4	10.4	22.6	22.6
La Garita WA	2.2	2.2	9.3	9.3	12.4	12.4	25.3	25.3
Maroon Bells-Snowmass WA	0.4	0.4	8.2	8.2	10.4	10.4	22.6	22.6
Mesa Verde NP	2.4	2.4	10.3	10.3	12.8	12.8	28.0	28.0
Mount Zirkel WA	0.7	0.7	8.7	8.7	10.8	10.7	23.9	23.9
Rawah WA	0.7	0.7	8.7	8.7	10.8	10.7	23.9	23.9
Rocky Mountain NP	1.7	1.7	11.3	11.3	11.9	11.9	30.8	30.8
Weminuche WA	2.1	2.1	9.3	9.3	12.4	12.4	25.4	25.4
West Elk WA	0.4	0.4	8.2	8.2	10.4	10.4	22.6	22.6

4.8 2021 Control Scenario 3

Table 4-14 presents the modeled light extinction values for the 20th percentile best and 20th percentile worst visibility days for the future year 2021 Scenario 3 and 2010 Typical Year. **Table 4-15** presents the MATS-estimated visibility impacts at Class I areas for the future year 2021 Scenario 3 and baseline year. **Table 4-16** presents the modeled visibility impacts for the 20th percentile best and 20th percentile worst visibility days for the future year 2021 Scenario 3 and 2021 OTB Controls Scenario. **Table 4-17** presents the MATS-estimated visibility impacts at Class I areas for the future year 2021 Scenario 3 and 2021 OTB Controls Scenario.

Based on the modeled 2021 Scenario 3 data**,** the assessment areas with the lowest and highest light extinction values are identical to those analyzed for the 2021 OTB Controls Scenario, 2021 Scenario 1, and 2021 Scenario 2.

4.8.1 Comparison to Typical Year and Baseline

Model-predicted light extinction for 2021 Scenario 3 is compared to the 2010 Typical Year in **Table 4-14**. The predicted 2021 visibility generally improves relative to the 2010 Typical Year for both the 20th percentile best and 20th percentile worst days for most Class I and sensitive Class II assessment areas, with some exceptions. Results for Controls Scenario 3 are identical to the OTB Controls Scenario and a description can be found in Section 4.5.1 comparing the 2021 OTB Controls Scenario to the 2010 Typical Year.

MATS-predicted light extinction at Class I areas for 2021 Scenario 3 is compared to the 2010 Typical Year in **Table 4-15**. Similar to model-predicted comparisons, the MATS-predicted 2021 visibility impacts generally show improvement relative to the 2010 Typical Year for both the 20 percent best and 20 percent worst days for most Class I assessment areas. Results are similar to comparisons of the 2021 OTB Controls Scenario to the 2010 Typical Year described in Section 4.5.1.

4.8.2 Comparison to OTB Controls Scenario

Model-predicted light extinction in the 2021 Scenario 3 is compared to the 2021 OTB Controls Scenario in **Table 4-16**. In general, light extinction values generally remain the same or show some improvement in the 2021 Scenario 2 results compared to the 2021 OTB Controls Scenario. The largest improvement in model-predicted visibility impacts occurs at the Uintah and Ouray IR, the 20 percent worst visibility values decreasing from 31.2 Mm^{-1} (11.4 dv) for the 2021 OTB Controls Scenario to 28.0 Mm^{-1} (10.3 dv) for the 2021 Scenario 3. Significant improvement is also modeled at Dinosaur National Monument, the 20 percent worst visibility improving from 27.5 Mm^{-1} (10.1 dv) in the 2021 OTB Controls Scenario to 26.1 Mm^{-1} (9.6 dv) in the 2021 Scenario 3.

MATS-predicted light extinction at Class I areas for 2021 Scenario 3 is compared to the 2021 OTB Controls Scenario in **Table 4-17**. Light extinction values for all Class I areas generally are unchanged in the 2021 Scenario 3 from the 2021 OTB Controls Scenario.

Table 4-14 2021 Scenario 3 and 2010 Typical Year Model-Predicted Visibility Impacts for Class I and Sensitive Class II Areas

Receptor Site	20th Percentile Best Visibility (dv)		20th Percentile Worst Visibility (dv)		20th Percentile Best Visibility (Mm^{-1})		20th Percentile Worst Visibility (Mm^{-1})	
	Scen3	Typ10	Scen3	Typ10	Scen3	Typ10	Scen3	Typ10
Class I Areas								
Arches NP	2.5	3.0	8.7	11.1	12.8	13.5	23.9	30.3
Black Canyon of the Gunnison WA/NP	1.3	2.0	4.8	6.0	11.4	12.2	16.1	18.2
Bridger WA	2.3	2.1	6.1	6.7	12.6	12.3	18.4	19.5
Bryce Canyon NP	2.7	3.3	7.2	8.5	13.1	13.9	20.6	23.5
Canyonlands NP	2.2	2.7	7.8	9.7	12.5	13.2	21.7	26.3
Capitol Reef NP	2.4	2.9	7.8	9.2	12.7	13.3	21.7	25.0
Eagles Nest WA	1.8	2.6	5.3	6.2	12.0	13.0	17.0	18.7
Fitzpatrick WA	2.1	2.0	6.0	6.5	12.4	12.2	18.2	19.1
Flat Tops WA	1.5	2.1	5.1	5.9	11.6	12.3	16.7	18.1
La Garita WA	1.7	2.2	4.6	5.2	11.9	12.4	15.8	16.8
Maroon Bells-Snowmass WA	1.2	1.7	4.3	5.0	11.3	11.8	15.3	16.4
Mesa Verde NP	2.6	3.4	6.3	7.7	12.9	14.0	18.7	21.5
Mount Zirkel WA	1.7	2.3	5.7	6.8	11.8	12.6	17.7	19.8
Rawah WA	1.3	1.9	5.4	6.5	11.4	12.1	17.1	19.1
Rocky Mountain NP	2.4	3.0	6.2	7.0	12.7	13.4	18.6	20.2
Weminuche WA	1.8	2.3	4.6	5.3	12.0	12.6	15.8	17.0
West Elk WA	1.2	1.7	4.3	5.2	11.2	11.8	15.4	16.8

Table 4-14 2021 Scenario 3 and 2010 Typical Year Model-Predicted Visibility Impacts for Class I and Sensitive Class II Areas

Receptor Site	20th Percentile Best Visibility (dv)		20th Percentile Worst Visibility (dv)		20th Percentile Best Visibility (Mm^{-1})		20th Percentile Worst Visibility (Mm^{-1})	
	Scen3	Typ10	Scen3	Typ10	Scen3	Typ10	Scen3	Typ10
Class II Areas								
Dinosaur National Monument	2.1	2.6	9.6	11.0	12.4	12.9	26.1	29.9
Flaming Gorge National Recreation Area	2.0	2.5	8.0	9.5	12.3	12.8	22.2	25.9
Fort Hall IR	4.9	4.3	12.9	13.3	16.4	15.4	36.2	37.7
Goshute IR	1.4	1.5	4.3	4.8	11.5	11.6	15.4	16.1
High Uintas WA	2.4	2.8	7.1	8.3	12.7	13.2	20.3	23.0
Navajo IR	2.6	3.1	6.3	7.4	12.9	13.7	18.8	20.9
Paitute IR	3.4	3.9	6.9	8.3	14.0	14.8	19.9	23.0
Skull Valley IR	2.0	2.1	6.9	7.9	12.2	12.4	20.0	22.0
Southern Ute IR	2.9	3.7	6.7	8.1	13.4	14.5	19.6	22.4
Uintah and Ouray IR	2.7	3.1	10.3	12.0	13.1	13.7	28.0	33.3
Ute Mountain IR	3.0	3.9	7.3	9.1	13.4	14.8	20.7	24.7
Wind River IR	2.1	2.1	6.2	7.1	12.3	12.3	18.7	20.3

Table 4-15 2021 Scenario 3 and Baseline MATS-Estimated Visibility Impacts for Class I and Sensitive Class II Areas

Receptor Site	20th Percent Best Visibility (dv)		20th Percent Worst Visibility (dv)		20th Percent Best Visibility (Mm^{-1})		20th Percent Worst Visibility (Mm^{-1})	
	Scen3	Baseline	Scen3	Baseline	Scen3	Baseline	Scen3	Baseline
Class I Areas								
Arches NP	2.4	2.9	10.3	11.0	12.7	13.3	28.1	30.1
Black Canyon of the Gunnison WA/NP	2.2	2.3	9.3	10.0	12.4	12.5	25.3	27.0
Bridger WA	1.6	1.4	10.9	10.6	11.8	11.5	29.9	28.8
Bryce Canyon NP	1.7	2.0	10.6	11.4	11.8	12.2	28.9	31.2
Canyonlands NP	2.4	2.9	10.3	11.0	12.7	13.3	28.1	30.1
Capitol Reef NP	2.3	2.6	10.0	10.7	12.6	12.9	27.3	29.2
Eagles Nest WA	0.4	0.7	8.1	8.7	10.4	10.7	22.6	23.8
Fitzpatrick WA	1.6	1.4	10.9	10.6	11.8	11.5	29.9	28.8
Flat Tops WA	0.4	0.7	8.1	8.7	10.4	10.7	22.6	23.8
La Garita WA	2.2	2.3	9.3	10.0	12.4	12.5	25.3	27.0
Maroon Bells-Snowmass WA	0.4	0.7	8.1	8.7	10.4	10.7	22.6	23.8
Mesa Verde NP	2.4	3.1	10.3	11.2	12.7	13.7	28.0	30.6
Mount Zirkel WA	0.7	1.0	8.7	9.4	10.7	11.0	23.8	25.5
Rawah WA	0.7	1.0	8.7	9.4	10.7	11.0	23.8	25.5
Rocky Mountain NP	1.7	1.9	11.3	12.0	11.8	12.1	30.8	33.3
Weminuche WA	2.1	2.3	9.3	10.0	12.4	12.5	25.4	27.0
West Elk WA	0.4	0.7	8.1	8.7	10.4	10.7	22.6	23.8

Table 4-16 2021 Scenario 3 and OTB Controls Scenario Model-Predicted Visibility Impacts for Class I and Sensitive Class II Areas

Receptor Site	20th Percentile Best Visibility (dv)		20th Percentile Worst Visibility (dv)		20th Percentile Best Visibility (Mm^{-1})		20th Percentile Worst Visibility (Mm^{-1})	
	Scen3	OTB	Scen3	OTB	Scen3	OTB	Scen3	OTB
Class I Areas								
Arches NP	2.5	2.5	8.7	8.8	12.8	12.8	23.9	24.1
Black Canyon of the Gunnison WA/NP	1.3	1.3	4.8	4.8	11.4	11.4	16.1	16.1
Bridger WA	2.3	2.3	6.1	6.1	12.6	12.6	18.4	18.5
Bryce Canyon NP	2.7	2.7	7.2	7.2	13.1	13.1	20.6	20.6
Canyonlands NP	2.2	2.2	7.8	7.8	12.5	12.5	21.7	21.8
Capitol Reef NP	2.4	2.4	7.8	7.8	12.7	12.7	21.7	21.8
Eagles Nest WA	1.8	1.8	5.3	5.3	12.0	12.0	17.0	17.0
Fitzpatrick WA	2.1	2.1	6.0	6.0	12.4	12.4	18.2	18.3
Flat Tops WA	1.5	1.5	5.1	5.2	11.6	11.6	16.7	16.7
La Garita WA	1.7	1.7	4.6	4.6	11.9	11.9	15.8	15.8
Maroon Bells-Snowmass WA	1.2	1.2	4.3	4.3	11.3	11.3	15.3	15.4
Mesa Verde NP	2.6	2.6	6.3	6.3	12.9	12.9	18.7	18.7
Mount Zirkel WA	1.7	1.7	5.7	5.8	11.8	11.9	17.7	17.9
Rawah WA	1.3	1.4	5.4	5.4	11.4	11.5	17.1	17.2
Rocky Mountain NP	2.4	2.4	6.2	6.3	12.7	12.7	18.6	18.7
Weminuche WA	1.8	1.8	4.6	4.6	12.0	12.0	15.8	15.8
West Elk WA	1.2	1.2	4.3	4.4	11.2	11.2	15.4	15.5

Table 4-16 2021 Scenario 3 and OTB Controls Scenario Model-Predicted Visibility Impacts for Class I and Sensitive Class II Areas

Receptor Site	20th Percentile Best Visibility (dv)		20th Percentile Worst Visibility (dv)		20th Percentile Best Visibility (Mm^{-1})		20th Percentile Worst Visibility (Mm^{-1})	
	Scen3	OTB	Scen3	OTB	Scen3	OTB	Scen3	OTB
Class II Areas								
Dinosaur National Monument	2.1	2.2	9.6	10.1	12.4	12.5	26.1	27.5
Flaming Gorge National Recreation Area	2.0	2.1	8.0	8.2	12.3	12.3	22.2	22.6
Fort Hall IR	4.9	4.9	12.9	12.9	16.4	16.4	36.2	36.2
Goshute IR	1.4	1.4	4.3	4.3	11.5	11.5	15.4	15.4
High Uintas WA	2.4	2.4	7.1	7.2	12.7	12.7	20.3	20.5
Navajo IR	2.6	2.6	6.3	6.3	12.9	13.0	18.8	18.8
Paitute IR	3.4	3.4	6.9	6.9	14.0	14.0	19.9	19.9
Skull Valley IR	2.0	2.0	6.9	6.9	12.2	12.2	20.0	20.0
Southern Ute IR	2.9	2.9	6.7	6.7	13.4	13.4	19.6	19.6
Uintah and Ouray IR	2.7	2.8	10.3	11.4	13.1	13.3	28.0	31.2
Ute Mountain IR	3.0	3.0	7.3	7.3	13.4	13.4	20.7	20.7
Wind River IR	2.1	2.1	6.2	6.2	12.3	12.3	18.7	18.7

Table 4-17 2021 Scenario 3 and OTB Controls Scenario MATS-Estimated Visibility Impacts for Class I and Sensitive Class II Areas

Receptor Site	20th Percent Best Visibility (dv)		20th Percent Worst Visibility (dv)		20th Percent Best Visibility (Mm^{-1})		20th Percent Worst Visibility (Mm^{-1})	
	Scen3	OTB	Scen3	OTB	Scen3	OTB	Scen3	OTB
Class I Areas								
Arches NP	2.4	2.4	10.3	10.4	12.7	12.7	28.1	30.1
Black Canyon of the Gunnison WA/NP	2.2	2.2	9.3	9.3	12.4	12.4	25.3	27.0
Bridger WA	1.6	1.6	10.9	10.9	11.8	11.8	29.9	28.8
Bryce Canyon NP	1.7	1.7	10.6	10.6	11.8	11.8	28.9	31.2
Canyonlands NP	2.4	2.4	10.3	10.4	12.7	12.7	28.1	30.1
Capitol Reef NP	2.3	2.3	10.0	10.0	12.6	12.6	27.3	29.2
Eagles Nest WA	0.4	0.4	8.1	8.2	10.4	10.4	22.6	23.8
Fitzpatrick WA	1.6	1.6	10.9	10.9	11.8	11.8	29.9	28.8
Flat Tops WA	0.4	0.4	8.1	8.2	10.4	10.4	22.6	23.8
La Garita WA	2.2	2.2	9.3	9.3	12.4	12.4	25.3	27.0
Maroon Bells-Snowmass WA	0.4	0.4	8.1	8.2	10.4	10.4	22.6	23.8
Mesa Verde NP	2.4	2.4	10.3	10.3	12.7	12.8	28.0	30.6
Mount Zirkel WA	0.7	0.7	8.7	8.7	10.7	10.7	23.8	25.5
Rawah WA	0.7	0.7	8.7	8.7	10.7	10.7	23.8	25.5
Rocky Mountain NP	1.7	1.7	11.3	11.3	11.8	11.9	30.8	33.3
Weminuche WA	2.1	2.1	9.3	9.3	12.4	12.4	25.4	27.0
West Elk WA	0.4	0.4	8.1	8.2	10.4	10.4	22.6	23.8

5.0 Impacts on Atmospheric Deposition

Atmospheric deposition has been established as an AQRV because of the ecological effects of increased nutrient loading and acidification resulting from airborne nitrogen and sulfur compounds deposited in sensitive areas. The effects of nitrogen and sulfur deposition on terrestrial and aquatic ecosystems are well-documented (Pardo et al. 2011) and have been shown to cause leaching of nutrients from soils; acidification of soils, groundwater, and surface waters; injury to high elevation vegetation; and changes in nutrient cycling and species composition. Related to acidification, acid neutralizing capacity (ANC) is a measure of the ability of a water body to neutralize acid deposition; reduction in ANC can be detrimental to the chemistry of sensitive aquatic ecosystems.

This Chapter analyzes the potential nutrification and acidification impacts to terrestrial and aquatic ecosystems as a result of model-predicted nitrogen and sulfur deposition. For this analysis, nutrification and acidification impacts to terrestrial and aquatic ecosystems are analyzed at Class I areas, sensitive Class II areas, and sensitive lakes for all model scenarios. Section 5.1 introduces the assessment methods and thresholds used to evaluate impacts for the ARMS Modeling Project, while Sections 5.2 through 5.8 report the results for each model scenario.

5.1 Assessment Method and Thresholds

Impacts on deposition have been assessed using model results processed by the IAS tool. Nutrification impacts are evaluated from the model-predicted total nitrogen deposition expressed in units of kilograms per hectare per year (kg/ha/yr). Acidification impacts are calculated from model-predicted total nitrogen and sulfur deposition fluxes converted into units of nitrogen (N) and sulfur (S) equivalents (eq) per hectare per year (eq/ha/yr).

Two different thresholds are used to evaluate the impacts of deposition: nutrient critical loads and deposition analysis thresholds (DATs). The selection of nutrient critical loads used for assessing the potential nutrification impacts at each Class I areas, sensitive Class II areas, and identified sensitive lakes is described in Section 5.1.1.1. The nitrogen and sulfur DATs for Class I and sensitive Class II areas are described in Section 5.1.1.2.

Currently, there are no established thresholds for evaluating acidification impacts on terrestrial ecosystems in the western U.S. To evaluate the acidification impact to aquatic ecosystems, the change in ANC is analyzed. The change in ANC for identified sensitive lakes was calculated using the model-predicted N and S deposition fluxes combined with other lake characteristics. Thresholds to evaluate the impacts on ANC change are known as limits of acceptable change. Impacts on ANC for a sensitive lake is evaluated by comparing the percent change from the measured background ANC to the limit of acceptable change. The evaluation of ANC and limit of acceptable change are described in Section 5.1.2.

5.1.1 Deposition Fluxes

The IAS depends on model-predicted wet and dry deposition fluxes of nitrogen and sulfur containing compounds to calculate total nitrogen and sulfur deposition fluxes for each assessment area. To obtain model-predicted deposition fluxes in kg/ha/yr, model-predicted nitrogen and sulfur deposition fluxes from gas species are converted from units of grams per hectare per hour, and deposition fluxes from particulates are converted from units of moles per hectare per hour. The following equations are then used to calculate total nitrogen and sulfur deposition fluxes:

Equation 5-1 $$\boldsymbol{Total\ Nitrogen\ Deposition\ Flux = 0.001 \times \Big[NO + NO_2 + NO_3 + HNO_3 + NH_3 + HONO + 2 \times N_2O_5 + PAN + PANX + PNA + OPAN + NTR + INTR + CRON + CRPX + \left(\frac{14}{18}\right) \times PNO_3 + \left(\frac{14}{62}\right) \times PNH_4\Big]}$$

Equation 5-2 $$\boldsymbol{Total\ Sulfur\ Deposition\ Flux = 0.001 \times \Big[SO_2 + SULF + \left(\frac{32}{96}\right) \times PSO_4\Big]}$$

where SO_2 is sulfur dioxide, SULF is sulfuric acid, and PSO_4 is particulate sulfate. Modeled nitrogen deposition species are described in more detail in **Appendix C**. Using the total annual nitrogen and sulfur deposition fluxes calculated in **Equations 5-4** and **5-3**, acidification impacts are converted into units of eq/ha/yr as follows:

Equation 5-3 $$\boldsymbol{Total\ Acid\ Deposition\ Flux = \Big[Nitrogen\ Deposition\ \left(\frac{kg\ N}{ha \cdot yr}\right)\Big] \times \left(\frac{1000\ g}{1\ kg}\right)\left(\frac{1\ eq}{14\ g\ N}\right) + \Big[Sulfur\ Deposition\ \left(\frac{kg\ S}{ha \cdot yr}\right)\Big]\left(\frac{1000\ g}{1\ kg}\right)\left(\frac{1\ eq}{16\ g\ S}\right)}$$

5.1.1.1 Nutrient Nitrogen Critical Loads

Nutrification impacts for the ARMS Modeling Project are assessed by comparing nitrogen deposition fluxes to nutrient nitrogen critical loads. Recent objectives by the NPS and USFS have led to the development of area-specific critical loads. Recent research and empirical critical loads compiled in Pardo et al. (2011) and methods in Ellis et al. (2013) were used to develop the nutrient nitrogen critical loads for each ARMS assessment area. North American critical loads in Pardo et al. (2011) are compiled by Level I ecological regions (ecoregions) as defined by the Commission for Environmental Cooperation. The following steps outline the approach used to determine nutrient nitrogen critical loads for each ARMS assessment area. Since all assessment areas are within the 12-km model domain the following steps were applied to the 12-km domain area:

1. Determine the Level I ecoregions that are within the ARMS Modeling Project 12-km domain. The following Level I ecoregions occur:
    - Northwestern Forested Mountains
    - North American Deserts
    - Temperate Sierras
    - Great Plains
    - Inland Surface Waters
2. Determine representative critical loads for each ecoregion. For each relevant ecoregion determined in Step 1, critical loads were compiled based on the most sensitive and representative ecosystem components from Pardo et al. (2011) in Table 5-1. Note that for inland surface waters, Baron et al. (2011), a more recent study published after Pardo et al. (2011), was used to determine a representative critical load for sensitive lakes.
3. Determine which ecoregion(s) are present in each Class I and sensitive Class II area. For each Class I and sensitive Class II area, a GIS analysis was conducted to determine which ecoregions are contained within each assessment area. If two or more ecoregions were present in an assessment area, the ecoregion with the lowest (and thereby most restrictive) critical load was selected to protect the most sensitive receptor in an assessment area, regardless of the proportion of each ecoregion within the assessment area.
4. Assign the minimum critical load for applicable ecoregion(s) as the representative critical load for each ARMS assessment area. The minimum critical load for each ecoregion is denoted by an

asterisk (*) in Table 5-1. For studies that suggest a range of critical loads, the smallest value in the range was selected as the minimum critical load. For each assessment area, the minimum critical load for the applicable ecoregion(s) was assigned as the representative critical load for the evaluation of nitrogen deposition impacts.

Table 5-2 provides the ecoregions and the selected nutrient nitrogen critical loads for each Class I area, sensitive Class II area, and sensitive lake. These nutrient critical loads are used to evaluate the potential current and future cumulative nutrification impacts.

Table 5-1 Representative Critical Loads for Ecoregions in the 12-km and 4-km Domains

Ecosystem Component	Nutrient Nitrogen Critical Load[1] (kg N/ha/yr)	Reliability[2]	Response	Study
Northwestern Forested Mountains				
Lichens	2.5* – 7.1	##	Epiphytic lichen community change, thallus N enrichment in mixed-conifer forests	Fenn et al. (2008) Geiser et al. (2010)
Subalpine forest	4	##	Increase in organic horizon N, foliar N, potential net mineralization, and soil solution N, initial increases in N leaching below the organic layer	Rueth and Baron (2002) Baron et al. (1994)
Alpine lakes	4.0	#	Episodic freshwater acidification	Williams and Tonnesson (2000)
Alpine grassland	4 – 10	##	Plant species composition	Bowman et al. (2006)
Ectomycorrhizal fungi	5 – 10	(#)	Ectomycorrhizal fungi community structure in white, black, and Engelmann spruce forests	Lilleskov (1999) Lilleskov et al. (2001), (2002), (2008)
Mixed conifer forest	17	## #	NO_3^- leaching Reduced fine root biomass	Fenn et al. (2008), based on Sierra Nevada and San Bernadino Mountains
North American Deserts				
Lichens	3*	(#)	Lichen community shifts, increase in thallus N concentration	Geiser et al. (2008) Porter (2007)
Schrubland, woodland, and desert grassland	3* – 8.4	#	Vegetation response, community change; increased biomass of invasive grasses; decrease of native forbs	Allen et al. (2009) Inouye (2006) Rao et al. (2010)
Temperate Sierras				
Lichens	4* – 7	(#)	Epiphytic lichen community change	Based on application of Geiser et al. (2010) model
Great Plains[3]				
Tallgrass prairie	5* – 15	#	Biogeochemical N cycling, plant, and insect community shifts	Clark et al. (2009) Clark and Tilman (2008) Tilman (1993) Tilman (1987) Wedin and Tilman (1996)
Mixed-grass	10 – 25	#	Soil NO_3^- pools, leaching,	Clark et al. (2003), (2005)

Table 5-1 Representative Critical Loads for Ecoregions in the 12-km and 4-km Domains

Ecosystem Component	Nutrient Nitrogen Critical Load[1] (kg N/ha/yr)	Reliability[2]	Response	Study
prairie			plant community shifts	Jorgenson et al. (2005)
Shortgrass prairie	10 – 25	(#)	Not noted	Epstein (2001) Barret and Burke (2002)
Mycorrhizal fungi	12	(#)	Decline in arbuscular mycorrhizal fungal activity	Egerton-Warburton, L.M. Unpublished data.
Inland Surface Waters				
Rocky Mountain Lakes	3.0*	##	Eutrophication	Baron et al. (2011)[4]

1 Nutrient nitrogen critical loads are for total (wet + dry) nitrogen deposition.

2 Reliability rating: ## reliable, # fairly reliable, (#) expert judgment. Based on rating system in Pardo et al. (2011).

3 The Great Plains ecoregion was determined not to intersect any Class I or sensitive Class II areas for the ARMS Modeling Project. Therefore, representative critical loads for the Great Plains were not utilized in the analysis presented but are included in this table for informational purposes only for potential unanalyzed areas of the 12-km domain.

4 Baron et al. (2011) was published after Pardo et al. (2011) and provides more recent research applicable to sensitive lakes for the ARMS Modeling Project.

* Indicates the minimum critical load for each ecoregion to be used as thresholds for evaluating modeled nitrogen deposition impacts.

Table 5-2 Summary of Nutrient Nitrogen Critical Loads

Assessment Area	Ecoregion(s)[1]	Minimum Nutrient Nitrogen Critical Load (kg N/ha/yr)
Class I Areas		
Arches NP	North American Deserts	3.0
Black Canyon of the Gunnison WA	North American Deserts	3.0
Bridger WA	North American Deserts Northwestern Forested Mountains	2.5
Bryce Canyon NP	North American Deserts Northwestern Forested Mountains	2.5
Canyonlands NP	North American Deserts	3.0
Capitol Reef NP	North American Deserts Northwestern Forested Mountains	2.5
Eagles Nest WA	Northwestern Forested Mountains	2.5

Table 5-2 Summary of Nutrient Nitrogen Critical Loads

Assessment Area	Ecoregion(s)[1]	Minimum Nutrient Nitrogen Critical Load (kg N/ha/yr)
Fitzpatrick WA	Northwestern Forested Mountains	2.5
Flat Tops WA	Northwestern Forested Mountains	2.5
La Garita WA	Northwestern Forested Mountains	2.5
Maroon Bells-Snowmass WA	Northwestern Forested Mountains	2.5
Mesa Verde NP	North American Deserts	3.0
Mount Zirkel WA	Northwestern Forested Mountains	2.5
Rawah WA	North American Deserts Northwestern Forested Mountains	2.5
Rocky Mountain NP	Northwestern Forested Mountains	2.5
Weminuche WA	Northwestern Forested Mountains	2.5
West Elk WA	Northwestern Forested Mountains	2.5
Class II Areas		
Dinosaur National Monument	North American Deserts	3.0
Flaming Gorge National Recreation Area	North American Deserts Northwestern Forested Mountains	2.5
Fort Hall IR	North American Deserts	3.0
Goshute IR	North American Deserts	3.0
High Uintas WA	North American Deserts Northwestern Forested Mountains	2.5
Navajo IR	North American Deserts Temperate Sierras	3.0
Paitute IR	North American Deserts Northwestern Forested Mountains	2.5
Skull Valley IR	North American Deserts	3.0

Table 5-2 Summary of Nutrient Nitrogen Critical Loads

Assessment Area	Ecoregion(s)[1]	Minimum Nutrient Nitrogen Critical Load (kg N/ha/yr)
Southern Ute IR	North American Deserts Northwestern Forested Mountains	2.5
Uintah and Ouray IR	North American Deserts Northwestern Forested Mountains	2.5
Ute Mountain IR	North American Deserts	3.0
Wind River IR	North American Deserts Northwestern Forested Mountains	2.5
Sensitive Lakes		
Heart Lake, High Uintas WA	Inland Surface Waters	3.0
4D2-039, High Uintas WA	Inland Surface Waters	3.0
Dean Lake, High Uintas WA	Inland Surface Waters	3.0
Walk Up Lake, Ashley National Forest	Inland Surface Waters	3.0
4D1-044, High Uintas WA	Inland Surface Waters	3.0
Fish Lake, High Uintas WA	Inland Surface Waters	3.0

[1] Level I Ecological Regions of North America (Commission for Environmental Cooperation 1997) as determined by a GIS analysis of assessment areas.

5.1.1.2 Deposition Analysis Thresholds

The DATs were developed by the FLMs for the analysis of deposition impacts associated with specific projects (FLAG 2010). The DATs represent screening level values for nitrogen and sulfur deposition from project-only emission sources below which estimated impacts are considered to be negligible. Because this study is not a project-specific analysis, DATs are not fully applicable. However, the change in deposition due to cumulative impacts between the 2010 Typical Year and the 2021 future year scenarios at Class I and sensitive Class II areas will be compared to DATs for informational purposes only. The DATs established for both nitrogen and sulfur in western Class I areas are 0.005 kg/ha/yr. This threshold was applied to differences in respective model-predicted deposition fluxes at Class I and sensitive Class II areas for informational purposes.

5.1.2 Acid Neutralizing Capacity

Total nitrogen and sulfur deposition fluxes from the IAS are also used to estimate potential changes in ANC at sensitive lake receptors by following the procedure outlined in the USFS's *Screening Methodology for Calculating ANC Change to High Elevation Lakes* (USFS 2000). The calculated background ANC [ANC(o)] in units of equivalents (eq) and the acid deposition (H_{dep}) in units of eq, are used to calculate the change in ANC (percent) from a measured background for each sensitive lake.

Equation 5-4 $$ANC(o)\,(eq) = [Watershed\ Area\ (ha)] \times [Average\ Annual\ Precipitation\ (m)] \times (1 - E(t)) \times \left[Baseline\ Lake\ ANC\ \left(\frac{\mu eq}{L}\right)\right] \times \left(\frac{10{,}000\ m^2}{ha}\right) \times \left(\frac{1\ eq}{10^6\ \mu eq}\right) \times \left(\frac{10^3\ L}{1\ m^3}\right)$$

Equation 5-5 $$H(s) = \left(Sulfur\ Deposition\ \left[\frac{kg\ S}{ha \cdot yr}\right]\right) \times \left(\frac{1\ ha}{10{,}000\ m^2}\right) \times \left(\frac{1{,}000\ g}{1\ kg}\right) \times \left(\frac{1\ eq}{16\ g\ S}\right)$$

Equation 5-6 $$H(n) = \left(Nitrogen\ Deposition\ \left[\frac{kg\ N}{ha \cdot yr}\right]\right) \times \left(\frac{1\ ha}{10{,}000\ m^2}\right) \times \left(\frac{1{,}000\ g}{1\ kg}\right) \times \left(\frac{1\ eq}{14\ g\ N}\right)$$

Equation 5-7 $$H_{dep}(eq) = [H(s) + H(n)] \times [Watershed\ Area\ (ha)] \times \left(\frac{10{,}000\ m^2}{1\ ha}\right)$$

Equation 5-8 $$ANC\ Change\ (percent) = \left[\frac{H_{dep}}{ANC(o)}\right] \times 100$$

Lake-specific input data and other background information related to the calculation of ANC change, including watershed area, annual average precipitation, background ANC, and number of samples, was provided by the USFS (2011, 2014). The fraction of precipitation lost to evaporation and transpiration [E(t)] is assumed to be 0.33 (USFS 2014).

5.1.2.1 Acid Neutralizing Capacity Limit of Acceptable Change

To evaluate impacts, the ANC change (percent) calculated in **Equation 5-8** is compared to a limit of acceptable change. The limit of acceptable change for ANC is a 10 percent change for lakes with a background ANC greater than or equal to 25 micro-equivalents per liter (µeq/L) and 1 µeq/L for lakes with a background ANC less than 25 µeq/L. All the sensitive lakes identified for the ARMS Modeling Project have a background ANC greater than or equal to 25 µeq/L.

5.2 Summary of Deposition Impacts

A summary of model-predicted deposition impacts in terms of total annual nitrogen and sulfur deposition fluxes, as well as total predicted acidification is presented in **Table 5-3** for the 2010 Base Year, 2010 Typical Year, and 2021 future year scenarios. A summary of ANC impacts to sensitive lakes is presented in Table 5-4. Results generally show a decrease in deposition values for the 2021 future year scenarios relative to the 2010 Typical Year. However, the differences in estimated deposition values between all four future year scenarios are generally very small. All Class I areas, sensitive Class II areas, and sensitive lakes show decreases in model-predicted nitrogen and acidification impacts between the 2010 Typical Year and all 2021 future year scenarios. In general, the largest decrease in model-predicted deposition and ANC impacts occurs between the 2010 Typical Year and the 2021 Scenario 1. However, the largest decrease in deposition impacts near the Uinta Basin study area occurs under 2021 Scenario 3. The largest decrease in model-predicted nitrogen deposition impacts occurs at Mesa Verde NP, deposition fluxes change from 5.09 kg N/ha/yr in the 2010 Typical Year to 3.56 kg N/ha/yr in the 2021 Scenario 1. The second most significant reduction in modeled nitrogen deposition impacts occurs at Southern Ute IR, deposition fluxes change from 4.86 kg N/ha/yr in the 2010 Typical Year to 3.49 kg N/ha/yr in the 2021 Scenario 1. The smallest changes in deposition occur at Wind River IR, where deposition fluxes change from 2.66 kg N/ha/yr in the 2010 Typical Year to 2.36 kg N/ha/yr in the 2021 Scenario 1. Similar to nitrogen deposition impacts, the largest decrease in model-predicted acidification impacts occurs at Mesa Verde and Southern Ute IR, while the smallest changes occur at Paitute IR.

While model-predicted nitrogen deposition is shown to be decreasing between the 2010 Typical Year and the 2021 future year scenarios, the contribution of individual nitrogen species to the total nitrogen deposition is also changing. From the 2010 Typical Year to the 2021 future year scenarios, there is a shift in the percentage contribution of oxidized nitrogen species such as nitric acid (HNO_3) to reduced nitrogen species such as NH_3 for dry deposition and similarly from particulate nitrate (PNO_3) to particulate ammonium (PNH_4) for wet deposition. This shift is due in part to the large reduction in NO_2 emissions between the 2010 Typical Year and the 2021 future year scenarios. A much smaller reduction in NH_3 emissions has been modeled between the 2010 Typical Year and the 2021 future year scenarios.

Though DATs are not applicable to the ARMS Modeling Project, differences in cumulative model-predicted nitrogen and sulfur deposition fluxes between the 2010 Typical Year and the 2021 future year scenarios were compared to the 0.005 kg/ha/yr DATs for nitrogen and sulfur for informational purposes only. In all 2021 future year scenarios, the sulfur DATs are exceeded in Bridger WA and Fitzpatrick WA; the increase in model-predicted sulfur deposition is approximately 0.2 kg S/ha/yr at both Class I areas. However, for nitrogen, there were no exceedances of the DATs for any assessment area or model scenario.

Nutrient nitrogen critical loads for individual assessment areas (shown in **Table 5-2**) were used to evaluate cumulative model-predicted impacts at Class I areas, sensitive Class II areas, and sensitive lakes. In the 2010 Base Year and 2010 Typical Year, model-predicted nitrogen deposition at all Class I areas, all Class II areas (except for Goshute IR and Navajo IR), and all sensitive lakes exceed nutrient nitrogen critical loads. In the 2021 future year scenarios, model-predicted nitrogen deposition at 16 of the 17 Class I areas, eight of 12 sensitive Class II areas, and all seven sensitive lakes exceed nutrient nitrogen critical loads. For the 2021 future year scenarios the following sensitive areas do not exceed nutrient nitrogen critical loads: Canyonlands NP, Goshute IR, Navajo IR, Skull Valley, and Wind River IR.

Of the identified sensitive lakes, Lake 4D2-039 in the High Uintas WA is predicted to have the largest impacts on ANC change for all model scenarios. Change in ANC for Lake 4D2-039 decreases from 166.9 percent in the 2010 Typical Year to 146.2 percent in the 2021 Scenario 1. Fish Lake in the High Uintas WA is predicted to have the smallest impacts on ANC change for all model scenarios. Change in ANC for Fish Lake changes from 98.6 percent in the 2010 Typical Year to 86.8 percent in the 2021 Scenario 1. ANC change at all seven identified sensitive lakes for the ARMS Modeling Project exceed the limit of acceptable change of 10 percent for lakes with a background ANC greater than or equal to 25 µeq/L for all six model scenarios.

Table 5-3 Summary of Model-Predicted Deposition Impacts

Model Scenario	Sensitive Area	Maximum Impacts: Nitrogen Deposition (kg N/ha/yr)	Maximum Impacts: Sulfur Deposition (kg S/ha/yr)	Maximum Impacts: Acidification (eq/ha/yr)	Number of Areas Exceeding: Nutrient Nitrogen Critical Loads	Number of Areas Exceeding: Deposition Analysis Thresholds (DATs): Nitrogen	Number of Areas Exceeding: Deposition Analysis Thresholds (DATs): Sulfur
2010 Base Year	Class I	6.09 Arches NP	3.17 Mesa Verde NP	562 Mesa Verde NP	17 / 17	NA	NA
	Class II	5.62 Fort Hall IR	2.67 Southern Ute IR	514 Southern Ute IR	10 / 12	NA	NA
	Lakes	7.21 4D2-039	2.11 4D2-039	647 4D2-039	7 / 7	NA	NA
2010 Typical Year	Class I	6.09 Arches NP	3.12 Mesa Verde NP	559 Mesa Verde NP	17 / 17	NA	NA
	Class II	5.63 Fort Hall IR	2.63 Southern Ute IR	512 Southern Ute IR	10 / 12	NA	NA
	Lakes	7.20 4D2-039	2.10 4D2-039	645 4D2-039	7 / 7	NA	NA
2021 OTB Controls Scenario	Class I	5.52 Arches NP	1.85 Bridger WA	446 Arches NP	16 / 17	0 / 17	2 / 17
	Class II	5.18 Fort Hall IR	1.43 Southern Ute IR	432 Fort Hall IR	8 / 12	0 / 12	0 / 12
	Lakes	6.48 4D2-039	1.67 4D2-039	568 4D2-039	7 / 7	NA	NA
2021 Scenario 1	Class I	5.51 Arches NP	1.85 Bridger WA	445 Arches NP	16 / 17	0 / 17	2 / 17
	Class II	5.17 Fort Hall IR	1.43 Southern Ute IR	432 Fort Hall IR	8 / 12	0 / 12	0 / 12
	Lakes	6.45 4D2-039	1.67 4D2-039	565 4D2-039	7 / 7	NA	NA

Table 5-3 Summary of Model-Predicted Deposition Impacts

Model Scenario	Sensitive Area	Maximum Impacts			Number of Areas Exceeding		
		Nitrogen Deposition (kg N/ha/yr)	Sulfur Deposition (kg S/ha/yr)	Acidification (eq/ha/yr)	Nutrient Nitrogen Critical Loads	Deposition Analysis Thresholds (DATs)	
						Nitrogen	Sulfur
2021 Scenario 2	Class I	5.52 Arches NP	1.85 Bridger WA	446 Arches NP	16 / 17	0 / 17	2 / 17
	Class II	5.18 Fort Hall IR	1.43 Southern Ute IR	432 Fort Hall IR	8 / 12	0 / 12	0 / 12
	Lakes	6.48 4D2-039	1.67 4D2-039	568 4D2-039	7 / 7	NA	NA
2021 Scenario 3	Class I	5.51 Arches NP	1.85 Bridger WA	445 Arches NP	16 / 17	0 / 17	2 / 17
	Class II	5.17 Fort Hall IR	1.43 Southern Ute IR	432 Fort Hall IR	8 / 12	0 / 12	0 / 12
	Lakes	6.45 4D2-039	1.67 4D2-039	565 4D2-039	7 / 7	NA	NA

Table 5-4 Summary of Model-Predicted Impacts on ANC of Sensitive Lakes

Model Scenario	ANC Change from Measurement[1] (percent)		Number of Lakes Exceeding the ANC Limit of Acceptable Change[2]
	Minimum	Maximum	
2010 Base Year	98.8 Fish Lake	167.5 4D2-039	7 / 7
2010 Typical Year	98.6 Fish Lake	166.9 4D2-039	7 / 7
2021 OTB Controls Scenario	87.3 Fish Lake	146.9 4D2-039	7 / 7
2021 Scenario 1	86.8 Fish Lake	146.2 4D2-039	7 / 7
2021 Scenario 2	87.2 Fish Lake	146.8 4D2-039	7 / 7
2021 Scenario 3	86.8 Fish Lake	146.3 4D2-039	7 / 7

5.3 2010 Base Year

This section presents the analyses of the 2010 Base Year model results for total annual nitrogen and sulfur deposition, acidification, and ANC change.

5.3.1 Total Annual Deposition and Acidification

Results of total annual deposition modeling for the 2010 Base Year are provided in **Table 5-5** for Class I areas, sensitive Class II areas, and sensitive lakes. Of all the Class I areas, the highest modeled nitrogen deposition impact is 6.09 kg N/ha/yr at Arches NP, and the highest modeled acidification impact is 562 eq/ha/yr at Mesa Verde NP. Of the sensitive Class II areas, the highest modeled nitrogen deposition impact is 5.62 kg N/ha/yr at Fort Hall IR, and the highest modeled acidification impact is 514 eq/ha/yr at Southern Ute IR. The highest modeled aquatic deposition and acidification impacts occur at Lake 4D2-039 and are 7.21 kg N/ha/yr and 647 eq/ha/yr, respectively. All Class I areas, sensitive Class II areas, and sensitive lakes exceed nutrient nitrogen critical loads except Goshute IR and Navajo IR.

Figure 5-1 depicts model-predicted total annual nitrogen and sulfur deposition throughout the 4-km domain for the 2010 Base Year. Both nitrogen and sulfur deposition impacts tend to be localized near stationary sources and other industrial sources. Nitrogen deposition impacts also tend to be localized near areas of heavy transportation such as Salt Lake City and subsequent industry near the Interstate 15 corridor and near oil and gas sources in the Uinta Basin. Although wet deposition may represent approximately half of total nitrogen deposition, the influence of modeled precipitation on nitrogen deposition is also evident in the spatial distribution of nitrogen deposition impacts.

In general, modeled nitrogen deposition for the 2010 Base Year is approximately equally apportioned between wet and dry deposition, although significant variations exist between assessment areas; the contribution of wet and dry deposition to total deposition varies from approximately 30 to 70 percent depending on assessment area. Dry nitrogen deposition is dominated by ammonia (NH_3) and nitric acid (HNO_3), each contributing anywhere from approximately 15 to 70 percent of total dry deposition. Nitrogen dioxide, dinitrogen pentoxide (N_2O_5), peroxyacetyl nitrate (PAN), organic nitrates (NTR), PNO_3, and PNH_4 each contribute trace amounts up to approximately 5 to 10 percent of total dry deposition, with only trace contributions from all other nitrogen species. Total wet deposition is dominated by the contribution of the nitrate and ammonium ions (PNO_3 and PNH_4), each contributing anywhere from approximately 30 to 60 percent of total wet deposition, with only trace contributions by all other nitrogen species. Additional information about model-predicted deposition fluxes for individual modeled nitrogen species is provided in **Appendix C**.

Model performance for certain modeled wet deposition species was evaluated in the ARMS Air Quality MPE for the 2010 Base Year (AECOM and STI 2014). In general, the model tended to over-predict SO_4 wet deposition relative to observations throughout the year and for all model domains based on mean predicted and mean fractional bias values. The model tended to be relatively close to measured NO_3 wet deposition throughout the year and for all model domains; though seasonally modeled NO_3 wet deposition tended to be biased low during the fall. The model also tended to be relatively close to measured NH_4 wet deposition throughout the year and for all domains; though seasonally NH_4 wet deposition tended to be over-predicted during the spring and summer and under-predicted during the fall and winter. It is important to remember that very limited data is available to compare dry deposition model estimates to observations, thus nitrogen and sulfur dry deposition were not evaluated as part of the MPE.

5.3.2 Acid Neutralizing Capacity

Table 5-6 presents the input data and calculated ANC change (percent) based on model-predicted total annual nitrogen and sulfur deposition fluxes for the 2010 Base Year. The ANC change (percent) for all of the identified sensitive lakes for the ARMS Modeling Project exceed the limit of acceptable change of 10 percent for lakes with a background ANC greater than or equal to 25 µeq/L. Of these sensitive lakes, the highest calculated ANC change is 167.5 percent in Lake 4D2-039 (High Uintas WA). The smallest predicted ANC change is 98.8 percent in Fish Lake (High Uintas WA).

Table 5-5 2010 Base Year Model-Predicted Total Annual Nitrogen, Sulfur, and Acidification

Assessment Areas	Total Annual Nitrogen Deposition (kg N/ha/yr)		Total Annual Sulfur Deposition (kg S/ha/yr)	Total Annual Acidification (eq/ha/yr)
	Critical Load[1]	2010 Base Year[2]		
Class I Areas				
Arches NP	3.0	**6.09**	1.20	510
Black Canyon of the Gunnison WA	3.0	**3.82**	1.56	370
Bridger WA	2.5	**5.05**	1.63	463
Bryce Canyon NP	2.5	**5.49**	1.09	461
Canyonlands NP	3.0	**3.08**	0.95	279
Capitol Reef NP	2.5	**3.55**	0.80	304
Eagles Nest WA	2.5	**3.38**	1.22	318
Fitzpatrick WA	2.5	**3.98**	1.21	360
Flat Tops WA	2.5	**4.55**	1.65	428
La Garita WA	2.5	**3.16**	1.17	299
Maroon Bells-Snowmass WA	2.5	**3.72**	1.39	352
Mesa Verde NP	3.0	**5.10**	3.17	562

Table 5-5 2010 Base Year Model-Predicted Total Annual Nitrogen, Sulfur, and Acidification

Assessment Areas	Total Annual Nitrogen Deposition (kg N/ha/yr)		Total Annual Sulfur Deposition (kg S/ha/yr)	Total Annual Acidification (eq/ha/yr)
	Critical Load[1]	2010 Base Year[2]		
Mount Zirkel WA	2.5	**5.40**	2.19	523
Rawah WA	2.5	**4.54**	1.62	425
Rocky Mountain NP	2.5	**5.07**	1.90	481
Weminuche WA	2.5	**4.79**	2.73	513
West Elk WA	2.5	**4.17**	1.75	407
Class II Areas				
Dinosaur National Monument	3.0	**3.86**	1.11	345
Flaming Gorge National Recreation Area	2.5	**3.81**	1.03	336
Fort Hall IR	3.0	**5.62**	1.15	474
Goshute IR	3.0	2.36	0.90	225
High Uintas WA	2.5	**5.41**	1.44	476
Navajo IR	3.0	2.63	1.30	269
Paitute IR	2.5	**5.47**	1.60	490
Skull Valley IR	3.0	**3.42**	0.99	306
Southern Ute IR	2.5	**4.87**	2.67	514
Uintah and Ouray IR	2.5	**5.50**	0.97	454
Ute Mountain IR	3.0	**4.22**	2.66	468
Wind River IR	2.5	**2.67**	1.15	262
Sensitive Lakes				
Heart Lake, High Uintas WA	3.0	**5.71**	1.61	509
4D2-039, High Uintas WA	3.0	**7.21**	2.11	647
Dean Lake, High Uintas WA	3.0	**5.05**	1.28	441
Walk Up Lake, Ashley National Forest	3.0	**6.49**	1.64	566
4D1-044, High Uintas WA	3.0	**5.08**	1.46	454
Fish Lake, High Uintas WA	3.0	**6.89**	1.83	606

[1] Assessment area-specific nutrient nitrogen critical loads were determined as described in **Section 5.1.1.1**.

[2] **Bold** text indicates model-predicted deposition fluxes that exceed the applicable critical load for that assessment area.

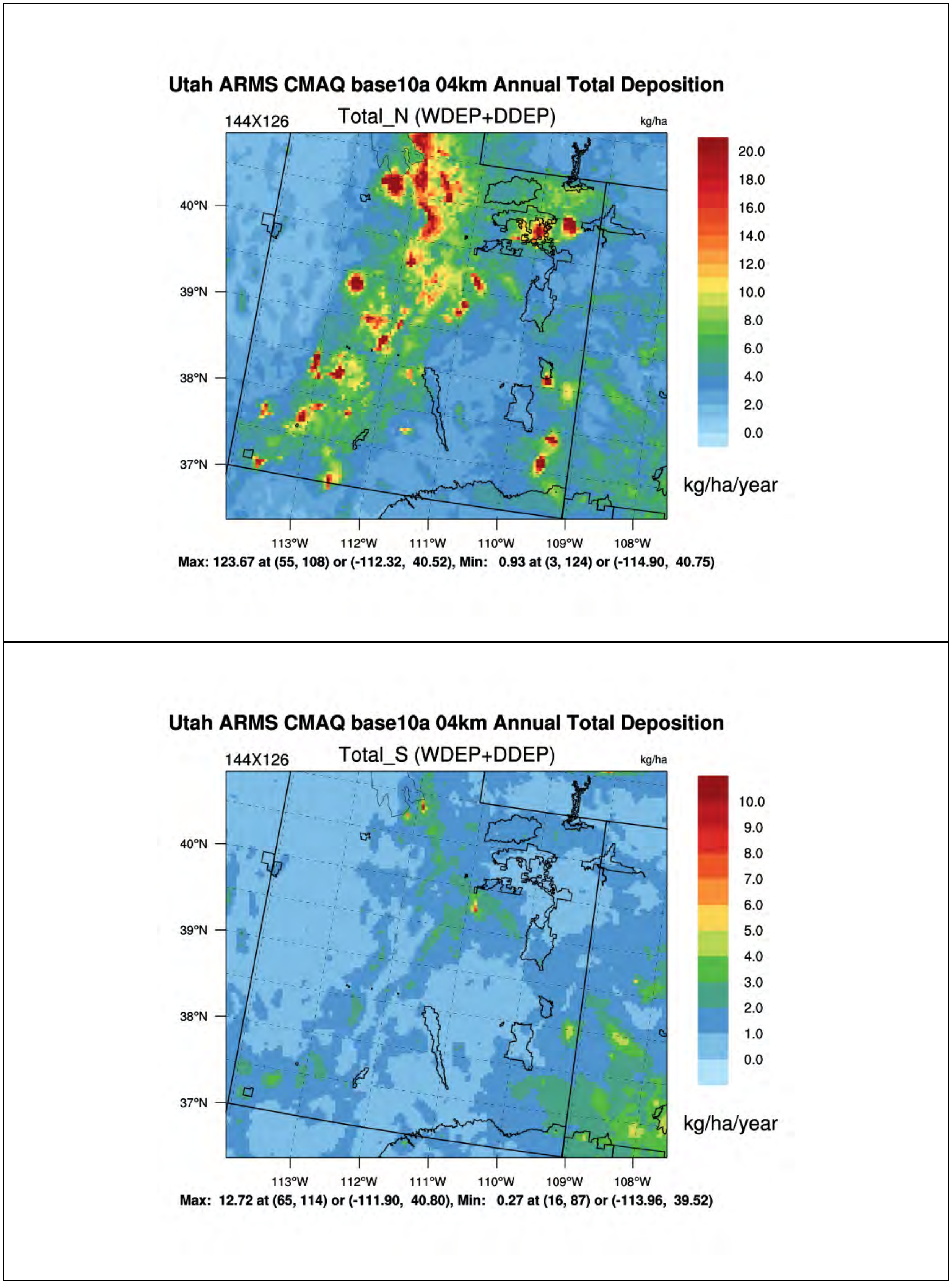


Figure 5-1 2010 Base Year Model-Predicted Total Annual Nitrogen and Sulfur Deposition

Table 5-6 2010 Base Year Model-Predicted Impacts on ANC of Sensitive Lakes

Sensitive Lake	Number of Samples[1]	Actual Watershed Area[2] (hectare)	Annual Precipitation[2] (meter)	Background ANC[1] (µeq/L)	Nitrogen Deposition[3]		Sulfur Deposition		ANC(o) (eq)	Hdep (eq)	ANC Change from Measurement[4,5] (percent)
					(kg/ha/yr)	(eq/m²/yr)	(kg/ha/yr)	(eq/m²/yr)			
Heart Lake, High Uintas WA	7	117	1.03	54.60	**5.71**	4.08E-02	1.61	1.00E-02	44,166	59,514	**134.8**
4D2-039, High Uintas WA	6	174	0.89	65.16	**7.21**	5.15E-02	2.11	1.32E-02	67,269	112,653	**167.5**
Dean Lake, High Uintas WA	1	122	1.10	51.40	**5.05**	3.61E-02	1.28	8.02E-03	46,031	53,776	**116.8**
Walk Up Lake, Ashley National Forest	6	175	0.88	61.43	**6.49**	4.63E-02	1.64	1.03E-02	63,406	99,043	**156.2**
4D1-044, High Uintas WA	3	59.6	1.01	64.98	**5.08**	3.63E-02	1.46	9.13E-03	26,100	27,078	**103.7**
Fish Lake, High Uintas WA	2	220	0.88	104.50	**6.89**	4.92E-02	1.83	1.14E-02	135,006	133,362	**98.8**

[1] Number of samples and background ANC (µeq/L) provided by USFS (2011).

[2] Actual watershed area and annual precipitation provided by USFS (2014).

[3] **Bold** text indicates model-predicted deposition fluxes that exceed the nutrient nitrogen critical load of 3.0 kg N/ha/yr as determined in Section 5.1.1.1.

[4] The ANC change (percent) is calculated according to the USFS's *Screen Methodology for Calculating ANC change to High Elevation Lakes* (USFS 2000).

[5] **Bold** text indicates an ANC change (percent) that exceeds the limit of acceptable change of 10 percent for lakes with a background ANC greater than 25 µeq/L (Haddow et al. 1998) as described in Section 5.1.2.

5.4 2010 Typical Year

This section presents the analyses of the 2010 Typical Year model results for total annual nitrogen and sulfur deposition, acidification, and ANC change.

5.4.1 Total Annual Deposition and Acidification

Table 5-7 presents the model-predicted total annual nitrogen, sulfur, and acidification for Class I areas, sensitive Class II areas, and sensitive lakes for the 2010 Typical Year and the change from the 2010 Base Year for comparison. Similar to the 2010 Base Year, model-predicted total annual nitrogen deposition is generally a factor of two or greater than sulfur deposition. The assessment areas with the greatest modeled deposition impacts in the 2010 Typical Year are identical to those in the 2010 Base Year. As expected overall, there is little difference in model-predicted total annual nitrogen, sulfur, and acidification between the 2010 Typical Year and 2010 Base Year. Differences in model-predicted total annual nitrogen and sulfur deposition between the 2010 Typical Year and 2010 Base Year are on the order 0.01 kg/ha/yr of nitrogen or sulfur. Model-predicted total annual acidification is slightly lower at all assessment areas for the 2010 Typical Year compared to the 2010 Base Year, except at Fort Hall IR at which acidification increases by 0.4 eq/ha/yr.

Figure 5-2 depicts model-predicted total annual nitrogen and sulfur deposition throughout the 4-km domain for the 2010 Typical Year. Model-predicted impacts for the 2010 Typical Year show no significant differences to those in the 2010 Base Year. Similarly, the contribution of individual nitrogen species to total wet and dry deposition in the 2010 Typical Year is similar to that in the 2010 Base Year.

5.4.2 Acid Neutralizing Capacity

Table 5-8 presents the calculated change in ANC (percent) based on model-predicted total annual nitrogen and sulfur deposition fluxes for the 2010 Typical Year, assuming lake input data are the same as the 2010 Base Year. Similar to modeled deposition impacts, there are only slight differences in ANC change between the 2010 Typical Year and 2010 Base Year. The sensitive lakes with the highest and lowest calculated ANC change are identical to those for the 2010 Base Year. The ANC change at all sensitive lakes for the 2010 Typical Year is slightly lower than calculated ANC change for the 2010 Base Year; differences between the 2010 Typical Year and 2010 Base Year are on the order of 0.1 percent.

Table 5-7 Typical Year 2010 Model-Predicted Total Annual Nitrogen, Sulfur, and Acidification

Assessment Areas	Total Annual Nitrogen Deposition (kg N/ha/yr)			Total Annual Sulfur Deposition (kg S/ha/yr)		Total Annual Acidification (eq/ha/yr)	
	Critical Load[1]	2010 Typical Year[2]	Change from 2010 Base Year	2010 Typical Year	Change from 2010 Base Year	2010 Typical Year	Change from 2010 Base Year
Class I Areas							
Arches NP	3.0	**6.09**	0.00	1.20	0.00	510	-0.2
Black Canyon of the Gunnison WA	3.0	**3.81**	0.00	1.54	-0.01	369	-1.0
Bridger WA	2.5	**5.05**	-0.01	1.63	0.00	462	-0.7
Bryce Canyon NP	2.5	**5.48**	-0.01	1.09	0.00	460	-0.9
Canyonlands NP	3.0	**3.08**	0.00	0.95	0.00	279	-0.2
Capitol Reef NP	2.5	**3.54**	0.00	0.81	0.00	303	-0.3
Eagles Nest WA	2.5	**3.38**	0.00	1.22	-0.01	317	-0.7
Fitzpatrick WA	2.5	**3.98**	-0.01	1.21	0.00	360	-0.5
Flat Tops WA	2.5	**4.55**	0.00	1.64	-0.01	428	-0.5
La Garita WA	2.5	**3.15**	0.00	1.16	-0.01	298	-0.7
Maroon Bells-Snowmass WA	2.5	**3.72**	0.00	1.38	-0.01	352	-0.6
Mesa Verde NP	3.0	**5.09**	-0.01	3.12	-0.05	559	-3.5
Mount Zirkel WA	2.5	**5.39**	-0.01	2.17	-0.02	521	-1.9
Rawah WA	2.5	**4.53**	-0.01	1.61	-0.01	424	-1.4
Rocky Mountain NP	2.5	**5.07**	-0.01	1.90	0.00	480	-0.9
Weminuche WA	2.5	**4.79**	0.00	2.71	-0.03	512	-1.9
West Elk WA	2.5	**4.17**	0.00	1.74	-0.01	407	-0.8

Table 5-7 Typical Year 2010 Model-Predicted Total Annual Nitrogen, Sulfur, and Acidification

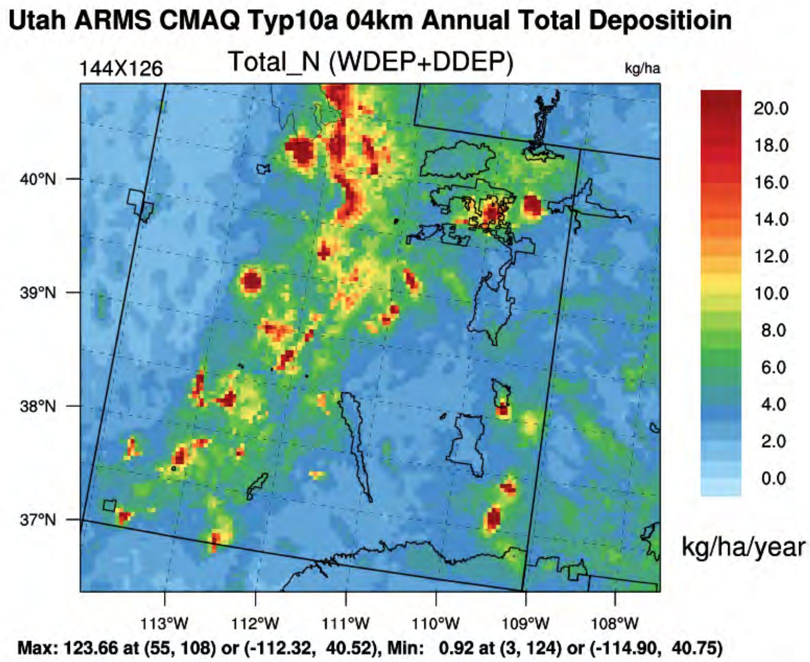
Assessment Areas	Total Annual Nitrogen Deposition (kg N/ha/yr)			Total Annual Sulfur Deposition (kg S/ha/yr)		Total Annual Acidification (eq/ha/yr)	
	Critical Load[1]	2010 Typical Year[2]	Change from 2010 Base Year	2010 Typical Year	Change from 2010 Base Year	2010 Typical Year	Change from 2010 Base Year
Class II Areas							
Dinosaur National Monument	3.0	**3.84**	-0.01	1.11	0.00	344	-1.1
Flaming Gorge National Recreation Area	2.5	**3.80**	-0.01	1.02	0.00	335	-0.7
Fort Hall IR	3.0	**5.63**	0.00	1.16	0.00	474	0.4
Goshute IR	3.0	2.36	0.00	0.90	0.00	224	-0.3
High Uintas WA	2.5	**5.40**	-0.01	1.43	-0.01	475	-1.0
Navajo IR	3.0	2.63	0.00	1.26	-0.04	266	-2.6
Paitute IR	2.5	**5.45**	-0.01	1.59	0.00	489	-1.1
Skull Valley IR	3.0	**3.41**	0.00	0.99	0.00	306	-0.3
Southern Ute IR	2.5	**4.86**	-0.01	2.63	-0.04	512	-2.7
Uintah and Ouray IR	2.5	**5.50**	-0.01	0.97	0.00	453	-0.7
Ute Mountain IR	3.0	**4.22**	0.00	2.63	-0.03	466	-2.3
Wind River IR	2.5	**2.66**	0.00	1.15	0.00	262	-0.4
Sensitive Lakes							
Heart Lake, High Uintas WA	3.0	**5.71**	0.00	1.61	0.00	508	-0.3
4D2-039, High Uintas WA	3.0	**7.20**	-0.01	2.10	-0.02	645	-2.1
Dean Lake, High Uintas WA	3.0	**5.04**	-0.01	1.28	0.00	440	-0.4
Walk Up Lake, Ashley National	3.0	**6.48**	-0.01	1.64	-0.01	565	-0.7

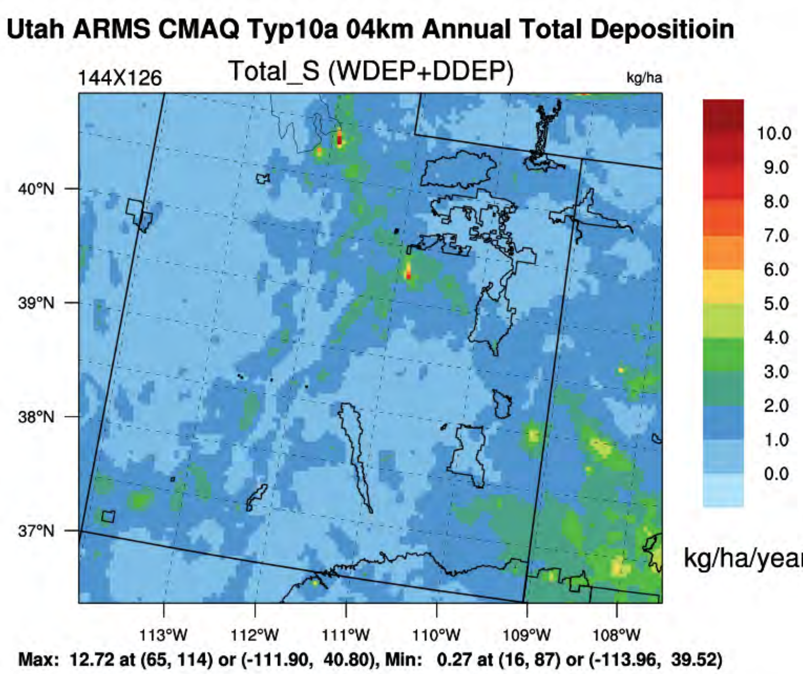
Table 5-7 Typical Year 2010 Model-Predicted Total Annual Nitrogen, Sulfur, and Acidification

Assessment Areas	Total Annual Nitrogen Deposition (kg N/ha/yr)			Total Annual Sulfur Deposition (kg S/ha/yr)		Total Annual Acidification (eq/ha/yr)	
	Critical Load[1]	2010 Typical Year[2]	Change from 2010 Base Year	2010 Typical Year	Change from 2010 Base Year	2010 Typical Year	Change from 2010 Base Year
Forest							
4D1-044, High Uintas WA	3.0	**507**	-0.01	1.45	-0.01	453	-1.1
Fish Lake, High Uintas WA	3.0	**6.88**	-0.01	1.82	-0.01	605	-1.2

[1] Assessment area-specific nutrient nitrogen critical loads were determined as described in **Section 5.1.1.1**.

[2] **Bold** text indicates model-predicted deposition fluxes that exceed the applicable critical load for that assessment area.


Utah ARMS CMAQ Typ10a 04km Annual Total Depositioin
144X126
Total_N (WDEP+DDEP)
kg/ha
20.0
18.0
16.0
14.0
12.0
10.0
8.0
6.0
4.0
2.0
0.0
kg/ha/year
40°N
39°N
38°N
37°N
113°W
112°W
111°W
110°W
109°W
108°W
Max: 123.66 at (55, 108) or (-112.32, 40.52), Min: 0.92 at (3, 124) or (-114.90, 40.75)


Utah ARMS CMAQ Typ10a 04km Annual Total Depositioin
144X126
Total_S (WDEP+DDEP)
kg/ha
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
kg/ha/year
40°N
39°N
38°N
37°N
113°W
112°W
111°W
110°W
109°W
108°W
Max: 12.72 at (65, 114) or (-111.90, 40.80), Min: 0.27 at (16, 87) or (-113.96, 39.52)

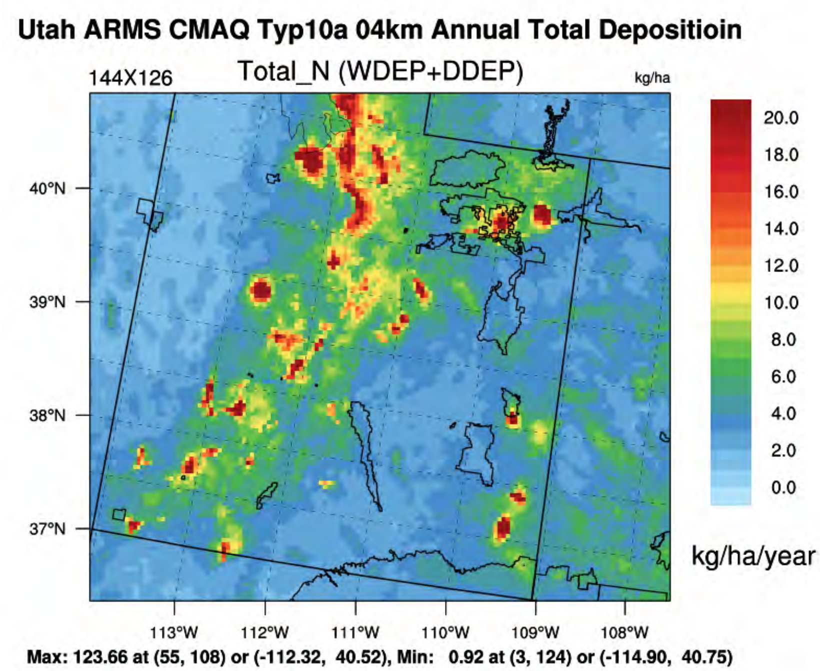


Figure 5-2 2010 Typical Year Model-Predicted Total Annual Nitrogen and Sulfur Deposition

Table 5-8 2010 Typical Year Model-Predicted Impacts on ANC of Sensitive Lakes[1]

Sensitive Lake	Nitrogen Deposition[2] (kg/ha/yr)	Nitrogen Deposition[2] ($eq/m^2/yr$)	Sulfur Deposition (kg/ha/yr)	Sulfur Deposition ($eq/m^2/yr$)	ANC(o) (eq)	Hdep (eq)	ANC Change from Measurement[3,4] (percent) 2010 Typical Year	ANC Change from Measurement[3,4] (percent) 2010 Base Year
Heart Lake, High Uintas WA	**5.71**	4.08E-02	1.61	1.00E-02	44,166	59,473	**134.7**	**134.8**
4D2-039, High Uintas WA	**7.20**	5.14E-02	2.10	1.31E-02	67,269	112,293	**166.9**	**167.5**
Dean Lake, High Uintas WA	**5.04**	3.60E-02	1.28	8.02E-03	46,031	53,725	**116.7**	**116.8**
Walk Up Lake, Ashley National Forest	**6.48**	4.63E-02	1.64	1.02E-02	63,406	98,924	**156.0**	**156.2**
4D1-044, High Uintas WA	**5.07**	3.62E-02	1.45	9.08E-03	26,100	27,010	**103.5**	**103.7**
Fish Lake, High Uintas WA	**6.88**	4.91E-02	1.82	1.14E-02	135,006	133,089	**98.6**	**98.8**

1 The number of samples, actual watershed area, annual precipitation, and background ANC are assumed to remain constant from the 2010 Base Year.

2 **Bold** text indicates model-predicted deposition fluxes that exceed the nutrient nitrogen critical load of 3.0 kg N/ha/yr as determined in Section 5.1.1.1.

3 The ANC change (percent) is calculated according to the USFS's *Screen Methodology for Calculating ANC change to High Elevation Lakes* (USFS 2000).

4 **Bold** text indicates an ANC change (percent) that exceeds the limit of acceptable change of 10 percent for lakes with a background ANC greater than 25 µeq/L (Haddow et al. 1998) as described in **Section 5.1.2.**

5.5 2021 On-the-Books Controls Scenario

This section presents the analyses of the 2021 OTB Controls Scenario model results for total annual nitrogen and sulfur deposition, acidification, and ANC change.

5.5.1 Total Annual Deposition and Acidification

Results of total annual deposition modeling for the 2021 OTB Controls Scenario are provided in **Table 5-9** for Class I areas, sensitive Class II areas, and sensitive lakes. Of all the Class I areas, the highest model-predicted nitrogen and acidification impacts occur at Arches NP: 5.52 kg N/ha/yr and 446 eq/ha/yr, respectively. Nitrogen deposition at 16 of the 17 Class I areas exceed the nutrient nitrogen critical load, except for Canyonlands NP. Of the sensitive Class II areas, the highest model-predicted nitrogen and acidification impacts occur at Fort Hall IR: 5.18 kg N/ha/yr and 432 eq/ha/yr, respectively. Nitrogen deposition at eight of the 12 sensitive Class II areas exceeds nutrient nitrogen critical loads, except at Goshute IR, Navajo IR, Skull Valley IR, and Wind River IR. The highest model-predicted aquatic nitrogen and acidification impacts occur at Lake 4D2-039 (High Uintas WA): 6.48 kg N/ha/yr and 568 eq/ha/yr, respectively. Aquatic nitrogen deposition at all identified sensitive lakes exceeds the nutrient nitrogen critical loads.

For comparison, the difference in model-predicted total annual nitrogen, sulfur, and acidification between the 2021 OTB Controls Scenario and 2010 Typical Year is provided in **Table 5-9**. In general, model-predicted deposition impacts show decreases between the 2010 Typical Year and 2021 OTB Controls Scenario. For total annual nitrogen deposition, the change ranges from 0.29 kg N/ha/yr at Wind River IR to 1.53 kg N/ha/yr at Mesa Verde NP. Total annual sulfur deposition shows a similar range of change at most Class I and sensitive Class II areas, except at Bridger WA and Fitzpatrick WA which show greater impacts. Similarly, model-predicted acidification impacts decrease between the 2010 Typical Year and 2021 OTB Controls Scenario varying from 9 eq/ha/yr at Fitzpatrick WA to 208 eq/ha/yr at Mesa Verde.

The model-predicted sulfur deposition impacts at two Class I areas, Bridger WA and Fitzpatrick WA, exceed the sulfur DATs between the 2010 Typical Year and 2021 OTB Controls Scenario. No Class I areas exceed the nitrogen DATs, and no sensitive Class II areas exceed the nitrogen or sulfur DATs between the 2010 Typical Year and 2021 OTB Controls Scenario.

Model-predicted total annual nitrogen, sulfur, and acidification for sensitive lakes also show decreases between the 2010 Typical Year and 2021 OTB Controls Scenario. Nitrogen deposition t ranges from 0.52 kg N/ha/yr at Dean Lake (High Uinta WA) to 0.72 kg N/ha/yr at Lake 4D2-039 (High Uintas WA); acidification ranges from 49 eq/ha/yr at Lake 4D1-044 (High Uintas WA) to 78 eq/ha/yr at Lake 4D2-039 (High Uintas WA).

Figure 5-3 depicts model-predicted nitrogen and sulfur deposition throughout the 4-km domain for the 2021 OTB Controls Scenario. There is little change in the general features or the extent of the deposition impacts between the 2010 Typical Year and 2021 OTB Controls Scenario, though localized areas of elevated impacts and the magnitude of surrounding background impacts appear smaller in the 2021 OTB Controls Scenario.

In general, model-predicted total annual nitrogen deposition for the 2021 OTB Controls Scenario is approximately equally apportioned between wet and dry deposition, though significant variations exist between assessment areas similar to the 2010 Base Year and 2010 Typical Year. However, there is a change in the contribution of individual nitrogen species to total wet and dry deposition. In the 2010 Base Year and 2021 Typical Year, NH_3 and HNO_3 contributed approximately equally to total dry deposition, and NH_4 and NO_3 ions contributed approximately equally to total wet deposition. In the 2021 OTB Controls Scenario, dry deposition becomes more dominated by NH_3, contributing from approximately 20 to 80 percent of total dry deposition, rather than HNO_3 which contributes approximately 10 to 50 percent in the 2021 OTB Controls Scenario. Similarly in the 2021 OTB Controls Scenario, wet nitrogen deposition becomes more dominated by NH_4, contributing approximately 50 to 70 percent to total wet deposition, rather than NO_3 which contributes approximately 30 to 50 percent in the 2021 OTB Controls Scenario. The contribution to both dry and wet from other nitrogen species is similar to those in the 2010 Typical Year.

5.5.2 Acid Neutralizing Capacity

Table 5-10 presents the calculated ANC change (percent) based on model-predicted total annual nitrogen and sulfur deposition fluxes for the 2021 OTB Controls Scenario, assuming lake input data are the same as the 2010 Base Year. Of these sensitive lakes, the highest calculated change in ANC is 146.9 percent in Lake 4D2-039 (High Uintas WA). The smallest change in ANC is 87.3 percent in Fish Lake (High Uintas WA). The ANC change (percent) for all of the identified sensitive lakes exceed the limit of acceptable change of 10 percent in the 2021 OTB Controls Scenario.

Similar to model-predicted deposition and acidification impacts, there is general decrease in ANC change at sensitive lakes in the 2021 OTB Controls Scenario relative to the 2010 Typical Year. The greatest improvement in ANC change (percent) occurs at Lake 4D2-039 (High Uintas WA), projected ANC change changing from 166.9 percent in the 2010 Typical Year to 146.9 percent in the 2021 OTB Controls Scenario, followed by Heart Lake (High Uintas WA) changing from 134.7 in the 2010 Typical Year to 116.9 percent in the 2021 OTB Controls Scenario.

Table 5-9 2021 OTB Controls Scenario Model-Predicted Total Annual Nitrogen, Sulfur, and Acidification

Assessment Areas	Total Annual Nitrogen Deposition (kg N/ha/yr)			Total Annual Sulfur Deposition (kg S/ha/yr)		Total Annual Acidification (eq/ha/yr)	
	Critical Load[1]	2021 OTB Controls[2]	Change from 2010 Typical Year[3]	2021 OTB Controls	Change from 2010 Typical Year[3]	2021 OTB Controls	Change from 2010 Typical Year
Class I Areas							
Arches NP	3.0	**5.52**	-0.567	0.82	-0.379	446	-64
Black Canyon of the Gunnison WA	3.0	**3.09**	-0.723	0.99	-0.556	282	-86
Bridger WA	2.5	**4.60**	-0.442	1.85	**0.228**	445	-17
Bryce Canyon NP	2.5	**5.03**	-0.453	0.74	-0.346	406	-54
Canyonlands NP	3.0	2.61	-0.469	0.65	-0.299	227	-52
Capitol Reef NP	2.5	**3.14**	-0.406	0.59	-0.214	261	-42
Eagles Nest WA	2.5	**2.73**	-0.650	0.90	-0.318	251	-66
Fitzpatrick WA	2.5	**3.67**	-0.313	1.43	**0.217**	351	-9
Flat Tops WA	2.5	**3.79**	-0.761	1.22	-0.428	346	-81
La Garita WA	2.5	**2.60**	-0.557	0.80	-0.361	236	-62
Maroon Bells-Snowmass WA	2.5	**3.08**	-0.635	1.01	-0.373	283	-69
Mesa Verde NP	3.0	**3.56**	-1.527	1.54	-1.583	351	-208
Mount Zirkel WA	2.5	**4.25**	-1.141	1.61	-0.567	404	-117
Rawah WA	2.5	**3.61**	-0.914	1.19	-0.422	332	-92
Rocky Mountain NP	2.5	**4.03**	-1.032	1.45	-0.451	379	-102
Weminuche WA	2.5	**3.79**	-1.002	1.72	-0.991	378	-133
West Elk WA	2.5	**3.46**	-0.709	1.21	-0.529	323	-84

Table 5-9 2021 OTB Controls Scenario Model-Predicted Total Annual Nitrogen, Sulfur, and Acidification

Assessment Areas	Total Annual Nitrogen Deposition (kg N/ha/yr)			Total Annual Sulfur Deposition (kg S/ha/yr)		Total Annual Acidification (eq/ha/yr)	
	Critical Load[1]	2021 OTB Controls[2]	Change from 2010 Typical Year[3]	2021 OTB Controls	Change from 2010 Typical Year[3]	2021 OTB Controls	Change from 2010 Typical Year
Class II Areas							
Dinosaur National Monument	3.0	**3.44**	-0.401	0.88	-0.231	301	-43
Flaming Gorge National Recreation Area	2.5	**3.42**	-0.378	0.82	-0.202	296	-40
Fort Hall IR	3.0	**5.18**	-0.452	1.00	-0.153	432	-42
Goshute IR	3.0	1.97	-0.384	0.66	-0.233	182	-42
High Uintas WA	2.5	**4.87**	-0.528	1.14	-0.290	420	-56
Navajo IR	3.0	2.06	-0.561	0.77	-0.495	195	-71
Paitute IR	2.5	**4.70**	-0.749	0.92	-0.674	393	-96
Skull Valley IR	3.0	2.97	-0.445	0.76	-0.222	260	-46
Southern Ute IR	2.5	**3.50**	-1.356	1.43	-1.206	339	-172
Uintah and Ouray IR	2.5	**5.10**	-0.391	0.75	-0.218	412	-42
Ute Mountain IR	3.0	**3.07**	-1.146	1.28	-1.351	299	-166
Wind River IR	2.5	2.37	-0.287	1.03	-0.123	234	-28
Sensitive Lakes							
Heart Lake, High Uintas WA	3.0	**5.09**	-0.62	1.24	-0.36	441	-67
4D2-039, High Uintas WA	3.0	**6.48**	-0.72	1.67	-0.42	568	-78
Dean Lake, High Uintas WA	3.0	**4.53**	-0.52	1.03	-0.25	388	-53

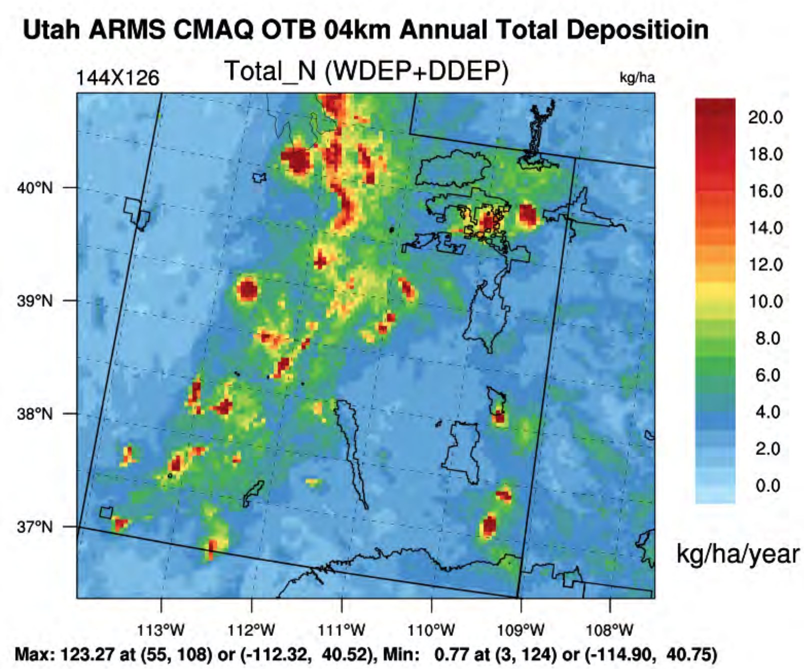
Table 5-9 2021 OTB Controls Scenario Model-Predicted Total Annual Nitrogen, Sulfur, and Acidification

Assessment Areas	Total Annual Nitrogen Deposition (kg N/ha/yr)			Total Annual Sulfur Deposition (kg S/ha/yr)		Total Annual Acidification (eq/ha/yr)	
	Critical Load[1]	2021 OTB Controls[2]	Change from 2010 Typical Year[3]	2021 OTB Controls	Change from 2010 Typical Year[3]	2021 OTB Controls	Change from 2010 Typical Year
Walk Up Lake, Ashley National Forest	3.0	**5.91**	-0.57	1.31	-0.32	504	-61
4D1-044, High Uintas WA	3.0	**4.63**	-0.44	1.17	-0.28	404	-49
Fish Lake, High Uintas WA	3.0	**6.22**	-0.66	1.46	-0.36	535	-69

1 Assessment area-specific nutrient nitrogen critical loads were determined as described in **Section 5.1.1.1**.

2 **Bold** text indicates model-predicted deposition fluxes that exceed the applicable critical load for that assessment area.

3 **Bold** text indicates differences in model-predicted deposition fluxes that exceed the deposition analysis thresholds (DATs); the DATs established for both nitrogen and sulfur deposition in western Class I areas are 0.005 kg/ha/yr.



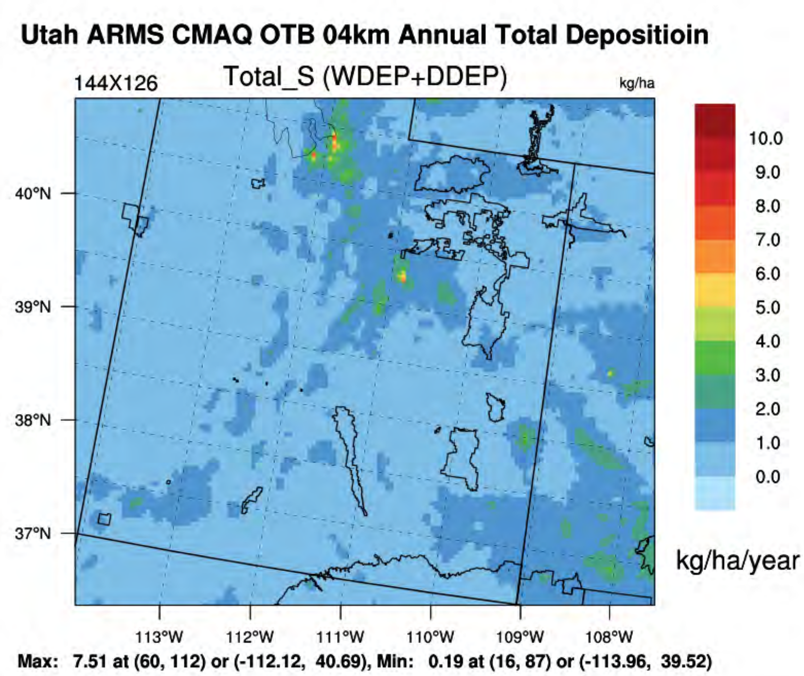


Figure 5-3 2021 OTB Controls Scenario Model-Predicted Total Annual Nitrogen and Sulfur Deposition

Table 5-10 2021 OTB Controls Scenario Model-Predicted Impacts on ANC of Sensitive Lakes[1]

Sensitive Lake	Nitrogen Deposition[2]		Sulfur Deposition		ANC(o)	Hdep	ANC Change from Measurement[3,4] (percent)	
	(kg/ha/yr)	(eq/m²/yr)	(kg/ha/yr)	(eq/m²/yr)	(eq)	(eq)	2021 OTB Controls	2010 Typical Year
Heart Lake, High Uintas WA	**5.09**	3.63E-02	1.24	7.78E-03	44,166	51,631	**116.9**	**134.7**
4D2-039, High Uintas WA	**6.48**	4.63E-02	1.67	1.05E-02	67,269	98,791	**146.9**	**166.9**
Dean Lake, High Uintas WA	**4.53**	3.23E-02	1.03	6.45E-03	46,031	47,316	**102.8**	**116.7**
Walk Up Lake, Ashley National Forest	**5.91**	4.22E-02	1.31	8.20E-03	63,406	88,281	**139.2**	**156.0**
4D1-044, High Uintas WA	**4.63**	3.31E-02	1.17	7.34E-03	26,100	24,100	**92.3**	**103.5**
Fish Lake, High Uintas WA	**6.22**	4.44E-02	1.46	9.12E-03	135,006	117,809	**87.3**	**98.6**

1 The number of samples, actual watershed area, annual precipitation, and background ANC are assumed to remain constant from the 2010 Base Year.

2 **Bold** text indicates model-predicted deposition fluxes that exceed the nutrient nitrogen critical load of 3.0 kg N/ha/yr as determined in Section 5.1.1.1.

3 The ANC change (percent) is calculated according to the USFS's *Screen Methodology for Calculating ANC change to High Elevation Lakes* (USFS 2000).

4 **Bold** text indicates an ANC change (percent) that exceeds the limit of acceptable change of 10 percent for lakes with a background ANC greater than 25 µeq/L (Haddow et al. 1998) as described in Section 5.1.2.

5.6 2021 Control Scenario 1

This section presents the analyses of the 2021 Scenario 1 model results for total annual nitrogen and sulfur deposition, acidification, and ANC change.

5.6.1 Total Annual Deposition and Acidification

Results of total annual deposition modeling for the 2021 Scenario 1 are provided in **Table 5-11** for Class I areas, sensitive Class II areas, and sensitive lakes. For comparison, the differences in model-predicted total annual nitrogen, sulfur, and acidification between the 2021 Scenario 1 and 2010 Typical Year, as well as between the 2021 Scenario 1 and 2021 OTB Controls Scenario, are provided in **Table 5-11**. **Figure 5-4** depicts model-predicted total annual nitrogen and sulfur deposition throughout the 4-km domain for the 2021 Scenario 1. There is little change in the general features or the extent of deposition impacts between the 2021 OTB Controls Scenario and 2021 Scenario 1.

Results for the 2021 Scenario 1 are not significantly different from results for the 2021 OTB Controls Scenario. The 2021 Scenario 1 shows a general decrease in deposition for Class I areas, sensitive Class II areas, and sensitive lakes relative to the 2010 Typical Year. Model-predicted total annual nitrogen and acidification decreases at all assessment areas between the 2010 Typical Year and 2021 Scenario 1; model-predicted total annual sulfur deposition decreases at all assessment areas except at Bridger WA and Fitzpatrick WA. Total annual sulfur deposition at these two Class I areas are shown to exceed the sulfur DATs, each showing an increase in model-predicted total annual sulfur deposition of approximately 0.2 kg S/ha/yr relative to the 2010 Typical Year.

Compared to the 2021 OTB Controls Scenario, 2021 Scenario 1 model-predicted total annual nitrogen deposition fluxes decrease only slightly with differences on the order of 0.01 kg N/ha/yr. The largest differences in model-predicted total annual nitrogen deposition are -0.07 kg N/ha/yr at Uintah and Ouray IR and -0.06 kg N/ha/yr at Dinosaur National Monument. Differences in sulfur deposition fluxes between the 2021 OTB Controls Scenario and 2021 Scenario 1 are on the order of 0.001 kg S/ha/yr. Differences in acidification fluxes between the 2021 OTB Controls Scenario and 2021 Scenario 1 range from -0.3 eq/ha/yr at Class I Capitol Reef NP to -5.3 eq/ha/yr at Uintah and Ouray IR.

5.6.2 Acid Neutralizing Capacity

Table 5-12 presents the calculated ANC change (percent) based on model-predicted total annual nitrogen and sulfur deposition fluxes for the 2021 Scenario 1, assuming lake input data are the same as the 2010 Base Year. For comparison, the calculated ANC change for the 2010 Typical Year and 2021 OTB Controls Scenario are also provided in **Table 5-12**.

There are only small differences in the calculated ANC change (percent) between the 2021 OTB Controls Scenario and 2021 Scenario 1. The 2021 Scenario 1 shows similar changes from the 2010 Typical Year, as the 2021 OTB Controls Scenario. The ANC change (percent) for all of the identified sensitive lakes exceeds the limit of acceptable change of 10 percent in the 2021 Scenario 1. The calculated change in ANC for the 2021 Scenario 1 is only slightly less than the calculated values for the 2021 OTB Controls Scenario; absolute differences are on the order 0.1 percent ANC change. Walk Up Lake (Ashley National Forest) has the largest decrease in calculated ANC change, changing from139.2 percent in the 2021 OTB Controls Scenario to 138.3 in the 2021 Scenario 1.

Table 5-11 2021 Scenario 1 Model-Predicted Total Annual Nitrogen, Sulfur, and Acidification

Assessment Areas	Total Annual Nitrogen Deposition (kg N/ha/yr)				Total Annual Sulfur Deposition (kg S/ha/yr)			Total Annual Acidification (eq/ha/yr)		
	Critical Load[1]	2021 Scenario 1[2]	Change from 2010 Typical Year[3]	Change from 2021 OTB Controls	2021 Scenario 1	Change from 2010 Typical Year[3]	Change from 2021 OTB Controls	2021 Scenario 1	Change from 2010 Typical Year	Change from 2021 OTB Controls
Class I Areas										
Arches NP	3.0	**5.51**	-0.580	-0.01	0.82	-0.380	0.00	445	-65	-0.94
Black Canyon of the Gunnison WA	3.0	**3.07**	-0.738	-0.02	0.99	-0.557	0.00	281	-88	-1.18
Bridger WA	2.5	**4.59**	-0.460	-0.02	1.85	**0.226**	0.00	443	-19	-1.36
Bryce Canyon NP	2.5	**5.02**	-0.458	0.00	0.74	-0.346	0.00	405	-54	-0.32
Canyonlands NP	3.0	2.60	-0.475	-0.01	0.65	-0.300	0.00	226	-53	-0.44
Capitol Reef NP	2.5	**3.13**	-0.410	0.00	0.59	-0.214	0.00	261	-43	-0.30
Eagles Nest WA	2.5	**2.71**	-0.671	-0.02	0.90	-0.319	0.00	249	-68	-1.55
Fitzpatrick WA	2.5	**3.65**	-0.327	-0.01	1.43	**0.217**	0.00	350	-10	-1.01
Flat Tops WA	2.5	**3.76**	-0.787	-0.03	1.22	-0.429	0.00	345	-83	-1.92
La Garita WA	2.5	**2.58**	-0.575	-0.02	0.80	-0.362	0.00	234	-64	-1.35
Maroon Bells-Snowmass WA	2.5	**3.07**	-0.652	-0.02	1.01	-0.373	0.00	282	-70	-1.25
Mesa Verde NP	3.0	**3.55**	-1.535	-0.01	1.54	-1.584	0.00	350	-209	-0.63
Mount Zirkel WA	2.5	**4.21**	-1.185	-0.04	1.61	-0.564	0.00	401	-120	-2.98
Rawah WA	2.5	**3.58**	-0.948	-0.03	1.18	-0.423	0.00	330	-94	-2.44
Rocky Mountain NP	2.5	**4.00**	-1.063	-0.03	1.45	-0.452	0.00	376	-104	-2.24
Weminuche WA	2.5	**3.77**	-1.018	-0.02	1.72	-0.992	0.00	377	-135	-1.23

Table 5-11 2021 Scenario 1 Model-Predicted Total Annual Nitrogen, Sulfur, and Acidification

Assessment Areas	Total Annual Nitrogen Deposition (kg N/ha/yr)				Total Annual Sulfur Deposition (kg S/ha/yr)			Total Annual Acidification (eq/ha/yr)		
	Critical Load[1]	2021 Scenario 1[2]	Change from 2010 Typical Year[3]	Change from 2021 OTB Controls	2021 Scenario 1	Change from 2010 Typical Year[3]	Change from 2021 OTB Controls	2021 Scenario 1	Change from 2010 Typical Year	Change from 2021 OTB Controls
West Elk WA	2.5	**3.45**	-0.726	-0.02	1.21	-0.529	0.00	322	-85	-1.24
Class II Areas										
Dinosaur National Monument	3.0	**3.38**	-0.463	-0.06	0.88	-0.233	0.00	296	-48	-4.56
Flaming Gorge National Recreation Area	2.5	**3.40**	-0.399	-0.02	0.82	-0.203	0.00	294	-41	-1.49
Fort Hall IR	3.0	**5.17**	-0.455	0.00	1.00	-0.153	0.00	432	-42	-0.18
Goshute IR	3.0	1.97	-0.389	0.00	0.66	-0.233	0.00	182	-42	-0.31
High Uintas WA	2.5	**4.85**	-0.551	-0.02	1.14	-0.291	0.00	418	-57	-1.67
Navajo IR	3.0	2.06	-0.567	-0.01	0.77	-0.495	0.00	195	-71	-0.44
Paitute IR	2.5	**4.70**	-0.752	0.00	0.92	-0.674	0.00	393	-96	-0.16
Skull Valley IR	3.0	2.96	-0.450	0.00	0.76	-0.222	0.00	260	-46	-0.34
Southern Ute IR	2.5	**3.49**	-1.368	-0.01	1.43	-1.207	0.00	339	-173	-0.90
Uintah and Ouray IR	2.5	**5.03**	-0.463	-0.07	0.75	-0.221	0.00	406	-47	-5.34
Ute Mountain IR	3.0	**3.07**	-1.153	-0.01	1.28	-1.352	0.00	299	-167	-0.55
Wind River IR	2.5	2.36	-0.298	-0.01	1.03	-0.123	0.00	233	-29	-0.80

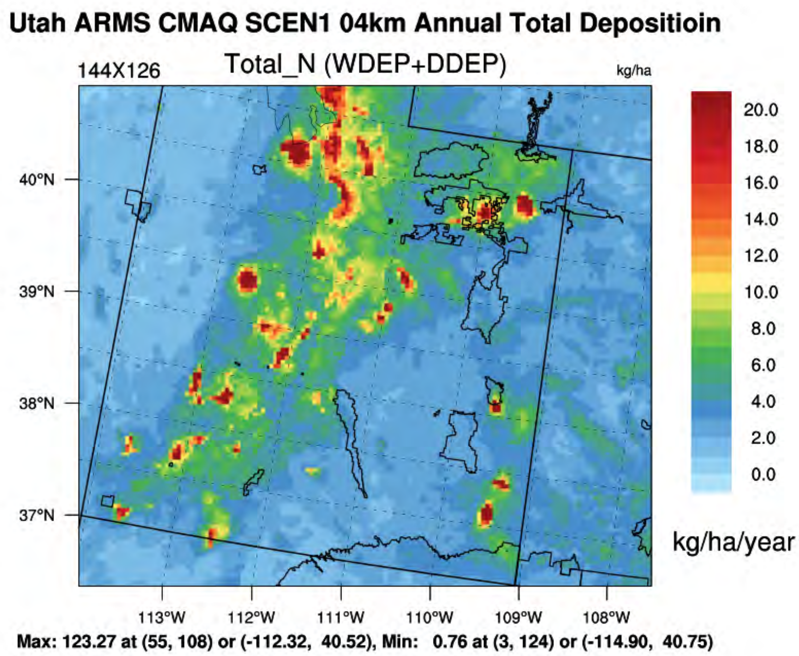
Table 5-11 2021 Scenario 1 Model-Predicted Total Annual Nitrogen, Sulfur, and Acidification

Assessment Areas	Total Annual Nitrogen Deposition (kg N/ha/yr)				Total Annual Sulfur Deposition (kg S/ha/yr)			Total Annual Acidification (eq/ha/yr)		
	Critical Load[1]	2021 Scenario 1[2]	Change from 2010 Typical Year[3]	Change from 2021 OTB Controls	2021 Scenario 1	Change from 2010 Typical Year[3]	Change from 2021 OTB Controls	2021 Scenario 1	Change from 2010 Typical Year	Change from 2021 OTB Controls
Sensitive Lakes										
Heart Lake, High Uintas WA	3.0	**5.06**	-0.65	-0.02	1.24	-0.36	0.00	440	-69	-1.77
4D2-039, High Uintas WA	3.0	**6.45**	-0.75	-0.03	1.67	-0.42	0.00	565	-80	-2.46
Dean Lake, High Uintas WA	3.0	**4.51**	-0.53	-0.02	1.03	-0.25	0.00	387	-54	-1.21
Walk Up Lake, Ashley National Forest	3.0	**5.87**	-0.61	-0.04	1.31	-0.33	0.00	501	-64	-3.21
4D1-044, High Uintas WA	3.0	**4.61**	-0.46	-0.02	1.17	-0.28	0.00	403	-50	-1.43
Fish Lake, High Uintas WA	3.0	**6.18**	-0.70	-0.04	1.46	-0.36	0.00	533	-72	-2.79

1 Assessment area-specific nutrient nitrogen critical loads were determined as described in Section 5.1.1.1.

2 **Bold** text indicates model-predicted deposition fluxes that exceed the applicable critical load for that assessment area.

3 **Bold** text indicates differences in model-predicted deposition fluxes that exceed the deposition analysis thresholds (DATs); the DATs established for both nitrogen and sulfur deposition in western Class I areas are 0.005 kg/ha/yr.



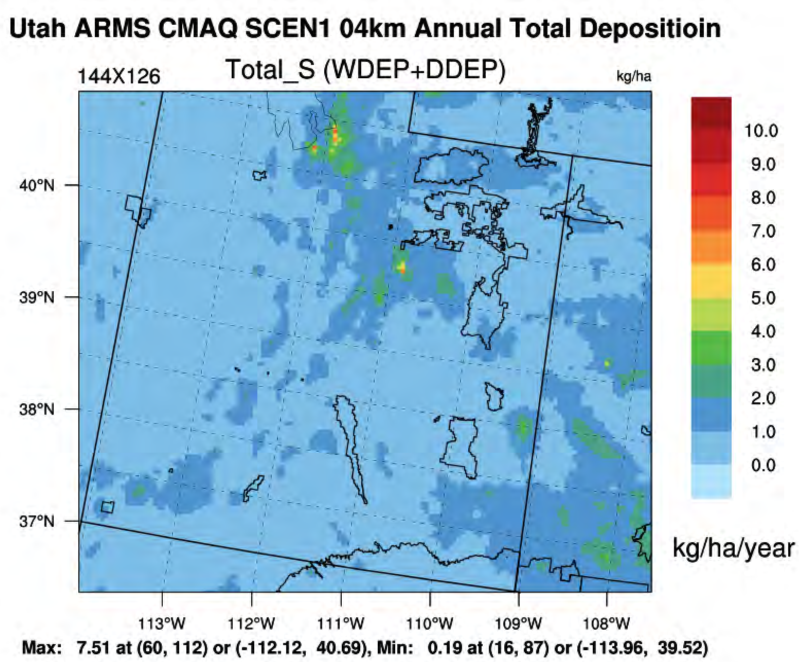


Figure 5-4 2021 Scenario 1 Model-Predicted Total Annual Nitrogen and Sulfur Deposition

Table 5-12 2021 Scenario 1 Model-Predicted Impacts on ANC of Sensitive Lakes[1]

Sensitive Lake	Nitrogen Deposition[2]		Sulfur Deposition		ANC(o)	Hdep	ANC Change from Measurement[3,4] (percent)		
	(kg/ha/yr)	(eq/m^2/yr)	(kg/ha/yr)	(eq/m^2/yr)	(eq)	(eq)	2021 Scenario 1	2021 OTB Controls	2010 Typical Year
Heart Lake, High Uintas WA	**5.06**	3.62E-02	1.24	7.78E-03	44,166	51,424	**116.4**	**116.9**	**134.7**
4D2-039, High Uintas WA	**6.45**	4.61E-02	1.67	1.05E-02	67,269	98,363	**146.2**	**146.9**	**166.9**
Dean Lake, High Uintas WA	**4.51**	3.22E-02	1.03	6.45E-03	46,031	47,169	**102.5**	**102.8**	**116.7**
Walk Up Lake, Ashley National Forest	**5.87**	4.19E-02	1.31	8.19E-03	63,406	87,719	**138.3**	**139.2**	**156.0**
4D1-044, High Uintas WA	**4.61**	3.30E-02	1.17	7.34E-03	26,100	24,015	**92.0**	**92.3**	**103.5**
Fish Lake, High Uintas WA	**6.18**	4.42E-02	1.46	9.11E-03	135,006	117,195	**86.8**	**87.3**	**98.6**

1 The number of samples, actual watershed area, annual precipitation, and background ANC are assumed to remain constant from the 2010 Base Year.

2 **Bold** text indicates model-predicted deposition fluxes that exceed the nutrient nitrogen critical load of 3.0 kg N/ha/yr as determined in Section 5.1.1.1.

3 The ANC change (percent) is calculated according to the USFS's *Screen Methodology for Calculating ANC change to High Elevation Lakes* (USFS 2000).

4 **Bold** text indicates an ANC change (percent) that exceeds the limit of acceptable change of 10 percent for lakes with a background ANC greater than 25 µeq/L (Haddow et al. 1998) as described in Section 5.1.2.

5.7 2021 Control Scenario 2

This section presents the analyses of the 2021 Scenario 2 model results for total annual nitrogen and sulfur deposition, acidification, and ANC change.

5.7.1 Total Annual Deposition and Acidification

Results of total annual deposition modeling for the 2021 Scenario 2 are provided in **Table 5-13** for Class I areas, sensitive Class II areas, and sensitive lakes. For comparison, the differences in model-predicted total annual nitrogen, sulfur, and acidification between the 2021 Scenario 2 and 2010 Typical Year, as well as between the 2021 Scenario 2 and 2021 OTB Controls Scenario, are provided in **Table 5-13**. **Figure 5-5** depicts model-predicted total annual nitrogen and sulfur deposition throughout the 4-km domain for the 2021 Scenario 2. There is little change in the general features or the extent of deposition impacts between the 2021 OTB Controls Scenario and 2021 Scenario 2.

Results for the 2021 Scenario 2 are not significantly different from results for the 2021 OTB Controls Scenario. The 2021 Scenario 2 shows a general decrease in deposition for Class I areas, sensitive Class II areas, and sensitive lakes relative to the 2010 Typical Year. Model-predicted total annual nitrogen and acidification decreases at all assessment areas between the 2010 Typical Year and 2021 Scenario 2; model-predicted total annual sulfur deposition decreases at all assessment areas except Bridger WA and Fitzpatrick WA. Total annual sulfur deposition at these two Class I areas are shown to exceed the sulfur DATs, each showing an increase in model-predicted total annual sulfur deposition of approximately 0.2 kg S/ha/yr relative to the 2010 Typical Year.

Compared to the 2021 OTB Controls Scenario, 2021 Scenario 2 model-predicted total annual nitrogen deposition does not change significantly with the largest differences on the order of 0.01 kg N/ha/yr. The majority of Class I areas show slightly more nitrogen deposition compared to the 2021 OTB Controls Scenario whereas the majority of sensitive Class II areas and sensitive lakes show slightly less nitrogen deposition that the 2021 OTB Controls Scenario. The largest differences in model-predicted total annual nitrogen deposition are -0.003 kg N/ha/yr at Fish Lake and High Uintas WA. Differences in sulfur deposition fluxes between the 2021 OTB Controls Scenario and 2021 Scenario 2 are insignificant on the order of 0.00001 kg S/ha/yr. Differences in acidification fluxes between the 2021 OTB Controls Scenario and 2021 Scenario 2 are on the order of 0.1 eq/ha/yr or less for all assessment areas.

5.7.2 Acid Neutralizing Capacity

Table 5-14 presents the calculated ANC change (percent) based on model-predicted total annual nitrogen and sulfur deposition fluxes for the 2021 Scenario 2, assuming lake input data are the same as the 2010 Base Year. For comparison, the calculated ANC change for the 2010 Typical Year and 2021 OTB Controls Scenario are also provided in **Table 5-14**.

There are only small differences in the calculated ANC change (percent) between the 2021 OTB Controls Scenario and 2021 Scenario 2. The 2021 Scenario 2 shows similar changes from the 2010 Typical Year, as the 2021 OTB Controls Scenario. The ANC change (percent) for all of the identified sensitive lakes exceeds the limit of acceptable change of 10 percent in the 2021 Scenario 2. The calculated change in ANC for the 2021 Scenario 2 is only slightly less than the calculated values for the 2021 OTB Controls Scenario; absolute differences are on the order 0.01 percent ANC change.

Table 5-13 2021 Scenario 2 Model-Predicted Total Annual Nitrogen, Sulfur, and Acidification

	Total Annual Nitrogen Deposition (kg N/ha/yr)				Total Annual Sulfur Deposition (kg S/ha/yr)			Total Annual Acidification (eq/ha/yr)		
Assessment Areas	**Critical Load[1]**	**2021 Scenario 2[2]**	**Change from 2010 Typical Year[3]**	**Change from 2021 OTB Controls**	**2021 Scenario 2**	**Change from 2010 Typical Year[3]**	**Change from 2021 OTB Controls**	**2021 Scenario 2**	**Change from 2010 Typical Year**	**Change from 2021 OTB Controls**
Class I Areas										
Arches NP	3.0	**5.52**	-0.567	0.00	0.82	-0.379	0.00	446	-64	-0.02
Black Canyon of the Gunnison WA	3.0	**3.09**	-0.722	0.00	0.99	-0.556	0.00	282	-86	0.01
Bridger WA	2.5	**4.60**	-0.442	0.00	1.85	**0.228**	0.00	445	-17	0.01
Bryce Canyon NP	2.5	**5.03**	-0.453	0.00	0.74	-0.346	0.00	406	-54	-0.02
Canyonlands NP	3.0	2.61	-0.469	0.00	0.65	-0.299	0.00	227	-52	-0.01
Capitol Reef NP	2.5	**3.14**	-0.407	0.00	0.59	-0.214	0.00	261	-42	-0.03
Eagles Nest WA	2.5	**2.73**	-0.649	0.00	0.90	-0.318	0.00	251	-66	0.03
Fitzpatrick WA	2.5	**3.67**	-0.313	0.00	1.43	**0.217**	0.00	351	-9	0.01
Flat Tops WA	2.5	**3.79**	-0.760	0.00	1.22	-0.428	0.00	346	-81	0.05
La Garita WA	2.5	**2.60**	-0.557	0.00	0.80	-0.361	0.00	236	-62	0.01
Maroon Bells-Snowmass WA	2.5	**3.08**	-0.635	0.00	1.01	-0.373	0.00	283	-69	0.02
Mesa Verde NP	3.0	**3.56**	-1.527	0.00	1.54	-1.583	0.00	351	-208	0.00
Mount Zirkel WA	2.5	**4.26**	-1.140	0.00	1.61	-0.567	0.00	404	-117	0.09
Rawah WA	2.5	**3.61**	-0.914	0.00	1.19	-0.422	0.00	332	-92	0.07
Rocky Mountain NP	2.5	**4.03**	-1.031	0.00	1.45	-0.451	0.00	379	-102	0.07

Table 5-13 2021 Scenario 2 Model-Predicted Total Annual Nitrogen, Sulfur, and Acidification

Assessment Areas	Total Annual Nitrogen Deposition (kg N/ha/yr)				Total Annual Sulfur Deposition (kg S/ha/yr)			Total Annual Acidification (eq/ha/yr)		
	Critical Load[1]	2021 Scenario 2[2]	Change from 2010 Typical Year[3]	Change from 2021 OTB Controls	2021 Scenario 2	Change from 2010 Typical Year[3]	Change from 2021 OTB Controls	2021 Scenario 2	Change from 2010 Typical Year	Change from 2021 OTB Controls
Weminuche WA	2.5	**3.79**	-1.002	0.00	1.72	-0.991	0.00	378	-133	-0.01
West Elk WA	2.5	**3.46**	-0.709	0.00	1.21	-0.529	0.00	323	-84	0.02
Class II Areas										
Dinosaur National Monument	3.0	**3.44**	-0.400	0.00	0.88	-0.231	0.00	301	-43	0.02
Flaming Gorge National Recreation Area	2.5	**3.42**	-0.380	0.00	0.82	-0.202	0.00	296	-40	-0.10
Fort Hall IR	3.0	**5.18**	-0.452	0.00	1.00	-0.153	0.00	432	-42	0.01
Goshute IR	3.0	1.97	-0.385	0.00	0.66	-0.233	0.00	182	-42	-0.03
High Uintas WA	2.5	**4.87**	-0.531	0.00	1.14	-0.290	0.00	419	-56	-0.21
Navajo IR	3.0	2.06	-0.561	0.00	0.77	-0.495	0.00	195	-71	0.00
Paitute IR	2.5	**4.70**	-0.750	0.00	0.92	-0.674	0.00	393	-96	-0.02
Skull Valley IR	3.0	2.97	-0.445	0.00	0.76	-0.222	0.00	260	-46	-0.03
Southern Ute IR	2.5	**3.50**	-1.356	0.00	1.43	-1.206	0.00	339	-172	0.01
Uintah and Ouray IR	2.5	**5.10**	-0.392	0.00	0.75	-0.218	0.00	412	-42	-0.05
Ute Mountain IR	3.0	**3.07**	-1.146	0.00	1.28	-1.351	0.00	299	-166	0.01
Wind River IR	2.5	2.37	-0.287	0.00	1.03	-0.123	0.00	234	-28	0.00

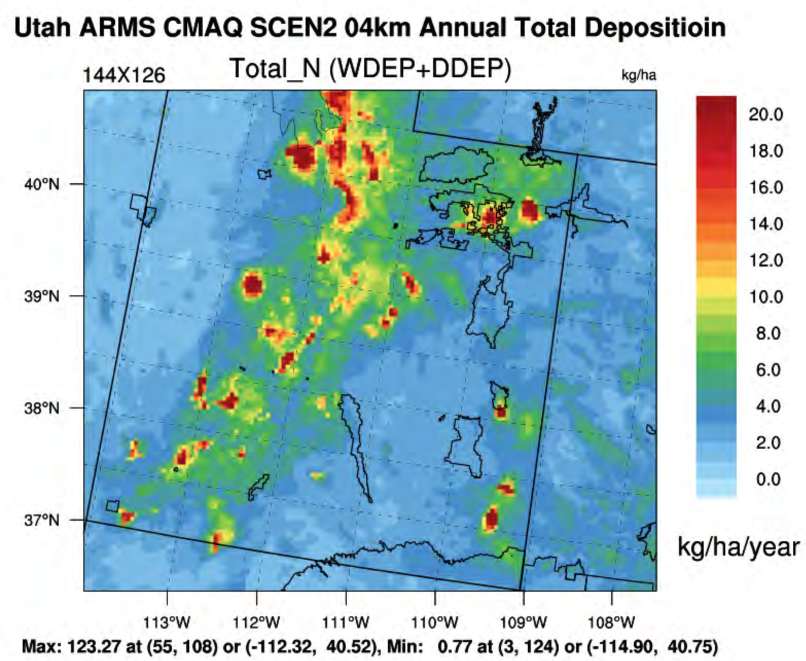
Table 5-13 2021 Scenario 2 Model-Predicted Total Annual Nitrogen, Sulfur, and Acidification

Assessment Areas	Total Annual Nitrogen Deposition (kg N/ha/yr)				Total Annual Sulfur Deposition (kg S/ha/yr)			Total Annual Acidification (eq/ha/yr)		
	Critical Load[1]	2021 Scenario 2[2]	Change from 2010 Typical Year[3]	Change from 2021 OTB Controls	2021 Scenario 2	Change from 2010 Typical Year[3]	Change from 2021 OTB Controls	2021 Scenario 2	Change from 2010 Typical Year	Change from 2021 OTB Controls
Sensitive Lakes										
Heart Lake, High Uintas WA	3.0	**5.09**	-0.63	0.00	1.24	-0.36	0.00	441	-67	-0.20
4D2-039, High Uintas WA	3.0	**6.48**	-0.72	0.00	1.67	-0.42	0.00	568	-78	-0.12
Dean Lake, High Uintas WA	3.0	**4.52**	-0.52	0.00	1.03	-0.25	0.00	388	-53	-0.20
Walk Up Lake, Ashley National Forest	3.0	**5.91**	-0.57	0.00	1.31	-0.32	0.00	504	-61	-0.18
4D1-044, High Uintas WA	3.0	**4.63**	-0.44	0.00	1.17	-0.28	0.00	404	-49	-0.13
Fish Lake, High Uintas WA	3.0	**6.22**	-0.66	0.00	1.46	-0.36	0.00	535	-70	-0.23

1 Assessment area-specific nutrient nitrogen critical loads were determined as described in Section 5.1.1.1.

2 **Bold** text indicates model-predicted deposition fluxes that exceed the applicable critical load for that assessment area.

3 **Bold** text indicates differences in model-predicted deposition fluxes that exceed the deposition analysis thresholds (DATs); the DATs established for both nitrogen and sulfur deposition in western Class I areas are 0.005 kg/ha/yr.



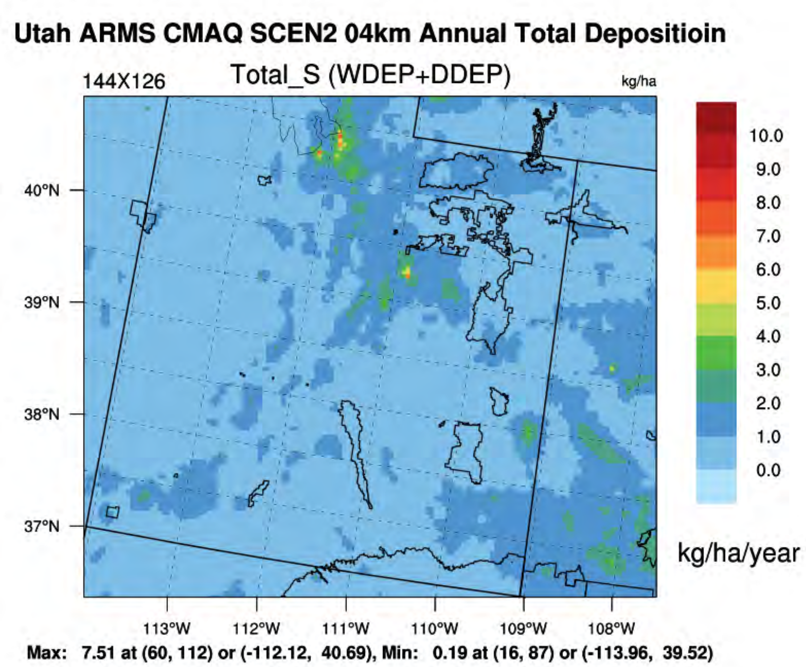


Figure 5-5 2021 Scenario 2 Model-Predicted Total Annual Nitrogen and Sulfur Deposition

Table 5-14 2021 Scenario 2 Model-Predicted Impacts on ANC of Sensitive Lakes[1]

Sensitive Lake	Nitrogen Deposition[2] (kg/ha/yr)	Nitrogen Deposition[2] (eq/m²/yr)	Sulfur Deposition (kg/ha/yr)	Sulfur Deposition (eq/m²/yr)	ANC(o) (eq)	Hdep (eq)	ANC Change from Measurement[3,4] (percent): 2021 Scenario 2	2021 OTB Controls	2010 Typical Year
Heart Lake, High Uintas WA	**5.09**	3.63E-02	1.24	7.78E-03	44,166	51,608	**116.8**	**116.9**	**134.7**
4D2-039, High Uintas WA	**6.48**	4.63E-02	1.67	1.05E-02	67,269	98,770	**146.8**	**146.9**	**166.9**
Dean Lake, High Uintas WA	**4.52**	3.23E-02	1.03	6.45E-03	46,031	47,292	**102.7**	**102.8**	**116.7**
Walk Up Lake, Ashley National Forest	**5.91**	4.22E-02	1.31	8.20E-03	63,406	88,250	**139.2**	**139.2**	**156.0**
4D1-044, High Uintas WA	**4.63**	3.31E-02	1.17	7.34E-03	26,100	24,092	**92.3**	**92.3**	**103.5**
Fish Lake, High Uintas WA	**6.22**	4.44E-02	1.46	9.12E-03	135,006	117,759	**87.2**	**87.3**	**98.6**

1 The number of samples, actual watershed area, annual precipitation, and background ANC are assumed to remain constant from the 2010 Base Year.

2 **Bold** text indicates modeled deposition fluxes that exceed the nutrient nitrogen critical load of 3.0 kg N/ha/yr as determined in Section 5.1.1.1.

3 The ANC change (percent) is calculated according to the USFS's *Screen Methodology for Calculating ANC change to High Elevation Lakes* (USFS 2000).

4 **Bold** text indicates an ANC change (percent) that exceeds the limit of acceptable change of 10 percent for lakes with a background ANC greater than 25 µeq/L (Haddow et al. 1998) as described in Section 5.1.2.

5.8 2021 Control Scenario 3

This section presents the analyses of the 2021 Scenario 3 model results for total annual nitrogen and sulfur deposition, acidification, and ANC change.

5.8.1 Total Annual Deposition and Acidification

Results of total annual deposition modeling for the 2021 Scenario 3 are provided in **Table 5-15** for Class I areas, sensitive Class II areas, and sensitive lakes. For comparison, the differences in model-predicted total annual nitrogen, sulfur, and acidification between the 2021 Scenario 3 and 2010 Typical Year, as well as between the 2021 Scenario 3 and 2021 OTB Controls Scenario, are provided in **Table 5-15**. **Figure 5-6** depicts model-predicted total annual nitrogen and sulfur deposition throughout the 4-km domain for the 2021 Scenario 3. There is little change in the general features or the extent of deposition impacts between the 2021 OTB Controls Scenario and 2021 Scenario 3.

Results for the 2021 Scenario 3 are not significantly different from results for the 2021 OTB Controls Scenario. The 2021 Scenario 3 shows a general decrease in deposition for Class I areas, sensitive Class II areas, and sensitive lakes relative to the 2010 Typical Year,. Model-predicted total annual nitrogen and acidification decreases at all assessment areas between the 2010 Typical Year and 2021 Scenario 3; model-predicted total annual sulfur deposition decreases at all assessment areas except at Bridger WA and Fitzpatrick WA. Total annual sulfur deposition at these two Class I areas are shown to exceed the sulfur DATs, each showing an increase in model-predicted total annual sulfur deposition of approximately 0.2 kg S/ha/yr relative to the 2010 Typical Year.

Compared to the 2021 OTB Controls Scenario, 2021 Scenario 3 model-predicted total annual nitrogen deposition fluxes decrease only slightly with the largest differences on the order of 0.01 kg N/ha/yr. The largest differences in model-predicted total annual nitrogen deposition are -0.07 kg N/ha/yr at Class II Uintah and Ouray IR and -0.06 kg N/ha/yr at Dinosaur National Monument. Differences in sulfur deposition fluxes between the 2021 OTB Controls Scenario and 2021 Scenario 3 are on the order of 0.001 kg S/ha/yr. Differences in acidification fluxes between the 2021 OTB Controls Scenario and 2021 Scenario 1 range from -0.05 eq/ha/yr at Bryce Canyon and Paitute IR to -5.7 eq/ha/yr at Uintah and Ouray IR.

5.8.2 Acid Neutralizing Capacity

Table 5-16 presents the calculated ANC change (percent) based on model-predicted total annual nitrogen and sulfur deposition fluxes for the 2021 Scenario 3, assuming lake input data are the same as the 2010 Base Year. For comparison, the calculated ANC change for the 2010 Typical Year and 2021 OTB Controls Scenario are also provided in **Table 5-16**.

There are only small differences in the calculated ANC change (percent) between the 2021 OTB Controls Scenario and 2021 Scenario 3. The 2021 Scenario 3 shows similar change from the 2010 Typical Year as the 2021 OTB Controls Scenario. The ANC change (percent) for all of the identified sensitive lakes exceeds the limit of acceptable change of 10 percent in the 2021 Scenario 3. The calculated change in ANC for the 2021 Scenario 3 is only slightly less than the calculated values for the 2021 OTB Controls Scenario; absolute differences are on the order 0.1 percent ANC change. Walk Up Lake (Ashley National Forest) has the greatest improvement in calculated ANC change, decreasing from139.2 percent in the 2021 OTB Controls Scenario to 138.4 in the 2021 Scenario 3.

Table 5-15 2021 Scenario 3 Model-Predicted Total Annual Nitrogen, Sulfur, and Acidification

Assessment Areas	Total Annual Nitrogen Deposition (kg N/ha/yr)				Total Annual Sulfur Deposition (kg S/ha/yr)			Total Annual Acidification (eq/ha/yr)		
	Critical Load[1]	2021 Scenario 3[2]	Change from 2010 Typical Year[3]	Change from 2021 OTB Controls	2021 Scenario 3	Change from 2010 Typical Year[3]	Change from 2021 OTB Controls	2021 Scenario 3	Change from 2010 Typical Year	Change from 2021 OTB Controls
Class I Areas										
Arches NP	3.0	**5.51**	-0.578	-0.01	0.82	-0.380	0.00	445	-65	-0.82
Black Canyon of the Gunnison WA	3.0	**3.09**	-0.727	0.00	0.99	-0.556	0.00	282	-87	-0.34
Bridger WA	2.5	**4.60**	-0.447	-0.01	1.85	**0.227**	0.00	444	-18	-0.42
Bryce Canyon NP	2.5	**5.03**	-0.454	0.00	0.74	-0.346	0.00	406	-54	-0.05
Canyonlands NP	3.0	2.60	-0.473	0.00	0.65	-0.300	0.00	227	-52	-0.30
Capitol Reef NP	2.5	**3.14**	-0.408	0.00	0.59	-0.214	0.00	261	-43	-0.12
Eagles Nest WA	2.5	**2.72**	-0.658	-0.01	0.90	-0.318	0.00	250	-67	-0.62
Fitzpatrick WA	2.5	**3.66**	-0.316	0.00	1.43	**0.217**	0.00	351	-9	-0.24
Flat Tops WA	2.5	**3.77**	-0.777	-0.02	1.22	-0.429	0.00	345	-82	-1.24
La Garita WA	2.5	**2.59**	-0.560	0.00	0.80	-0.361	0.00	235	-63	-0.24
Maroon Bells-Snowmass WA	2.5	**3.08**	-0.642	-0.01	1.01	-0.373	0.00	283	-69	-0.50
Mesa Verde NP	3.0	**3.56**	-1.529	0.00	1.54	-1.584	0.00	351	-208	-0.20
Mount Zirkel WA	2.5	**4.22**	-1.174	-0.03	1.61	-0.565	0.00	402	-119	-2.20
Rawah WA	2.5	**3.60**	-0.931	-0.02	1.18	-0.423	0.00	331	-93	-1.27
Rocky Mountain NP	2.5	**4.02**	-1.048	-0.02	1.45	-0.452	0.00	377	-103	-1.20
Weminuche WA	2.5	**3.79**	-1.004	0.00	1.72	-0.991	0.00	378	-134	-0.19

Table 5-15 2021 Scenario 3 Model-Predicted Total Annual Nitrogen, Sulfur, and Acidification

	Total Annual Nitrogen Deposition (kg N/ha/yr)				Total Annual Sulfur Deposition (kg S/ha/yr)			Total Annual Acidification (eq/ha/yr)		
Assessment Areas	Critical Load[1]	2021 Scenario 3[2]	Change from 2010 Typical Year[3]	Change from 2021 OTB Controls	2021 Scenario 3	Change from 2010 Typical Year[3]	Change from 2021 OTB Controls	2021 Scenario 3	Change from 2010 Typical Year	Change from 2021 OTB Controls
West Elk WA	2.5	**3.46**	-0.714	0.00	1.21	-0.529	0.00	323	-84	-0.35
Class II Areas										
Dinosaur National Monument	3.0	**3.38**	-0.463	-0.06	0.87	-0.235	0.00	296	-48	-4.69
Flaming Gorge National Recreation Area	2.5	**3.40**	-0.396	-0.02	0.82	-0.204	0.00	294	-41	-1.37
Fort Hall IR	3.0	**5.17**	-0.454	0.00	1.00	-0.153	0.00	432	-42	-0.12
Goshute IR	3.0	1.97	-0.385	0.00	0.66	-0.233	0.00	182	-42	-0.07
High Uintas WA	2.5	**4.86**	-0.546	-0.02	1.14	-0.291	0.00	418	-57	-1.35
Navajo IR	3.0	2.06	-0.562	0.00	0.77	-0.495	0.00	195	-71	-0.07
Paitute IR	2.5	**4.70**	-0.750	0.00	0.92	-0.674	0.00	393	-96	-0.05
Skull Valley IR	3.0	2.97	-0.448	0.00	0.76	-0.222	0.00	260	-46	-0.21
Southern Ute IR	2.5	**3.50**	-1.358	0.00	1.43	-1.206	0.00	339	-172	-0.14
Uintah and Ouray IR	2.5	**5.03**	-0.465	-0.07	0.75	-0.225	-0.01	406	-47	-5.74
Ute Mountain IR	3.0	**3.07**	-1.147	0.00	1.28	-1.351	0.00	299	-166	-0.11
Wind River IR	2.5	2.37	-0.290	0.00	1.03	-0.123	0.00	234	-28	-0.20

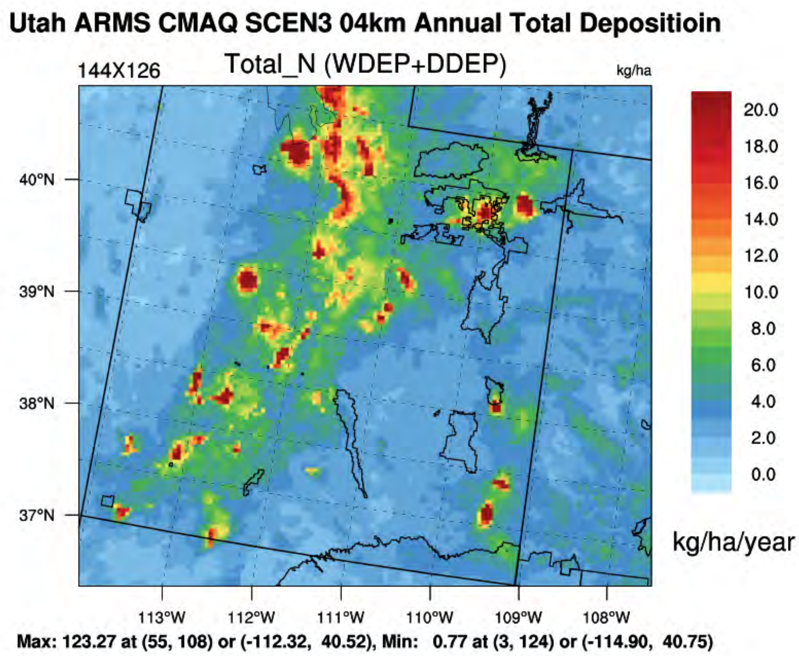
Table 5-15 2021 Scenario 3 Model-Predicted Total Annual Nitrogen, Sulfur, and Acidification

Assessment Areas	Total Annual Nitrogen Deposition (kg N/ha/yr)				Total Annual Sulfur Deposition (kg S/ha/yr)			Total Annual Acidification (eq/ha/yr)		
	Critical Load[1]	2021 Scenario 3[2]	Change from 2010 Typical Year[3]	Change from 2021 OTB Controls	2021 Scenario 3	Change from 2010 Typical Year[3]	Change from 2021 OTB Controls	2021 Scenario 3	Change from 2010 Typical Year	Change from 2021 OTB Controls
Sensitive Lakes										
Heart Lake, High Uintas WA	3.0	**5.07**	-0.65	-0.02	1.24	-0.36	0.00	440	-69	-1.68
4D2-039, High Uintas WA	3.0	**6.45**	-0.75	-0.03	1.67	-0.43	0.00	565	-80	-2.30
Dean Lake, High Uintas WA	3.0	**4.51**	-0.53	-0.01	1.03	-0.25	0.00	387	-53	-0.95
Walk Up Lake, Ashley National Forest	3.0	**5.87**	-0.61	-0.04	1.31	-0.33	0.00	501	-64	-3.14
4D1-044, High Uintas WA	3.0	**4.62**	-0.45	-0.01	1.17	-0.28	0.00	403	-50	-1.04
Fish Lake, High Uintas WA	3.0	**6.19**	-0.69	-0.03	1.46	-0.36	0.00	533	-72	-2.54

1 Assessment area-specific nutrient nitrogen critical loads were determined as described in Section 5.1.1.1.

2 **Bold** text indicates model-predicted deposition fluxes that exceed the applicable critical load for that assessment area.

3 **Bold** text indicates differences in model-predicted deposition fluxes that exceed the deposition analysis thresholds (DATs); the DATs established for both nitrogen and sulfur deposition in western Class I areas are 0.005 kg/ha/yr.



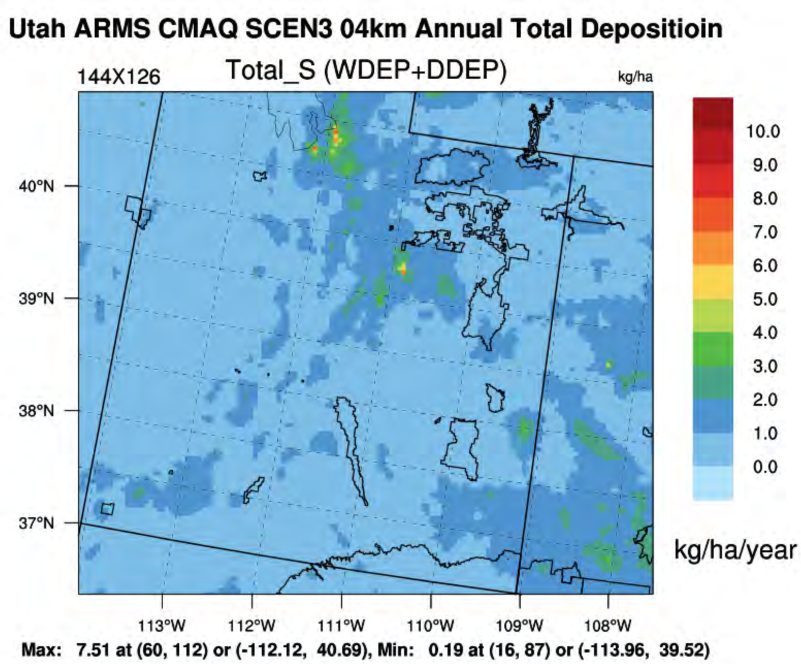


Figure 5-6 2021 Scenario 3 Model-Predicted Total Annual Nitrogen and Sulfur Deposition

Table 5-16 2021 Scenario 3 Model-Predicted Impacts on ANC of Sensitive Lakes[1]

Sensitive Lake	Nitrogen Deposition[2]		Sulfur Deposition		ANC(o) (eq)	Hdep (eq)	ANC Change from Measurement[3,4] (percent)		
	(kg/ha/yr)	(eq/m²/yr)	(kg/ha/yr)	(eq/m²/yr)			2021 Scenario 3	2021 OTB Controls	2010 Typical Year
Heart Lake, High Uintas WA	**5.07**	3.62E-02	1.24	7.78E-03	44,166	51,434	**116.5**	**116.9**	**134.7**
4D2-039, High Uintas WA	**6.45**	4.61E-02	1.67	1.04E-02	67,269	98,391	**146.3**	**146.9**	**166.9**
Dean Lake, High Uintas WA	**4.51**	3.22E-02	1.03	6.45E-03	46,031	47,200	**102.5**	**102.8**	**116.7**
Walk Up Lake, Ashley National Forest	**5.87**	4.20E-02	1.31	8.18E-03	63,406	87,731	**138.4**	**139.2**	**156.0**
4D1-044, High Uintas WA	**4.62**	3.30E-02	1.17	7.33E-03	26,100	24,038	**92.1**	**92.3**	**103.5**
Fish Lake, High Uintas WA	**6.19**	4.42E-02	1.46	9.10E-03	135,006	117,251	**86.8**	**87.3**	**98.6**

[1] The number of samples, actual watershed area, annual precipitation, and background ANC are assumed to remain constant from the 2010 Base Year.

[2] **Bold** text indicates modeled deposition fluxes that exceed the nutrient nitrogen critical load of 3.0 kg N/ha/yr as determined in Section 5.1.1.1.

[3] The ANC change (percent) is calculated according to the USFS's *Screen Methodology for Calculating ANC change to High Elevation Lakes* (USFS 2000).

[4] **Bold** text indicates an ANC change (percent) that exceeds the limit of acceptable change of 10 percent for lakes with a background ANC greater than 25 µeq/L (Haddow et al. 1998) as described in Section 5.1.2.

6.0 Conclusions

The ARMS Modeling Project results are summarized below for ambient air quality impacts, as well as AQRVs for visibility and atmospheric deposition, in order to provide a consolidated description of the key findings for all modeling scenarios.

6.1 Summary of Ambient Air Quality Impacts

The 2010 Base Year and Typical Year modeling scenarios were assessed and modeled cumulative air quality impacts are compared to each other. The modeled future years (OTB controls, Scenario 1, Scenario 2, and Scenario 3) were evaluated and modeled cumulative air quality impacts are compared to the air quality conditions for 2010 Typical Year. The modeled results from the 2021 Scenario 1, 2, and 3 are also compared to the 2021 OTB Controls modeling results.

A summary of modeled impacts for the key components of the air quality analysis for all modeling scenarios (2010 Base Year, 2010 Typical Year, 2021 OTB Controls, 2021 Scenario 1, 2021 Scenario 2, and 2021 Scenario 3) are presented in **Table 6-1**.

In general, it is found that the highest modeled ozone occurs in the Uinta Basin study area regardless of model scenario and that all scenarios predict exceedences of the ozone NAAQS and state AAQS in the Uinta Basin. Typically, the ozone concentrations are highest during the winter period in the Uinta Basin, while the ozone concentrations are highest during the summer period in Class I and Class II areas outside the Uinta Basin study area (i.e., Class I and Class II assessment areas excluding Dinosaur National Monument, the High Uintas WA, and the Uintah and Ouray IR).

It is important to qualify that the model performance evaluation for ozone indicated a negative model bias during winter and a positive model bias during summer in the 4-km domain (AECOM and STI 2014). A negative bias indicates that the model may predict lower concentrations than might actually occur and conversely a positive bias indicates that the model may predict higher concentrations than might actually occur. Therefore, for this study, the model-predicted winter concentrations might underestimate future concentrations and model-predicted summer concentrations might overestimate future concentrations.

During non-winter months in the Uinta Basin the model predicts that ozone may exceed the NAAQS and state AAQS; however, model-adjusted results from the MATS tool indicate that non-winter ozone concentrations are below the NAAQS and state AAQS for all monitors and areas analyzed. Furthermore, the future year mitigation scenarios have minimal effect on model-predicted ozone concentrations during non-winter months. For these reasons, the ozone assessment focuses on the relative differences between the model scenarios and the corresponding effects on winter ozone concentrations in the Uinta Basin study area.

When evaluating the ozone impacts associated with the future year mitigation scenarios, 2021 Scenario 2 tends to have the lowest ozone relative to all other future year scenarios. The 4th highest daily maximum 8-hour ozone concentration in 2021 Scenario 2 is 3 ppb lower compared to the 2021 OTB Scenario, while 2021 Scenarios 1 and 3 are predicted to have higher ozone impacts than either the 2010 Typical year and the 2021 OTB Scenario. 2021 Scenarios 1 and 3 are fairly similar to each other. Both scenarios predict a relatively large increase in ozone concentrations within the vicinity of Ouray (where the concentrations are already largest) indicating potential ozone disbenefits associated with NOx control mitigation measures.

When comparing Scenario 2 to the OTB Scenario, a potential reduction in ozone concentrations occurs in the vicinity of the Ouray site. While the reduction of ozone is not particularly large, there is no predicted ozone disbenefit associated with Scenario 2 mitigation measures (i.e., there is no area with predicted ozone increases relative to the OTB Scenario). That Scenario 2, which is designed to reduce VOC emissions, provides the lowest ozone impacts of all future year scenarios supports the assessment that peak ozone impacts are in VOC-limited areas.

While all modeled NO_2, CO, SO_2, $PM_{2.5}$, and PM_{10} values are well below the NAAQS and state AAQS in the Uinta Basin, the model performance is an important consideration to qualify and understand the model-predicted concentrations of these pollutants. The model performance evaluation for $PM_{2.5}$ and PM_{10} indicated a negative model bias throughout the year in the 4-km domain (AECOM and STI 2014) with the largest bias occurring in summer. As a result, the model-predicted $PM_{2.5}$ and PM_{10} concentrations may underestimate future impacts. Model-adjusted results from the MATS tool, which account for model performance biases, indicate that $PM_{2.5}$ concentrations may exceed the NAAQS and state AAQS for select monitors and assessment areas. There are seven monitoring stations within the 4-km domain with daily $PM_{2.5}$ concentrations that exceed the NAAQS and state AAQS during the baseline. All future model scenarios predict that only one of these monitoring station would continue to exceed the NAAQS and state AAQS. For annual $PM_{2.5}$, no monitoring stations within the 4-km domain exceed the NAAQS and state AAQS during the baseline or future years; however, two unmonitored areas within the Uinta Basin exceed the NAAQS and state AAQS during the baseline and impacts in these areas tend to increase for all future year scenarios except for mitigation Scenario 3. It is predicted that under mitigation Scenario 3, the annual $PM_{2.5}$ impacts would decrease in the Uinta Basin relative to the baseline due to a reduction of combustion control measures.

The future year scenarios generally have lower NO_2, CO, SO_2, $PM_{2.5}$, and PM_{10} concentrations than the 2010 Typical Year scenario, except for areas within the Uinta Basin. In the future year, all assessment areas are within the applicable PSD increments for annual NO_2, 3-hour SO_2, annual SO_2, and annual PM_{10} while most assessment areas exceed the 24-hour $PM_{2.5}$ PSD increment.[1]

[1] The comparison of model concentrations to the PSD Class I or Class II increments does not represent a formal, regulatory PSD increment consumption analysis since the modeling effort does not separate emissions sources into PSD increment-consuming and non-PSD increment-consuming sources. Rather, the modeled levels are compared to the established PSD increments for informational purposes only.

Table 6-1 Summary of Modeled Air Quality Impacts

Model Scenario	Area	NAAQS		PSD Increments[1]	MATS	
		Ozone	Other Standards		Ozone Design Values[2]	$PM_{2.5}$ Design Values
2010 Base Year	Uinta Basin study area	Uinta Basin study area, Ouray, and Dinosaur exceed the NAAQS	All areas below the NAAQS	All areas are within PSD increment for annual NO_2, annual SO_2, 3-hour SO_2, 24-hour SO_2, and annual PM_{10}. All areas exceed PSD increment for 24-hour $PM_{2.5}$.	NA	NA
	Class I	Nine Class I areas exceed the NAAQS	All areas below the NAAQS	All areas are within PSD increment for annual PM_{10} and annual SO_2. All or most areas exceed PSD increment for 24-hour $PM_{2.5}$, annual $PM_{2.5}$, and 24-hour PM_{10}.		
	Sensitive Class II	Nine Sensitive Class II areas exceed the NAAQS	All areas below the NAAQS	All areas are within PSD increment for annual NO_2, annual PM_{10}, annual $PM_{2.5}$, 3-hour SO_2, 24-hour SO_2, and annual SO_2. Most areas exceed PSD increment for 24-hour $PM_{2.5}$.		

Table 6-1 Summary of Modeled Air Quality Impacts

Model Scenario	Area	NAAQS		PSD Increments[1]	MATS	
		Ozone	Other Standards		Ozone Design Values[2]	$PM_{2.5}$ Design Values
2010 Typical Year	Uinta Basin study area	Uinta Basin study area, Ouray, and Dinosaur Station exceed the NAAQS	All areas below the NAAQS	All areas are within PSD increment for annual NO_2, annual SO_2, 3-hour SO_2, 24-hour SO_2, and annual PM_{10}. All areas exceed PSD increment for 24-hour $PM_{2.5}$.	NA	NA
	Class I	Nine Class I areas exceed the NAAQS	All areas below the NAAQS	All areas are within PSD increment for annual PM_{10} and annual SO_2. All or most areas exceed PSD increment for 24-hour $PM_{2.5}$, annual $PM_{2.5}$, and 24-hour PM_{10}.		
	Sensitive Class II	Nine Sensitive Class II areas exceed the NAAQS	All areas below the NAAQS	All areas are within PSD increment for annual NO_2, annual PM_{10}, annual $PM_{2.5}$, 3-hour SO_2, 24-hour SO_2, and annual SO_2. Most areas exceed PSD increment for 24-hour $PM_{2.5}$.		

Table 6-1 Summary of Modeled Air Quality Impacts

Model Scenario	Area	NAAQS		PSD Increments[1]	MATS	
		Ozone	Other Standards		Ozone Design Values[2]	$PM_{2.5}$ Design Values
2021 OTB Controls	Uinta Basin study area	Uinta Basin study area, Ouray, and Dinosaur Station exceed the NAAQS	All areas below the NAAQS	All areas are within PSD increment for annual NO_2, 3-hour SO_2, 24-hour SO_2, annual SO_2, and annual PM_{10}. All areas exceed PSD increment for 24-hour $PM_{2.5}$.	Four monitors have design values over the NAAQS versus two monitors with design values over the NAAQS during the baseline. Design values for most monitors are lower in 2021 than during the baseline.	All monitors have annual $PM_{2.5}$ design values below the NAAQS. One monitor has daily $PM_{2.5}$ design values above the NAAQS. Annual $PM_{2.5}$ design values for all monitors are lower in 2021 than during the baseline; however, the design value is predicted to exceed the NAAQS in some areas without monitors, including the Uinta Basin study area.
	Class I	Three Class I areas exceed the NAAQS	All areas below the NAAQS	All areas are within PSD increment for annual NO_2, 3-hour SO_2, annual SO_2, and annual PM_{10}. All or most areas exceed PSD increment for 24-hour $PM_{2.5}$, annual $PM_{2.5}$, and 24-hour PM_{10}.		
	Sensitive Class II	Two Sensitive Class II areas exceed the NAAQS	All areas below the NAAQS	All areas are within PSD increment for annual NO_2, annual PM_{10}, annual $PM_{2.5}$, 3-hour SO_2, 24-hour SO_2, and annual SO_2. Most areas exceed PSD increment for 24-hour $PM_{2.5}$.		

Table 6-1 Summary of Modeled Air Quality Impacts

Model Scenario	Area	NAAQS		PSD Increments[1]	MATS	
		Ozone	Other Standards		Ozone Design Values[2]	$PM_{2.5}$ Design Values
2021 Scenario 1	Uinta Basin study area	Uinta Basin study area and Ouray Station exceed the NAAQS	All areas below the NAAQS	All areas are within PSD increment for annual NO_2, 3-hour SO_2, 24-hour SO_2, annual SO_2, and annual PM_{10}. All areas exceed PSD increment for 24-hour $PM_{2.5}$.	Four monitors have design values that exceed the NAAQS versus two monitors with design values exceeding the NAAQS during the baseline. Design values for most monitors are lower in 2021 than during the baseline. Ozone design values in Uinta Basin increase relative to the 2021 On-the-Books case.	All monitors have annual $PM_{2.5}$ design values below the NAAQS. One monitor has daily $PM_{2.5}$ design values above the NAAQS. Annual $PM_{2.5}$ design values for all monitors are lower in 2021 than during the baseline; however, the design value is predicted to exceed the NAAQS in some areas without monitors, including the Uinta Basin study area. Annual $PM_{2.5}$ design values in Uinta Basin decrease relative to the 2021 On-the-Books case.
	Class I	Three Class I areas exceed the NAAQS	All areas below the NAAQS	All areas are within PSD increment for annual NO_2, 3-hour SO_2, annual SO_2, and annual PM_{10}. All or most areas exceed PSD increment for 24-hour $PM_{2.5}$, annual $PM_{2.5}$, and 24-hour PM_{10}.		
	Sensitive Class II	Two Sensitive Class II areas exceed the NAAQS	All areas below the NAAQS	All areas are within PSD increment for annual NO_2, annual PM_{10}, annual $PM_{2.5}$, 3-hour SO_2, 24-hour SO_2, and annual SO_2. Most areas exceed PSD increment for 24-hour $PM_{2.5}$.		

Table 6-1 Summary of Modeled Air Quality Impacts

Model Scenario	Area	NAAQS		PSD Increments[1]	MATS	
		Ozone	Other Standards		Ozone Design Values[2]	$PM_{2.5}$ Design Values
2021 Scenario 2	Uinta Basin study area	Uinta Basin study area, Ouray, and Dinosaur Stations exceed the NAAQS	All areas below the NAAQS	All areas are within PSD increment for annual NO_2, 3-hour SO_2, 24-hour SO_2, annual SO_2, and annual PM_{10}. All areas exceed PSD increment for 24-hour $PM_{2.5}$.	Three monitors have design values that exceed the NAAQS versus two monitors with design values exceeding the NAAQS during the baseline. Design values for most monitors are lower in 2021 than during the baseline. Ozone design values in Uinta Basin decrease relative to the 2021 On-the-Books case.	All monitors have annual $PM_{2.5}$ design values below the NAAQS. One monitor has daily $PM_{2.5}$ design values above the NAAQS. Annual $PM_{2.5}$ design values for all monitors are lower in 2021 than during the baseline; however, the design value is predicted to exceed the NAAQS in some areas without monitors, including the Uinta Basin study area. Annual $PM_{2.5}$ design values in Uinta Basin decrease relative to the 2021 On-the-Books case.
	Class I	Three Class I areas exceed the NAAQS	All areas below the NAAQS	All areas are within PSD increment for annual NO_2, 3-hour SO_2, annual SO_2, and annual PM_{10}. All or most areas exceed PSD increment for 24-hour $PM_{2.5}$, annual $PM_{2.5}$, and 24-hour PM_{10}.		
	Sensitive Class II	Two Sensitive Class II areas exceed the NAAQS	All areas below the NAAQS	All areas are within PSD increment for annual NO_2, annual PM_{10}, annual $PM_{2.5}$, 3-hour SO_2, 24-hour SO_2, and annual SO_2. Most areas exceed PSD increment for 24-hour $PM_{2.5}$.		

Table 6-1 Summary of Modeled Air Quality Impacts

Model Scenario	Area	NAAQS: Ozone	NAAQS: Other Standards	PSD Increments[1]	MATS: Ozone Design Values[2]	MATS: $PM_{2.5}$ Design Values
2021 Scenario 3	Uinta Basin study area	Uinta Basin study area, Ouray Stations exceed the NAAQS	All areas below the NAAQS	All areas are within PSD increment for annual NO_2, 3-hour SO_2, 24-hour SO_2, annual SO_2, and annual PM_{10}. All areas exceed PSD increment for 24-hour $PM_{2.5}$.	Four monitors have design values that exceed the NAAQS versus two monitors with design values exceeding the NAAQS during the baseline. Design values for most monitors are lower in 2021 than during the baseline. Ozone design values in Uinta Basin increase relative to the 2021 On-the-Books case.	All monitors have annual $PM_{2.5}$ design values below the NAAQS. One monitor has daily $PM_{2.5}$ design values above the NAAQS. Annual $PM_{2.5}$ design values for all monitors and most unmonitored areas are lower in 2021 than during the baseline. Annual $PM_{2.5}$ design values in Uinta Basin decrease relative to the 2021 On-the-Books case.
	Class I	Three Class I areas exceed the NAAQS	All areas below the NAAQS	All areas are within PSD increment for annual NO_2, 3-hour SO_2, annual SO_2, and annual PM_{10}. All or most areas exceed PSD increment for 24-hour $PM_{2.5}$, annual $PM_{2.5}$, and 24-hour PM_{10}.		
	Sensitive Class II	Two Sensitive Class II areas exceed the NAAQS	All areas below the NAAQS	All areas are within PSD increment for annual NO_2, annual PM_{10}, annual $PM_{2.5}$, 3-hour SO_2, 24-hour SO_2, and annual SO_2. Most areas exceed PSD increment for 24-hour $PM_{2.5}$.		

[1] The comparison of model concentrations to the PSD Class I or Class II increments does not represent a formal, regulatory PSD increment consumption analysis since the modeling effort does not separate emissions sources into PSD increment-consuming and non-PSD increment-consuming sources. Rather, the modeled levels are compared to the established PSD increments for informational purposes only.

[2] There is insufficient data collected at regulatory monitors in the Uinta Basin study area to calculate a true ozone design value. All ozone design values reported for the Uinta Basin do not represent actual design values and are for informational purposes only.

6.2 Summary of Visibility Impacts

A summary of model-predicted visibility impacts at Class I and sensitive Class II areas is presented in terms of the 20th percentile best and worst visibility days in **Table 6-2**. Visibility conditions in Class I and sensitive Class II areas generally show improvement in the 2021 future year scenarios relative to the 2010 Base Year and 2010 Typical Year using both the IAS and MATS to assess impacts. There are not substantial differences in the 20th percentile best and worst visibility days between the 2010 Base Year and 2010 Typical Year. There also are not substantial differences in the 20th percentile best and worst visibility days between the four future year scenarios.

In general, the IAS results show that the greatest improvement in visibility for the 20th percentile worst visibility days occurs for the 2021 Scenario 3 relative to the 2010 Typical Year. As shown in Chapter 2.0, 2021 Scenario 3 also has the lowest oil and gas emissions of the four future year scenarios considered, especially for particulate matter.

The IAS results show that the greatest improvement in visibility between the 2010 Typical Year and 2021 Scenario 3 occurs at Arches NP, with light extinction values changing from 30.3 Mm^{-1} (11.1 dv) in the 2010 Typical Year to 23.9 Mm^{-1} (8.7 dv) in the 2021 Scenario 3. The second most substantial improvement occurs at the Uintah and Ouray IR, with light extinction values changing from 33.3 Mm^{-1} (12.0 dv) in the 2010 Typical Year to 28.0 Mm^{-1} (10.3 dv) in the 2021 Scenario 3. Across all future year scenarios, the largest improvement in visibility occurs at Arches NP, Canyonlands NP, Capitol Reef NP, Dinosaur National Monument, Flaming Gorge National Recreation Area, Uintah and Ouray IR, and Ute Mountain IR. Areas that do not have a noteworthy change in visibility impacts for any of the future year scenarios include Fitzpatrick WA and Goshute IR. The assessment area with the largest light extinction values, indicative of greater visibility impairment, is Fort Hall IR for the 2010 Base Year, 2010 Typical Year, and 2021 future year scenarios. The assessment areas with the lowest light extinction values, indicative of the best visibility, are Goshute IR in the 2010 Base Year and 2010 Typical Year and West Elk WA in the 2021 future year scenarios.

IAS results indicate that most Class I and sensitive Class II areas show improvement in the 20th percentile best visibility days, though the magnitude of the improvement tends to be less than the 20th percentile worst visibility days. The 20th percentile best visibility light extinction values increase, indicative of greater visibility impairment, for Bridger WA, Fitzpatrick WA, and Fort Hall IR across all four 2021 future year scenarios.

Table 6-2 Summary of Modeled Visibility Air Quality Impacts

Model Scenario	Assessment Method	Area	Range of Modeled Visibility Values	
			Best Visibility	Worst Visibility
2010 Base Year	IAS	Class I	11.8 Mm^{-1} (1.7 dv) West Elk WA	30.2 Mm^{-1} (11.1 dv) Arches NP
		Class II	11.6 Mm^{-1} (1.5 dv) Goshute IR	37.8 Mm^{-1} (13.3 dv) Fort Hall IR
2010 Typical Year	IAS	Class I	11.8 Mm^{-1} (1.7 dv) West Elk WA	30.3 Mm^{-1} (11.1 dv) Arches NP
		Class II	11.6 Mm^{-1} (1.5 dv) Goshute IR	37.7 Mm^{-1} (13.3 dv) Fort Hall IR

Table 6-2 Summary of Modeled Visibility Air Quality Impacts

Model Scenario	Assessment Method	Area	Range of Modeled Visibility Values	
			Best Visibility	Worst Visibility
2021 OTB Controls Scenario	IAS	Class I	11.2 Mm^{-1} (1.2 dv) West Elk WA	24.1 Mm^{-1} (8.8 dv) Arches NP
		Class II	11.5 Mm^{-1} (1.4 dv) Goshute IR	36.2 Mm^{-1} (12.9 dv) Fort Hall IR
	MATS	Class I	10.4 Mm^{-1} (0.43 dv) Eagles Nest WA, Flat Tops WA, Maroon Bells-Snowmass WA, West Elk WA	30.8 Mm^{-1} (11.3 dv) Rocky Mountain NP
2021 Scenario 1	IAS	Class I	11.2 Mm^{-1} (1.2 dv) West Elk WA	23.9 Mm^{-1} (8.7 dv) Arches NP
		Class II	11.5 Mm^{-1} (1.4 dv) Goshute IR	36.2 Mm^{-1} (12.9 dv) Fort Hall IR
	MATS	Class I	10.4 Mm^{-1} (0.43 dv) Eagles Nest WA, Flat Tops WA, Maroon Bells-Snowmass WA, West Elk WA	30.8 Mm^{-1} (11.3 dv) Rocky Mountain NP
2021 Scenario 2	IAS	Class I	11.2 Mm^{-1} (1.2 dv) West Elk WA	24.1 Mm^{-1} (8.8 dv) Arches NP
		Class II	11.5 Mm^{-1} (1.4 dv) Goshute IR	36.2 Mm^{-1} (12.9 dv) Fort Hall IR
	MATS	Class I	10.4 Mm^{-1} (0.43 dv) Eagles Nest WA, Flat Tops WA, Maroon Bells-Snowmass WA, West Elk WA	30.8 Mm^{-1} (11.3 dv) Rocky Mountain NP
2021 Scenario 3	IAS	Class I	11.2 Mm^{-1} (1.2 dv) West Elk WA	23.9 Mm^{-1} (8.7 dv) Arches NP
		Class II	11.5 Mm^{-1} (1.4 dv) Goshute IR	36.2 Mm^{-1} (12.9 dv) Fort Hall IR
	MATS	Class I	10.4 Mm^{-1} (0.43 dv) Eagles Nest WA, Flat Tops WA, Maroon Bells-Snowmass WA, West Elk WA	30.8 Mm^{-1} (11.3 dv) Rocky Mountain NP

MATS estimates show that there is a general improvement between the baseline year and 2021 future year scenarios, similar to the IAS results; however, there are not substantial differences in visibility impacts between the four future year scenarios at any Class I area. This is likely because all Class I assessment areas are not in proximity to the Uinta Basin study area where the different emission control scenarios are implemented.

Unlike the IAS results, the MATS visibility analysis indicates that two Class I areas, Bridger WA and Fitzpatrick WA, show a deterioration in visibility in terms of the 20 percent worst visibility days between the baseline year and 2021 future year scenarios; all other Class I areas show an improvement between the baseline year and 2021 future year scenarios. The greatest improvement in visibility between the baseline year and 2021 future year scenarios occurs at Mesa Verde NP: light extinction values changing from 30.6 Mm^{-1} (11.2 dv) in the baseline year to 28.0 Mm^{-1} (10.3 dv) in the 2021 future year scenarios. The assessment area with the highest light extinction values, indicative of greater visibility impairment, is Rocky Mountain NP for both the baseline and 2021 future year scenarios.

6.3 Summary of Atmospheric Deposition Impacts

A summary of model-predicted deposition impacts in terms of total annual nitrogen and sulfur deposition fluxes, as well as total predicted acidification is presented in **Table 6-3** for the 2010 Base Year, 2010 Typical Year, and 2021 future year scenarios. A summary of ANC impacts to sensitive lakes is presented in **Table 6-4**. Results generally show a decrease in deposition values for the 2021 future year scenarios relative to the 2010 Typical Year. However, the differences in estimated deposition values between all four future year scenarios are generally very small. All Class I areas, sensitive Class II areas, and sensitive lakes show decreases in model-predicted nitrogen and acidification impacts between the 2010 Typical Year and all 2021 future year scenarios. In general, the largest decrease in model-predicted deposition and ANC impacts occurs between the 2010 Typical Year and the 2021 Scenario 1. However, the largest decrease in deposition impacts near the Uinta Basin study area occurs under 2021 Scenario 3. The largest decrease in model-predicted nitrogen deposition impacts occurs at Mesa Verde NP, deposition fluxes change from 5.09 kg N/ha/yr in the 2010 Typical Year to 3.56 kg N/ha/yr in the 2021 Scenario 1. The second most substantial reduction in modeled nitrogen deposition impacts occurs at Southern Ute IR, deposition fluxes change from 4.86 kg N/ha/yr in the 2010 Typical Year to 3.49 kg N/ha/yr in the 2021 Scenario 1. The smallest changes in deposition occur at Wind River IR, where deposition fluxes change from 2.66 kg N/ha/yr in the 2010 Typical Year to 2.36 kg N/ha/yr in the 2021 Scenario 1. Similar to nitrogen deposition impacts, the largest decrease in model-predicted acidification impacts occurs at Mesa Verde and Southern Ute IR, while the smallest changes occur at Paitute IR.

While model-predicted nitrogen deposition is shown to be decreasing between the 2010 Typical Year and the 2021 future year scenarios, the contribution of individual nitrogen species to the total nitrogen deposition is also changing. From the 2010 Typical Year to the 2021 future year scenarios, there is a shift in the percentage contribution of oxidized nitrogen species such as nitric acid (HNO_3) to reduced nitrogen species such as NH_3 for dry deposition and similarly from particulate nitrate (PNO_3) to particulate ammonium (PNH_4) for wet deposition. This shift is due in part to the large reduction in NO_2 emissions between the 2010 Typical Year and the 2021 future year scenarios. A much smaller reduction in NH_3 emissions has been modeled between the 2010 Typical Year and the 2021 future year scenarios.

Though DATs are not applicable to the ARMS Modeling Project, differences in cumulative model-predicted nitrogen and sulfur deposition fluxes between the 2010 Typical Year and the 2021 future year scenarios were compared to the 0.005 kg/ha/yr DATs for nitrogen and sulfur for informational purposes only. In all 2021 future year scenarios, the sulfur DATs are exceeded in Bridger WA and Fitzpatrick WA; the increase in model-predicted sulfur deposition is approximately 0.2 kg S/ha/yr at both Class I areas. However, for nitrogen, there were no exceedances of the DATs for any assessment area or model scenario.

Nutrient nitrogen critical loads for individual assessment areas were used to evaluate cumulative model-predicted impacts at Class I areas, sensitive Class II areas, and sensitive lakes. In the 2010 Base Year and 2010 Typical Year, model-predicted nitrogen deposition at all Class I areas, all Class II areas (except for Goshute IR and Navajo IR), and all sensitive lakes exceed nutrient nitrogen critical loads. In the 2021 future year scenarios, model-predicted nitrogen deposition at 16 of the 17 Class I areas, eight of 12 sensitive Class II areas, and all seven sensitive lakes exceed nutrient nitrogen critical loads. For the 2021 future year scenarios the following sensitive areas do not exceed nutrient nitrogen critical loads: Canyonlands NP, Goshute IR, Navajo IR, Skull Valley, and Wind River IR.

Of the identified sensitive lakes, Lake 4D2-039 in the High Uintas WA is predicted to have the largest impacts on ANC change for all model scenarios. Change in ANC for Lake 4D2-039 decreases from 166.9 percent in the 2010 Typical Year to 146.2 percent in the 2021 Scenario 1. Fish Lake in the High

Uintas WA is predicted to have the smallest impacts on ANC change for all model scenarios. Change in ANC for Fish Lake changes from 98.6 percent in the 2010 Typical Year to 86.8 percent in the 2021 Scenario 1. ANC change at all seven identified sensitive lakes for the ARMS Modeling Project exceed the limit of acceptable change of 10 percent for lakes with a background ANC greater than or equal to 25 μeq/L for all six model scenarios.

Table 6-3 Summary of Model-Predicted Deposition Impacts

Model Scenario	Sensitive Area	Maximum Impacts: Nitrogen Deposition (kg N/ha/yr)	Maximum Impacts: Sulfur Deposition (kg S/ha/yr)	Maximum Impacts: Acidification (eq/ha/yr)	Number of Areas Exceeding: Nutrient Nitrogen Critical Loads	Number of Areas Exceeding: Deposition Analysis Thresholds (DATs): Nitrogen	Number of Areas Exceeding: Deposition Analysis Thresholds (DATs): Sulfur
2010 Base Year	Class I	6.09 Arches NP	3.17 Mesa Verde NP	562 Mesa Verde NP	17 / 17	NA	NA
	Class II	5.62 Fort Hall IR	2.67 Southern Ute IR	514 Southern Ute IR	10 / 12	NA	NA
	Lakes	7.21 4D2-039	2.11 4D2-039	647 4D2-039	7 / 7	NA	NA
2010 Typical Year	Class I	6.09 Arches NP	3.12 Mesa Verde NP	559 Mesa Verde NP	17 / 17	NA	NA
	Class II	5.63 Fort Hall IR	2.63 Southern Ute IR	512 Southern Ute IR	10 / 12	NA	NA
	Lakes	7.20 4D2-039	2.10 4D2-039	645 4D2-039	7 / 7	NA	NA
2021 OTB Controls Scenario	Class I	5.52 Arches NP	1.85 Bridger WA	446 Arches NP	16 / 17	0 / 17	2 / 17
	Class II	5.18 Fort Hall IR	1.43 Southern Ute IR	432 Fort Hall IR	8 / 12	0 / 12	0 / 12
	Lakes	6.48 4D2-039	1.67 4D2-039	568 4D2-039	7 / 7	NA	NA
2021 Scenario 1	Class I	5.51 Arches NP	1.85 Bridger WA	445 Arches NP	16 / 17	0 / 17	2 / 17
	Class II	5.17 Fort Hall IR	1.43 Southern Ute IR	432 Fort Hall IR	8 / 12	0 / 12	0 / 12
	Lakes	6.45 4D2-039	1.67 4D2-039	565 4D2-039	7 / 7	NA	NA

Table 6-3 Summary of Model-Predicted Deposition Impacts

Model Scenario	Sensitive Area	Maximum Impacts: Nitrogen Deposition (kg N/ha/yr)	Maximum Impacts: Sulfur Deposition (kg S/ha/yr)	Maximum Impacts: Acidification (eq/ha/yr)	Number of Areas Exceeding: Nutrient Nitrogen Critical Loads	Number of Areas Exceeding: Deposition Analysis Thresholds (DATs): Nitrogen	Number of Areas Exceeding: Deposition Analysis Thresholds (DATs): Sulfur
2021 Scenario 2	Class I	5.52 Arches NP	1.85 Bridger WA	446 Arches NP	16 / 17	0 / 17	2 / 17
	Class II	5.18 Fort Hall IR	1.43 Southern Ute IR	432 Fort Hall IR	8 / 12	0 / 12	0 / 12
	Lakes	6.48 4D2-039	1.67 4D2-039	568 4D2-039	7 / 7	NA	NA
2021 Scenario 3	Class I	5.51 Arches NP	1.85 Bridger WA	445 Arches NP	16 / 17	0 / 17	2 / 17
	Class II	5.17 Fort Hall IR	1.43 Southern Ute IR	432 Fort Hall IR	8 / 12	0 / 12	0 / 12
	Lakes	6.45 4D2-039	1.67 4D2-039	565 4D2-039	7 / 7	NA	NA

Table 6-4 Summary of Model-Predicted Impacts on ANC of Sensitive Lakes

Model Scenario	ANC Change from Measurement[1] (percent)		Number of Lakes Exceeding the ANC Limit of Acceptable Change[2]
	Minimum	Maximum	
2010 Base Year	98.8 Fish Lake	167.5 4D2-039	7 / 7
2010 Typical Year	98.6 Fish Lake	166.9 4D2-039	7 / 7
2021 OTB Controls Scenario	87.3 Fish Lake	146.9 4D2-039	7 / 7
2021 Scenario 1	86.8 Fish Lake	146.2 4D2-039	7 / 7
2021 Scenario 2	87.2 Fish Lake	146.8 4D2-039	7 / 7
2021 Scenario 3	86.8 Fish Lake	146.3 4D2-039	7 / 7

6.4 Study Conclusions

In general, it is found that the highest modeled ozone occurs in the Uinta Basin study area regardless of model scenario and that all scenarios predict exceedences of the ozone NAAQS and state AAQS in the Uinta Basin. When evaluating the ozone impacts associated with the future year mitigation scenarios, 2021 Scenario 2, which focuses on VOC emissions controls, tends to have the lowest ozone impacts relative to all other future year scenarios, while 2021 Scenarios 1 and 3 indicate potential ozone disbenefits associated with NOx control mitigation measures. While all modeled NO_2, CO, SO_2, $PM_{2.5}$, and PM_{10} values are well below the NAAQS and state AAQS in the Uinta Basin, actual $PM_{2.5}$ and PM_{10} impacts may exceed the NAAQS and state AAQS.

Visibility conditions in Class I and sensitive Class II areas generally show improvement in the 2021 future year scenarios relative to the 2010 Base Year and 2010 Typical Year. There are not substantial differences in the 20th percentile best and worst visibility days between the 2010 Base Year and 2010 Typical Year. There also are not substantial differences in the 20th percentile best and worst visibility days between the four future year scenarios.

Results generally show a decrease in deposition values for the 2021 future year scenarios relative to the 2010 Typical Year. However, the differences in estimated deposition values between all four future year scenarios are generally very small. ANC change at all seven sensitive lakes exceeds the 10 percent limit of acceptable change for all model scenarios.

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Appendix A

MATS Application and Configuration

1.0 MATS Settings

This section describes the methods and configuration settings used to process the CMAQ air quality model results with the USEPA's Modeled Attainment Test Software (MATS) (Abt Associates, Inc. 2009). The USEPA developed MATS to perform modeled attainment tests for ozone, $PM_{2.5}$, and changes in visibility by combining model results with monitored air quality concentrations. For the ARMS Modeling Project, the MATS tool (v.2.5.1) was used to estimate potential future ozone and $PM_{2.5}$ impacts following USEPA guidance (USEPA 2007). In addition, the MATS tool was also used to estimate visibility impacts at the Class I areas included in the 12-km and 4-km domains. MATS settings used for each air quality metric are presented in the following sections.

For the ARMS Modeling Project, the modeled base year was 2010. The current version of MATS was updated to include more recent monitoring data within Utah, with particular attention to the Uinta Basin study area. **Table A-1** shows the MATS baseline year for each air quality metric.

Table A-1 Baseline Year for each MATS Analysis

MATS Analysis	Stations within Utah	Stations Outside of Utah
Ozone	2010	2008
Daily $PM_{2.5}$	2010	2008
Annual $PM_{2.5}$	2008	2008
Visibility	2008	2008

MATS calculates current design values (DVC) for a 5-year weighted average of monitoring data centered on the baseline year. For example, to develop DVC for a 2010 baseline year, monitoring values are required for the 5 year period from 2008 through 2012. The necessary monitoring data for the 5-year period centered on the baseline year indicated in **Table A-1** were obtained and processed for MATS to calculate the DVC.

The USEPA guidance (2007) for estimating future attainment recommends using the photochemical grid model in a relative sense to scale current design values (DVC). Scaling factors, called relative response factors (RRFs), are calculated from model results. RRFs are applied to the DVC in order to predict future year design values (DVF) at the monitored location as shown in the following equation.

$$\boldsymbol{DVF = DVC \times RRF}$$

RRFs are the ratio of the modeled future year concentrations to the modeled baseline concentrations near a monitor site. For this study, MATS was used to calculate RRFs for all future year model scenarios, described in **Section 2.5**, relative to the 2010 Typical Year, which is the baseline model scenario used in the ARMS Modeling Project. The RFFs were then applied to DVC for ozone, $PM_{2.5}$, and visibility to estimate potential future impacts as described in the following sections.

1.1 Ozone

The MATS ozone DVCs were calculated in accordance with 40 CFR Part 50.10, and Appendix I to Part 50. To develop ozone design values for a 2010 baseline year, ozone monitoring values are required for the 5 year period from 2008 through 2012. These data were obtained and processed for MATS, but only for monitoring stations within the state of Utah. Monitors outside of Utah used a 2008 baseline year.

RRFs are the ratio of the modeled future year 8-hour ozone concentrations to the modeled baseline 8-hour ozone concentrations near a monitor site. The USEPA has defined “near the monitor” to be approximately 15-km from the monitor location. The modeled ozone concentrations were extracted and processed for input into MATS using the Impact Assessment Suite (IAS) tool. To select the concentrations near the monitor, MATS selected the modeled daily maximum 8-hour ozone concentration from a 7x7 array of grid cells centered on the monitor in the 4-km domain and an array of 3 x 3 grid cells in the 12-domain. MATS uses these values from the base case and the future year model results to calculate the RRFs for each monitor.

The RRFs were calculated for all days in which the modeled 8-hour ozone value is above 40 ppb to provide an adequate number of days. A threshold was applied so that the model response to future changes in emissions is considered only on high ozone days of comparable conditions to the days used to produce the DVC.

An unmonitored area analysis (UAA) was also performed, particularly in areas where the ozone monitoring network just meets or minimally exceeds the size of the network required to report data to USEPA’s AQS. This analysis is intended to ensure that a control strategy leads to reductions in ozone at other locations that could have DVCs and DVFs exceeding the NAAQS if a monitor was deployed there. The UAA for the ARMS Modeling Project includes all areas in the Uinta Basin study area that are found to not be included in the monitored attainment test. To assist with the UAA, the MATS tool produces spatial fields of interpolated ambient data combined with gridded modeled outputs.

The complete set of configuration options used in this study for both the monitored and unmonitored MATS ozone analysis is presented in **Table A-2**.

Table A-2 Configuration Settings for Ozone MATS Analysis

Category	Parameter	Setting	4-km Domain	12-km Domain
Desired Output	Scenario Name	Name		
	Point estimates - forecast	Temporally-adjust ozone levels at monitors	check	check
	Spatial field- baseline	Interpolate monitor data to spatial field	check	check
		Interpolate gradient-adjusted monitor data to spatial field	check	check
	Spatial field- forecast	Interpolate monitor data to spatial field. Temporally adjusted ozone levels.	check	check
		Interpolate gradient-adjusted monitor data to spatial field. Temporally adjust.	check	check
	Actions on run completion	Automatically extract all selected output files	check	check
	Design value periods	Output design value periods	uncheck	uncheck
Data Input	Monitor data	Ozone data	AECOM Modified OZONE_MATS_input.csv	OZONE_MATS_input_00-09-v1.csv
	Model data	Baseline	ARMS 2010 Typical Year 4-km model results	ARMS 2010 Typical Year 12-km model results
		Forecast	ARMS 2021 future year 4-km model results	ARMS 2021 future year 12-km model results
	Using model data	Temporal adjustment at monitor	7x7-maximum	3x3-maximum
Filtering and Interpolation	Choose ozone design value	Start year	2008-2010	2005-2007
		End year	2010-2012	2007-2009
	Valid ozone monitors	Minimum number of design values	1	1
		Required design values	none selected	none selected
	Default interpolation method		Inverse Distance Weights	Inverse Distance Weights

Table A-2 Configuration Settings for Ozone MATS Analysis

Category	Parameter	Setting	4-km Domain	12-km Domain
RRF and Spatial Gradient	RRF Setup	Initial threshold value (ppb)	85	85
		Minimum number of days in baseline at or above threshold	10	10
		Minimum allowable threshold value (ppb)	40	40
		Min number of days at or above minimum allowable threshold	5	5
		Backstop minimum threshold for spatial fields	n/a	n/a
		Subrange first day of ozone season used in RRF	1	1
		Subrange last day of ozone season used in RRF	365	365
		Pair days based on high concentration instead of date	check	check
	Spatial gradient setup	Start value	1	1
		End value	5	5

1.2 $PM_{2.5}$

MATS can forecast 24-hour and annual design values at $PM_{2.5}$ monitor locations. The $PM_{2.5}$ attainment test is more complicated than the ozone test due to the fact that $PM_{2.5}$ is a mixture of chemical compounds. To estimate future concentrations, ambient $PM_{2.5}$ is divided into its primary components (nitrate, sulfate, ammonium, organic carbon, elemental carbon, etc.). This information is used in combination with measured site-specific $PM_{2.5}$ design values to estimate a design value associated with each PM component.

A separate RRF is calculated for each of the $PM_{2.5}$ components. Future $PM_{2.5}$ design values for each component are estimated by multiplying species' RRF by the design value of each PM component at existing monitoring sites. The total future $PM_{2.5}$ design value at a site is estimated by adding the future $PM_{2.5}$ design value for each component.

For this study, both 24-hour and annual $PM_{2.5}$ design values were estimated using the MATS tool. The Utah Department of Environmental Quality (UDAQ) as part of their PM analysis for Salt Lake City and Wasatch Mountain region updated the MATS monitoring database for 24-hour $PM_{2.5}$ and their database contains data through 2012. UDAQ kindly provided their $PM_{2.5}$ monitoring database for use in this project. The complete set of MATS configuration options used in this study for the 24-hour $PM_{2.5}$ analysis is presented in **Table A-3**, while the annual $PM_{2.5}$ analysis is presented in **Table A-4**.

Table A-3 Configuration Settings for Daily $PM_{2.5}$ MATS Analysis

Category	Parameter	Setting	4-km Domain	12-km Domain
Choose Desired Output	Scenario Name	Name		
	Standard analysis	Interpolate monitor data to FRM monitor sites. Temporally-adjust.	check	check
	Quarterly model data	output quarterly average model data file	check	check
		Output used quarterly average model data file	check	check
	Species fraction	Output species fractions file	check	check
	Actions on run completion	Automatically extract all selected output files	check	check
Output Choices-Advanced	Misc outputs-quarterly peak files	Point	uncheck	uncheck
	High county sites	File "c"	uncheck	uncheck
	Quarterly average speciated monitors	File "E"	uncheck	uncheck
	Design Value Periods	Output design value periods	uncheck	uncheck
	Neighbor Files	Point	uncheck	uncheck
Data Input	Species data	Species monitor data file	UPDATED DATA FROM UDEQ: Spec-f-Frac-0612_051413.csv	Species-for-fractions-02-10-v3.csv
	Species data	Species fractions file	n/a	n/a
	$PM_{2.5}$ Monitor Data	Unofficial daily average $PM_{2.5}$ data file (for all species fractions and $PM_{2.5}$ spatial field)	UPDATED DATA FROM UDEQ: Unofficial_PM_2006_2012.csv	PM25-for-fractions-02-10-v3.csv
	$PM_{2.5}$ Monitor Data	Official quarterly average FRM data file (for $PM_{2.5}$ point calc)	UPDATED DATA FROM UDEQ: rank_98_MATS251_2006_2012_v4.csv	official_24-hr-FRM-99-10-v3.csv
	Model data	Daily model data input or quarterly model data input	Daily model data input	Daily model data input

Table A-3 Configuration Settings for Daily $PM_{2.5}$ MATS Analysis

Category	Parameter	Setting	4-km Domain	12-km Domain
		Baseline file	ARMS 2010 Typical Year 4-km model results	ARMS 2010 Typical Year 12-km model results
		Forecast file	ARMS 2021 future year 4-km model results	ARMS 2021 future year 12-km model results
Species Fractions Options	Improve-STN monitor data	Monitor data start year	2009	2008
		Monitor data end year	2011	2010
	Delete specified data values	EPA-specified deletions from monitor data	check	check
		User-specified deletions from monitor data	uncheck	uncheck
	Minimum data requirements	Minimum number of valid days per quarter	11	11
		minimum number of valid years required for valid season	1	1
		Minimum number of valid seasons for valid monitor	1	1
	$PM_{2.5}$ Monitor Data	Monitor data start year	2009	2008
		Monitor data end year	2011	2010
	Delete specified data values	EPA-specified deletions from monitor data	check	check
		User-specified deletions from monitor data	uncheck	uncheck
	Minimum data requirements	Minimum number of valid days per quarter	11	11
		Minimum number of valid seasons for valid monitor (point calc)	4	4

Table A-3 Configuration Settings for Daily $PM_{2.5}$ MATS Analysis

Category	Parameter	Setting	4-km Domain	12-km Domain
		Minimum number of valid seasons for valid monitor	1	1
Species Fractions-Advanced	Improve-STN monitor data	Use top X percent of daily monitor data	use/10	use/10
		Use all daily monitor values greater than fixed amount (ug/m^3)	not use/0	not use/0
		Minimum number of days required above fixed amount	not use/1	not use/1
		Use top X number of daily monitor data	not use/25	not use/25
	$PM_{2.5}$ Monitor Data	Use top X percent of daily monitor data	use/10	use/10
		Use all daily monitor values greater than fixed amount (ug/m^3)	not use/0	not use/0
		Minimum number of days required above fixed amount	not use/1	not use/1
		Use top X number of daily monitor data	not use/25	not use/25
	Interpolation Options	$PM_{2.5}$	n/a	n/a
		SO_4	inverse distance squared values-9000000000	inverse distance squared values-9000000000
		NO_3	inverse distance squared values-9000000000	inverse distance squared values-9000000000
		EC	inverse distance squared values-9000000000	inverse distance squared values-9000000000
		Salt	inverse distance squared values-9000000000	inverse distance squared values-9000000000
		Crustal	inverse distance squared values-9000000000	inverse distance squared values-9000000000

Table A-3 Configuration Settings for Daily $PM_{2.5}$ MATS Analysis

Category	Parameter	Setting	4-km Domain	12-km Domain
		DON	inverse distance squared values-9000000000	inverse distance squared values-9000000000
		OC	inverse distance squared values-9000000000	inverse distance squared values-9000000000
		NH4	n/a	n/a
	Misc. Options	Ammonium- Use?	use DON values	use DON values
		Default Blank Mass	0.5	0.5
		Organic carbon mass balance floor	1	1
		Organic carbon mass balance ceiling	0.8	0.8
$PM_{2.5}$ Calc Options	$PM_{2.5}$ Monitor data years	Start year	2008	2006
		End year	2012	2010
	Valid FRM Monitors	Minimum number of design values	1	1
		Required design valued	none selected	none selected
		NH4 future calculation	calculated future year NH4 using base year (constant) DON values	calculated future year NH4 using base year (constant) DON values
Model Data Options	Temporal adjustment at monitor	Grid for point forecast	7x7	3x3
		Grid for spatial forecast	5x5	1x1
		Statistic	mean	mean
	RRF- model values used	Use top X percent of daily monitor data	10	10
		Use all daily monitor values greater than fixed amount (ug/m3)	0	0
		Minimum number of days required above fixed amount	1	1
		Use top X number of daily monitor data	25	25

Table A-4 Configuration Settings for Annual $PM_{2.5}$ MATS Analysis

Category	Parameter	Setting	4-km Domain	12-km Domain
Choose Desired Output	Scenario	Name		
	Standard analysis	Interpolate monitor data to FRM monitor sites. Temporally-adjust.	check	check
	Quarterly model data	Output quarterly average model data file	uncheck	uncheck
		Output used quarterly average model data file	uncheck	uncheck
	Species fraction	Output species	check	check
	Actions on run completion	Automatically extract all selected output files	check	check
Output Choices-Advanced	Forecast	Interpolate FRM and speciation monitor data to spatial field. Temporally adjust.	check	check
		Interpolate gradient-adjusted FRM and speciation monitor data to spatial field. Temporally adjust.	check	check
	Misc outputs-quarterly average files	Point	uncheck	uncheck
		Spatial field	uncheck	uncheck
		Spatial field-gradient adjusted	uncheck	uncheck
	High county sites	File "c"	uncheck	uncheck
	Species fraction spatial field	Spatial field	uncheck	uncheck
		Spatial field-gradient adjusted	uncheck	uncheck
	Quarterly average speciated monitors	File "E"	uncheck	uncheck
	Design Value Periods	Output design value periods	uncheck	uncheck

Table A-4 Configuration Settings for Annual $PM_{2.5}$ MATS Analysis

Category	Parameter	Setting	4-km Domain	12-km Domain
	Neighbor files	Point	uncheck	uncheck
		Spatial field	uncheck	uncheck
Data Input	Species data	Species monitor data file	Species-for-fractions-02-10-v3.csv	Species-for-fractions-02-10-v3.csv
		Species fractions file	n/a	n/a
	$PM_{2.5}$ Monitor Data	Unofficial daily average PM2.5 data file (for all species fractions and pm2.5 spatial field)	PM25-for-fractions-02-10-v3.csv	PM25-for-fractions-02-10-v3.csv
		Official quarterly average FRM data file (for PM2.5 point calc)	official_annual-PM25-99-10-v1.csv	official_annual-PM25-99-10-v1.csv
	Model data	Daily model data input or quarterly model data input	check	che
		Baseline file	ARMS 2010 Typical Year 4-km model results	ARMS 2010 Typical Year -km model results
		Forecast file	ARMS 2021 future year 4-km model results	ARMS 2021 future year 12-km model results
Specie Fractions Options	Improve-STN monitor data	Monitor data-start year	2008	2008
		Monitor data-end year	2010	2010
	Delete specified data values	EPA-specified deletions from monitor data	check	check
		User-specified deletions from monitor data	uncheck	uncheck
	Minimum data requirements	Minimum number of valid days per quarter	11	11
		Minimum number of valid years required for valid season	1	1

Table A-4 Configuration Settings for Annual $PM_{2.5}$ MATS Analysis

Category	Parameter	Setting	4-km Domain	12-km Domain
		Minimum number of valid seasons for valid monitor	1	1
	$PM_{2.5}$ Monitor Data	Monitor data start year	2008	2008
		Monitor data end year	2010	2010
	Delete specified data values	EPA-specified deletions from monitor data	check	check
		User-specified deletions from monitor data	uncheck	uncheck
	Minimum data requirements	Minimum number of valid days per quarter	11	11
		Minimum number of valid years required for valid season	1	1
		Minimum number of valid seasons for valid monitor (point calc)	4	4
		Minimum number of valid seasons for valid monitor (spatial fields calc)	1	1
Specie Fractions-Advanced	Interpolation Options	PM2.5	n/a	n/a
		SO4	inverse distance squared values-9000000000	inverse distance squared values-9000000000
		NO3	inverse distance squared values-9000000000	inverse distance squared values-9000000000
		EC	inverse distance squared values-9000000000	inverse distance squared values-9000000000
		Salt	inverse distance squared values-9000000000	inverse distance squared values-9000000000

Table A-4 Configuration Settings for Annual $PM_{2.5}$ MATS Analysis

Category	Parameter	Setting	4-km Domain	12-km Domain
		Crustal	inverse distance squared values-9000000000	inverse distance squared values-9000000000
		DON	inverse distance squared values-9000000000	inverse distance squared values-9000000000
		OC	inverse distance squared values-9000000000	inverse distance squared values-9000000000
		NH4	n/a	n/a
	Misc. Options	Ammonium- Use?	use DON values	use DON values
		Default Blank Mass	0.5	0.5
		Organic carbon mass balance floor	1	1
		Organic carbon mass balance ceiling	0.8	0.8
$PM_{2.5}$ Calc Options	$PM_{2.5}$ Monitor data years	Start year	2006	2006
		End year	2010	2010
		Official design values	check	check
		Custom design values- valid FRM Quarters	Uncheck	Uncheck
		Custom design values- valid FRM Design Values	Uncheck	Uncheck
	Valid FRM Monitors	Minimum number of design values	1	1
		Required design valued	none selected	none selected
		NH4 future calculation	calculate future year NH4 using base year (constant) DON values	calculate future year NH4 using base year (constant) DON values
Model Data Options	Temporal adjustment at monitor	Grid for point forecast	7x7	3x3
		Grid for spatial forecast	5x5	1x1

1.3 Visibility

The MATS tool was used to perform the USEPA recommended modeled test to assess visibility impacts (USEPA 2007). Regional haze is calculated by estimating light scattering and absorption by the chemical components of $PM_{2.5}$. The IMPROVE equation (shown in Chapter 4) provides an estimate of light extinction based on measured ambient particulate matter (Hand and Malm 2006). The equation reflects an empirical relationship between mass of particulate matter components and transmissometer measurement of extinction at monitoring sites in Class I areas within the IMPROVE network.

Similar to the estimation of future year $PM_{2.5}$ design values, the MATS tool uses the modeled RFF of individual $PM_{2.5}$ chemical components coupled with measured concentrations to estimate changes in visibility. The IMPROVE equation is used to convert the predicted future mass of PM components into an estimate of visibility changes.

The MATS visibility analysis implements the following 6 step process recommended in the USEPA guidance:

1. For each Class I area, rank visibility (in deciviews) on each day with observed speciated $PM_{2.5}$ data for each of the 5 years comprising the base period. In this study, the base period spans the years 2006 to 2010.
2. For each of the 5 years comprising the base period, calculate the mean deciviews for the 20 percent of days with worst and 20 percent of days with best visibility. For each Class I area, calculate the 5 year mean deciviews for worst and best days from each of the 5 years.
3. Calculate RRF for each PM component based on model results.
4. Multiply the RRF by the measured species concentration data during the base period (individually for the measured 20 percent best and worst days). This results in estimates of daily future year PM concentrations for each chemical component.
5. Using the results in Step 4 and the IMPROVE equation calculate the future daily extinction coefficients for the 20 percent best and 20 percent worst visibility days in each of the five base years.
6. Calculate daily deciview values (from total daily extinction) and then compute the future average mean deciviews for the worst and best days for each year. Then average the 5 years together to get the final future mean deciview value for the worst and best days.

The complete set of configuration options used for the MATS visibility analyses is presented in **Table A-5**.

Table A-5 Configuration Settings for Visibility MATS Analysis

Category	Parameter	Setting	4-km Domain	12-km Domain
Desired Output	Scenario Name	Name		
	Forecast	Temporally-adjust visibility levels at class 1 area	check	check
		Improve algorithm	use new version	use new version
		Use model grid cells at monitors	select	select
		Use model grid cells at class 1 area centroid	n/a	n/a
	Actions on run completion	Automatically extract all selected output files	check	check
Data Input	Monitor data	File name	ClassIareas_NEW_IMPROVEALG_2000to2010_v1.csv	ClassIareas_NEW_IMPROVEALG_2000to2010_v1.csv
	Model data	Baseline file	ARMS 2010 Typical Year 4-km model results	ARMS 2010 Typical Year 12-km model results
		Forecast file	ARMS 2021 future year 4-km model results	ARMS 2021 future year 12-km model results
	Using model data	Temporal adjustment at monitor	7x7	3x3
Filtering	Choose visibility data years	Start monitor year	2006	2006
		End monitor year	2010	2010
		Base model year	2008	2008
	Valid visibility monitors	Minimum years required for valid monitor	3	3

1.4 References

Abt Associates, Inc. 2009. Modeled Attainment Test Software User's Manual. Prepared for Office of Air Quality Planning and Standards, USEPA, Research Triangle Park, North Carolina. March 2009.

United States Environmental Protection Agency (USEPA). 2007. Guidance on the Use of Models and Other Analyses for Demonstrating Attainment of Air Quality Goals for Ozone, PM2.5, and Regional Haze. USEPA, Office of Air Quality and Planning Standards, Research Triangle Park, North Carolina. EPA 454/B-07-002. April 2007.

Appendix B

Detailed Ozone Assessment

1. Introduction

In Chapter 3, model-predicted ozone impacts are presented and compared to AAQS. Model results were processed to calculate the fourth highest daily maximum 8-hour ozone concentrations for direct comparison to AAQS. This method selects the results that occur during any given day during the full annual simulation, independent of time. The spatial plots apply this process to every grid cell and the resulting plots show the fourth highest daily maximum 8-hour concentrations irrespective of when the impacts occurred, meaning that the plots show the predicted spatial extent of elevated ozone concentrations over the course of a year but the elevated impacts do not necessarily occur simultaneously. While this approach is appropriate for comparing ozone impacts to AAQS, it is also beneficial to review specific ozone events for a more complete understanding of ozone impacts and effectiveness of mitigation measures.

To provide a more robust analysis of model-predicted ozone impacts, several additional analyses are presented in this appendix. Specifically, the following analyses are presented below for all future year model scenarios relative to the 2010 typical year:

- Summary of modeled maximum and 4th highest 8-hour ozone and date of occurrence;
- Time series of daily maximum 8-hour ozone at Ouray; and
- Spatial plots of two modeled ozone events.

In addition, analyses related to model-predicted ozone impacts and precursor concentrations are conducted to provide additional insight into the modeled ozone response for the mitigation scenarios. Together these analyses supplement the overall understanding of ozone formation in the Uinta Basin study area and assist with development and application of potential future mitigations measures.

2. Detailed Comparison of Ozone Impacts During Selected Model Events

Table B-1 summarizes the peak 8-hour ozone concentrations in the Uinta Basin study area for each model scenario and timing of when those peak concentrations occur throughout the year. While the specific locations of peak ozone impacts are not shown in **Table B-1,** the peak concentration tends to occur in the vicinity of the Ouray monitor (shown in figures in Chapter 3).

To evaluate the model-predicted differences between future year mitigation scenarios, the model-predicted daily maximum 8-hour ozone concentration was calculated at Ouray for each day of the full annual model simulation. The results are plotted as time series for each model simulation in **Figure B-1**. The time series of the full annual simulations are shown on the top graph and a more detailed review of the period from January 1 to March 15 are shown on the bottom graph. As shown in both **Table B-1** and **Figure B-1**, all model scenarios have the highest 8-hour ozone values during January through March. Outside of the January through March period, the model results are fairly similar between scenarios indicating that proposed mitigation measures have limited effect during periods without elevated ozone. While 2021 Scenarios 1 and 3 have similar temporal trends as the 2010 Typical year, 2021 Scenario 2 tends to have the lowest ozone relative to all other future year scenarios. Importantly, the 4th highest daily maximum 8-hour ozone concentration in 2021 Scenario 2 has a relatively small decrease of 3 ppb compared to the 2021 OTB Scenario, while 2021 Scenarios 1 and 3 are predicted to have higher ozone impacts than either the 2010 Typical year and the 2021 OTB Scenario.

As shown in **Table B-1**, the maximum modeled ozone concentrations do not occur on the same day for all scenarios. The events modeled on February 16 and March 1 have the highest 8-hour ozone concentrations and were selected to analyze the spatial differences from each future mitigation scenario during these peak events. **Figures B-2** and **B-3** show the spatial differences between the three mitigation scenarios relative to the 2021 OTB scenario for February 16 and March 1, respectively.

Table B-1 Summary of 8-hour Ozone Concentrations by Model Scenarios

Scenario	Daily Maximum 8-hr Ozone		4th Highest Daily Maximum 8-hr Ozone	
	Concentration (ppb)	Date	Concentration (ppb)	Date
2010 Typical Year	115	2/16	98	2/3
2021 OTB Controls	98	3/1	91	2/26
2021 Scenario 1	127	2/16	97	1/13
2021 Scenario 2	91	3/1	88	2/25
2021 Scenario 3	121	2/16	95	1/13

When comparing Scenario 1 to the OTB Scenario in **Figures B-2** and **B-3**, a potential 5~6 ppb reduction in ozone concentrations occurs in northern half of the Uinta Basin study area. However, there is a large potential increase of 30 ppb on February 16 and 20 ppb on March 1 in the vicinity of Ouray (where the concentrations are already largest) indicating large potential disbenefits associated with Scenario 1 mitigation measures. These results are similar to the spatial analyses shown in Chapter 3 (**Figure 3-12**); however, the day-specific differences are larger in magnitude and located in a smaller geographic area than results that are independent of time.

When comparing Scenario 2 to the OTB Scenario in **Figures B-2** and **B-3**, a potential 6-8 ppb reduction in ozone concentrations occurs in the vicinity of the Ouray site. While the reduction of ozone is not particularly large, there is no predicted ozone disbenefit associated with Scenario 2 mitigation measures (i.e., there is no area with predicted ozone increases relative to the OTB Scenario). These results are similar to the spatial analyses shown in Chapter 3 (**Figure 3-16**); however, the day-specific differences are larger in magnitude and located in a concentrated area in the vicinity of the Ouray site.

When comparing Scenario 3 to the OTB Scenario in **Figures B-2** and **B-3**, the combined NOx and VOC emissions reductions have similar impacts as shown for Scenario1. However, the important differences are that the areas with predicted ozone reduction have a greater reduction (i.e., larger benefit) and the areas with predicted ozone increases are predicted to have lower increases (i.e., smaller disbenefit) under Scenario 3. Furthermore, the largest ozone reduction of all mitigation scenarios is 8.6 ppb on March 1, which is a result of Scenario 3. Notably, this predicted reduction does not occur in an area with peak ozone concentrations.

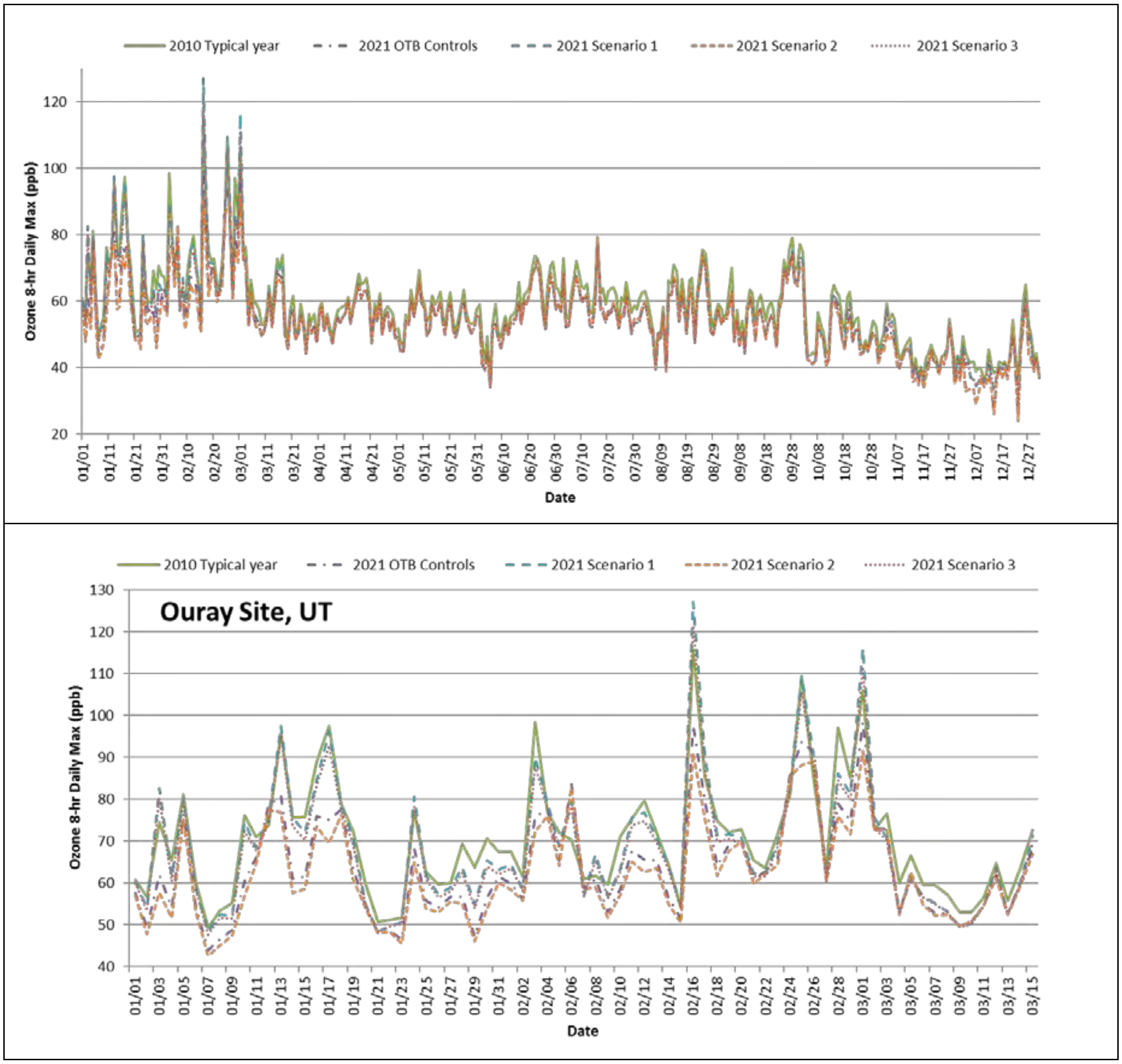
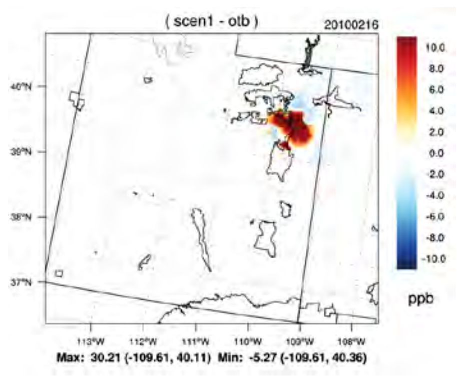
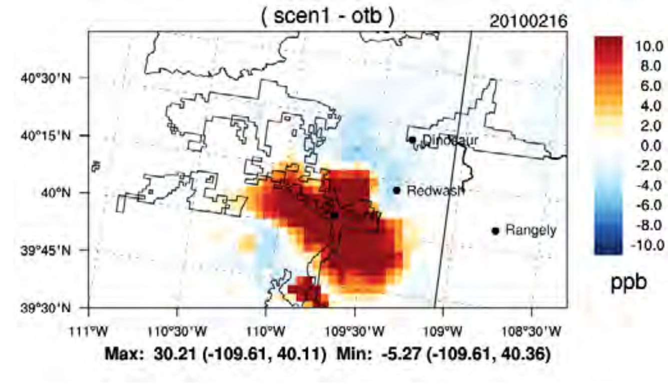
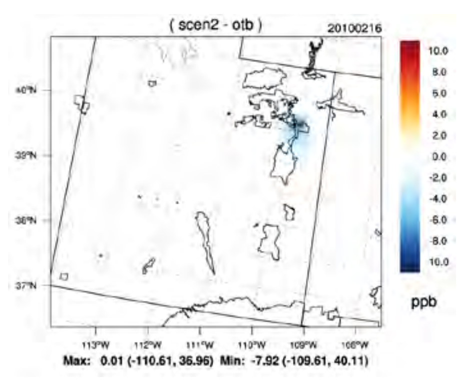
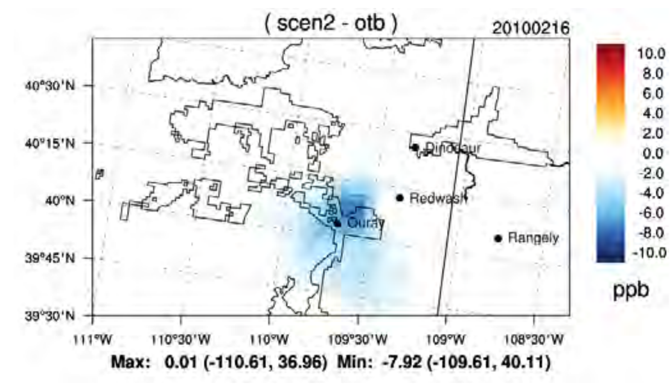


Figure B-1 Daily Maximum 8-hour Ozone at Ouray for all Model Scenarios

<table>
<tr><th></th><th>4-km Domain</th><th>Uinta Basin study area</th></tr>
<tr><td>Scen1 versus OTB</td><td>
</td><td>
</td></tr>
<tr><td>Scen2 versus OTB</td><td>
</td><td>
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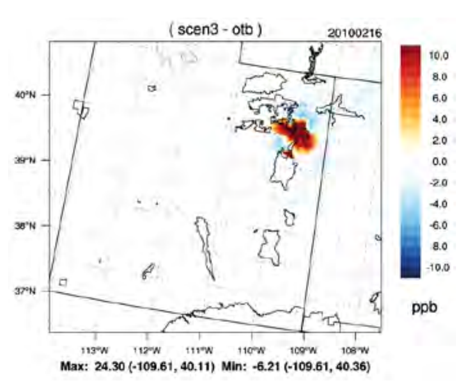
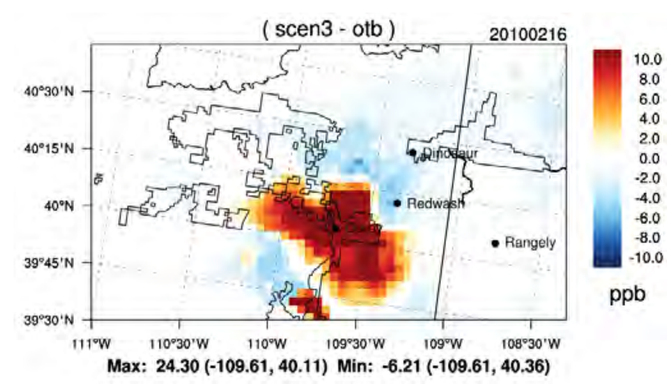
<tr><td>Scen3 versus OTB</td><td>
</td><td>
</td></tr>
</table>

Figure B-2 Daily Maximum 8-hour Ozone Spatial Differences on February 16

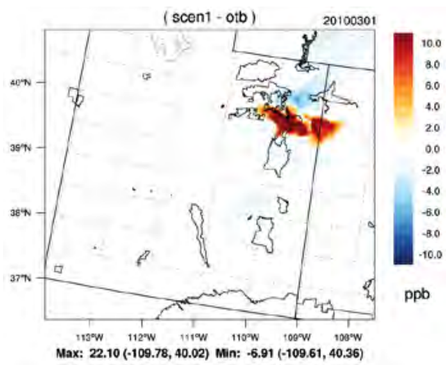
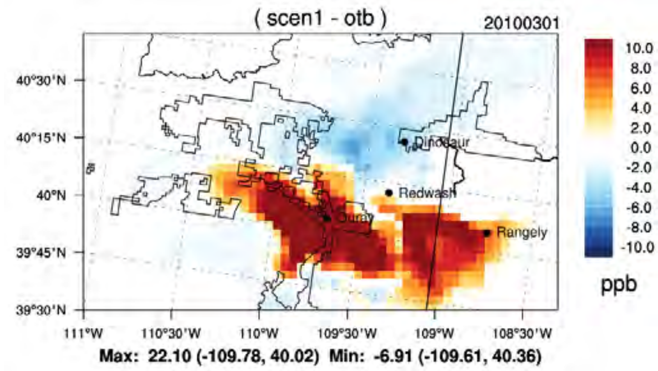
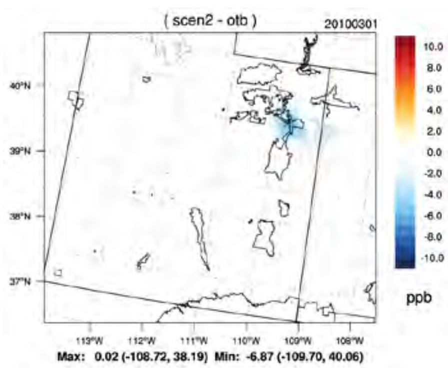
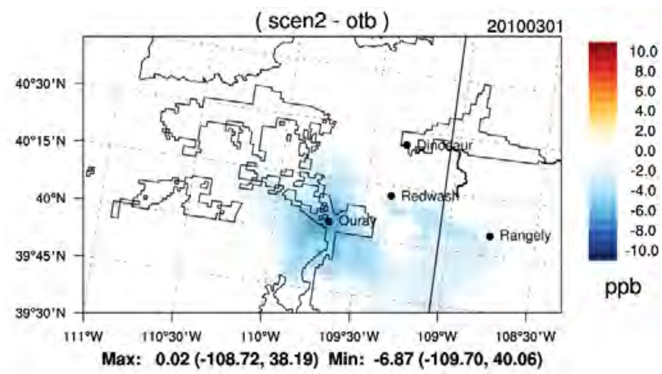
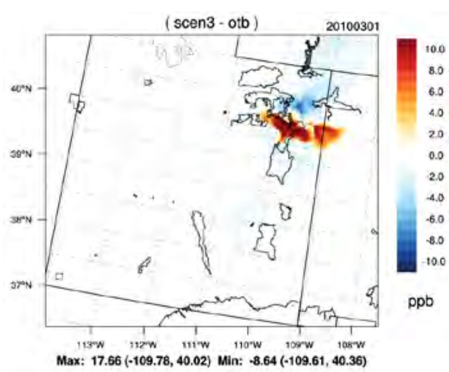
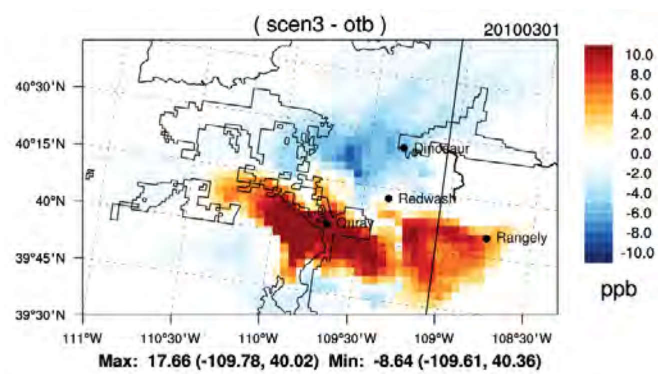
	4-km Domain	Uinta Basin study area
Scen1 versus OTB		
Scen2 versus OTB		
Scen3 versus OTB		

Figure B-3 Daily Maximum 8-hour Ozone Spatial Differences on March 16

3. Ozone Responses to Emissions Controls: Radical-limited or NOx-limited Regions

3.1 NMHC to NOx ratio

The ozone-production mechanism in the literature is often illustrated using ozone isopleths (Dodge, 1977). When the ratios of non-methane hydrocarbons (NMHCs) to NO_x are less than 15:1 in the Empirical Kinetic Modeling Approach (EKMA), the maximum ozone concentration is sensitive to the hydrocarbon concentrations and ozone is "VOC-limited". In general, under VOC-limited conditions, increases of VOC concentrations would lead to increases in ozone production (and vice versa), but under NO_x-limited conditions, the change in VOC concentrations has little effect on ozone production or destruction. Although ozone formation can be affected by reducing either NO_x or VOC emissions, depending on the limiting reagent and the conditions of the environment (Dodge, 1987), NOx emissions reductions could lead to increased ozone formation. Increased levels of ozone that occur as a result of emissions reductions is referred to as "ozone disbenefits". As described in the previous section, ozone disbenefits are predicted to occur in some areas of the Uinta Basin study area during ozone events under Scenarios 1 and 3. In this section, additional information is provided to further understand the ozone sensitivity to the three mitigation scenarios.

The spatial variability in the NMHCs to NO_x ratio is presented in **Figure B-4** (top panel) for the total annual total emissions in the 2021 OTB scenario. As can be seen, the NMHC/NO_x ratios generally exceed 15:1 throughout the Uinta Basin study area. The exception is the area in center of the study area (south of the oil wells in Duschense County), and the area southeast of Ouray where the NMHC/NO_x ratios are generally less than 10:1, which is classified as VOC-limited. As shown in **Figure B-4** (bottom panel) the areas with the lower NMHC/NO_x ratios typically correspond with higher modeled ozone concentrations. In conjunction with high ozone production in VOC-limited areas, the reduction of NO_x emissions under Scenarios 1 and 3 lead to ozone disbenefits (shown as ozone increases relative to OTB scenario in **Figures 3-12**, **B-2**, and **B-3**) when reductions in NO_x inhibits ozone titration. In areas of the Uinta Basin with NMHC/NO_x ratios exceeding 15:1, NO_x emissions reductions under Scenarios 1 and 3 show decreases in ozone concentrations, which is indicative of NO_x-limited regimes.

Since Scenario 2 (VOC mitigation measures) provides the lowest ozone impacts of all future year scenarios it is likely the peak ozone impacts are in VOC-limited areas. This is supported by the spatial plots of VOC emissions reductions under Scenario 2 which are focused in the south central part of the study area (**Figure 2-7**) and the corresponding changes in ozone, as shown in **Figures 3-16, B-2,** and **B-3**. In contrast, the VOC emissions reductions seem to have little effect on ozone formation in the northern portions of the study area, suggesting that those areas are in NO_x-limited regime.

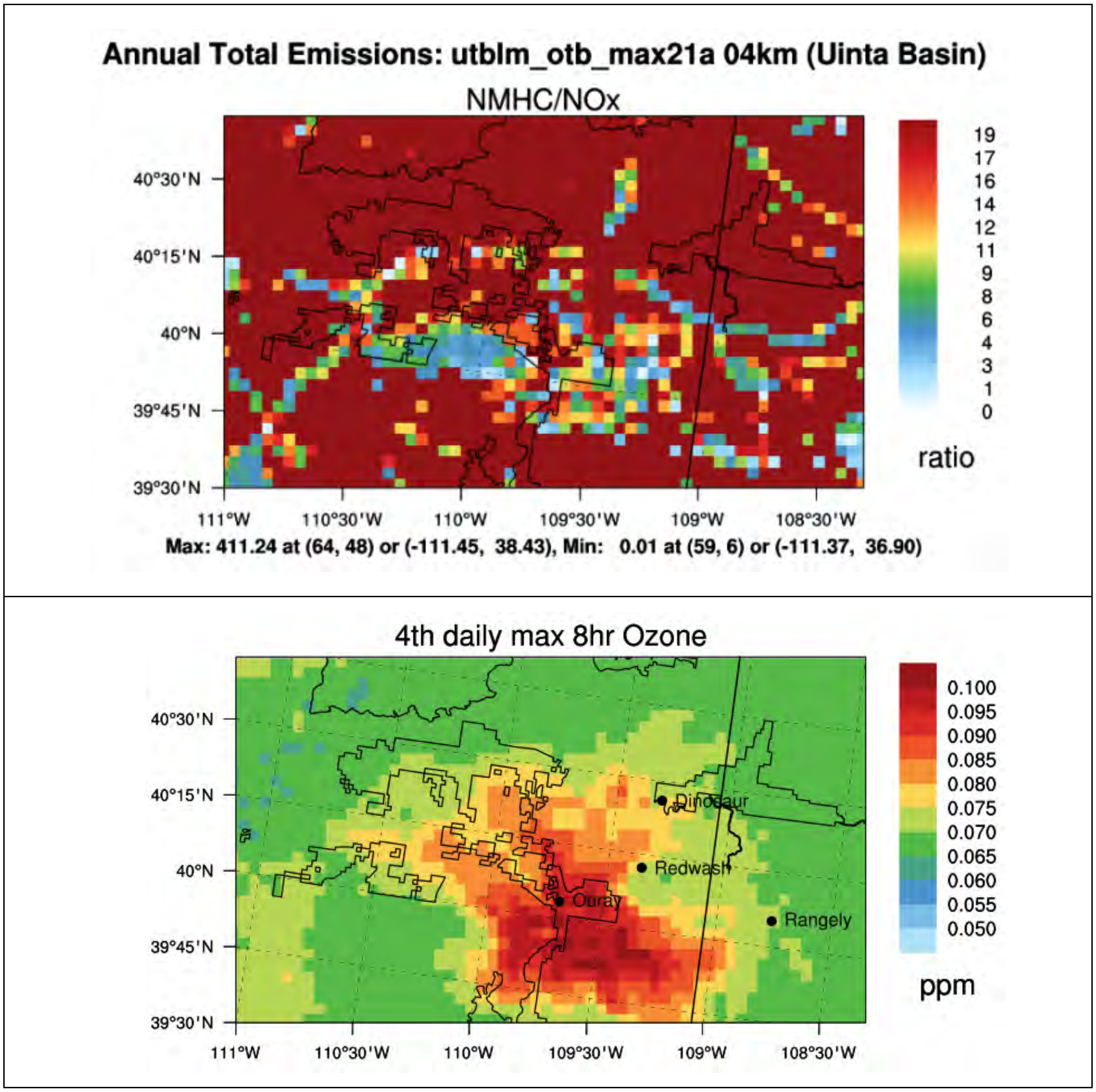


Figure B-4 Spatial Variability in NMHC and NOx ratios under the OTB Scenario and Fourth Highest Daily Maximum 8-hour Ozone

3.2 Indicator Species

To further analyze and support the classification of VOC-limited or NO_x-limited areas, it is helpful to evaluate the total radical concentration generated by photolysis of the VOCs in the atmosphere since radical concentrations are the limiting factor for many oxidation pathways (Tonnesen and Dennis, 2000a, b). One method to evaluate radical formation and availability is the indicator species approach to identify production of odd oxygen (P(Ox)) as related to ozone sensitivity to VOC or NO_x. The indicator species approach is based on ratios such as $HCHO/NO_2$, ozone/NO_y, ozone/HNO_3, and $P(H_2O_2)/P(HNO_3)$. If these ratios exceeded a certain threshold it is indicative of NO_x-sensitive chemistry while if the ratios are below a certain threshold it is indicative of VOC-sensitive chemistry (Sillman, 1995). Importantly, these approaches (and related classifications) were developed for assessment of urban summer ozone. Winter ozone formation in the Uinta Basin may be complicated by additional sources of radicals, such as HONO formation via reaction with snow surfaces. Therefore, it is recommended to refer to the VOC-limited regime as a radical-limited regime instead.

The indicator species approach is applied to the model results from the 2021 OTB Scenario. **Figure B-5** shows the spatial distribution of $HCHO/NO_2$ in Uinta Basin study area during February 16 (top panel) and March 1 (bottom panel) from the 2021 OTB Scenario. Martin et al. (2004) and Sillman (1995) indicate that NOx-limited regime is represented by $HCHO/NO_2$ greater than 1, while values less than 1 indicate a radical-limited regime. As shown in **Figure B-5**, the northern central and eastern parts of the Uinta Basin study area have $HCHO/NO_2$ ratios greater than 1, consistent with NOx-limited areas. In contrast, southern and central regions generally have $HCHO/NO_2$ ratios less than 1, consistent with radical-limited areas. The results of the indicator species approach are consistent with the evaluation of the NMHC/NOx ratios.

4. Future Analysis

To fully characterize ozone sensitivity to mitigation measures, it is recommended that a complete control strategy evaluation include a comprehensive analysis of the values of indicators of both P(Ox) and ozone concentration sensitivity to radicals or NOx as a function of time during the day for a number of high ozone days and for several upwind grid cells (Tonnesen and Dennis, 2000a). The analysis of the diurnal ozone response could be particularly informative related to the diurnal HONO measurements collected in snowy winter conditions.

One can use a chemical budget analysis using integrated reaction rates (IRR) to analyze the budgets of radicals, NO_y, odd oxygen (Ox), and ozone. IRR includes a detailed mass budget analysis of reactions of VOC, generation of free radicals (HO_X) and conversion of reactive NO_X to inert forms of oxidized nitrogen (NO_Z). The IRR outputs also could be used to evaluate the different sources of radicals (HONO, HCHO, ozone) and the pathways for conversion of NO_X to HNO_3. The IRR is very useful for finding where (i.e., which grid cells and which layers) ozone production and reactivity are represented in the model, and thus help determining whether they are radical- or NOx-limited.

For future analysis in developing a control strategy that leads to reductions in ozone, it is recommended further examine additional indicator species using IRR approach to fully investigate two types of indicator species: 1) local indicators of the instantaneous rate of odd oxygen production ($P(O_X)$); and 2) long-lived indicators of ozone concentration to help determine the radical- or NOx-limited nature of the study area.

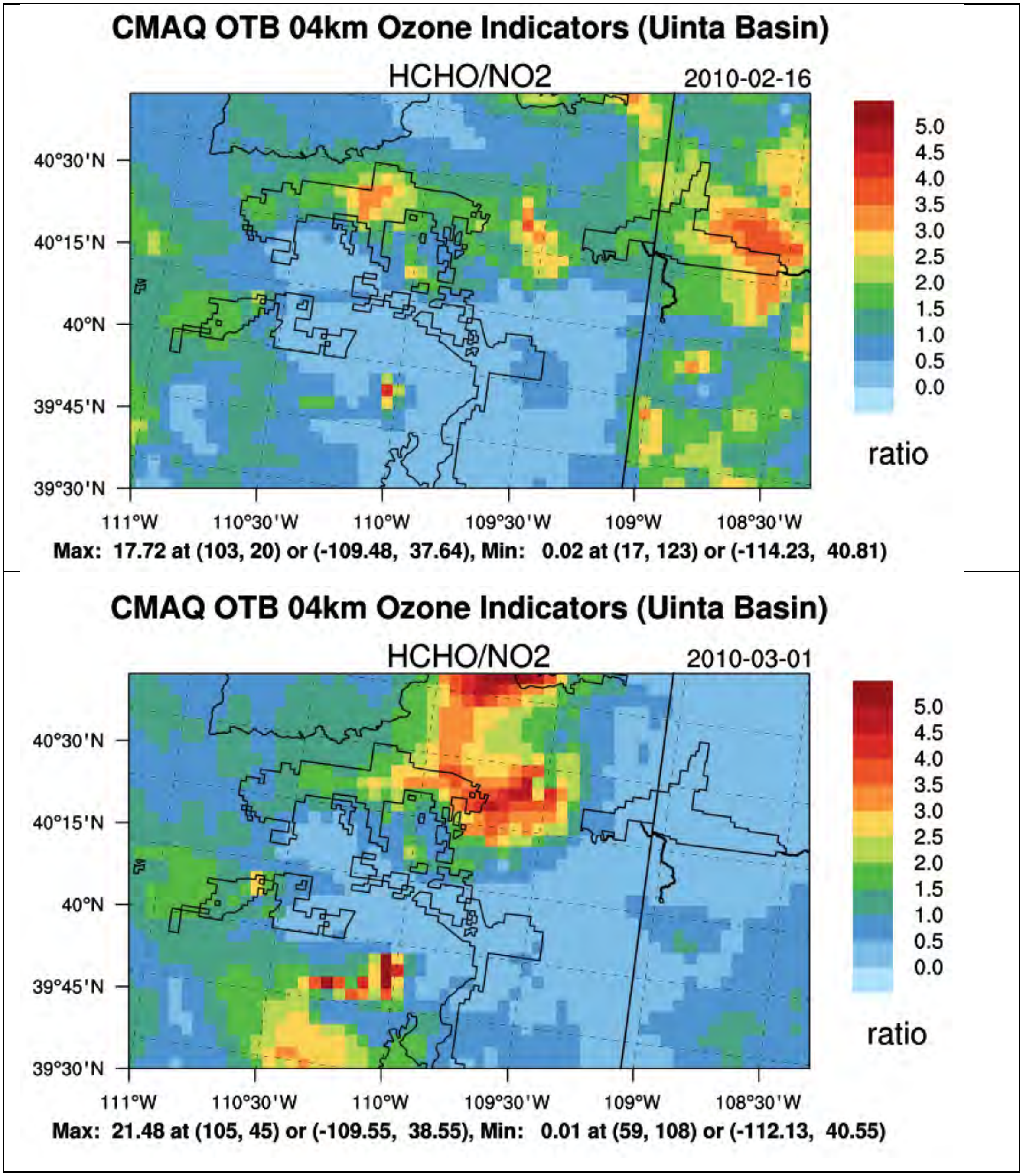


Figure B-5 OTB Scenario Indicator Species HCHO/NO_2 During Feburary 16 and March 1

5. References

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Tonnesen, G. S. and R. L. Dennis. 2000a. Analysis of Radical Propagation Efficiency to Assess Ozone Sensitivity to Hydrocarbons and NO_X. Part I: Local Indicators of Instantaneous Odd Oxygen Production Sensitivity. Journal of Geophysical Research 105:9213-9225.

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Sillman, S. 1995. The use of NOy, H2O2, and HNO3 as indicators for ozone-NOx-hydrocarbon sensitivity in urban locations, J. Geophys. Res., 100, 14,175-14,188.

Appendix C

Speciated Nitrogen Deposition

C. Speciated Nitrogen Deposition

Appendix C provides additional information regarding the individual nitrogen deposition species modeled in the 2010 base year, 2010 typical year, 2021 OTB Control Scenario, 2021 Scenario 1, 2021 Scenario 2, and 2021 Scenario 3. **Table C-1** describes each of the modeled nitrogen deposition species that comprise the total modeled nitrogen deposition fluxes discussed in Chapter 5. **Tables C-2** through **C-13** show modeled nitrogen deposition results for each species in **Table C-1**. Results are grouped by oxidized and reduced nitrogen species for both dry and wet deposition.

Table C-1 Modeled Nitrogen Deposition Species

Modeled Species Abbreviation	Description	Category
NO	nitric oxide	oxidized
NO2	nitrogen dioxide	oxidized
NO3	nitrate radical	oxidized
HNO3	nitric acid	oxidized
HONO	nitrous acid	oxidized
N2O5	dinitrogen pentoxide	oxidized
PAN	peroxyacetyl nitrate	oxidized
PANX	C3+ peroxyacetyl nitrate species	oxidized
PNA	peroxynitric acid	oxidized
OPAN	peroxyacyl nitrate from OPO3 (peroxyacyl radical from an unsaturated dicarbonyl)	oxidized
NTR	organic nitrates	oxidized
INTR	organic nitrates from NO+ISO2 (peroxy radical from OH+isoprene)	oxidized
CRON	nitro-cresols	oxidized
CRPX	nitro-cresol hydroperoxides	oxidized
PNO3	particulate nitrate	oxidized
NH3	ammonia	reduced
PNH4	particulate ammonium	reduced

Table C-2 Modeled Dry Deposition Nitrogen Species for the 2010 Base Year

Assessment Areas	Dry Deposition (kg N/ha/yr)																		
	Oxidized Nitrogen																Reduced Nitrogen		
	NO	NO2	NO3	HNO3	HONO	N2O5	PAN	PANX	PNA	OPAN	NTR	INTR	CRON	CRPX	PNO3	Total	NH3	PNH4	Total
Class I Areas																			
Arches NP	2.2E-03	2.2E-02	2.8E-03	6.4E-01	8.4E-04	2.1E-02	6.5E-02	3.9E-02	3.9E-11	3.2E-03	7.4E-02	7.4E-11	9.7E-13	9.7E-04	5.0E-02	0.9	3.1E+00	7.6E-02	3.2
Black Canyon of the Gunnison WA	3.0E-03	3.4E-02	2.1E-03	7.6E-01	1.7E-03	2.3E-02	9.1E-02	5.0E-02	5.0E-11	2.2E-03	9.9E-02	9.9E-11	9.9E-13	9.9E-04	4.0E-02	1.1	4.8E-01	6.1E-02	0.5
Bridger WA	1.4E-03	1.2E-02	3.5E-03	6.1E-01	4.8E-04	3.4E-02	7.7E-02	4.1E-02	4.1E-11	2.3E-03	7.0E-02	7.0E-11	9.2E-13	9.2E-04	8.7E-02	0.9	6.6E-01	1.3E-01	0.8
Bryce Canyon NP	1.2E-03	1.3E-02	3.2E-03	6.7E-01	7.3E-04	2.7E-02	6.9E-02	3.9E-02	3.9E-11	3.0E-03	7.9E-02	7.9E-11	1.2E-12	1.2E-03	7.7E-02	1.0	2.7E+00	8.9E-02	2.8
Canyonlands NP	1.7E-03	1.6E-02	5.3E-03	7.7E-01	7.3E-04	3.4E-02	6.3E-02	3.5E-02	3.5E-11	2.7E-03	7.3E-02	7.3E-11	9.7E-13	9.7E-04	5.5E-02	1.1	7.5E-01	8.0E-02	0.8
Capitol Reef NP	1.3E-03	1.2E-02	3.1E-03	7.0E-01	5.9E-04	2.3E-02	6.1E-02	3.4E-02	3.4E-11	2.5E-03	6.8E-02	6.8E-11	9.5E-13	9.5E-04	6.2E-02	1.0	1.4E+00	8.8E-02	1.4
Eagles Nest WA	1.0E-02	6.7E-02	1.5E-03	8.4E-01	4.3E-03	5.3E-02	9.6E-02	5.2E-02	5.2E-11	2.0E-03	9.2E-02	9.2E-11	8.4E-13	8.4E-04	4.9E-02	1.3	3.3E-01	8.1E-02	0.4
Fitzpatrick WA	1.2E-03	8.9E-03	3.9E-03	6.2E-01	4.6E-04	3.1E-02	7.4E-02	3.8E-02	3.8E-11	2.1E-03	6.6E-02	6.6E-11	9.6E-13	9.6E-04	9.7E-02	0.9	6.3E-01	1.4E-01	0.8
Flat Tops WA	3.4E-03	3.2E-02	4.7E-03	1.1E+00	1.8E-03	8.2E-02	1.1E-01	6.1E-02	6.1E-11	2.7E-03	1.1E-01	1.1E-10	1.3E-12	1.3E-03	7.7E-02	1.5	5.3E-01	1.2E-01	0.7
La Garita WA	1.7E-03	1.4E-02	3.1E-03	9.3E-01	7.9E-04	5.2E-02	9.0E-02	4.6E-02	4.6E-11	1.5E-03	8.3E-02	8.3E-11	7.7E-13	7.7E-04	5.8E-02	1.3	2.8E-01	8.1E-02	0.4
Maroon Bells-Snowmass WA	3.3E-03	2.7E-02	3.0E-03	9.4E-01	1.4E-03	4.6E-02	1.0E-01	5.4E-02	5.4E-11	2.0E-03	1.0E-01	1.0E-10	1.0E-12	1.0E-03	5.8E-02	1.3	4.3E-01	8.7E-02	0.5
Mesa Verde NP	9.2E-03	1.0E-01	9.6E-03	1.7E+00	3.8E-03	1.5E-01	1.0E-01	5.4E-02	5.4E-11	2.5E-03	1.0E-01	1.0E-10	1.0E-12	1.0E-03	6.6E-02	2.3	3.5E-01	8.1E-02	0.4
Mount Zirkel WA	7.6E-03	7.8E-02	6.6E-03	1.3E+00	3.6E-03	2.2E-01	1.3E-01	7.0E-02	7.0E-11	3.2E-03	1.2E-01	1.2E-10	1.4E-12	1.4E-03	9.1E-02	2.1	5.0E-01	1.5E-01	0.6
Rawah WA	4.5E-03	4.1E-02	5.9E-03	1.2E+00	2.1E-03	2.0E-01	1.2E-01	6.3E-02	6.3E-11	2.7E-03	1.1E-01	1.1E-10	1.2E-12	1.2E-03	8.6E-02	1.9	4.8E-01	1.5E-01	0.6
Rocky Mountain NP	7.5E-03	5.0E-02	6.0E-03	1.1E+00	3.6E-03	1.4E-01	1.2E-01	6.3E-02	6.3E-11	2.8E-03	1.1E-01	1.1E-10	1.1E-12	1.1E-03	8.3E-02	1.7	4.3E-01	1.4E-01	0.6
Weminuche WA	4.1E-03	3.0E-02	2.1E-03	9.4E-01	1.7E-03	5.1E-02	9.9E-02	5.2E-02	5.2E-11	1.6E-03	9.2E-02	9.2E-11	7.8E-13	7.8E-04	5.3E-02	1.3	2.5E-01	6.7E-02	0.3
West Elk WA	2.0E-03	2.0E-02	2.7E-03	8.6E-01	1.1E-03	3.4E-02	9.4E-02	5.0E-02	5.0E-11	2.0E-03	9.8E-02	9.8E-11	1.0E-12	1.0E-03	5.2E-02	1.2	4.7E-01	8.0E-02	0.5
Class II Areas																			
Dinosaur National Monument	3.0E-03	2.6E-02	4.9E-03	8.0E-01	1.6E-03	6.7E-02	8.5E-02	4.9E-02	4.9E-11	3.9E-03	8.7E-02	8.7E-11	1.2E-12	1.2E-03	5.4E-02	1.2	8.3E-01	8.6E-02	0.9
Flaming Gorge National Recreation Area	4.3E-03	3.3E-02	2.4E-03	5.9E-01	1.7E-03	3.3E-02	7.3E-02	4.2E-02	4.2E-11	3.4E-03	7.1E-02	7.1E-11	1.1E-12	1.1E-03	4.4E-02	0.9	1.2E+00	7.2E-02	1.3
Fort Hall IR	1.0E-02	1.3E-01	4.0E-03	5.2E-01	4.0E-03	6.0E-02	8.8E-02	4.9E-02	4.9E-11	6.0E-03	8.9E-02	8.9E-11	1.6E-12	1.6E-03	5.7E-02	1.0	2.9E+00	7.1E-02	3.0
Goshute IR	6.4E-04	6.0E-03	2.6E-03	6.7E-01	3.9E-04	1.3E-02	4.9E-02	2.4E-02	2.4E-11	1.3E-03	5.3E-02	5.3E-11	7.6E-13	7.6E-04	4.5E-02	0.9	2.3E-01	5.0E-02	0.3
High Uintas WA	1.8E-03	1.7E-02	3.8E-03	6.7E-01	5.9E-04	5.0E-02	9.7E-02	5.4E-02	5.4E-11	3.7E-03	8.7E-02	8.7E-11	1.0E-12	1.0E-03	1.3E-01	1.1	1.2E+00	1.8E-01	1.4
Navajo IR	9.3E-03	5.8E-02	4.7E-03	8.2E-01	2.4E-03	5.3E-02	6.0E-02	3.3E-02	3.3E-11	2.0E-03	7.4E-02	7.4E-11	8.0E-13	8.0E-04	6.5E-02	1.2	3.6E-01	6.2E-02	0.4
Paitute IR	5.3E-03	4.3E-02	5.1E-03	8.7E-01	3.1E-03	2.9E-02	6.9E-02	4.4E-02	4.4E-11	4.9E-03	8.3E-02	8.3E-11	1.0E-12	1.0E-03	8.2E-02	1.2	2.1E+00	6.9E-02	2.2
Skull Valley IR	2.2E-03	1.8E-02	4.5E-03	6.8E-01	1.0E-03	3.9E-02	6.1E-02	3.5E-02	3.5E-11	3.2E-03	6.5E-02	6.5E-11	1.2E-12	1.2E-03	4.7E-02	1.0	7.2E-01	5.9E-02	0.8
Southern Ute IR	2.6E-02	2.4E-01	1.6E-03	1.3E+00	6.4E-03	5.2E-02	9.9E-02	5.5E-02	5.5E-11	1.9E-03	1.0E-01	1.0E-10	7.1E-13	7.1E-04	4.6E-02	2.0	2.9E-01	6.1E-02	0.4
Uintah and Ouray IR	1.1E-02	8.9E-02	2.8E-03	7.7E-01	2.2E-03	4.3E-02	9.5E-02	5.7E-02	5.7E-11	5.6E-03	1.0E-01	1.0E-10	1.2E-12	1.2E-03	6.2E-02	1.2	2.5E+00	9.2E-02	2.6
Ute Mountain IR	2.1E-02	1.2E-01	5.4E-03	1.2E+00	4.3E-03	9.6E-02	7.4E-02	4.1E-02	4.1E-11	2.1E-03	8.3E-02	8.3E-11	7.2E-13	7.2E-04	4.5E-02	1.7	5.7E-01	6.1E-02	0.6
Wind River IR	3.6E-03	2.7E-02	2.5E-03	5.0E-01	1.0E-03	1.9E-02	6.3E-02	3.3E-02	3.3E-11	1.8E-03	6.0E-02	6.0E-11	7.9E-13	7.9E-04	3.7E-02	0.7	4.3E-01	6.2E-02	0.5

Table C-3 Modeled Wet Deposition Nitrogen Species for the 2010 Base Year

Assessment Areas	Wet Deposition (kg N/ha/yr)																		
	Oxidized Nitrogen																Reduced Nitrogen		
	NO	NO2	NO3	HNO3	HONO	N2O5	PAN	PANX	PNA	OPAN	NTR	INTR	CRON	CRPX	PNO3	Total	NH3	PNH4	Total
Class I Areas																			
Arches NP	0.0E+00	3.0E-08	4.1E-09	5.0E-07	2.8E-05	0.0E+00	3.3E-04	7.9E-06	1.5E-02	2.8E-07	8.8E-06	8.8E-15	2.8E-16	2.8E-16	8.5E-01	0.9	4.4E-04	1.1E+00	1.1
Black Canyon of the Gunnison WA	6.3E-12	2.0E-07	6.6E-09	4.0E-07	4.9E-05	0.0E+00	7.5E-04	1.8E-05	2.8E-02	3.7E-07	1.8E-05	1.8E-14	3.7E-16	3.7E-16	1.0E+00	1.1	6.5E-05	1.1E+00	1.1
Bridger WA	1.6E-12	4.5E-07	9.1E-09	3.2E-03	7.6E-05	3.9E-05	5.7E-04	2.1E-05	4.6E-02	6.4E-07	2.0E-05	2.0E-14	6.4E-16	6.4E-16	1.3E+00	1.4	9.0E-04	2.0E+00	2.0
Bryce Canyon NP	0.0E+00	1.7E-07	6.1E-09	2.6E-07	3.5E-05	0.0E+00	3.4E-04	9.6E-06	1.2E-02	3.0E-07	1.3E-05	1.3E-14	3.0E-16	3.0E-16	6.1E-01	0.6	2.5E-04	1.1E+00	1.1
Canyonlands NP	0.0E+00	2.8E-08	3.0E-09	3.7E-07	1.7E-05	0.0E+00	1.9E-04	6.3E-06	1.0E-02	1.9E-07	7.1E-06	7.1E-15	1.9E-16	1.9E-16	5.4E-01	0.5	1.3E-04	6.4E-01	0.6
Capitol Reef NP	0.0E+00	1.4E-08	2.1E-09	2.6E-07	1.5E-05	0.0E+00	1.5E-04	5.2E-06	8.5E-03	1.7E-07	5.5E-06	5.5E-15	1.7E-16	1.7E-16	4.9E-01	0.5	1.2E-04	6.4E-01	0.6
Eagles Nest WA	0.0E+00	3.3E-07	3.7E-09	5.0E-03	8.7E-05	3.5E-05	4.0E-04	1.8E-05	4.0E-02	2.9E-07	1.6E-05	1.6E-14	2.9E-16	2.9E-16	8.4E-01	0.9	3.9E-04	8.1E-01	0.8
Fitzpatrick WA	0.0E+00	2.4E-07	5.1E-09	2.2E-03	3.9E-05	1.2E-05	4.2E-04	1.5E-05	3.1E-02	3.9E-07	1.5E-05	1.5E-14	3.9E-16	3.9E-16	8.7E-01	0.9	8.0E-04	1.4E+00	1.4
Flat Tops WA	0.0E+00	4.1E-07	6.1E-09	5.6E-03	9.9E-05	1.1E-04	4.5E-04	1.8E-05	4.6E-02	3.8E-07	1.6E-05	1.6E-14	3.8E-16	3.8E-16	1.1E+00	1.1	1.3E-03	1.2E+00	1.2
La Garita WA	0.0E+00	7.7E-08	3.2E-09	3.8E-03	2.8E-05	1.4E-04	5.2E-04	2.2E-05	3.1E-02	1.9E-07	2.3E-05	2.3E-14	1.9E-16	1.9E-16	7.7E-01	0.8	3.0E-04	7.1E-01	0.7
Maroon Bells-Snowmass WA	0.0E+00	2.7E-07	5.8E-09	4.2E-03	7.9E-05	3.5E-05	4.9E-04	1.9E-05	4.3E-02	3.2E-07	1.9E-05	1.9E-14	3.2E-16	3.2E-16	9.3E-01	1.0	4.2E-04	8.8E-01	0.9
Mesa Verde NP	6.4E-18	8.1E-07	1.2E-08	3.1E-06	1.3E-04	0.0E+00	7.3E-04	1.8E-05	2.7E-02	3.5E-07	1.9E-05	1.9E-14	3.5E-16	3.5E-16	1.6E+00	1.6	1.3E-05	8.3E-01	0.8
Mount Zirkel WA	0.0E+00	8.6E-07	9.0E-09	3.4E-03	1.2E-04	2.5E-05	4.6E-04	2.0E-05	4.4E-02	4.8E-07	1.8E-05	1.8E-14	4.8E-16	4.8E-16	1.3E+00	1.4	4.0E-04	1.3E+00	1.3
Rawah WA	0.0E+00	2.6E-07	4.8E-09	6.4E-03	6.6E-05	1.0E-05	4.3E-04	2.1E-05	3.6E-02	3.8E-07	1.9E-05	1.9E-14	3.8E-16	3.8E-16	9.9E-01	1.0	1.6E-04	1.0E+00	1.0
Rocky Mountain NP	0.0E+00	4.4E-07	5.7E-09	4.2E-03	1.3E-04	7.9E-05	5.5E-04	2.6E-05	5.1E-02	5.0E-07	2.3E-05	2.3E-14	5.0E-16	5.0E-16	1.4E+00	1.4	2.0E-04	1.3E+00	1.3
Weminuche WA	1.6E-10	1.0E-06	1.2E-08	4.6E-03	1.6E-04	5.4E-05	1.4E-03	3.4E-05	6.0E-02	3.9E-07	3.6E-05	3.6E-14	3.9E-16	3.9E-16	1.8E+00	1.8	3.6E-05	1.3E+00	1.3
West Elk WA	0.0E+00	3.0E-07	1.3E-08	5.7E-03	7.4E-05	3.3E-04	6.0E-04	2.4E-05	4.3E-02	4.6E-07	2.4E-05	2.4E-14	4.6E-16	4.6E-16	1.2E+00	1.3	3.2E-04	1.1E+00	1.1
Class II Areas																			
Dinosaur National Monument	0.0E+00	4.2E-08	4.6E-09	2.2E-07	3.2E-05	0.0E+00	3.0E-04	8.1E-06	1.6E-02	2.6E-07	7.9E-06	7.9E-15	2.6E-16	2.6E-16	7.4E-01	0.8	2.0E-04	1.0E+00	1.0
Flaming Gorge National Recreation Area	0.0E+00	3.8E-08	2.5E-09	1.3E-07	2.5E-05	0.0E+00	2.8E-04	8.5E-06	1.3E-02	2.5E-07	7.6E-06	7.6E-15	2.5E-16	2.5E-16	5.7E-01	0.6	2.5E-04	1.0E+00	1.0
Fort Hall IR	0.0E+00	4.9E-08	8.7E-09	7.1E-05	2.3E-05	1.9E-06	1.6E-04	7.5E-06	1.3E-02	2.5E-07	7.1E-06	7.1E-15	2.5E-16	2.5E-16	5.2E-01	0.5	3.3E-04	1.1E+00	1.1
Goshute IR	7.0E-17	4.3E-08	5.1E-09	2.0E-07	2.0E-05	0.0E+00	3.1E-04	8.5E-06	1.3E-02	2.2E-07	8.2E-06	8.2E-15	2.2E-16	2.2E-16	5.4E-01	0.6	4.5E-05	6.5E-01	0.7
High Uintas WA	1.1E-16	1.4E-07	3.3E-09	9.0E-08	5.7E-05	0.0E+00	6.9E-04	1.9E-05	3.1E-02	6.4E-07	1.8E-05	1.8E-14	6.4E-16	6.4E-16	9.7E-01	1.0	4.5E-04	1.9E+00	1.9
Navajo IR	1.3E-10	1.9E-07	1.8E-08	1.7E-04	3.2E-05	7.1E-06	2.8E-04	1.1E-05	1.3E-02	1.7E-07	1.5E-05	1.5E-14	1.7E-16	1.7E-16	5.9E-01	0.6	5.0E-05	4.2E-01	0.4
Paitute IR	0.0E+00	2.7E-07	9.2E-09	6.2E-07	7.7E-05	0.0E+00	2.4E-04	7.6E-06	1.9E-02	3.9E-07	9.0E-06	9.0E-15	3.9E-16	3.9E-16	9.4E-01	1.0	5.4E-04	1.1E+00	1.1
Skull Valley IR	9.4E-13	2.7E-08	5.1E-09	2.9E-07	3.0E-05	0.0E+00	4.2E-04	9.0E-06	1.5E-02	3.2E-07	1.1E-05	1.1E-14	3.2E-16	3.2E-16	7.5E-01	0.8	2.0E-04	9.2E-01	0.9
Southern Ute IR	1.2E-09	1.0E-06	2.6E-08	1.4E-05	1.5E-04	1.7E-06	1.3E-03	2.8E-05	3.4E-02	3.2E-07	3.1E-05	3.1E-14	3.2E-16	3.2E-16	1.6E+00	1.6	5.7E-06	9.1E-01	0.9
Uintah and Ouray IR	0.0E+00	5.6E-08	3.4E-09	1.6E-07	3.3E-05	0.0E+00	2.3E-04	7.6E-06	1.5E-02	3.0E-07	7.9E-06	7.9E-15	3.0E-16	3.0E-16	6.3E-01	0.6	3.9E-04	1.0E+00	1.0
Ute Mountain IR	6.6E-10	9.3E-07	1.5E-08	3.3E-06	8.8E-05	0.0E+00	6.7E-04	1.4E-05	1.9E-02	2.7E-07	1.5E-05	1.5E-14	2.7E-16	2.7E-16	1.2E+00	1.3	3.3E-05	6.7E-01	0.7
Wind River IR	0.0E+00	7.2E-08	1.1E-08	6.3E-04	1.7E-05	3.9E-06	2.5E-04	1.2E-05	1.6E-02	2.2E-07	1.2E-05	1.2E-14	2.2E-16	2.2E-16	5.9E-01	0.6	1.2E-04	8.1E-01	0.8

Table C-4 Modeled Dry Deposition Nitrogen Species for the 2010 Typical Year

Assessment Areas	Dry Deposition (kg N/ha/yr)																		
	Oxidized Nitrogen																Reduced Nitrogen		
	NO	NO2	NO3	HNO3	HONO	N2O5	PAN	PANX	PNA	OPAN	NTR	INTR	CRON	CRPX	PNO3	Total	NH3	PNH4	Total
Class I Areas																			
Arches NP	2.2E-03	2.2E-02	2.8E-03	6.4E-01	8.5E-04	2.1E-02	6.5E-02	3.9E-02	3.9E-11	3.2E-03	7.4E-02	7.4E-11	9.7E-13	9.7E-04	5.0E-02	0.9	3.1E+00	7.5E-02	3.2
Black Canyon of the Gunnison WA	3.0E-03	3.4E-02	2.1E-03	7.6E-01	1.7E-03	2.4E-02	9.1E-02	5.0E-02	5.0E-11	2.2E-03	9.9E-02	9.9E-11	9.9E-13	9.9E-04	4.1E-02	1.1	4.8E-01	6.0E-02	0.5
Bridger WA	1.4E-03	1.2E-02	3.5E-03	6.1E-01	4.8E-04	3.3E-02	7.7E-02	4.1E-02	4.1E-11	2.3E-03	7.0E-02	7.0E-11	9.2E-13	9.2E-04	8.7E-02	0.9	6.6E-01	1.3E-01	0.8
Bryce Canyon NP	1.2E-03	1.3E-02	3.3E-03	6.6E-01	7.3E-04	2.7E-02	6.9E-02	3.9E-02	3.9E-11	3.0E-03	7.8E-02	7.8E-11	1.2E-12	1.2E-03	7.7E-02	1.0	2.7E+00	8.9E-02	2.8
Canyonlands NP	1.7E-03	1.6E-02	5.3E-03	7.7E-01	7.5E-04	3.4E-02	6.2E-02	3.5E-02	3.5E-11	2.6E-03	7.3E-02	7.3E-11	9.7E-13	9.7E-04	5.5E-02	1.1	7.5E-01	7.9E-02	0.8
Capitol Reef NP	1.3E-03	1.1E-02	3.1E-03	7.0E-01	6.0E-04	2.2E-02	6.1E-02	3.4E-02	3.4E-11	2.5E-03	6.8E-02	6.8E-11	9.5E-13	9.5E-04	6.2E-02	1.0	1.4E+00	8.7E-02	1.4
Eagles Nest WA	1.0E-02	6.7E-02	1.5E-03	8.4E-01	4.3E-03	5.4E-02	9.6E-02	5.2E-02	5.2E-11	2.0E-03	9.2E-02	9.2E-11	8.4E-13	8.4E-04	4.9E-02	1.3	3.3E-01	8.1E-02	0.4
Fitzpatrick WA	1.2E-03	8.9E-03	3.9E-03	6.1E-01	4.6E-04	3.1E-02	7.4E-02	3.8E-02	3.8E-11	2.1E-03	6.6E-02	6.6E-11	9.6E-13	9.6E-04	9.7E-02	0.9	6.3E-01	1.4E-01	0.8
Flat Tops WA	3.4E-03	3.2E-02	4.8E-03	1.1E+00	1.8E-03	8.2E-02	1.1E-01	6.1E-02	6.1E-11	2.7E-03	1.1E-01	1.1E-10	1.3E-12	1.3E-03	7.7E-02	1.6	5.3E-01	1.2E-01	0.6
La Garita WA	1.8E-03	1.4E-02	3.1E-03	9.2E-01	8.1E-04	5.2E-02	9.0E-02	4.6E-02	4.6E-11	1.5E-03	8.3E-02	8.3E-11	7.7E-13	7.7E-04	5.9E-02	1.3	2.8E-01	8.1E-02	0.4
Maroon Bells-Snowmass WA	3.3E-03	2.7E-02	3.0E-03	9.4E-01	1.4E-03	4.6E-02	1.0E-01	5.4E-02	5.4E-11	2.0E-03	1.0E-01	1.0E-10	1.0E-12	1.0E-03	5.8E-02	1.3	4.3E-01	8.7E-02	0.5
Mesa Verde NP	9.4E-03	1.0E-01	9.6E-03	1.6E+00	3.8E-03	1.5E-01	1.0E-01	5.4E-02	5.4E-11	2.5E-03	1.0E-01	1.0E-10	1.0E-12	1.0E-03	6.6E-02	2.3	3.5E-01	8.1E-02	0.4
Mount Zirkel WA	7.5E-03	7.7E-02	6.5E-03	1.3E+00	3.6E-03	2.2E-01	1.3E-01	7.0E-02	7.0E-11	3.2E-03	1.2E-01	1.2E-10	1.4E-12	1.4E-03	9.1E-02	2.1	5.0E-01	1.5E-01	0.6
Rawah WA	4.5E-03	4.1E-02	5.9E-03	1.2E+00	2.1E-03	2.0E-01	1.2E-01	6.3E-02	6.3E-11	2.7E-03	1.1E-01	1.1E-10	1.2E-12	1.2E-03	8.5E-02	1.9	4.8E-01	1.5E-01	0.6
Rocky Mountain NP	7.6E-03	5.0E-02	6.0E-03	1.1E+00	3.6E-03	1.4E-01	1.2E-01	6.3E-02	6.3E-11	2.8E-03	1.1E-01	1.1E-10	1.1E-12	1.1E-03	8.3E-02	1.7	4.3E-01	1.4E-01	0.6
Weminuche WA	4.2E-03	3.0E-02	2.1E-03	9.4E-01	1.7E-03	5.1E-02	9.8E-02	5.2E-02	5.2E-11	1.6E-03	9.2E-02	9.2E-11	7.8E-13	7.8E-04	5.3E-02	1.3	2.5E-01	6.6E-02	0.3
West Elk WA	2.0E-03	2.0E-02	2.7E-03	8.6E-01	1.1E-03	3.5E-02	9.4E-02	5.0E-02	5.0E-11	2.0E-03	9.8E-02	9.8E-11	1.0E-12	1.0E-03	5.3E-02	1.2	4.6E-01	8.0E-02	0.5
Class II Areas																			
Dinosaur National Monument	2.9E-03	2.6E-02	4.9E-03	7.9E-01	1.6E-03	6.6E-02	8.5E-02	4.9E-02	4.9E-11	3.9E-03	8.7E-02	8.7E-11	1.2E-12	1.2E-03	5.4E-02	1.2	8.3E-01	8.6E-02	0.9
Flaming Gorge National Recreation Area	4.3E-03	3.3E-02	2.4E-03	5.9E-01	1.7E-03	3.3E-02	7.3E-02	4.2E-02	4.2E-11	3.4E-03	7.1E-02	7.1E-11	1.1E-12	1.1E-03	4.4E-02	0.9	1.2E+00	7.1E-02	1.3
Fort Hall IR	1.0E-02	1.3E-01	4.0E-03	5.2E-01	4.0E-03	6.0E-02	8.8E-02	4.9E-02	4.9E-11	6.0E-03	8.9E-02	8.9E-11	1.6E-12	1.6E-03	5.7E-02	1.0	2.9E+00	7.1E-02	3.0
Goshute IR	6.6E-04	5.9E-03	2.7E-03	6.7E-01	3.9E-04	1.3E-02	4.9E-02	2.4E-02	2.4E-11	1.3E-03	5.3E-02	5.3E-11	7.6E-13	7.6E-04	4.5E-02	0.9	2.3E-01	5.0E-02	0.3
High Uintas WA	1.8E-03	1.7E-02	3.9E-03	6.7E-01	5.9E-04	5.1E-02	9.7E-02	5.4E-02	5.4E-11	3.7E-03	8.7E-02	8.7E-11	1.0E-12	1.0E-03	1.3E-01	1.1	1.2E+00	1.8E-01	1.3
Navajo IR	9.2E-03	5.7E-02	4.7E-03	8.2E-01	2.4E-03	5.3E-02	6.0E-02	3.3E-02	3.3E-11	2.0E-03	7.4E-02	7.4E-11	8.0E-13	8.0E-04	6.5E-02	1.2	3.6E-01	6.1E-02	0.4
Paitute IR	5.8E-03	4.2E-02	5.2E-03	8.7E-01	3.1E-03	2.9E-02	6.9E-02	4.4E-02	4.4E-11	4.9E-03	8.3E-02	8.3E-11	1.0E-12	1.0E-03	8.2E-02	1.2	2.1E+00	6.9E-02	2.2
Skull Valley IR	2.2E-03	1.8E-02	4.6E-03	6.7E-01	1.0E-03	3.9E-02	6.1E-02	3.5E-02	3.5E-11	3.2E-03	6.4E-02	6.4E-11	1.2E-12	1.2E-03	4.7E-02	1.0	7.2E-01	5.9E-02	0.8
Southern Ute IR	2.6E-02	2.4E-01	1.6E-03	1.3E+00	6.4E-03	5.2E-02	9.9E-02	5.5E-02	5.5E-11	1.9E-03	1.0E-01	1.0E-10	7.1E-13	7.1E-04	4.6E-02	2.0	2.9E-01	6.1E-02	0.4
Uintah and Ouray IR	1.2E-02	9.1E-02	2.8E-03	7.6E-01	2.1E-03	4.2E-02	9.6E-02	5.7E-02	5.7E-11	5.6E-03	1.0E-01	1.0E-10	1.2E-12	1.2E-03	6.3E-02	1.2	2.5E+00	9.2E-02	2.6
Ute Mountain IR	2.1E-02	1.2E-01	5.4E-03	1.2E+00	4.3E-03	9.6E-02	7.4E-02	4.1E-02	4.1E-11	2.1E-03	8.3E-02	8.3E-11	7.2E-13	7.2E-04	4.6E-02	1.7	5.6E-01	6.1E-02	0.6
Wind River IR	3.6E-03	2.7E-02	2.5E-03	5.0E-01	9.9E-04	1.9E-02	6.3E-02	3.3E-02	3.3E-11	1.8E-03	6.0E-02	6.0E-11	7.9E-13	7.9E-04	3.7E-02	0.7	4.3E-01	6.2E-02	0.5

Table C-5 Modeled Wet Deposition Nitrogen Species for the 2010 Typical Year

Assessment Areas	Wet Deposition (kg N/ha/yr)																		
	Oxidized Nitrogen																Reduced Nitrogen		
	NO	NO2	NO3	HNO3	HONO	N2O5	PAN	PANX	PNA	OPAN	NTR	INTR	CRON	CRPX	PNO3	Total	NH3	PNH4	Total
Class I Areas																			
Arches NP	0.0E+00	3.1E-08	4.4E-09	5.1E-07	2.8E-05	0.0E+00	3.3E-04	7.9E-06	1.5E-02	2.8E-07	8.8E-06	8.8E-15	2.8E-16	2.8E-16	8.6E-01	0.9	4.4E-04	1.1E+00	1.1
Black Canyon of the Gunnison WA	6.3E-12	2.0E-07	6.7E-09	3.9E-07	4.9E-05	0.0E+00	7.5E-04	1.8E-05	2.8E-02	3.7E-07	1.8E-05	1.8E-14	3.7E-16	3.7E-16	1.0E+00	1.1	6.5E-05	1.1E+00	1.1
Bridger WA	1.6E-12	4.5E-07	9.1E-09	3.2E-03	7.5E-05	3.9E-05	5.7E-04	2.1E-05	4.6E-02	6.4E-07	2.0E-05	2.0E-14	6.4E-16	6.4E-16	1.3E+00	1.3	8.9E-04	2.0E+00	2.0
Bryce Canyon NP	0.0E+00	1.6E-07	6.4E-09	2.4E-07	3.4E-05	0.0E+00	3.4E-04	9.6E-06	1.2E-02	3.0E-07	1.3E-05	1.3E-14	3.0E-16	3.0E-16	6.1E-01	0.6	2.5E-04	1.1E+00	1.1
Canyonlands NP	0.0E+00	2.8E-08	3.2E-09	3.7E-07	1.7E-05	0.0E+00	1.9E-04	6.3E-06	1.0E-02	1.9E-07	7.1E-06	7.1E-15	1.9E-16	1.9E-16	5.4E-01	0.6	1.3E-04	6.4E-01	0.6
Capitol Reef NP	0.0E+00	1.5E-08	2.2E-09	2.6E-07	1.5E-05	0.0E+00	1.5E-04	5.2E-06	8.5E-03	1.7E-07	5.5E-06	5.5E-15	1.7E-16	1.7E-16	4.9E-01	0.5	1.2E-04	6.4E-01	0.6
Eagles Nest WA	0.0E+00	3.4E-07	3.7E-09	5.0E-03	8.7E-05	3.4E-05	4.0E-04	1.8E-05	4.0E-02	2.9E-07	1.6E-05	1.6E-14	2.9E-16	2.9E-16	8.4E-01	0.9	4.0E-04	8.1E-01	0.8
Fitzpatrick WA	0.0E+00	2.4E-07	5.1E-09	2.2E-03	3.9E-05	1.3E-05	4.2E-04	1.5E-05	3.1E-02	3.9E-07	1.5E-05	1.5E-14	3.9E-16	3.9E-16	8.7E-01	0.9	7.9E-04	1.4E+00	1.4
Flat Tops WA	0.0E+00	4.2E-07	6.1E-09	5.6E-03	1.0E-04	1.1E-04	4.5E-04	1.8E-05	4.6E-02	3.8E-07	1.6E-05	1.6E-14	3.8E-16	3.8E-16	1.1E+00	1.1	1.2E-03	1.2E+00	1.2
La Garita WA	0.0E+00	8.3E-08	3.2E-09	3.8E-03	2.9E-05	1.4E-04	5.2E-04	2.2E-05	3.1E-02	1.9E-07	2.3E-05	2.3E-14	1.9E-16	1.9E-16	7.7E-01	0.8	3.1E-04	7.1E-01	0.7
Maroon Bells-Snowmass WA	0.0E+00	2.7E-07	5.8E-09	4.2E-03	8.0E-05	3.6E-05	4.9E-04	1.9E-05	4.3E-02	3.2E-07	1.9E-05	1.9E-14	3.2E-16	3.2E-16	9.3E-01	1.0	4.1E-04	8.8E-01	0.9
Mesa Verde NP	6.4E-18	8.2E-07	1.3E-08	3.1E-06	1.3E-04	0.0E+00	7.3E-04	1.8E-05	2.7E-02	3.5E-07	1.9E-05	1.9E-14	3.5E-16	3.5E-16	1.6E+00	1.6	1.4E-05	8.2E-01	0.8
Mount Zirkel WA	0.0E+00	8.7E-07	9.0E-09	3.4E-03	1.2E-04	2.6E-05	4.6E-04	2.0E-05	4.4E-02	4.8E-07	1.8E-05	1.8E-14	4.8E-16	4.8E-16	1.3E+00	1.4	4.0E-04	1.3E+00	1.3
Rawah WA	0.0E+00	2.7E-07	4.8E-09	6.4E-03	6.6E-05	1.0E-05	4.3E-04	2.1E-05	3.6E-02	3.8E-07	1.9E-05	1.9E-14	3.8E-16	3.8E-16	9.8E-01	1.0	1.6E-04	1.0E+00	1.0
Rocky Mountain NP	0.0E+00	4.6E-07	5.7E-09	4.2E-03	1.3E-04	7.9E-05	5.5E-04	2.6E-05	5.1E-02	5.0E-07	2.3E-05	2.3E-14	5.0E-16	5.0E-16	1.4E+00	1.4	2.0E-04	1.3E+00	1.3
Weminuche WA	1.6E-10	1.0E-06	1.2E-08	4.7E-03	1.6E-04	5.8E-05	1.4E-03	3.4E-05	6.0E-02	3.9E-07	3.6E-05	3.6E-14	3.9E-16	3.9E-16	1.8E+00	1.8	3.7E-05	1.3E+00	1.3
West Elk WA	0.0E+00	3.0E-07	1.2E-08	5.7E-03	7.4E-05	3.3E-04	6.0E-04	2.4E-05	4.3E-02	4.6E-07	2.4E-05	2.4E-14	4.6E-16	4.6E-16	1.2E+00	1.3	3.1E-04	1.1E+00	1.1
Class II Areas																			
Dinosaur National Monument	0.0E+00	4.2E-08	5.0E-09	2.2E-07	3.3E-05	0.0E+00	3.0E-04	8.1E-06	1.6E-02	2.6E-07	7.9E-06	7.9E-15	2.6E-16	2.6E-16	7.4E-01	0.8	2.0E-04	1.0E+00	1.0
Flaming Gorge National Recreation Area	0.0E+00	3.8E-08	2.7E-09	1.3E-07	2.5E-05	0.0E+00	2.8E-04	8.5E-06	1.3E-02	2.5E-07	7.6E-06	7.6E-15	2.5E-16	2.5E-16	5.7E-01	0.6	2.5E-04	1.0E+00	1.0
Fort Hall IR	0.0E+00	4.9E-08	8.7E-09	7.1E-05	2.3E-05	1.9E-06	1.6E-04	7.5E-06	1.3E-02	2.5E-07	7.1E-06	7.1E-15	2.5E-16	2.5E-16	5.2E-01	0.5	3.3E-04	1.1E+00	1.1
Goshute IR	1.4E-16	4.3E-08	5.4E-09	1.9E-07	2.1E-05	0.0E+00	3.1E-04	8.5E-06	1.3E-02	2.2E-07	8.2E-06	8.2E-15	2.2E-16	2.2E-16	5.4E-01	0.6	4.5E-05	6.5E-01	0.7
High Uintas WA	1.1E-16	1.4E-07	3.4E-09	8.6E-08	5.7E-05	0.0E+00	6.9E-04	1.9E-05	3.1E-02	6.4E-07	1.8E-05	1.8E-14	6.4E-16	6.4E-16	9.6E-01	1.0	4.5E-04	1.9E+00	1.9
Navajo IR	1.8E-10	2.0E-07	1.9E-08	1.7E-04	3.3E-05	7.1E-06	2.8E-04	1.1E-05	1.3E-02	1.7E-07	1.5E-05	1.5E-14	1.7E-16	1.7E-16	5.9E-01	0.6	5.0E-05	4.2E-01	0.4
Paitute IR	0.0E+00	2.7E-07	9.9E-09	6.2E-07	7.7E-05	0.0E+00	2.4E-04	7.6E-06	1.9E-02	3.9E-07	9.0E-06	9.0E-15	3.9E-16	3.9E-16	9.4E-01	1.0	5.4E-04	1.1E+00	1.1
Skull Valley IR	9.4E-13	2.7E-08	5.5E-09	2.8E-07	3.1E-05	0.0E+00	4.2E-04	9.0E-06	1.5E-02	3.2E-07	1.1E-05	1.1E-14	3.2E-16	3.2E-16	7.5E-01	0.8	2.0E-04	9.2E-01	0.9
Southern Ute IR	1.2E-09	1.0E-06	2.6E-08	1.4E-05	1.5E-04	1.6E-06	1.3E-03	2.8E-05	3.4E-02	3.2E-07	3.1E-05	3.1E-14	3.2E-16	3.2E-16	1.6E+00	1.6	5.8E-06	9.1E-01	0.9
Uintah and Ouray IR	0.0E+00	5.5E-08	3.7E-09	1.6E-07	3.2E-05	0.0E+00	2.3E-04	7.6E-06	1.5E-02	3.0E-07	7.9E-06	7.9E-15	3.0E-16	3.0E-16	6.3E-01	0.6	3.9E-04	1.0E+00	1.0
Ute Mountain IR	8.0E-10	9.3E-07	1.5E-08	3.3E-06	8.9E-05	0.0E+00	6.7E-04	1.4E-05	1.9E-02	2.7E-07	1.5E-05	1.5E-14	2.7E-16	2.7E-16	1.2E+00	1.3	3.4E-05	6.7E-01	0.7
Wind River IR	0.0E+00	8.2E-08	1.2E-08	6.2E-04	1.7E-05	4.0E-06	2.5E-04	1.2E-05	1.6E-02	2.2E-07	1.2E-05	1.2E-14	2.2E-16	2.2E-16	5.9E-01	0.6	1.2E-04	8.1E-01	0.8

Table C-6 Modeled Dry Deposition Nitrogen Species for the 2021 OTB Controls Scenario

Assessment Areas	Dry Deposition (kg N/ha/yr)																		
	Oxidized Nitrogen																Reduced Nitrogen		
	NO	NO2	NO3	HNO3	HONO	N2O5	PAN	PANX	PNA	OPAN	NTR	INTR	CRON	CRPX	PNO3	Total	NH3	PNH4	Total
Class I Areas																			
Arches NP	1.2E-03	1.3E-02	1.6E-03	4.4E-01	4.1E-04	9.2E-03	4.9E-02	3.0E-02	3.0E-11	2.3E-03	6.3E-02	6.3E-11	9.4E-13	9.4E-04	3.9E-02	0.6	3.2E+00	5.2E-02	3.2
Black Canyon of the Gunnison WA	1.4E-03	1.8E-02	1.2E-03	4.8E-01	5.8E-04	9.5E-03	6.6E-02	3.7E-02	3.7E-11	1.6E-03	8.3E-02	8.3E-11	9.4E-13	9.4E-04	3.4E-02	0.7	5.5E-01	4.3E-02	0.6
Bridger WA	1.6E-03	1.4E-02	2.8E-03	5.0E-01	4.5E-04	3.3E-02	6.4E-02	3.4E-02	3.4E-11	1.7E-03	6.3E-02	6.3E-11	7.7E-13	7.7E-04	6.0E-02	0.8	6.9E-01	9.5E-02	0.8
Bryce Canyon NP	7.9E-04	7.7E-03	1.6E-03	4.4E-01	3.1E-04	1.1E-02	5.0E-02	2.8E-02	2.8E-11	2.0E-03	6.6E-02	6.6E-11	1.0E-12	1.0E-03	6.2E-02	0.7	2.9E+00	6.4E-02	2.9
Canyonlands NP	9.9E-04	9.8E-03	3.0E-03	5.3E-01	4.0E-04	1.5E-02	4.7E-02	2.7E-02	2.7E-11	2.0E-03	6.2E-02	6.2E-11	9.0E-13	9.0E-04	4.5E-02	0.7	8.3E-01	5.7E-02	0.9
Capitol Reef NP	8.7E-04	7.6E-03	1.7E-03	4.9E-01	3.7E-04	1.2E-02	4.6E-02	2.6E-02	2.6E-11	1.8E-03	5.8E-02	5.8E-11	8.7E-13	8.7E-04	4.9E-02	0.7	1.4E+00	6.3E-02	1.5
Eagles Nest WA	4.8E-03	3.4E-02	1.0E-03	5.4E-01	2.0E-03	2.5E-02	7.1E-02	3.9E-02	3.9E-11	1.4E-03	7.6E-02	7.6E-11	7.8E-13	7.8E-04	3.9E-02	0.8	4.0E-01	5.8E-02	0.5
Fitzpatrick WA	1.1E-03	9.3E-03	3.2E-03	5.0E-01	3.8E-04	3.2E-02	6.1E-02	3.2E-02	3.2E-11	1.6E-03	5.9E-02	5.9E-11	8.0E-13	8.0E-04	6.7E-02	0.8	6.6E-01	9.9E-02	0.8
Flat Tops WA	1.9E-03	1.9E-02	2.8E-03	6.9E-01	8.2E-04	3.7E-02	8.6E-02	4.6E-02	4.6E-11	2.1E-03	9.4E-02	9.4E-11	1.2E-12	1.2E-03	6.0E-02	1.0	6.4E-01	8.2E-02	0.7
La Garita WA	1.1E-03	8.6E-03	1.9E-03	6.0E-01	4.1E-04	2.3E-02	6.7E-02	3.4E-02	3.4E-11	1.1E-03	7.1E-02	7.1E-11	7.0E-13	7.0E-04	4.9E-02	0.9	3.5E-01	6.0E-02	0.4
Maroon Bells-Snowmass WA	1.8E-03	1.6E-02	1.8E-03	6.2E-01	6.7E-04	2.0E-02	7.5E-02	4.0E-02	4.0E-11	1.4E-03	8.7E-02	8.7E-11	9.2E-13	9.2E-04	4.7E-02	0.9	5.1E-01	6.3E-02	0.6
Mesa Verde NP	3.4E-03	4.1E-02	6.1E-03	9.6E-01	1.7E-03	6.6E-02	7.6E-02	4.1E-02	4.1E-11	2.0E-03	8.8E-02	8.8E-11	1.0E-12	1.0E-03	5.5E-02	1.3	4.2E-01	5.6E-02	0.5
Mount Zirkel WA	3.5E-03	3.7E-02	4.2E-03	8.2E-01	1.9E-03	9.9E-02	9.7E-02	5.4E-02	5.4E-11	2.5E-03	1.0E-01	1.0E-10	1.4E-12	1.4E-03	6.9E-02	1.3	6.1E-01	1.0E-01	0.7
Rawah WA	2.2E-03	2.0E-02	3.7E-03	7.6E-01	1.0E-03	8.8E-02	8.8E-02	4.8E-02	4.8E-11	2.0E-03	9.2E-02	9.2E-11	1.1E-12	1.1E-03	6.6E-02	1.2	5.8E-01	1.0E-01	0.7
Rocky Mountain NP	3.3E-03	2.4E-02	3.8E-03	7.1E-01	1.6E-03	6.1E-02	8.8E-02	4.7E-02	4.7E-11	2.0E-03	8.9E-02	8.9E-11	1.0E-12	1.0E-03	6.4E-02	1.1	5.2E-01	9.9E-02	0.6
Weminuche WA	2.2E-03	1.7E-02	1.3E-03	5.7E-01	7.9E-04	2.3E-02	7.3E-02	3.8E-02	3.8E-11	1.2E-03	7.8E-02	7.8E-11	7.2E-13	7.2E-04	4.4E-02	0.8	3.1E-01	4.8E-02	0.4
West Elk WA	1.3E-03	1.3E-02	1.6E-03	5.6E-01	5.5E-04	1.5E-02	6.9E-02	3.7E-02	3.7E-11	1.4E-03	8.2E-02	8.2E-11	9.3E-13	9.3E-04	4.3E-02	0.8	5.5E-01	5.7E-02	0.6
Class II Areas																			
Dinosaur National Monument	2.8E-03	2.4E-02	3.6E-03	6.2E-01	1.3E-03	5.9E-02	7.2E-02	4.2E-02	4.2E-11	3.5E-03	7.9E-02	7.9E-11	1.1E-12	1.1E-03	4.6E-02	1.0	8.7E-01	6.7E-02	0.9
Flaming Gorge National Recreation Area	2.8E-03	2.1E-02	1.8E-03	4.4E-01	8.9E-04	2.1E-02	5.9E-02	3.5E-02	3.5E-11	2.7E-03	6.2E-02	6.2E-11	9.8E-13	9.8E-04	3.5E-02	0.7	1.3E+00	5.5E-02	1.3
Fort Hall IR	7.5E-03	9.8E-02	2.6E-03	3.8E-01	2.5E-03	3.3E-02	7.0E-02	3.9E-02	3.9E-11	4.4E-03	7.6E-02	7.6E-11	1.3E-12	1.3E-03	4.0E-02	0.8	3.0E+00	4.8E-02	3.0
Goshute IR	4.5E-04	3.9E-03	1.5E-03	4.7E-01	1.8E-04	5.6E-03	3.8E-02	1.8E-02	1.8E-11	8.9E-04	4.5E-02	4.5E-11	6.6E-13	6.6E-04	4.0E-02	0.6	2.7E-01	4.1E-02	0.3
High Uintas WA	1.3E-03	1.2E-02	2.6E-03	4.9E-01	3.0E-04	2.9E-02	7.5E-02	4.2E-02	4.2E-11	2.8E-03	7.4E-02	7.4E-11	9.0E-13	9.0E-04	9.4E-02	0.8	1.3E+00	1.2E-01	1.4
Navajo IR	4.5E-03	3.2E-02	2.8E-03	5.3E-01	1.3E-03	3.0E-02	4.6E-02	2.5E-02	2.5E-11	1.4E-03	6.3E-02	6.3E-11	7.3E-13	7.3E-04	5.6E-02	0.8	4.0E-01	4.7E-02	0.5
Paitute IR	2.2E-03	2.0E-02	2.4E-03	5.3E-01	5.9E-04	1.1E-02	4.9E-02	3.1E-02	3.1E-11	3.4E-03	6.8E-02	6.8E-11	9.2E-13	9.2E-04	6.8E-02	0.8	2.2E+00	4.9E-02	2.2
Skull Valley IR	1.8E-03	1.4E-02	3.0E-03	4.9E-01	7.0E-04	2.6E-02	4.8E-02	2.7E-02	2.7E-11	2.4E-03	5.5E-02	5.5E-11	1.1E-12	1.1E-03	3.9E-02	0.7	7.8E-01	4.5E-02	0.8
Southern Ute IR	1.4E-02	1.4E-01	9.5E-04	7.8E-01	3.8E-03	2.8E-02	7.6E-02	4.3E-02	4.3E-11	1.8E-03	8.8E-02	8.8E-11	7.0E-13	7.0E-04	3.9E-02	1.2	3.4E-01	4.3E-02	0.4
Uintah and Ouray IR	2.9E-02	1.0E-01	1.9E-03	6.0E-01	2.2E-03	2.7E-02	7.8E-02	4.8E-02	4.8E-11	4.8E-03	9.0E-02	9.0E-11	1.2E-12	1.2E-03	5.1E-02	1.0	2.5E+00	7.1E-02	2.6
Ute Mountain IR	7.1E-03	4.8E-02	3.6E-03	6.7E-01	2.0E-03	4.7E-02	5.7E-02	3.2E-02	3.2E-11	1.8E-03	7.0E-02	7.0E-11	7.0E-13	7.0E-04	3.8E-02	1.0	6.3E-01	4.3E-02	0.7
Wind River IR	2.0E-03	1.6E-02	2.0E-03	3.8E-01	5.7E-04	1.5E-02	5.0E-02	2.6E-02	2.6E-11	1.3E-03	5.2E-02	5.2E-11	6.8E-13	6.8E-04	2.8E-02	0.6	4.5E-01	4.8E-02	0.5

Table C-7 Modeled Wet Deposition Nitrogen Species for the 2021 OTB Controls Scenario

Assessment Areas	Wet Deposition (kg N/ha/yr)																		
	Oxidized Nitrogen																Reduced Nitrogen		
	NO	NO2	NO3	HNO3	HONO	N2O5	PAN	PANX	PNA	OPAN	NTR	INTR	CRON	CRPX	PNO3	Total	NH3	PNH4	Total
Class I Areas																			
Arches NP	0.0E+00	1.7E-08	3.9E-09	1.0E-07	1.5E-05	0.0E+00	2.6E-04	6.1E-06	1.2E-02	2.1E-07	7.7E-06	7.7E-15	2.1E-16	2.1E-16	5.6E-01	0.6	5.7E-04	1.1E+00	1.1
Black Canyon of the Gunnison WA	3.8E-13	9.7E-08	5.2E-09	7.7E-08	1.9E-05	0.0E+00	5.5E-04	1.3E-05	1.9E-02	2.6E-07	1.5E-05	1.5E-14	2.6E-16	2.6E-16	6.5E-01	0.7	1.6E-04	1.1E+00	1.1
Bridger WA	0.0E+00	3.4E-07	8.0E-09	2.3E-03	4.5E-05	2.3E-05	4.7E-04	1.7E-05	4.0E-02	4.8E-07	1.8E-05	1.8E-14	4.8E-16	4.8E-16	1.0E+00	1.1	1.2E-03	2.0E+00	2.0
Bryce Canyon NP	0.0E+00	1.0E-07	5.3E-09	5.9E-08	1.7E-05	0.0E+00	2.5E-04	6.8E-06	8.4E-03	1.9E-07	1.1E-05	1.1E-14	1.9E-16	1.9E-16	4.2E-01	0.4	3.9E-04	1.0E+00	1.0
Canyonlands NP	0.0E+00	1.6E-08	2.8E-09	8.6E-08	8.1E-06	0.0E+00	1.5E-04	4.9E-06	7.1E-03	1.4E-07	6.2E-06	6.2E-15	1.4E-16	1.4E-16	3.6E-01	0.4	1.9E-04	6.1E-01	0.6
Capitol Reef NP	0.0E+00	9.7E-09	2.0E-09	7.0E-08	8.4E-06	0.0E+00	1.2E-04	4.0E-06	6.1E-03	1.2E-07	4.8E-06	4.8E-15	1.2E-16	1.2E-16	3.3E-01	0.3	1.7E-04	6.2E-01	0.6
Eagles Nest WA	0.0E+00	1.6E-07	2.5E-09	3.0E-03	4.2E-05	1.4E-05	3.1E-04	1.3E-05	3.0E-02	2.0E-07	1.3E-05	1.3E-14	2.0E-16	2.0E-16	6.1E-01	0.6	9.4E-04	8.0E-01	0.8
Fitzpatrick WA	0.0E+00	2.0E-07	4.5E-09	1.6E-03	2.6E-05	9.2E-06	3.5E-04	1.3E-05	2.7E-02	2.9E-07	1.4E-05	1.4E-14	2.9E-16	2.9E-16	7.3E-01	0.8	1.0E-03	1.4E+00	1.4
Flat Tops WA	0.0E+00	2.1E-07	4.9E-09	4.1E-03	4.7E-05	5.3E-05	3.6E-04	1.4E-05	3.6E-02	2.8E-07	1.4E-05	1.4E-14	2.8E-16	2.8E-16	8.1E-01	0.8	2.2E-03	1.2E+00	1.2
La Garita WA	0.0E+00	3.6E-08	2.1E-09	2.8E-03	1.3E-05	5.7E-05	3.9E-04	1.6E-05	2.3E-02	1.3E-07	2.0E-05	2.0E-14	1.3E-16	1.3E-16	6.1E-01	0.6	4.5E-04	7.0E-01	0.7
Maroon Bells-Snowmass WA	0.0E+00	1.4E-07	4.5E-09	2.9E-03	3.6E-05	1.8E-05	3.8E-04	1.4E-05	3.2E-02	2.2E-07	1.6E-05	1.6E-14	2.2E-16	2.2E-16	6.9E-01	0.7	8.0E-04	8.7E-01	0.9
Mesa Verde NP	3.2E-18	3.2E-07	1.1E-08	5.9E-07	4.6E-05	0.0E+00	5.6E-04	1.4E-05	1.7E-02	2.5E-07	1.7E-05	1.7E-14	2.5E-16	2.5E-16	9.1E-01	0.9	3.6E-05	8.2E-01	0.8
Mount Zirkel WA	0.0E+00	4.5E-07	7.4E-09	2.3E-03	6.6E-05	1.5E-05	3.6E-04	1.6E-05	3.6E-02	3.6E-07	1.5E-05	1.5E-14	3.6E-16	3.6E-16	9.0E-01	0.9	6.9E-04	1.3E+00	1.3
Rawah WA	0.0E+00	1.4E-07	3.7E-09	4.2E-03	3.2E-05	5.5E-06	3.2E-04	1.6E-05	2.8E-02	2.6E-07	1.6E-05	1.6E-14	2.6E-16	2.6E-16	7.2E-01	0.8	4.6E-04	1.0E+00	1.0
Rocky Mountain NP	0.0E+00	2.1E-07	4.2E-09	2.9E-03	5.8E-05	3.7E-05	4.2E-04	1.9E-05	3.9E-02	3.2E-07	1.9E-05	1.9E-14	3.2E-16	3.2E-16	9.7E-01	1.0	4.6E-04	1.3E+00	1.3
Weminuche WA	7.9E-11	5.1E-07	9.9E-09	3.2E-03	7.3E-05	3.0E-05	1.1E-03	2.5E-05	4.4E-02	2.8E-07	3.1E-05	3.1E-14	2.8E-16	2.8E-16	1.2E+00	1.3	8.2E-05	1.3E+00	1.3
West Elk WA	0.0E+00	1.5E-07	8.6E-09	3.7E-03	3.1E-05	1.7E-04	4.6E-04	1.8E-05	3.1E-02	3.1E-07	2.0E-05	2.0E-14	3.1E-16	3.1E-16	8.6E-01	0.9	5.8E-04	1.1E+00	1.1
Class II Areas																			
Dinosaur National Monument	0.0E+00	4.3E-08	4.5E-09	8.5E-08	2.4E-05	0.0E+00	2.5E-04	6.4E-06	1.3E-02	1.9E-07	7.0E-06	7.0E-15	1.9E-16	1.9E-16	5.7E-01	0.6	2.5E-04	9.7E-01	1.0
Flaming Gorge National Recreation Area	0.0E+00	2.6E-08	2.4E-09	4.9E-08	1.5E-05	0.0E+00	2.2E-04	6.7E-06	9.9E-03	1.9E-07	6.6E-06	6.6E-15	1.9E-16	1.9E-16	4.2E-01	0.4	3.2E-04	9.6E-01	1.0
Fort Hall IR	0.0E+00	3.5E-08	6.8E-09	5.4E-05	1.4E-05	1.5E-06	1.3E-04	6.0E-06	1.1E-02	1.7E-07	6.2E-06	6.2E-15	1.7E-16	1.7E-16	3.9E-01	0.4	4.1E-04	1.0E+00	1.0
Goshute IR	1.4E-16	2.8E-08	4.9E-09	5.5E-08	1.1E-05	0.0E+00	2.5E-04	6.7E-06	9.1E-03	1.5E-07	7.1E-06	7.1E-15	1.5E-16	1.5E-16	3.9E-01	0.4	8.2E-05	6.5E-01	0.6
High Uintas WA	1.1E-16	8.5E-08	3.0E-09	2.3E-08	3.0E-05	0.0E+00	5.4E-04	1.4E-05	2.3E-02	4.8E-07	1.5E-05	1.5E-14	4.8E-16	4.8E-16	7.1E-01	0.7	6.5E-04	1.9E+00	1.9
Navajo IR	6.1E-11	1.0E-07	1.2E-08	1.2E-04	1.6E-05	4.3E-06	2.1E-04	8.3E-06	1.0E-02	1.2E-07	1.3E-05	1.3E-14	1.2E-16	1.2E-16	4.1E-01	0.4	7.5E-05	4.1E-01	0.4
Paitute IR	0.0E+00	1.1E-07	9.2E-09	2.0E-07	3.8E-05	0.0E+00	1.8E-04	6.0E-06	1.4E-02	2.7E-07	8.0E-06	8.0E-15	2.7E-16	2.7E-16	6.1E-01	0.6	6.4E-04	1.0E+00	1.0
Skull Valley IR	5.4E-13	1.8E-08	5.0E-09	5.7E-08	1.9E-05	0.0E+00	3.1E-04	6.9E-06	1.2E-02	2.3E-07	9.8E-06	9.8E-15	2.3E-16	2.3E-16	5.1E-01	0.5	2.3E-04	9.1E-01	0.9
Southern Ute IR	4.2E-10	5.1E-07	1.9E-08	6.7E-06	7.0E-05	6.8E-07	9.8E-04	2.1E-05	2.5E-02	2.3E-07	2.6E-05	2.6E-14	2.3E-16	2.3E-16	9.9E-01	1.0	1.8E-05	8.9E-01	0.9
Uintah and Ouray IR	0.0E+00	4.2E-08	3.3E-09	8.3E-08	2.1E-05	0.0E+00	1.8E-04	6.1E-06	1.2E-02	2.4E-07	6.9E-06	6.9E-15	2.4E-16	2.4E-16	4.7E-01	0.5	4.6E-04	1.0E+00	1.0
Ute Mountain IR	2.9E-10	4.0E-07	1.3E-08	6.8E-07	3.9E-05	0.0E+00	5.1E-04	1.0E-05	1.3E-02	1.9E-07	1.3E-05	1.3E-14	1.9E-16	1.9E-16	7.4E-01	0.8	5.5E-05	6.6E-01	0.7
Wind River IR	0.0E+00	4.6E-08	8.5E-09	4.4E-04	9.7E-06	2.9E-06	2.1E-04	9.4E-06	1.3E-02	1.6E-07	1.0E-05	1.0E-14	1.6E-16	1.6E-16	4.8E-01	0.5	1.6E-04	8.0E-01	0.8

Table C-8 Modeled Dry Deposition Nitrogen Species for the 2021 Control Scenario 1

Assessment Areas	Dry Deposition (kg N/ha/yr)																		
	Oxidized Nitrogen																Reduced Nitrogen		
	NO	NO2	NO3	HNO3	HONO	N2O5	PAN	PANX	PNA	OPAN	NTR	INTR	CRON	CRPX	PNO3	Total	NH3	PNH4	Total
Class I Areas																			
Arches NP	1.2E-03	1.3E-02	1.6E-03	4.3E-01	4.0E-04	8.9E-03	4.9E-02	3.0E-02	3.0E-11	2.3E-03	6.2E-02	6.2E-11	9.4E-13	9.4E-04	3.8E-02	0.6	3.2E+00	5.2E-02	3.2
Black Canyon of the Gunnison WA	1.5E-03	1.8E-02	1.2E-03	4.8E-01	5.7E-04	9.4E-03	6.5E-02	3.7E-02	3.7E-11	1.5E-03	8.2E-02	8.2E-11	9.4E-13	9.4E-04	3.4E-02	0.7	5.6E-01	4.3E-02	0.6
Bridger WA	1.6E-03	1.4E-02	2.8E-03	4.9E-01	4.5E-04	3.3E-02	6.3E-02	3.4E-02	3.4E-11	1.7E-03	6.3E-02	6.3E-11	7.7E-13	7.7E-04	5.9E-02	0.8	6.9E-01	9.4E-02	0.8
Bryce Canyon NP	7.9E-04	7.7E-03	1.6E-03	4.4E-01	3.1E-04	1.1E-02	5.0E-02	2.8E-02	2.8E-11	2.0E-03	6.6E-02	6.6E-11	1.0E-12	1.0E-03	6.2E-02	0.7	2.9E+00	6.4E-02	2.9
Canyonlands NP	9.8E-04	9.7E-03	3.0E-03	5.2E-01	4.0E-04	1.5E-02	4.7E-02	2.7E-02	2.7E-11	1.9E-03	6.2E-02	6.2E-11	9.0E-13	9.0E-04	4.5E-02	0.7	8.3E-01	5.7E-02	0.9
Capitol Reef NP	8.7E-04	7.6E-03	1.7E-03	4.9E-01	3.7E-04	1.2E-02	4.6E-02	2.6E-02	2.6E-11	1.8E-03	5.8E-02	5.8E-11	8.7E-13	8.7E-04	4.9E-02	0.7	1.4E+00	6.3E-02	1.5
Eagles Nest WA	4.8E-03	3.4E-02	1.0E-03	5.3E-01	2.0E-03	2.5E-02	7.1E-02	3.8E-02	3.8E-11	1.4E-03	7.6E-02	7.6E-11	7.8E-13	7.8E-04	3.9E-02	0.8	4.0E-01	5.7E-02	0.5
Fitzpatrick WA	1.1E-03	9.3E-03	3.2E-03	5.0E-01	3.8E-04	3.2E-02	6.1E-02	3.2E-02	3.2E-11	1.6E-03	5.9E-02	5.9E-11	8.1E-13	8.1E-04	6.6E-02	0.8	6.6E-01	9.9E-02	0.8
Flat Tops WA	1.9E-03	1.9E-02	2.8E-03	6.8E-01	8.1E-04	3.7E-02	8.6E-02	4.6E-02	4.6E-11	2.0E-03	9.4E-02	9.4E-11	1.2E-12	1.2E-03	5.9E-02	1.0	6.4E-01	8.1E-02	0.7
La Garita WA	1.1E-03	8.5E-03	1.9E-03	5.9E-01	4.1E-04	2.3E-02	6.7E-02	3.4E-02	3.4E-11	1.1E-03	7.0E-02	7.0E-11	7.0E-13	7.0E-04	4.9E-02	0.8	3.5E-01	5.9E-02	0.4
Maroon Bells-Snowmass WA	1.8E-03	1.6E-02	1.8E-03	6.1E-01	6.6E-04	2.0E-02	7.4E-02	4.0E-02	4.0E-11	1.4E-03	8.7E-02	8.7E-11	9.2E-13	9.2E-04	4.7E-02	0.9	5.1E-01	6.2E-02	0.6
Mesa Verde NP	3.4E-03	4.1E-02	6.1E-03	9.5E-01	1.7E-03	6.6E-02	7.5E-02	4.1E-02	4.1E-11	2.0E-03	8.8E-02	8.8E-11	1.0E-12	1.0E-03	5.5E-02	1.3	4.2E-01	5.6E-02	0.5
Mount Zirkel WA	3.5E-03	3.7E-02	4.1E-03	8.1E-01	1.8E-03	9.8E-02	9.7E-02	5.3E-02	5.3E-11	2.5E-03	1.0E-01	1.0E-10	1.4E-12	1.4E-03	6.8E-02	1.3	6.1E-01	1.0E-01	0.7
Rawah WA	2.1E-03	2.0E-02	3.7E-03	7.5E-01	9.9E-04	8.7E-02	8.8E-02	4.8E-02	4.8E-11	2.0E-03	9.1E-02	9.1E-11	1.1E-12	1.1E-03	6.5E-02	1.2	5.9E-01	1.0E-01	0.7
Rocky Mountain NP	3.3E-03	2.4E-02	3.8E-03	7.0E-01	1.6E-03	6.0E-02	8.8E-02	4.7E-02	4.7E-11	2.0E-03	8.8E-02	8.8E-11	1.0E-12	1.0E-03	6.3E-02	1.1	5.3E-01	9.7E-02	0.6
Weminuche WA	2.2E-03	1.7E-02	1.2E-03	5.7E-01	7.9E-04	2.2E-02	7.3E-02	3.8E-02	3.8E-11	1.2E-03	7.8E-02	7.8E-11	7.2E-13	7.2E-04	4.4E-02	0.8	3.1E-01	4.7E-02	0.4
West Elk WA	1.3E-03	1.3E-02	1.5E-03	5.5E-01	5.4E-04	1.5E-02	6.9E-02	3.7E-02	3.7E-11	1.4E-03	8.2E-02	8.2E-11	9.3E-13	9.3E-04	4.3E-02	0.8	5.5E-01	5.6E-02	0.6
Class II Areas																			
Dinosaur National Monument	2.4E-03	2.1E-02	3.4E-03	5.8E-01	1.1E-03	5.0E-02	7.0E-02	4.1E-02	4.1E-11	3.4E-03	7.8E-02	7.8E-11	1.2E-12	1.2E-03	4.3E-02	0.9	9.0E-01	6.3E-02	1.0
Flaming Gorge National Recreation Area	2.7E-03	2.1E-02	1.7E-03	4.3E-01	8.6E-04	1.9E-02	5.8E-02	3.4E-02	3.4E-11	2.7E-03	6.2E-02	6.2E-11	9.9E-13	9.9E-04	3.4E-02	0.7	1.3E+00	5.3E-02	1.4
Fort Hall IR	7.6E-03	9.8E-02	2.6E-03	3.7E-01	2.5E-03	3.3E-02	7.0E-02	3.9E-02	3.9E-11	4.4E-03	7.6E-02	7.6E-11	1.3E-12	1.3E-03	4.0E-02	0.7	3.0E+00	4.8E-02	3.0
Goshute IR	4.5E-04	3.9E-03	1.5E-03	4.6E-01	1.8E-04	5.6E-03	3.8E-02	1.8E-02	1.8E-11	8.9E-04	4.5E-02	4.5E-11	6.6E-13	6.6E-04	4.0E-02	0.6	2.7E-01	4.1E-02	0.3
High Uintas WA	1.2E-03	1.1E-02	2.6E-03	4.8E-01	2.9E-04	2.8E-02	7.5E-02	4.1E-02	4.1E-11	2.7E-03	7.4E-02	7.4E-11	9.0E-13	9.0E-04	9.2E-02	0.8	1.3E+00	1.2E-01	1.4
Navajo IR	4.5E-03	3.2E-02	2.8E-03	5.2E-01	1.3E-03	3.0E-02	4.6E-02	2.5E-02	2.5E-11	1.4E-03	6.3E-02	6.3E-11	7.3E-13	7.3E-04	5.6E-02	0.8	4.0E-01	4.7E-02	0.5
Paitute IR	2.2E-03	2.0E-02	2.4E-03	5.3E-01	5.9E-04	1.1E-02	4.9E-02	3.1E-02	3.1E-11	3.4E-03	6.8E-02	6.8E-11	9.2E-13	9.2E-04	6.8E-02	0.8	2.2E+00	4.9E-02	2.2
Skull Valley IR	1.8E-03	1.4E-02	3.0E-03	4.9E-01	7.0E-04	2.6E-02	4.8E-02	2.7E-02	2.7E-11	2.4E-03	5.5E-02	5.5E-11	1.1E-12	1.1E-03	3.9E-02	0.7	7.8E-01	4.5E-02	0.8
Southern Ute IR	1.4E-02	1.4E-01	9.6E-04	7.8E-01	3.8E-03	2.8E-02	7.6E-02	4.3E-02	4.3E-11	1.8E-03	8.8E-02	8.8E-11	7.0E-13	7.0E-04	3.9E-02	1.2	3.4E-01	4.3E-02	0.4
Uintah and Ouray IR	1.8E-02	8.7E-02	1.8E-03	5.7E-01	1.8E-03	2.5E-02	7.7E-02	4.7E-02	4.7E-11	4.7E-03	9.0E-02	9.0E-11	1.2E-12	1.2E-03	4.8E-02	1.0	2.5E+00	6.8E-02	2.6
Ute Mountain IR	7.1E-03	4.8E-02	3.6E-03	6.7E-01	2.0E-03	4.7E-02	5.7E-02	3.2E-02	3.2E-11	1.8E-03	7.0E-02	7.0E-11	7.0E-13	7.0E-04	3.8E-02	1.0	6.3E-01	4.3E-02	0.7
Wind River IR	2.0E-03	1.6E-02	2.0E-03	3.8E-01	5.7E-04	1.5E-02	5.0E-02	2.6E-02	2.6E-11	1.3E-03	5.2E-02	5.2E-11	6.8E-13	6.8E-04	2.8E-02	0.6	4.5E-01	4.8E-02	0.5

Table C-9 Modeled Wet Deposition Nitrogen Species for the 2021 Control Scenario 1

Assessment Areas	Wet Deposition (kg N/ha/yr)																		
	Oxidized Nitrogen																Reduced Nitrogen		
	NO	NO2	NO3	HNO3	HONO	N2O5	PAN	PANX	PNA	OPAN	NTR	INTR	CRON	CRPX	PNO3	Total	NH3	PNH4	Total
Class I Areas																			
Arches NP	0.0E+00	1.6E-08	3.9E-09	9.8E-08	1.5E-05	0.0E+00	2.6E-04	6.1E-06	1.2E-02	2.1E-07	7.7E-06	7.7E-15	2.1E-16	2.1E-16	5.5E-01	0.6	5.7E-04	1.1E+00	1.1
Black Canyon of the Gunnison WA	4.7E-12	9.7E-08	5.2E-09	7.6E-08	1.9E-05	0.0E+00	5.5E-04	1.3E-05	1.9E-02	2.6E-07	1.5E-05	1.5E-14	2.6E-16	2.6E-16	6.4E-01	0.7	1.6E-04	1.1E+00	1.1
Bridger WA	1.2E-12	3.5E-07	8.1E-09	2.3E-03	4.5E-05	2.3E-05	4.7E-04	1.7E-05	4.0E-02	4.8E-07	1.8E-05	1.8E-14	4.8E-16	4.8E-16	1.0E+00	1.1	1.2E-03	2.0E+00	2.0
Bryce Canyon NP	0.0E+00	1.0E-07	5.3E-09	5.8E-08	1.7E-05	0.0E+00	2.5E-04	6.8E-06	8.4E-03	1.9E-07	1.1E-05	1.1E-14	1.9E-16	1.9E-16	4.1E-01	0.4	3.9E-04	1.0E+00	1.0
Canyonlands NP	0.0E+00	1.6E-08	2.8E-09	8.5E-08	8.0E-06	0.0E+00	1.5E-04	4.9E-06	7.1E-03	1.4E-07	6.2E-06	6.2E-15	1.4E-16	1.4E-16	3.5E-01	0.4	1.9E-04	6.1E-01	0.6
Capitol Reef NP	0.0E+00	9.7E-09	2.0E-09	6.9E-08	8.3E-06	0.0E+00	1.2E-04	4.0E-06	6.1E-03	1.2E-07	4.8E-06	4.8E-15	1.2E-16	1.2E-16	3.3E-01	0.3	1.7E-04	6.2E-01	0.6
Eagles Nest WA	0.0E+00	1.7E-07	2.5E-09	2.9E-03	4.2E-05	1.4E-05	3.1E-04	1.3E-05	2.9E-02	2.0E-07	1.3E-05	1.3E-14	2.0E-16	2.0E-16	6.0E-01	0.6	9.8E-04	8.0E-01	0.8
Fitzpatrick WA	0.0E+00	2.1E-07	4.5E-09	1.6E-03	2.6E-05	9.0E-06	3.5E-04	1.3E-05	2.7E-02	2.9E-07	1.4E-05	1.4E-14	2.9E-16	2.9E-16	7.2E-01	0.8	1.0E-03	1.4E+00	1.4
Flat Tops WA	0.0E+00	2.1E-07	4.9E-09	4.1E-03	4.6E-05	5.0E-05	3.6E-04	1.3E-05	3.5E-02	2.8E-07	1.4E-05	1.4E-14	2.8E-16	2.8E-16	7.9E-01	0.8	2.3E-03	1.2E+00	1.2
La Garita WA	0.0E+00	4.2E-08	2.1E-09	2.8E-03	1.3E-05	5.7E-05	3.9E-04	1.6E-05	2.3E-02	1.3E-07	2.0E-05	2.0E-14	1.3E-16	1.3E-16	6.0E-01	0.6	4.5E-04	7.0E-01	0.7
Maroon Bells-Snowmass WA	0.0E+00	1.5E-07	4.5E-09	2.9E-03	3.5E-05	1.8E-05	3.8E-04	1.4E-05	3.2E-02	2.2E-07	1.6E-05	1.6E-14	2.2E-16	2.2E-16	6.8E-01	0.7	8.1E-04	8.7E-01	0.9
Mesa Verde NP	3.2E-18	3.2E-07	1.1E-08	5.8E-07	4.6E-05	0.0E+00	5.6E-04	1.4E-05	1.7E-02	2.5E-07	1.7E-05	1.7E-14	2.5E-16	2.5E-16	9.0E-01	0.9	3.6E-05	8.2E-01	0.8
Mount Zirkel WA	0.0E+00	4.5E-07	7.4E-09	2.3E-03	6.5E-05	1.4E-05	3.6E-04	1.6E-05	3.5E-02	3.6E-07	1.5E-05	1.5E-14	3.6E-16	3.6E-16	8.8E-01	0.9	7.3E-04	1.3E+00	1.3
Rawah WA	0.0E+00	1.4E-07	3.7E-09	4.0E-03	3.2E-05	5.5E-06	3.2E-04	1.5E-05	2.8E-02	2.6E-07	1.6E-05	1.6E-14	2.6E-16	2.6E-16	7.1E-01	0.7	4.9E-04	9.9E-01	1.0
Rocky Mountain NP	0.0E+00	2.2E-07	4.2E-09	2.9E-03	5.7E-05	3.6E-05	4.2E-04	1.9E-05	3.9E-02	3.2E-07	1.9E-05	1.9E-14	3.2E-16	3.2E-16	9.5E-01	1.0	4.7E-04	1.3E+00	1.3
Weminuche WA	8.4E-11	5.2E-07	1.0E-08	3.2E-03	7.3E-05	3.0E-05	1.1E-03	2.5E-05	4.4E-02	2.8E-07	3.1E-05	3.1E-14	2.8E-16	2.8E-16	1.2E+00	1.3	8.4E-05	1.3E+00	1.3
West Elk WA	0.0E+00	1.5E-07	8.7E-09	3.7E-03	3.1E-05	1.7E-04	4.6E-04	1.8E-05	3.1E-02	3.1E-07	2.0E-05	2.0E-14	3.1E-16	3.1E-16	8.5E-01	0.9	5.8E-04	1.1E+00	1.1
Class II Areas																			
Dinosaur National Monument	0.0E+00	3.7E-08	4.5E-09	7.4E-08	2.1E-05	0.0E+00	2.4E-04	6.3E-06	1.3E-02	1.9E-07	6.9E-06	6.9E-15	1.9E-16	1.9E-16	5.5E-01	0.6	2.6E-04	9.6E-01	1.0
Flaming Gorge National Recreation Area	0.0E+00	2.5E-08	2.4E-09	4.8E-08	1.4E-05	0.0E+00	2.2E-04	6.6E-06	9.8E-03	1.9E-07	6.5E-06	6.5E-15	1.9E-16	1.9E-16	4.1E-01	0.4	3.3E-04	9.6E-01	1.0
Fort Hall IR	0.0E+00	3.5E-08	6.8E-09	5.4E-05	1.4E-05	1.5E-06	1.3E-04	6.0E-06	1.1E-02	1.7E-07	6.1E-06	6.1E-15	1.7E-16	1.7E-16	3.9E-01	0.4	4.1E-04	1.0E+00	1.0
Goshute IR	1.4E-16	2.8E-08	4.9E-09	5.5E-08	1.1E-05	0.0E+00	2.5E-04	6.7E-06	9.1E-03	1.5E-07	7.1E-06	7.1E-15	1.5E-16	1.5E-16	3.9E-01	0.4	8.3E-05	6.5E-01	0.6
High Uintas WA	1.1E-16	8.1E-08	3.0E-09	2.2E-08	2.8E-05	0.0E+00	5.4E-04	1.4E-05	2.2E-02	4.8E-07	1.5E-05	1.5E-14	4.8E-16	4.8E-16	7.0E-01	0.7	6.5E-04	1.9E+00	1.9
Navajo IR	6.4E-11	1.1E-07	1.2E-08	1.2E-04	1.6E-05	4.3E-06	2.1E-04	8.3E-06	1.0E-02	1.2E-07	1.3E-05	1.3E-14	1.2E-16	1.2E-16	4.0E-01	0.4	7.5E-05	4.0E-01	0.4
Paitute IR	0.0E+00	1.1E-07	9.2E-09	2.0E-07	3.8E-05	0.0E+00	1.8E-04	6.0E-06	1.4E-02	2.7E-07	8.0E-06	8.0E-15	2.7E-16	2.7E-16	6.1E-01	0.6	6.5E-04	1.0E+00	1.0
Skull Valley IR	5.4E-13	1.8E-08	5.0E-09	5.7E-08	1.9E-05	0.0E+00	3.1E-04	6.8E-06	1.2E-02	2.3E-07	9.8E-06	9.8E-15	2.3E-16	2.3E-16	5.1E-01	0.5	2.3E-04	9.1E-01	0.9
Southern Ute IR	4.3E-10	5.1E-07	1.9E-08	6.7E-06	7.0E-05	6.8E-07	9.8E-04	2.1E-05	2.5E-02	2.3E-07	2.6E-05	2.6E-14	2.3E-16	2.3E-16	9.9E-01	1.0	1.9E-05	8.9E-01	0.9
Uintah and Ouray IR	0.0E+00	3.8E-08	3.3E-09	6.4E-08	1.9E-05	0.0E+00	1.8E-04	6.0E-06	1.2E-02	2.3E-07	6.9E-06	6.9E-15	2.3E-16	2.3E-16	4.5E-01	0.5	4.7E-04	9.9E-01	1.0
Ute Mountain IR	2.9E-10	4.0E-07	1.3E-08	6.8E-07	3.9E-05	0.0E+00	5.1E-04	1.0E-05	1.3E-02	1.9E-07	1.3E-05	1.3E-14	1.9E-16	1.9E-16	7.4E-01	0.8	5.6E-05	6.6E-01	0.7
Wind River IR	0.0E+00	5.0E-08	8.6E-09	4.4E-04	9.7E-06	2.8E-06	2.1E-04	9.4E-06	1.3E-02	1.6E-07	1.0E-05	1.0E-14	1.6E-16	1.6E-16	4.7E-01	0.5	1.6E-04	8.0E-01	0.8

Table C-10 Modeled Dry Deposition Nitrogen Species for the 2021 Control Scenario 2

Assessment Areas	Dry Deposition (kg N/ha/yr)																		
	Oxidized Nitrogen																Reduced Nitrogen		
	NO	NO2	NO3	HNO3	HONO	N2O5	PAN	PANX	PNA	OPAN	NTR	INTR	CRON	CRPX	PNO3	Total	NH3	PNH4	Total
Class I Areas																			
Arches NP	1.2E-03	1.3E-02	1.6E-03	4.4E-01	4.1E-04	9.2E-03	4.9E-02	3.0E-02	3.0E-11	2.3E-03	6.2E-02	6.2E-11	9.3E-13	9.3E-04	3.9E-02	0.6	3.2E+00	5.2E-02	3.2
Black Canyon of the Gunnison WA	1.4E-03	1.8E-02	1.2E-03	4.9E-01	5.8E-04	9.5E-03	6.5E-02	3.7E-02	3.7E-11	1.6E-03	8.2E-02	8.2E-11	9.4E-13	9.4E-04	3.4E-02	0.7	5.5E-01	4.3E-02	0.6
Bridger WA	1.6E-03	1.4E-02	2.8E-03	5.0E-01	4.5E-04	3.3E-02	6.4E-02	3.4E-02	3.4E-11	1.7E-03	6.3E-02	6.3E-11	7.7E-13	7.7E-04	6.0E-02	0.8	6.9E-01	9.5E-02	0.8
Bryce Canyon NP	7.9E-04	7.7E-03	1.6E-03	4.4E-01	3.1E-04	1.1E-02	5.0E-02	2.8E-02	2.8E-11	2.0E-03	6.6E-02	6.6E-11	1.0E-12	1.0E-03	6.2E-02	0.7	2.9E+00	6.4E-02	2.9
Canyonlands NP	9.9E-04	9.8E-03	3.0E-03	5.3E-01	4.0E-04	1.5E-02	4.7E-02	2.7E-02	2.7E-11	2.0E-03	6.2E-02	6.2E-11	9.0E-13	9.0E-04	4.5E-02	0.7	8.3E-01	5.7E-02	0.9
Capitol Reef NP	8.7E-04	7.6E-03	1.7E-03	4.9E-01	3.7E-04	1.2E-02	4.6E-02	2.6E-02	2.6E-11	1.8E-03	5.8E-02	5.8E-11	8.7E-13	8.7E-04	4.9E-02	0.7	1.4E+00	6.3E-02	1.5
Eagles Nest WA	4.8E-03	3.4E-02	1.0E-03	5.4E-01	2.0E-03	2.5E-02	7.1E-02	3.9E-02	3.9E-11	1.4E-03	7.6E-02	7.6E-11	7.8E-13	7.8E-04	3.9E-02	0.8	4.0E-01	5.8E-02	0.5
Fitzpatrick WA	1.1E-03	9.3E-03	3.2E-03	5.0E-01	3.8E-04	3.2E-02	6.1E-02	3.2E-02	3.2E-11	1.6E-03	5.9E-02	5.9E-11	8.0E-13	8.0E-04	6.7E-02	0.8	6.6E-01	9.9E-02	0.8
Flat Tops WA	1.9E-03	1.9E-02	2.8E-03	6.9E-01	8.2E-04	3.8E-02	8.6E-02	4.6E-02	4.6E-11	2.1E-03	9.4E-02	9.4E-11	1.2E-12	1.2E-03	6.0E-02	1.0	6.4E-01	8.2E-02	0.7
La Garita WA	1.1E-03	8.6E-03	1.9E-03	6.0E-01	4.1E-04	2.3E-02	6.7E-02	3.4E-02	3.4E-11	1.1E-03	7.0E-02	7.0E-11	7.0E-13	7.0E-04	4.9E-02	0.9	3.5E-01	6.0E-02	0.4
Maroon Bells-Snowmass WA	1.8E-03	1.6E-02	1.8E-03	6.2E-01	6.7E-04	2.0E-02	7.5E-02	4.0E-02	4.0E-11	1.4E-03	8.7E-02	8.7E-11	9.2E-13	9.2E-04	4.7E-02	0.9	5.1E-01	6.3E-02	0.6
Mesa Verde NP	3.4E-03	4.1E-02	6.1E-03	9.6E-01	1.7E-03	6.7E-02	7.5E-02	4.1E-02	4.1E-11	2.0E-03	8.8E-02	8.8E-11	1.0E-12	1.0E-03	5.5E-02	1.3	4.2E-01	5.6E-02	0.5
Mount Zirkel WA	3.5E-03	3.7E-02	4.2E-03	8.2E-01	1.9E-03	9.9E-02	9.7E-02	5.4E-02	5.4E-11	2.5E-03	1.0E-01	1.0E-10	1.4E-12	1.4E-03	6.9E-02	1.3	6.1E-01	1.0E-01	0.7
Rawah WA	2.2E-03	2.0E-02	3.7E-03	7.7E-01	1.0E-03	8.8E-02	8.8E-02	4.8E-02	4.8E-11	2.0E-03	9.1E-02	9.1E-11	1.1E-12	1.1E-03	6.6E-02	1.2	5.8E-01	1.0E-01	0.7
Rocky Mountain NP	3.3E-03	2.4E-02	3.8E-03	7.1E-01	1.6E-03	6.1E-02	8.8E-02	4.7E-02	4.7E-11	2.0E-03	8.8E-02	8.8E-11	1.0E-12	1.0E-03	6.4E-02	1.1	5.2E-01	9.9E-02	0.6
Weminuche WA	2.2E-03	1.7E-02	1.3E-03	5.7E-01	7.9E-04	2.3E-02	7.3E-02	3.8E-02	3.8E-11	1.2E-03	7.8E-02	7.8E-11	7.2E-13	7.2E-04	4.4E-02	0.8	3.1E-01	4.8E-02	0.4
West Elk WA	1.3E-03	1.3E-02	1.6E-03	5.6E-01	5.5E-04	1.5E-02	6.9E-02	3.7E-02	3.7E-11	1.4E-03	8.2E-02	8.2E-11	9.3E-13	9.3E-04	4.3E-02	0.8	5.5E-01	5.7E-02	0.6
Class II Areas																			
Dinosaur National Monument	2.8E-03	2.4E-02	3.6E-03	6.2E-01	1.3E-03	5.9E-02	7.1E-02	4.2E-02	4.2E-11	3.5E-03	7.8E-02	7.8E-11	1.1E-12	1.1E-03	4.6E-02	1.0	8.7E-01	6.7E-02	0.9
Flaming Gorge National Recreation Area	2.8E-03	2.1E-02	1.8E-03	4.4E-01	9.0E-04	2.1E-02	5.9E-02	3.5E-02	3.5E-11	2.7E-03	6.2E-02	6.2E-11	9.8E-13	9.8E-04	3.5E-02	0.7	1.3E+00	5.5E-02	1.3
Fort Hall IR	7.5E-03	9.8E-02	2.6E-03	3.8E-01	2.5E-03	3.3E-02	7.0E-02	3.9E-02	3.9E-11	4.4E-03	7.6E-02	7.6E-11	1.3E-12	1.3E-03	4.0E-02	0.8	3.0E+00	4.8E-02	3.0
Goshute IR	4.5E-04	3.9E-03	1.5E-03	4.7E-01	1.8E-04	5.6E-03	3.8E-02	1.8E-02	1.8E-11	8.9E-04	4.5E-02	4.5E-11	6.6E-13	6.6E-04	4.0E-02	0.6	2.7E-01	4.1E-02	0.3
High Uintas WA	1.3E-03	1.2E-02	2.6E-03	4.9E-01	3.0E-04	2.9E-02	7.5E-02	4.2E-02	4.2E-11	2.8E-03	7.4E-02	7.4E-11	9.0E-13	9.0E-04	9.3E-02	0.8	1.3E+00	1.2E-01	1.4
Navajo IR	4.5E-03	3.2E-02	2.8E-03	5.3E-01	1.3E-03	3.0E-02	4.6E-02	2.5E-02	2.5E-11	1.4E-03	6.3E-02	6.3E-11	7.2E-13	7.2E-04	5.6E-02	0.8	4.0E-01	4.7E-02	0.5
Paitute IR	2.2E-03	2.0E-02	2.4E-03	5.3E-01	5.9E-04	1.1E-02	4.9E-02	3.1E-02	3.1E-11	3.4E-03	6.8E-02	6.8E-11	9.2E-13	9.2E-04	6.8E-02	0.8	2.2E+00	4.9E-02	2.2
Skull Valley IR	1.8E-03	1.4E-02	3.0E-03	4.9E-01	7.0E-04	2.6E-02	4.8E-02	2.7E-02	2.7E-11	2.4E-03	5.5E-02	5.5E-11	1.1E-12	1.1E-03	3.9E-02	0.7	7.8E-01	4.5E-02	0.8
Southern Ute IR	1.4E-02	1.4E-01	9.5E-04	7.8E-01	3.8E-03	2.8E-02	7.6E-02	4.3E-02	4.3E-11	1.8E-03	8.8E-02	8.8E-11	7.0E-13	7.0E-04	3.9E-02	1.2	3.4E-01	4.3E-02	0.4
Uintah and Ouray IR	2.9E-02	1.0E-01	1.9E-03	6.0E-01	2.3E-03	2.7E-02	7.8E-02	4.8E-02	4.8E-11	4.8E-03	8.9E-02	8.9E-11	1.2E-12	1.2E-03	5.1E-02	1.0	2.5E+00	7.1E-02	2.6
Ute Mountain IR	7.1E-03	4.8E-02	3.6E-03	6.7E-01	2.0E-03	4.7E-02	5.7E-02	3.2E-02	3.2E-11	1.8E-03	7.0E-02	7.0E-11	7.0E-13	7.0E-04	3.8E-02	1.0	6.3E-01	4.3E-02	0.7
Wind River IR	2.0E-03	1.6E-02	2.0E-03	3.8E-01	5.7E-04	1.5E-02	5.0E-02	2.6E-02	2.6E-11	1.3E-03	5.2E-02	5.2E-11	6.8E-13	6.8E-04	2.8E-02	0.6	4.5E-01	4.8E-02	0.5

Table C-11 Modeled Wet Deposition Nitrogen Species for the 2021 Control Scenario 2

Assessment Areas	Wet Deposition (kg N/ha/yr)																		
	Oxidized Nitrogen																Reduced Nitrogen		
	NO	NO2	NO3	HNO3	HONO	N2O5	PAN	PANX	PNA	OPAN	NTR	INTR	CRON	CRPX	PNO3	Total	NH3	PNH4	Total
Class I Areas																			
Arches NP	0.0E+00	1.7E-08	3.9E-09	1.0E-07	1.5E-05	0.0E+00	2.6E-04	6.1E-06	1.2E-02	2.1E-07	7.6E-06	7.6E-15	2.1E-16	2.1E-16	5.6E-01	0.6	5.7E-04	1.1E+00	1.1
Black Canyon of the Gunnison WA	3.8E-13	9.7E-08	5.2E-09	7.7E-08	1.9E-05	0.0E+00	5.5E-04	1.3E-05	1.9E-02	2.6E-07	1.5E-05	1.5E-14	2.6E-16	2.6E-16	6.5E-01	0.7	1.6E-04	1.1E+00	1.1
Bridger WA	0.0E+00	3.4E-07	8.0E-09	2.3E-03	4.5E-05	2.3E-05	4.7E-04	1.7E-05	4.0E-02	4.8E-07	1.8E-05	1.8E-14	4.8E-16	4.8E-16	1.0E+00	1.1	1.2E-03	2.0E+00	2.0
Bryce Canyon NP	0.0E+00	1.0E-07	5.3E-09	5.9E-08	1.7E-05	0.0E+00	2.5E-04	6.8E-06	8.4E-03	1.9E-07	1.1E-05	1.1E-14	1.9E-16	1.9E-16	4.2E-01	0.4	3.9E-04	1.0E+00	1.0
Canyonlands NP	0.0E+00	1.6E-08	2.8E-09	8.6E-08	8.1E-06	0.0E+00	1.5E-04	4.9E-06	7.1E-03	1.4E-07	6.2E-06	6.2E-15	1.4E-16	1.4E-16	3.6E-01	0.4	1.9E-04	6.1E-01	0.6
Capitol Reef NP	0.0E+00	9.7E-09	2.0E-09	7.0E-08	8.4E-06	0.0E+00	1.2E-04	4.0E-06	6.1E-03	1.2E-07	4.8E-06	4.8E-15	1.2E-16	1.2E-16	3.3E-01	0.3	1.7E-04	6.2E-01	0.6
Eagles Nest WA	0.0E+00	1.6E-07	2.5E-09	3.0E-03	4.2E-05	1.4E-05	3.1E-04	1.3E-05	3.0E-02	2.0E-07	1.3E-05	1.3E-14	2.0E-16	2.0E-16	6.1E-01	0.6	9.4E-04	8.0E-01	0.8
Fitzpatrick WA	0.0E+00	2.0E-07	4.5E-09	1.6E-03	2.6E-05	9.2E-06	3.5E-04	1.3E-05	2.7E-02	2.9E-07	1.3E-05	1.3E-14	2.9E-16	2.9E-16	7.3E-01	0.8	1.0E-03	1.4E+00	1.4
Flat Tops WA	0.0E+00	2.1E-07	4.9E-09	4.1E-03	4.7E-05	5.3E-05	3.6E-04	1.4E-05	3.6E-02	2.8E-07	1.4E-05	1.4E-14	2.8E-16	2.8E-16	8.1E-01	0.8	2.2E-03	1.2E+00	1.2
La Garita WA	0.0E+00	3.6E-08	2.1E-09	2.8E-03	1.3E-05	5.7E-05	3.9E-04	1.6E-05	2.3E-02	1.3E-07	2.0E-05	2.0E-14	1.3E-16	1.3E-16	6.1E-01	0.6	4.5E-04	7.0E-01	0.7
Maroon Bells-Snowmass WA	0.0E+00	1.4E-07	4.5E-09	2.9E-03	3.6E-05	1.8E-05	3.8E-04	1.4E-05	3.2E-02	2.2E-07	1.6E-05	1.6E-14	2.2E-16	2.2E-16	6.9E-01	0.7	8.0E-04	8.7E-01	0.9
Mesa Verde NP	3.2E-18	3.2E-07	1.1E-08	5.9E-07	4.6E-05	0.0E+00	5.6E-04	1.4E-05	1.7E-02	2.5E-07	1.7E-05	1.7E-14	2.5E-16	2.5E-16	9.1E-01	0.9	3.6E-05	8.2E-01	0.8
Mount Zirkel WA	0.0E+00	4.5E-07	7.4E-09	2.3E-03	6.7E-05	1.5E-05	3.6E-04	1.6E-05	3.6E-02	3.6E-07	1.5E-05	1.5E-14	3.6E-16	3.6E-16	9.1E-01	0.9	6.8E-04	1.3E+00	1.3
Rawah WA	0.0E+00	1.4E-07	3.7E-09	4.2E-03	3.2E-05	5.5E-06	3.2E-04	1.6E-05	2.8E-02	2.6E-07	1.6E-05	1.6E-14	2.6E-16	2.6E-16	7.2E-01	0.8	4.6E-04	1.0E+00	1.0
Rocky Mountain NP	0.0E+00	2.1E-07	4.2E-09	2.9E-03	5.8E-05	3.7E-05	4.2E-04	1.9E-05	3.9E-02	3.2E-07	1.9E-05	1.9E-14	3.2E-16	3.2E-16	9.7E-01	1.0	4.5E-04	1.3E+00	1.3
Weminuche WA	7.9E-11	5.1E-07	9.9E-09	3.2E-03	7.3E-05	3.0E-05	1.1E-03	2.5E-05	4.4E-02	2.8E-07	3.1E-05	3.1E-14	2.8E-16	2.8E-16	1.2E+00	1.3	8.2E-05	1.3E+00	1.3
West Elk WA	0.0E+00	1.5E-07	8.6E-09	3.7E-03	3.1E-05	1.7E-04	4.6E-04	1.8E-05	3.1E-02	3.1E-07	2.0E-05	2.0E-14	3.1E-16	3.1E-16	8.6E-01	0.9	5.8E-04	1.1E+00	1.1
Class II Areas																			
Dinosaur National Monument	0.0E+00	4.2E-08	4.5E-09	8.6E-08	2.4E-05	0.0E+00	2.5E-04	6.4E-06	1.3E-02	1.9E-07	6.9E-06	6.9E-15	1.9E-16	1.9E-16	5.7E-01	0.6	2.5E-04	9.7E-01	1.0
Flaming Gorge National Recreation Area	0.0E+00	2.6E-08	2.4E-09	4.9E-08	1.5E-05	0.0E+00	2.2E-04	6.7E-06	9.9E-03	1.9E-07	6.5E-06	6.5E-15	1.9E-16	1.9E-16	4.2E-01	0.4	3.2E-04	9.6E-01	1.0
Fort Hall IR	0.0E+00	3.5E-08	6.8E-09	5.4E-05	1.4E-05	1.5E-06	1.3E-04	6.0E-06	1.1E-02	1.7E-07	6.1E-06	6.1E-15	1.7E-16	1.7E-16	3.9E-01	0.4	4.1E-04	1.0E+00	1.0
Goshute IR	1.4E-16	2.8E-08	4.9E-09	5.5E-08	1.1E-05	0.0E+00	2.5E-04	6.7E-06	9.2E-03	1.5E-07	7.1E-06	7.1E-15	1.5E-16	1.5E-16	3.9E-01	0.4	8.2E-05	6.5E-01	0.6
High Uintas WA	1.1E-16	8.5E-08	3.0E-09	2.3E-08	3.0E-05	0.0E+00	5.4E-04	1.4E-05	2.3E-02	4.8E-07	1.5E-05	1.5E-14	4.8E-16	4.8E-16	7.1E-01	0.7	6.5E-04	1.9E+00	1.9
Navajo IR	6.1E-11	1.0E-07	1.2E-08	1.2E-04	1.6E-05	4.3E-06	2.1E-04	8.3E-06	1.0E-02	1.2E-07	1.3E-05	1.3E-14	1.2E-16	1.2E-16	4.1E-01	0.4	7.5E-05	4.1E-01	0.4
Paitute IR	0.0E+00	1.1E-07	9.2E-09	2.0E-07	3.8E-05	0.0E+00	1.8E-04	6.0E-06	1.4E-02	2.7E-07	8.0E-06	8.0E-15	2.7E-16	2.7E-16	6.1E-01	0.6	6.4E-04	1.0E+00	1.0
Skull Valley IR	5.4E-13	1.8E-08	5.0E-09	5.7E-08	1.9E-05	0.0E+00	3.1E-04	6.9E-06	1.2E-02	2.3E-07	9.8E-06	9.8E-15	2.3E-16	2.3E-16	5.1E-01	0.5	2.3E-04	9.1E-01	0.9
Southern Ute IR	4.2E-10	5.1E-07	1.9E-08	6.7E-06	7.0E-05	6.8E-07	9.8E-04	2.1E-05	2.5E-02	2.3E-07	2.6E-05	2.6E-14	2.3E-16	2.3E-16	9.9E-01	1.0	1.8E-05	8.9E-01	0.9
Uintah and Ouray IR	0.0E+00	4.2E-08	3.3E-09	8.3E-08	2.1E-05	0.0E+00	1.8E-04	6.1E-06	1.2E-02	2.4E-07	6.8E-06	6.8E-15	2.4E-16	2.4E-16	4.7E-01	0.5	4.6E-04	1.0E+00	1.0
Ute Mountain IR	2.9E-10	4.0E-07	1.3E-08	6.8E-07	3.9E-05	0.0E+00	5.1E-04	1.0E-05	1.3E-02	1.9E-07	1.3E-05	1.3E-14	1.9E-16	1.9E-16	7.4E-01	0.8	5.5E-05	6.6E-01	0.7
Wind River IR	0.0E+00	4.6E-08	8.5E-09	4.4E-04	9.7E-06	2.9E-06	2.1E-04	9.4E-06	1.3E-02	1.6E-07	1.0E-05	1.0E-14	1.6E-16	1.6E-16	4.8E-01	0.5	1.6E-04	8.0E-01	0.8

Table C-12 Modeled Dry Deposition Nitrogen Species for the 2021 Control Scenario 3

Assessment Areas	Dry Deposition (kg N/ha/yr)																		
	Oxidized Nitrogen																Reduced Nitrogen		
	NO	NO2	NO3	HNO3	HONO	N2O5	PAN	PANX	PNA	OPAN	NTR	INTR	CRON	CRPX	PNO3	Total	NH3	PNH4	Total
Class I Areas																			
Arches NP	1.2E-03	1.3E-02	1.6E-03	4.3E-01	4.0E-04	8.9E-03	4.9E-02	3.0E-02	3.0E-11	2.3E-03	6.2E-02	6.2E-11	9.4E-13	9.4E-04	3.8E-02	0.6	3.2E+00	5.2E-02	3.2
Black Canyon of the Gunnison WA	1.4E-03	1.8E-02	1.2E-03	4.8E-01	5.7E-04	9.4E-03	6.5E-02	3.7E-02	3.7E-11	1.5E-03	8.2E-02	8.2E-11	9.4E-13	9.4E-04	3.4E-02	0.7	5.5E-01	4.3E-02	0.6
Bridger WA	1.6E-03	1.4E-02	2.8E-03	5.0E-01	4.5E-04	3.3E-02	6.3E-02	3.4E-02	3.4E-11	1.7E-03	6.3E-02	6.3E-11	7.7E-13	7.7E-04	5.9E-02	0.8	6.9E-01	9.4E-02	0.8
Bryce Canyon NP	7.9E-04	7.7E-03	1.6E-03	4.4E-01	3.1E-04	1.1E-02	5.0E-02	2.8E-02	2.8E-11	2.0E-03	6.6E-02	6.6E-11	1.0E-12	1.0E-03	6.2E-02	0.7	2.9E+00	6.4E-02	2.9
Canyonlands NP	9.8E-04	9.7E-03	3.0E-03	5.3E-01	4.0E-04	1.5E-02	4.7E-02	2.7E-02	2.7E-11	1.9E-03	6.2E-02	6.2E-11	9.0E-13	9.0E-04	4.5E-02	0.7	8.3E-01	5.7E-02	0.9
Capitol Reef NP	8.7E-04	7.6E-03	1.7E-03	4.9E-01	3.7E-04	1.2E-02	4.6E-02	2.6E-02	2.6E-11	1.8E-03	5.8E-02	5.8E-11	8.7E-13	8.7E-04	4.9E-02	0.7	1.4E+00	6.3E-02	1.5
Eagles Nest WA	4.8E-03	3.4E-02	1.0E-03	5.3E-01	2.0E-03	2.5E-02	7.1E-02	3.8E-02	3.8E-11	1.4E-03	7.6E-02	7.6E-11	7.8E-13	7.8E-04	3.9E-02	0.8	4.0E-01	5.8E-02	0.5
Fitzpatrick WA	1.1E-03	9.3E-03	3.2E-03	5.0E-01	3.8E-04	3.2E-02	6.1E-02	3.2E-02	3.2E-11	1.6E-03	5.8E-02	5.8E-11	8.0E-13	8.0E-04	6.6E-02	0.8	6.6E-01	9.9E-02	0.8
Flat Tops WA	1.9E-03	1.9E-02	2.8E-03	6.9E-01	8.1E-04	3.7E-02	8.6E-02	4.6E-02	4.6E-11	2.0E-03	9.4E-02	9.4E-11	1.2E-12	1.2E-03	5.9E-02	1.0	6.4E-01	8.1E-02	0.7
La Garita WA	1.1E-03	8.5E-03	1.9E-03	6.0E-01	4.1E-04	2.3E-02	6.7E-02	3.4E-02	3.4E-11	1.1E-03	7.0E-02	7.0E-11	7.0E-13	7.0E-04	4.9E-02	0.9	3.5E-01	6.0E-02	0.4
Maroon Bells-Snowmass WA	1.8E-03	1.6E-02	1.8E-03	6.1E-01	6.6E-04	2.0E-02	7.4E-02	4.0E-02	4.0E-11	1.4E-03	8.7E-02	8.7E-11	9.2E-13	9.2E-04	4.7E-02	0.9	5.1E-01	6.2E-02	0.6
Mesa Verde NP	3.4E-03	4.1E-02	6.1E-03	9.5E-01	1.7E-03	6.6E-02	7.5E-02	4.1E-02	4.1E-11	2.0E-03	8.8E-02	8.8E-11	1.0E-12	1.0E-03	5.5E-02	1.3	4.2E-01	5.6E-02	0.5
Mount Zirkel WA	3.5E-03	3.7E-02	4.1E-03	8.1E-01	1.9E-03	9.7E-02	9.6E-02	5.3E-02	5.3E-11	2.5E-03	1.0E-01	1.0E-10	1.4E-12	1.4E-03	6.8E-02	1.3	6.1E-01	1.0E-01	0.7
Rawah WA	2.1E-03	2.0E-02	3.7E-03	7.6E-01	9.9E-04	8.7E-02	8.8E-02	4.7E-02	4.7E-11	2.0E-03	9.1E-02	9.1E-11	1.1E-12	1.1E-03	6.5E-02	1.2	5.9E-01	1.0E-01	0.7
Rocky Mountain NP	3.2E-03	2.4E-02	3.8E-03	7.1E-01	1.6E-03	6.0E-02	8.8E-02	4.7E-02	4.7E-11	2.0E-03	8.8E-02	8.8E-11	1.0E-12	1.0E-03	6.3E-02	1.1	5.3E-01	9.8E-02	0.6
Weminuche WA	2.2E-03	1.7E-02	1.2E-03	5.7E-01	7.9E-04	2.2E-02	7.3E-02	3.8E-02	3.8E-11	1.2E-03	7.8E-02	7.8E-11	7.2E-13	7.2E-04	4.4E-02	0.8	3.1E-01	4.8E-02	0.4
West Elk WA	1.3E-03	1.3E-02	1.5E-03	5.6E-01	5.4E-04	1.5E-02	6.9E-02	3.7E-02	3.7E-11	1.4E-03	8.2E-02	8.2E-11	9.3E-13	9.3E-04	4.3E-02	0.8	5.5E-01	5.6E-02	0.6
Class II Areas																			
Dinosaur National Monument	2.4E-03	2.1E-02	3.4E-03	5.8E-01	1.1E-03	5.0E-02	7.0E-02	4.1E-02	4.1E-11	3.4E-03	7.7E-02	7.7E-11	1.2E-12	1.2E-03	4.4E-02	0.9	9.0E-01	6.4E-02	1.0
Flaming Gorge National Recreation Area	2.7E-03	2.1E-02	1.7E-03	4.3E-01	8.6E-04	1.9E-02	5.8E-02	3.4E-02	3.4E-11	2.7E-03	6.1E-02	6.1E-11	9.9E-13	9.9E-04	3.4E-02	0.7	1.3E+00	5.4E-02	1.4
Fort Hall IR	7.5E-03	9.8E-02	2.6E-03	3.8E-01	2.5E-03	3.3E-02	7.0E-02	3.9E-02	3.9E-11	4.4E-03	7.6E-02	7.6E-11	1.3E-12	1.3E-03	4.0E-02	0.8	3.0E+00	4.8E-02	3.0
Goshute IR	4.5E-04	3.9E-03	1.5E-03	4.7E-01	1.8E-04	5.6E-03	3.8E-02	1.8E-02	1.8E-11	8.9E-04	4.5E-02	4.5E-11	6.6E-13	6.6E-04	4.0E-02	0.6	2.7E-01	4.1E-02	0.3
High Uintas WA	1.2E-03	1.1E-02	2.6E-03	4.8E-01	2.9E-04	2.8E-02	7.5E-02	4.1E-02	4.1E-11	2.7E-03	7.3E-02	7.3E-11	9.0E-13	9.0E-04	9.3E-02	0.8	1.3E+00	1.2E-01	1.4
Navajo IR	4.5E-03	3.2E-02	2.8E-03	5.3E-01	1.3E-03	3.0E-02	4.5E-02	2.5E-02	2.5E-11	1.4E-03	6.3E-02	6.3E-11	7.3E-13	7.3E-04	5.6E-02	0.8	4.0E-01	4.7E-02	0.5
Paitute IR	2.2E-03	2.0E-02	2.4E-03	5.3E-01	5.9E-04	1.1E-02	4.9E-02	3.1E-02	3.1E-11	3.4E-03	6.8E-02	6.8E-11	9.2E-13	9.2E-04	6.8E-02	0.8	2.2E+00	4.9E-02	2.2
Skull Valley IR	1.8E-03	1.4E-02	3.0E-03	4.9E-01	7.0E-04	2.6E-02	4.8E-02	2.7E-02	2.7E-11	2.4E-03	5.5E-02	5.5E-11	1.1E-12	1.1E-03	3.9E-02	0.7	7.8E-01	4.5E-02	0.8
Southern Ute IR	1.4E-02	1.4E-01	9.5E-04	7.8E-01	3.8E-03	2.8E-02	7.6E-02	4.3E-02	4.3E-11	1.8E-03	8.8E-02	8.8E-11	7.0E-13	7.0E-04	3.9E-02	1.2	3.4E-01	4.3E-02	0.4
Uintah and Ouray IR	1.6E-02	8.4E-02	1.8E-03	5.6E-01	1.8E-03	2.5E-02	7.7E-02	4.7E-02	4.7E-11	4.7E-03	8.8E-02	8.8E-11	1.2E-12	1.2E-03	4.9E-02	1.0	2.6E+00	6.8E-02	2.6
Ute Mountain IR	7.1E-03	4.8E-02	3.6E-03	6.7E-01	2.0E-03	4.7E-02	5.7E-02	3.2E-02	3.2E-11	1.8E-03	7.0E-02	7.0E-11	7.0E-13	7.0E-04	3.8E-02	1.0	6.3E-01	4.3E-02	0.7
Wind River IR	2.0E-03	1.6E-02	2.0E-03	3.8E-01	5.7E-04	1.5E-02	5.0E-02	2.6E-02	2.6E-11	1.3E-03	5.2E-02	5.2E-11	6.8E-13	6.8E-04	2.8E-02	0.6	4.5E-01	4.8E-02	0.5

Table C-13 Modeled Wet Deposition Nitrogen Species for the 2021 Control Scenario 3

Assessment Areas	Wet Deposition (kg N/ha/yr)																		
	Oxidized Nitrogen																Reduced Nitrogen		
	NO	NO2	NO3	HNO3	HONO	N2O5	PAN	PANX	PNA	OPAN	NTR	INTR	CRON	CRPX	PNO3	Total	NH3	PNH4	Total
Class I Areas																			
Arches NP	0.0E+00	1.6E-08	3.9E-09	9.8E-08	1.5E-05	0.0E+00	2.6E-04	6.1E-06	1.2E-02	2.1E-07	7.6E-06	7.6E-15	2.1E-16	2.1E-16	5.5E-01	0.6	5.7E-04	1.1E+00	1.1
Black Canyon of the Gunnison WA	3.8E-13	9.7E-08	5.1E-09	7.7E-08	1.9E-05	0.0E+00	5.5E-04	1.3E-05	1.9E-02	2.6E-07	1.5E-05	1.5E-14	2.6E-16	2.6E-16	6.4E-01	0.7	1.6E-04	1.1E+00	1.1
Bridger WA	0.0E+00	3.4E-07	8.0E-09	2.3E-03	4.5E-05	2.3E-05	4.7E-04	1.7E-05	4.0E-02	4.8E-07	1.8E-05	1.8E-14	4.8E-16	4.8E-16	1.0E+00	1.1	1.2E-03	2.0E+00	2.0
Bryce Canyon NP	0.0E+00	1.0E-07	5.3E-09	5.9E-08	1.7E-05	0.0E+00	2.5E-04	6.8E-06	8.4E-03	1.9E-07	1.1E-05	1.1E-14	1.9E-16	1.9E-16	4.2E-01	0.4	3.9E-04	1.0E+00	1.0
Canyonlands NP	0.0E+00	1.6E-08	2.8E-09	8.5E-08	8.0E-06	0.0E+00	1.5E-04	4.9E-06	7.1E-03	1.4E-07	6.2E-06	6.2E-15	1.4E-16	1.4E-16	3.5E-01	0.4	1.9E-04	6.1E-01	0.6
Capitol Reef NP	0.0E+00	9.7E-09	2.0E-09	7.0E-08	8.3E-06	0.0E+00	1.2E-04	4.0E-06	6.1E-03	1.2E-07	4.8E-06	4.8E-15	1.2E-16	1.2E-16	3.3E-01	0.3	1.7E-04	6.2E-01	0.6
Eagles Nest WA	0.0E+00	1.6E-07	2.5E-09	2.9E-03	4.2E-05	1.4E-05	3.1E-04	1.3E-05	2.9E-02	2.0E-07	1.3E-05	1.3E-14	2.0E-16	2.0E-16	6.1E-01	0.6	9.8E-04	8.0E-01	0.8
Fitzpatrick WA	0.0E+00	2.0E-07	4.5E-09	1.6E-03	2.6E-05	9.2E-06	3.5E-04	1.3E-05	2.7E-02	2.9E-07	1.3E-05	1.3E-14	2.9E-16	2.9E-16	7.3E-01	0.8	1.0E-03	1.4E+00	1.4
Flat Tops WA	0.0E+00	2.0E-07	4.9E-09	4.1E-03	4.6E-05	5.0E-05	3.6E-04	1.3E-05	3.5E-02	2.8E-07	1.4E-05	1.4E-14	2.8E-16	2.8E-16	8.0E-01	0.8	2.3E-03	1.2E+00	1.2
La Garita WA	0.0E+00	3.6E-08	2.1E-09	2.8E-03	1.3E-05	5.7E-05	3.9E-04	1.6E-05	2.3E-02	1.3E-07	2.0E-05	2.0E-14	1.3E-16	1.3E-16	6.1E-01	0.6	4.5E-04	7.0E-01	0.7
Maroon Bells-Snowmass WA	0.0E+00	1.4E-07	4.4E-09	2.9E-03	3.5E-05	1.8E-05	3.8E-04	1.4E-05	3.2E-02	2.2E-07	1.6E-05	1.6E-14	2.2E-16	2.2E-16	6.9E-01	0.7	8.1E-04	8.7E-01	0.9
Mesa Verde NP	3.2E-18	3.2E-07	1.1E-08	5.9E-07	4.6E-05	0.0E+00	5.6E-04	1.4E-05	1.7E-02	2.5E-07	1.7E-05	1.7E-14	2.5E-16	2.5E-16	9.1E-01	0.9	3.6E-05	8.2E-01	0.8
Mount Zirkel WA	0.0E+00	4.4E-07	7.4E-09	2.3E-03	6.6E-05	1.4E-05	3.6E-04	1.6E-05	3.5E-02	3.6E-07	1.5E-05	1.5E-14	3.6E-16	3.6E-16	8.9E-01	0.9	7.3E-04	1.3E+00	1.3
Rawah WA	0.0E+00	1.3E-07	3.7E-09	4.0E-03	3.2E-05	5.5E-06	3.2E-04	1.5E-05	2.8E-02	2.6E-07	1.6E-05	1.6E-14	2.6E-16	2.6E-16	7.2E-01	0.7	4.9E-04	9.9E-01	1.0
Rocky Mountain NP	0.0E+00	2.1E-07	4.2E-09	2.9E-03	5.7E-05	3.6E-05	4.2E-04	1.9E-05	3.9E-02	3.2E-07	1.9E-05	1.9E-14	3.2E-16	3.2E-16	9.6E-01	1.0	4.7E-04	1.3E+00	1.3
Weminuche WA	7.9E-11	5.1E-07	9.9E-09	3.2E-03	7.3E-05	3.0E-05	1.1E-03	2.5E-05	4.4E-02	2.8E-07	3.1E-05	3.1E-14	2.8E-16	2.8E-16	1.2E+00	1.3	8.2E-05	1.3E+00	1.3
West Elk WA	0.0E+00	1.5E-07	8.6E-09	3.7E-03	3.1E-05	1.7E-04	4.6E-04	1.8E-05	3.1E-02	3.1E-07	2.0E-05	2.0E-14	3.1E-16	3.1E-16	8.6E-01	0.9	5.8E-04	1.1E+00	1.1
Class II Areas																			
Dinosaur National Monument	0.0E+00	3.6E-08	4.5E-09	7.3E-08	2.1E-05	0.0E+00	2.4E-04	6.3E-06	1.3E-02	1.9E-07	6.9E-06	6.9E-15	1.9E-16	1.9E-16	5.5E-01	0.6	2.6E-04	9.6E-01	1.0
Flaming Gorge National Recreation Area	0.0E+00	2.5E-08	2.4E-09	4.8E-08	1.4E-05	0.0E+00	2.2E-04	6.6E-06	9.7E-03	1.8E-07	6.5E-06	6.5E-15	1.8E-16	1.8E-16	4.1E-01	0.4	3.3E-04	9.6E-01	1.0
Fort Hall IR	0.0E+00	3.5E-08	6.8E-09	5.4E-05	1.4E-05	1.5E-06	1.3E-04	6.0E-06	1.1E-02	1.7E-07	6.1E-06	6.1E-15	1.7E-16	1.7E-16	3.9E-01	0.4	4.1E-04	1.0E+00	1.0
Goshute IR	1.4E-16	2.8E-08	4.9E-09	5.5E-08	1.1E-05	0.0E+00	2.5E-04	6.7E-06	9.1E-03	1.5E-07	7.1E-06	7.1E-15	1.5E-16	1.5E-16	3.9E-01	0.4	8.3E-05	6.5E-01	0.6
High Uintas WA	1.1E-16	8.1E-08	3.0E-09	2.2E-08	2.8E-05	0.0E+00	5.4E-04	1.4E-05	2.2E-02	4.8E-07	1.5E-05	1.5E-14	4.8E-16	4.8E-16	7.0E-01	0.7	6.5E-04	1.9E+00	1.9
Navajo IR	6.1E-11	1.0E-07	1.2E-08	1.2E-04	1.6E-05	4.3E-06	2.1E-04	8.3E-06	1.0E-02	1.1E-07	1.3E-05	1.3E-14	1.1E-16	1.1E-16	4.1E-01	0.4	7.5E-05	4.1E-01	0.4
Paitute IR	0.0E+00	1.1E-07	9.2E-09	2.0E-07	3.8E-05	0.0E+00	1.8E-04	6.0E-06	1.4E-02	2.7E-07	8.0E-06	8.0E-15	2.7E-16	2.7E-16	6.1E-01	0.6	6.4E-04	1.0E+00	1.0
Skull Valley IR	5.4E-13	1.8E-08	5.0E-09	5.7E-08	1.9E-05	0.0E+00	3.1E-04	6.8E-06	1.2E-02	2.3E-07	9.8E-06	9.8E-15	2.3E-16	2.3E-16	5.1E-01	0.5	2.3E-04	9.1E-01	0.9
Southern Ute IR	4.2E-10	5.1E-07	1.9E-08	6.7E-06	7.0E-05	6.8E-07	9.8E-04	2.1E-05	2.5E-02	2.3E-07	2.6E-05	2.6E-14	2.3E-16	2.3E-16	9.9E-01	1.0	1.8E-05	8.9E-01	0.9
Uintah and Ouray IR	0.0E+00	3.8E-08	3.3E-09	6.1E-08	1.9E-05	0.0E+00	1.8E-04	6.0E-06	1.2E-02	2.3E-07	6.8E-06	6.8E-15	2.3E-16	2.3E-16	4.5E-01	0.5	4.8E-04	9.9E-01	1.0
Ute Mountain IR	2.9E-10	4.0E-07	1.3E-08	6.8E-07	3.9E-05	0.0E+00	5.1E-04	1.0E-05	1.3E-02	1.9E-07	1.3E-05	1.3E-14	1.9E-16	1.9E-16	7.4E-01	0.8	5.5E-05	6.6E-01	0.7
Wind River IR	0.0E+00	4.6E-08	8.5E-09	4.4E-04	9.7E-06	2.9E-06	2.1E-04	9.4E-06	1.3E-02	1.6E-07	1.0E-05	1.0E-14	1.6E-16	1.6E-16	4.8E-01	0.5	1.6E-04	8.0E-01	0.8