APPENDIX D

AIR QUALITY

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ACRONYMS, ABBREVIATIONS, AND SYMBOLS

μg/m³	micrograms per cubic meter
ACAM	Air Conformity Applicability Model
AGL	above ground level
APU	auxiliary power unit
BAPC	Bureau of Air Pollution Control
CAA	Clean Air Act
CEQ	Council on Environmental Quality
CFR	Code of Federal Refagulations
CH_4	methane
CO	carbon monoxide
CO_2	carbon dioxide
CO_2-e	carbon dioxide equivalents
CY	calendar year
EAC	early action compact
ETR	engine thrust ratio
FFR	fuel flow rate
GBU	guided bomb unit
GHG	greenhouse gas
GOV	government-owned vehicle
HAP	hazardous air pollutant
lb	pound
mg/m³	milligrams per cubic meter
mm	millimeter
N_2O	nitrous oxide
NAA	No Action Alternative
NAAQS	National Ambient Air Quality Standards
NDEP	Nevada Division of Environmental Protection
NEI	National Emissions Inventory
NEW	net explosive weight
NO_2	nitrogen dioxide
NO_x	nitrogen oxides
O_3	ozone
Pb	lead
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
ppm	parts per million
ROI	region of influence
SO_2	sulfur dioxide
TGO	touch and go
TP	target practice
U.S.	United States
EPA	U.S. Environmental Protection Agency
VMT	volume of miles traveled
VOC	volatile organic compound
yr	year

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D.1 AIR QUALITY

This appendix presents an overview of the Clean Air Act (CAA) and the state of Nevada air quality program. The appendix also discusses emissions factor development and calculations, including the assumptions used for the air quality analyses presented in the Air Quality sections.

D.1.1 Air Quality Program Overview

In order to protect public health and welfare, the U.S. Environmental Protection Agency (EPA) has developed numerical concentration-based standards, or National Ambient Air Quality Standards (NAAQS), for six “criteria” pollutants (based on health-related criteria) under the provisions of the CAA Amendments of 1970. There are two kinds of NAAQS: primary and secondary standards. Primary standards prescribe the maximum permissible concentration in the ambient air to protect public health, including the health of “sensitive” populations such as asthmatics, children, and the elderly. Secondary standards prescribe the maximum concentration or level of air quality required to protect public welfare, including protection against decreased visibility, damage to animals, crops, vegetation, and buildings (40 Code of Federal Regulations [CFR] 50).

The CAA gives states the authority to establish air quality rules and regulations. These rules and regulations must be equivalent to, or more stringent than, the federal program. The Nevada Division of Environmental Protection’s (NDEP) Bureau of Air Pollution Control (BAPC) administers the state’s air pollution control program under the authority of the Nevada Revised Statutes (NRS) 445B.100 through 445B.825, inclusive, and NRS 486A.010 through 486A.180, inclusive. Washoe and Clark counties administer air quality programs within each of their respective jurisdictions. The Clark County Department of Air Quality is the air pollution control agency for all of Clark County, Nevada.

The Nevada Ambient Air Quality Standards differ from the EPA’s NAAQS for several pollutants and are included in Table D-1. Summary of Nevada and National Ambient Air Quality Standards. However, in accordance with Nevada Administrative Code 445B.22097, Nevada standards are only to be used “in considering whether to issue a permit for a stationary source and shall ensure that the stationary source will not cause the Nevada standards to be exceeded in areas where the general public has access” and further states that the NAAQS are to be used in determinations of attainment or nonattainment.

Based on measured ambient air pollutant concentrations, the EPA designates areas of the United States as having air quality better than (attainment) the NAAQS, worse than (nonattainment) the NAAQS, and unclassifiable. The areas that cannot be classified (on the basis of available information) as meeting or not meeting the NAAQS for a particular pollutant are “unclassifiable” and are treated as attainment until proven otherwise. Attainment areas can be further classified as “maintenance” areas, which are areas previously classified as nonattainment but where air pollutant concentrations have been successfully reduced to below the standard. Maintenance areas are under special maintenance plans and must operate under some of the nonattainment area plans to ensure compliance with the NAAQS. Clark, Lincoln, and Nye counties are in compliance with the NAAQS. Therefore, every county within the project region of influence (ROI) is classified as being in attainment.

A general conformity analysis is required to be conducted for areas designated as nonattainment or maintenance of the NAAQS if the action's direct and indirect emissions have a potential to emit one or more of the six criteria pollutants at or above concentrations standards shown in Table D-1 or the *de minimis* emission rate thresholds in Table D-2 or Table D-3.

Table D-1. Summary of Nevada and National Ambient Air Quality Standards

		NEVADA STANDARDS[a]		NATIONAL STANDARDS[b]		
Pollutant	**Averaging Time**	**Concentration[c]**	**Method[d]**	**Primary[c, e]**	**Secondary[c, f]**	**Method[d]**
Ozone	8 hours	0.070 ppm	Chemi-luminescence	0.070 ppm	Same as primary	Chemi-luminescence
Ozone-Lake Tahoe Basin, #90	1 hour	0.10 ppm(195 μg/m^3)	Ultraviolet absorption	--	--	--
Carbon monoxide less than 5,000′above mean sea level	8 hours	9 ppm(10,500 μg/m^3)	Nondispersive infrared photometry	9 ppm(10 mg/m^3)	None	Nondispersive infrared photometry
Carbon monoxide at or greater than 5,000′ above mean sea level		6 ppm(7,000 μg/m^3)				
Carbon monoxide at any elevation	1 hour	35 ppm(40,500 μg/m^3)		35 ppm(40 mg/m^3)		
Nitrogen dioxide	Annual arithmetic mean	0.053 ppm(100 μg/m^3)	Gas phase chemi-luminescence	53 ppb[g]	Same as primary	Gas phase chemi-luminescence
	1 hour	100 ppb	--	100 ppb	None	
Sulfur dioxide	Annual arithmetic mean	0.030 ppm(80 μg/m^3)	Ultraviolet fluorescence	0.03 ppm[h](1971 standard)	None	Spectro-photometry (Pararosaniline method)
	24 hours	0.14 ppm(365 μg/m^3)		0.14 ppm[h](1971 standard)		
	3 hours	0.5 ppm(1,300 μg/m^3)		None	0.5 ppm	
	1 hour	75 ppb	--	75 ppb	None	
Particulate	24 hours	150 μg/m^3	High volume	150 μg/m^3	Same as	High or low

Table D-1. Summary of Nevada and National Ambient Air Quality Standards

		NEVADA STANDARDS[a]		NATIONAL STANDARDS[b]		
Pollutant	**Averaging Time**	**Concentration[c]**	**Method[d]**	**Primary[c, e]**	**Secondary[c, f]**	**Method[d]**
matter as PM_{10}			PM_{10}sampling		primary	volume PM_{10} sampling
	Annual arithmetic mean	12.0 µg/m^3	--	12.0 µg/m^3	Same as primary	Low volume $PM_{2.5}$ sampling
as $PM_{2.5}$	24 hours	35 µg/m^3	--	35 µg/m^3	Same as primary	
Lead (Pb)	Rolling 3 mo. average	0.15 µg/m^3	High volume sampling, acid extraction and atomic absorption spectrometry	0.15 µg/m^3	Same as primary	High volume sampling, acid extraction and atomic absorption spectrometry
Hydrogen sulfide	1 hour	0.08 ppm (112 µg/m^3)[i]	Ultraviolet fluorescence	--	--	--

a The Director shall use the Nevada standards in considering whether to issue a permit for a stationary source and shall ensure that the stationary source will not cause the Nevada standards to be exceeded in areas where the general public has access. For the 2006 particulate matter as $PM_{2.5}$ 24-hour and annual standards, the 2010 nitrogen dioxide 1-hour standard and the 2010 sulfur dioxide 1-hour standard, the Director shall use the form of the standards set forth in 40 CFR 50.11, 50.13 and 50.17, as those provisions existed on June 23, 2014, to ensure that the Nevada standard is no more stringent than the National standard in determining whether the stationary source will comply with the Nevada standards in areas where the general public has access.

b The National standards are used in determinations of attainment or nonattainment. The form of a National standard is the criteria which must be satisfied for each respective concentration level of a standard for the purposes of attainment. The form for each National standard is set forth in 40 CFR Part 50 and may be viewed at http://www.epa.gov/air/criteria.html.

c Where applicable and except as otherwise described in Note G, concentration is expressed first in units in which it was adopted. Measurements of air quality that are expressed as mass per unit volume, such as micrograms per cubic meter, must be corrected to a reference temperature of 25 degrees Centigrade and a reference pressure of 760 mm of Hg (1,013.2 millibars), except measurements of particulate matter as $PM_{2.5}$ and lead (Pb), which are calculated in micrograms per cubic meter at local conditions; "ppb" in this table refers to parts per billion by volume, or nanomoles of regulated air pollutant per mole of gas; "ppm" refers to parts per million by volume, or micromoles of regulated air pollutant per mole of gas; "µg/m^3" refers to micrograms per cubic meter.

d Reference method as described by the EPA. Any reference method specified in accordance with 40 CFR Part 50 or any reference method or equivalent method designated in accordance with 40 CFR Part 53 may be substituted.

e National primary standards are the levels of air quality necessary, with an adequate margin of safety, to protect the public health.

f National secondary standards are the levels of air quality necessary to protect the public welfare from any known or anticipated adverse effects of a regulated air pollutant.

g The official National annual standard for nitrogen dioxide is 0.053 ppm. The National annual standard is identified in this table in equivalent units of parts per billion for the purpose of simplifying its comparison with the National 1-hour standard which is also identified in parts per billion.

h The 1971 National sulfur dioxide standards remain in effect for an area until 1 year after the area is designated for the 2010 National sulfur dioxide standard, except that in an area designated nonattainment for the 1971 National sulfur dioxide standards, the 1971 standards remain in effect until an implementation plan to attain or maintain the 2010 National sulfur dioxide standards is approved.

i The ambient air quality standard for hydrogen sulfide does not include naturally occurring background concentrations.

1. These standards of quality for ambient air are minimum goals, and it is the intent of the Commission to protect the existing quality of Nevada's air to the extent that it is economically and technically feasible. [Environmental Comm'n, Air Quality Reg. §§ 12.1-12.1.6, eff. 11-7-75; A and renumbered as § 12.1, 12-4-76; A 12-15-77; 8-28-79; §§ 12.2-12.4, eff. 11-7-75; § 12.5, eff. 12-4-76; A 8-28-79] — (NAC A 10-19-83; 9-5-84; 12-26-91; 10-30-95; R103-02, 12-17-2002; R198-03, 4-26-2004; R038-12, 9-14-2012; R042-13, 12-23-2013; R145-13, 6-23-2014; R027-15, 10-27-2015)

Table D-2. Emission Rates for Criteria Pollutants in Nonattainment Areas[1]

Pollutant	Emission Rate (tons/year)
Ozone (VOCs or NO_x)	
Serious nonattainment areas	50
Severe nonattainment areas	25
Extreme nonattainment areas	10
Other ozone nonattainment areas outside an ozone transport region	100
Marginal and moderate nonattainment areas inside an ozone transport region	
VOCs	50
NO_x	100
CO: All nonattainment areas	100
SO_2 or NO_2: All nonattainment areas	100
PM_{10}	
Moderate nonattainment areas	100
Serious nonattainment areas	70
$PM_{2.5}$	
Direct emissions	100
SO_2	100
NO_x (unless determined not to be a significant precursor)	100
VOCs or ammonia (if determined to be significant precursors)	100
Pb: All nonattainment areas	25

Source: EPA, 2006

CO = carbon monoxide; NO_2 = nitrogen dioxide; NO_x = nitrogen oxides; VOC = volatile organic compound; Pb = lead; $PM_{2.5}$ = particulate matter with a diameter less than or equal to 2.5 microns; PM_{10} = particulate matter with a diameter less than or equal to 10 microns; SO_2 = sulfur dioxide

1. *De minimis* threshold levels for conformity applicability analysis.

Table D-3. Emission Rates for Criteria Pollutants in Attainment (Maintenance) Areas[1]

Pollutant	Emission Rate (tons/year)
Ozone (NO_x, SO_2, or NO_2): All maintenance areas	100
Ozone (VOCs)	
Maintenance areas inside an ozone transport region	50
Maintenance areas outside an ozone transport region	100
CO: All maintenance areas	100
PM_{10}: All maintenance areas	100
$PM_{2.5}$	
Direct emissions	100
SO_2	100
NO_x (unless determined not to be a significant precursor)	100
VOCs or ammonia (if determined to be significant precursors)	100
Pb: All maintenance areas	25

Source: EPA, 2006

CO = carbon monoxide; NO_x = nitrogen oxides; VOC = volatile organic compound; Pb = lead; $PM_{2.5}$ = particulate matter with a diameter less than or equal to 2.5 microns; PM_{10} = particulate matter with a diameter less than or equal to 10 microns; SO_2 = sulfur dioxide

1. *De minimis* threshold levels for conformity applicability analysis.

Each state is required to develop a State Implementation Plan (SIP) that sets forth how CAA provisions will be imposed within the state. The SIP is the primary means for the implementation, maintenance, and enforcement of the measures needed to attain and maintain the NAAQS within each state and includes control measures, emissions limitations, and other provisions required to attain and maintain the ambient air quality standards. The purpose of the SIP is twofold. First, it must provide a control strategy that will result in the attainment and maintenance of the NAAQS. Second, it must demonstrate that progress is being made in attaining the standards in each nonattainment area. The State of Nevada last revised the SIP *Nevada Revised Statutes* and *Regulatory Elements: Air Pollution* and on November 11 and 28, 2012, respectively (NDEP, 2012a, 2012b).

In attainment areas, major new or modified stationary sources of air emissions on and in the area are subject to Prevention of Significant Deterioration (PSD) review to ensure that these sources are constructed without causing significant adverse deterioration of the clean air in the area. A major new source is defined as one that has the potential to emit any pollutant regulated under the CAA in amounts equal to or exceeding specific major source thresholds, that is, 100 or 250 tons/year based on the source's industrial category. A major modification is a physical change or change in the method of operation at an existing major source that causes a significant "net emissions increase" at that source of any regulated pollutant. Table D-4 lists the PSD significant emissions rate thresholds for selected criteria pollutants (EPA, 1990).

Table D-4. Criteria Pollutant Significant Emissions Rate Increases Under PSD Regulations

Pollutant	Significant Emissions Rate (tons/year)
PM_{10}	15
$PM_{2.5}$	10
Total suspended particulates	25
SO_2	40
NO_x	40
Ozone (VOCs)	40
CO	100

Source: Title 40 CFR Part 51

CO = carbon monoxide; NO_x = nitrogen oxides; VOC = volatile organic compound; Pb = lead; $PM_{2.5}$ = particulate matter with a diameter less than or equal to 2.5 microns; PM_{10} = particulate matter with a diameter less than or equal to 10 microns; PSD = Prevention of Significant Deterioration; SO_2 = sulfur dioxide; VOC = volatile organic compound

The goals of the PSD program are to (1) ensure economic growth while preserving existing air quality; (2) protect public health and welfare from adverse effects that might occur even at pollutant levels better than the NAAQS; and (3) preserve, protect, and enhance the air quality in areas of special natural recreational, scenic, or historic value, such as national parks and wilderness areas. Sources subject to PSD review are required by the CAA to obtain a permit before commencing construction. The permit process requires an extensive review of all other major sources within a 50-mile radius and all Class I areas within a 62-mile radius of the facility. Emissions from any new or modified source must be controlled using best available control technology. The air quality, in combination with other PSD sources in the area, must not exceed the maximum allowable incremental increase identified in Table D-5. National parks and wilderness areas are designated as Class I areas, where any appreciable deterioration in air quality is considered significant. Class II areas are those where moderate, well-controlled industrial growth could be permitted. Class III areas allow for greater industrial development.

Table D-5. Federal Allowable Pollutant Concentration Increases Under PSD Regulations

Pollutant	Averaging Time	Maximum Allowable Concentration ($\mu g/m^3$)		
		Class I	Class II	Class III
PM_{10}	Annual	4	17	34
	24-hour	8	30	60
SO_2	Annual	2	20	40
	24-hour	5	91	182
	3-hour	25	512	700
NO_2	Annual	2.5	25	50

Source: Title 40 CFR Part 51
NO_2 = nitrogen dioxide; PM_{10} = particulate matter with a diameter less than or equal to 10 microns; PSD = Prevention of Significant Deterioration; SO_2 = sulfur dioxide; $\mu g/m^3$ = micrograms per cubic meter

The Nevada Ambient Air Quality Monitoring Program of the Bureau of Air Quality Planning operates an ambient air quality monitoring network of gaseous and particulate pollutant monitors throughout rural Nevada, except those areas in Washoe and Clark County. Washoe and Clark County operate and maintain monitoring networks separate from the State and publish their findings independently (NDEP, 2016). The air quality is monitored for carbon monoxide, lead, nitrogen dioxide, ozone, and particulate matter. The monitors tend to be concentrated in areas with the largest population densities. Not all pollutants are monitored in all areas. The air quality monitoring network is used to identify areas where the ambient air quality standards are being violated and plans are needed to reduce pollutant concentration levels to be in attainment with the standards. Also included are areas where the ambient standards are being met, but plans are necessary to ensure maintenance of acceptable levels of air quality in the face of anticipated population or industrial growth.

The end result of this attainment/maintenance analysis is the development of local and statewide strategies for controlling emissions of criteria air pollutants from stationary and mobile sources. The first step in this process is the annual compilation of the ambient air monitoring results, and the second step is the analysis of the monitoring data for general air quality, exceedances of air quality standards, and pollutant trends.

The Nevada Air Pollution Control Program (NAPCP) currently operates monitors in Carson City, Gardnerville, Stateline, Fernley, Fallon, Elko, and Pahrump. The number of monitoring sites and their locations vary from year to year due to special purpose monitoring, temporary monitoring, and closing sites that are no longer needed. Due to the unique shape and wind patterns in the Las Vegas Valley, high concentration levels occur in different areas for the different pollutants. For example, CO occurs on calm cold days in the lowest (and eastern) part of the valley. In addition, ozone occurs on hot sunny days in the northwest and at higher elevations. Therefore, monitoring sites measure different pollutants based on their location within the valley (Clark County, 2016). Over the years of record, the general trend has been decreasing for all criteria pollutants and remaining below the NAAQS (NDEP, 2011).

D.1.2 Project Calculations

D.1.2.1 Methodology

In order to evaluate air emissions and their impact on the overall ROI, the emissions associated with the Proposed Action activities were evaluated in accordance with the tiered approach outlined in the *Air Force Air Quality Environmental Impact Analysis Process (EIAP) Guide – Fundamentals, Volume I and Volume II – Advanced Assessments*. The first step was to conduct an assessment to determine if the action was exempt for air quality analysis. The Proposed Action was not subject to any categorical exclusions or General Conformity exemptions. Since the Proposed Action is not subject to any exemptions under Tier I, a quantitative assessment (Tier II) was completed. The Tier II assessment requires a formal evaluation of air impacts based on a quantitative net change emission inventory of the annual net total direct and indirect emissions of pollutants of concern. It should be noted that in the case of the NTTR Proposed Action, there were not any net emissions realized.

Air quality impacts were evaluated quantitatively based on a two-pronged approach. Potential impacts to air quality were first identified as the total emissions of any primary pollutant that equals 250 tons per year for that pollutant based on the federal New Source Review/PSD major stationary source threshold. In addition to primary pollutants, greenhouse gases (GHGs) were compared to an indicator level of 75,000 tons of GHGs. This established a first-level indicator of potential significance for both primary pollutants and GHGs.

However, since the majority of the emissions related to the Proposed Action and alternatives would result from activities associated with mobile sources, a second-level indicator was deemed appropriate. Consequently, if the evaluation showed that the first-level indicators for primary pollutants and GHGs would be exceeded, each pollutant was evaluated and compared with the total ROI emissions (Lincoln, Clarke, and Nye Counties) on a pollutant-by-pollutant basis against the ROI's 2014 National Emissions Inventory data.

Potential impacts to air quality are evaluated with respect to the extent, context, and intensity of the impact in relation to relevant regulations, guidelines, and scientific documentation. The Council on Environmental Quality (CEQ) defines significance in terms of context and intensity in 40 CFR 1508.27. This requires that the significance of the action must be analyzed with respect to the setting of the Proposed Action and based relative to the severity of the impact. The CEQ National Environmental Policy Act Regulations (40 CFR 1508.27(b)) provide 10 key factors to consider in determining an impact's intensity.

Intensity refers to the severity of impact. Responsible officials must bear in mind that more than one agency may make decisions about partial aspects of a major action. The following should be considered in evaluating intensity:

(1) Impacts that may be both beneficial and adverse. A significant effect may exist even if the federal agency believes that on balance the effect will be beneficial.

(2) The degree to which the proposed action affects public health or safety.

(3) Unique characteristics of the geographic area such as proximity to historic or cultural resources, park lands, prime farmlands, wetlands, wild and scenic rivers, or ecologically critical areas.

(4) The degree to which the effects on the quality of the human environment are likely to be highly controversial.

(5) The degree to which the possible effects on the human environment are highly uncertain or involve unique or unknown risks.

(6) The degree to which the action may establish a precedent for future actions with significant effects or represents a decision in principle about a future consideration.

(7) Whether the action is related to other actions with individually insignificant but cumulatively significant impacts. Significance exists if it is reasonable to anticipate a cumulatively significant impact on the environment. Significance cannot be avoided by terming an action temporary or by breaking it down into small component parts.

(8) The degree to which the action may adversely affect districts, sites, highways, structures, or objects listed in or eligible for listing in the National Register of Historic Places or may cause loss or destruction of significant scientific, cultural, or historical resources.

(9) The degree to which the action may adversely affect an endangered or threatened species or its habitat that has been determined to be critical under the Endangered Species Act of 1973.

(10) Whether the action threatens a violation of federal, state, or local law or requirements imposed for the protection of the environment.

To provide a more conservative analysis, the three counties were selected as the ROI instead of the EPA-designated Air Quality Control Region, which is a much larger area. Air quality impacts would be considered significant if the increases in annual emissions of a pollutant would be anticipated to: (1) cause or contribute to a violation of any national or state ambient air quality standard; (2) expose sensitive receptors to substantially increased pollutant concentrations; (3) exceed any evaluation criteria established by an SIP or permit limitations/requirements; or (4) be anticipated to cause an exceedance of the NAAQS or contribute to nonattainment.

The Air Conformity Applicability Model (ACAM) Version 5.0.7 was utilized to provide a level of consistency with respect to emissions factors and calculations. The ACAM provides estimated air emissions from proposed federal actions in areas designated as nonattainment and/or maintenance for each specific criteria and precursor pollutant as defined in the NAAQS. ACAM was utilized to calculate construction emissions. Emission factors for aircraft were also obtained from ACAM. Munitions emission factors were used from EPA's AP-42, Fifth Edition (Volume I, Chapter 15: Ordnance Detonation), and calculated based on the net weight of the explosive (or a conversion factor for pounds per item) and the number of times that the munition was used annually. Threat emitter generator emissions factors were obtained from the *Air Emissions Guide for Air Force Mobile Sources* (U.S. Air Force, 2016), and calculated based on the horsepower and annual hours of operation. Equations and emission factors can be found in this appendix.

D.1.2.2 Construction Emissions

Calculations for construction emissions were completed using the methodologies described in the U.S. Air Force *Air Quality Environmental Impact Analysis Process (EIAP) Guide* (U.S. Air Force, 2016). As previously indicated, Lincoln and Nye Counties are designated as "attainment", and Clark County was redesignated to maintenance on November 5, 2014.

The ACAM was used to provide a level of consistency with respect to emissions factors and calculations. The ACAM evaluates the individual emissions from different sources associated with the construction phases. Phase I is the site preparation phase and Phase II is the actual construction phase. For emitter pad, roadway, and runway construction, these sources include grading activities, paving, construction worker trips, stationary equipment (such as saws and generators), and mobile equipment emissions (U.S. Air Force, 2014). Formulas and assumptions included in the ACAM program calculations are provided below in Sections D.1.2.3 through D.1.2.7.

Due to limited information, certain assumptions were made to develop the air quality analysis. It was assumed that there would be a number of 150' by 150' emitter pads constructed. Analysis calculated the emissions for construction of 15 such pads, to provide a conservative estimate for the number of pads ultimately constructed and representative data for various potential increased numbers of emitters. It was further assumed that for Alternatives 2 and 3, approximately 4 acres of roadway improvements would be required in order to facilitate installation, maintenance, and potential relocation of threat emitters and relays. Additionally, under Alternative 3C, it was assumed that surface improvements of approximately 13 acres would be necessary in order to prepare the runway to be used in Forward Area Arming and Refueling Points activities.

The total square footage of each construction footprint was entered into the ACAM. Based on these assumptions, the construction emissions were calculated using the methodology expressed below.

D.1.2.3 Grading Activities

Grading activities are divided into grading equipment emissions and grading operations emissions.

Grading equipment emissions are combustive emissions from equipment engines and are calculated in the following manner:

$$VOC = 0.22\ (lb/acre/day) * acres * DPY_1/2{,}000$$

$$NO_x = 2.07\ (lb/acre/day) * acres * DPY_1/2{,}000$$

$$PM_{10} = 0.17\ (lb/acre/day) * acres * DPY_1/2{,}000$$

$$CO = 0.55\ (lb/acre/day) * acres * DPY_1/2{,}000$$

$$SO_2 = 0.21\ (lb/acre/day) * acres * DPY_1/2{,}000$$

Where

acres = number of gross acres to be graded during Phase I construction

DPY_1 = number of days per year used for grading during Phase I construction

2,000 = conversion factor from pounds to tons

All emissions are represented as tons per year.

Grading operations emissions are fugitive dust and tiny soil particles distributed into the air through ground disturbance and are calculated using a similar equation.

Emissions calculation:

$$PM_{10}\ (tons/yr) = 60.7\ (lb/acre/day) * acres * DPY_1/2{,}000$$

Where

acres = number of gross acres to be graded during Phase I construction

DPY_1 = number of days per year used for grading during Phase I construction

2,000 = conversion factor from pounds to tons

The calculations assumed there were no controls used to reduce fugitive emissions. Also, it was assumed construction activities would occur within a single calendar year to provide a conservative estimate.

D.1.2.4 Construction Worker Trips

Construction worker trips during the construction phases of the project are calculated and represented as a function of the number of facilities constructed and/or square feet of commercial construction.

Calculation:

$$Trips\ (trips/day) = 0.42\ (trip/facility/day) * Area\ of\ training\ facilities$$

Where:

Areas of training facilities = total square footage of construction projects to be constructed in the given year of construction

Total daily trips are applied to the following factors depending on the corresponding years.

Year 2009:

- VOC_E = 0.016 * trips
- NOx_E = 0.015 * trips
- PM_{10E} = 0.0022 * trips
- CO_E = 0.262 * trips

Year 2010 and beyond:

- VOC_E = 0.012 * trips
- NOx_E = 0.013 * trips
- PM_{10E} = 0.0022 * trips
- CO_E = 0.262 * trips

To convert from pounds per day to tons per year:

$$VOC\ (tons/yr) = VOC_E * DPY_{II}/2,000$$

$$NOx\ (tons/yr) = NOx_E * DPY_{II}/2,000$$

$$PM_{10}\ (tons/yr) = PM10_E * DPY_{II}/2,000$$

$$CO\ (tons/yr) = CO_E * DPY_{II}/2,000$$

Where

2,000 = conversion factor from pounds to tons

DPY_{II} = number of days per year during Phase II construction activities

D.1.2.5 Stationary Equipment

Emissions from stationary equipment occur when gasoline-powered equipment (e.g., saws, generators) are used at the construction site.

Emissions calculations:

$$VOC = 0.198\ pounds\ (lbs)/day * (GRSQFT) * DPY_{II}/2,000$$

$$NO_x = 0.137\ lbs/day * (GRSQFT) * DPY_{II}/2,000$$

$$PM_{10} = 0.004\ lbs/day * (GRSQFT) * DPY_{II}/2,000$$

$$CO = 5.29\ lbs/day * (GRSQFT) * DPY_{II}/2{,}000$$

$$SO_2 = 0.007\ lbs/day * (GRSQFT) * DPY_{II}/2{,}000$$

Where

GRSQF = gross square feet of commercial buildings to be constructed during Phase II

DPY_{II} = number of days per year during Phase II construction

2,000 = conversion factor from pounds to tons

D.1.2.6 Mobile Equipment

Mobile equipment (such as forklifts and dump trucks) emissions include pollutant releases generated by the equipment during Phase II construction.

Emissions calculations:

$$VOC = 0.17\ lbs/day * (GRSQFT) * DPY_{II}/2{,}000$$

$$NO_x = 1.86\ lbs/day * (GRSQFT) * DPY_{II}/2{,}000$$

$$PM_{10} = 0.15\ lbs/day * (GRSQFT) * DPY_{II}/2{,}000$$

$$CO = 0.78\ lbs/day * (GRSQFT) * DPY_{II}/2{,}000$$

$$SO_2 = 0.23\ lbs/day * (GRSQFT) * DPY_{II}/2{,}000$$

Where

GRSQF = gross square feet of training area to be constructed during Phase II

DPY_{II} = number of days per year during Phase II construction

2,000 = conversion factor from pounds to tons

D.1.2.7 Vehicle Emissions

Vehicle emissions are generated from on-road government use, off-road base-support vehicles, and maintenance construction vehicles. Since specific numbers and types of vehicles for each base are difficult to obtain, emissions from this category were based on historical installation fuel consumption data.

D.1.2.7.1 On-Road Government-Owned Vehicle (GOV)

Emissions calculation:

$$E_p = N \times F \times GOVVMT \times \frac{EF_p}{454 \times 2000}$$

Where

N = number of personnel realigned

F = fraction of the year the personnel operate

GOVVMT = per-employee volume of miles traveled (VMT), miles/employee

EF_p = emissions factor for pollutant, *p*, grams/mile. These factors were determined from MOVES 2014a for total hydrocarbons (VOCs), CO, and NO_x for the chosen fleet mix.

454 = conversion factor from grams to pounds

2,000 = conversion factor from pounds to tons

D.1.2.7.2 Off-Road Base-Support Vehicles

A variety of off-road base-support vehicles are used at typical Air Force installations. There are many types of these vehicles, both gasoline and diesel fueled. Since specific numbers and types of vehicles for each base are difficult to obtain, emissions from this category were based on historical installation fuel consumption data.

Emissions calculation:

$$E_p = N \times F \times \frac{EF_p}{2000}$$

Where

N = number of personnel realigned

F = fraction of the year the personnel operate

EF_p = per employee emissions factor, pounds.

The emissions factors are as follows:

SO_2 = 0.24, PM_{10} = 0.34, CO = 7.91, VOC = 0.74

2,000 = conversion factor from pounds to tons

D.1.2.8 Aircraft Emissions

Due to limited information, certain assumptions were made to develop the air quality analysis. The baseline aircraft emissions were calculated using the operations and scheduling data obtained from operators, schedulers, and air traffic controllers for calendar year (CY) 2015. This level of activity is assumed representative of an average baseline year of aircraft operations in NTTR airspace.

D.1.2.8.1 Aircraft Flying Operations

Aircraft operations of concern are those that occur from ground level up to 3,000 feet above ground level (AGL). The 3,000-foot AGL ceiling was assumed as the atmospheric mixing height above which any pollutant generated would not contribute to increased pollutant concentrations at ground level. This is the default value suggested by the EPA in *Procedures for Emission Inventory Preparation Volume IV: Mobile Sources* (EPA, 1992). While the *aircraft operation of interest* within the mixing zone is typically the landing and takeoff (LTO) cycle, because air installation operations are not included in the analysis, the operations of concern are any low-level testing or training operations that occur below 3,000'.

For each mode of operation, an aircraft engine operates at a specified power setting and for a specific period (time in mode). The pollutant emission rate is a function of the engine's operating mode, the fuel flow rate, and the engine's overall efficiency. Emissions for a particular aircraft are calculated by knowing the specific engine pollutant emissions factors for each mode of operation and the time of operation in that mode.

The U.S. Air Force has developed emissions factors for aircraft engines, and Table D-6 presents an example of the emissions factors and aircraft engine performance data for each of the aircraft type used in this analysis. The table lists the various engine modes, time in for each mode, fuel flow, and corresponding pollutant emissions factors. Using these data, as well as information on activity levels (i.e., number of sorties/LTO operations), pollutant emissions for each aircraft were calculated.

Table D-6. Aircraft Performance Data and Emissions Factors

Aircraft Type	Power Setting	Fuel Flow	VOC	SO_x	NO_x	CO	PM_{10}	$PM_{2.5}$	CO_2e
F-16C	Idle	1,006	2.05	1.06	6.21	24.06	2.49	2.24	3,234
	Approach	3,252	0.05	1.06	17.93	1.22	2.37	2.13	3,234
	Intermediate	5,651	0.07	1.06	26.55	0.38	1.58	1.42	3,234
	Military	8,888	0.11	1.06	34.32	0.56	1.58	1.42	3,234
	After Burn	40,122	0.69	1.06	6.63	10.42	3.04	2.74	3,234
F-15E/I	Idle	1,084	7.94	1.06	4.61	35.3	2.06	1.85	3,234
	Approach	3,837	5.12	1.06	12.53	1.92	2.63	2.37	3,234
	Intermediate	5,770	2.89	1.06	22.18	0.86	2.06	1.85	3,234
	Military	96,79	1.79	1.06	29.32	0.86	1.33	1.2	3,234
	After Burn	41,682	1.53	1.06	8.37	11.99	1.15	1.04	3,234

Source: U.S. Air Force, 2016

CO = carbon monoxide; hr = hour; lb = pound; NO_x = nitrous oxides; PM_{10} = particulate matter with an aerodynamic diameter of 10 microns or less; VOC = volatile organic compound

Aircraft flying operations were calculated using ACAM emission factors and applying them to the operational parameters provided by operators in order to calculate the emissions based on time in mode below 3,000 for each particular aircraft. The operational parameters used are reflective of the data used for noise analysis. Only those portions of the flying operation that take place below the atmospheric mixing height are considered (these are the only emissions presumed to affect ground-level concentrations).

Emissions calculation based on aircraft flying operations:

$$Ep = N * F * OPS * NUMEG * (\Sigma TIMi * EFi,p)/2{,}000)$$

Where

N = number of aircraft

F = fraction of the year the aircraft operate

OPS = the number of operations [total LTOs and touch and go (TGOs)] per year for each aircraft in the Proposed Action unit

TIMi = time in mode for aircraft operating mode, *i*, hours

The engine operating mode used in the emissions factors is correlated to the aircraft operating mode as follows.

M = number of aircraft operating modes (five for LTOs; three for TGOs)

NUMEG = the number of engines for the aircraft type

EFi,p = emissions factor for pollutant, *p*, for each engine operating mode, *i*, lb/hr

2,000 = conversion from pounds to tons

Air emissions were estimated for each criteria pollutant based on fuel flow rates for each engine mode (e.g., idle, taxi, intermediate, military) per the flight profiles provided by NTTR XP. Emissions were then calculated for airspace in the following manner:

$$Ep = (T_{airspace} * (FFR/1000) * EI_p)/2000$$

Where

E_p = Emissions of pollutant, p, in tons per year

$T_{airspace}$ = Time all aircraft in airspace below 3,000 feet AGL (hours per year)

FFR = Fuel flow rate (pounds per hour)

1000 = Factor for converting pound per hour to 1,000 pounds per hour

EI_p = Emission Index for pollutant, p (pounds per 1,000 pounds of fuel)

2000 = Factor to convert pounds to tons

Airspace units cover large areas of ground and often cover multiple counties. Due to the large area and uncertainty of knowing the precise area within any airspace an aircraft may be operating, the emissions were compared to a ROI consisting of all counties that underlay the airspace.

D.1.2.9 Munition Emissions

Munition emissions for NTTR operations were calculated using similar methodology, using operational parameters and munitions quantities consistent with those used for noise analysis. Emissions from munitions expended on each of the test areas were calculated based on surrogate munitions from each category of munitions expended on the test areas. Table D-7 shows the surrogates and the per item emission factors for each munition based on its Net Explosive Weight (NEW) used in this analysis.

Table D-7. Munitions for NTTR Operations Emissions Factors

Munition Type	Surrogate	DODIC	Emissions Factor (lbs/item)							
			CO	NO_x	PM_{10}	$PM_{2.5}$	SO_x	VOCs	CO_2	CH_4
5.56mm	M855 5.56-mm Ball Cartridge	A059	1.60E-03	8.50E-05	3.90E-05	2.80E-05			7.50E-04	6.70E-06
7.62mm	M80 7.62-mm Ball Cartridge	A143	2.30E-03	9.70E-05	5.10E-05	3.80E-05			1.20E-03	1.00E-05
.50 Caliber	A518, M903 .50 Caliber SLAP Ball Cartridge	A518	9.60E-03	8.50E-05	2.10E-04	1.80E-04			5.30E-03	8.00E-05
.50 Caliber	A557, .50 Cal Ball/Tracer Cart	A557	1.10E-02	1.20E-03	3.10E-04	1.90E-04			5.10E-03	1.30E-04
20mm	A652, M220 20-mm Target Practice Tracer Cartridge	A652	3.30E-02	4.30E-04	6.60E-04	4.60E-04			1.60E-02	2.50E-04
30mm	B129, M789 30-mm High Explosive Dual Purpose Cartridge	B129	8.60E-04	2.00E-04	3.90E-03	2.50E-03			4.40E-03	4.60E-05
40mm	B542, M430 40-mm High Explosive Dual Purpose Cartridge	B542	4.00E-03	1.30E-03	9.50E-03	5.10E-03			4.90E-02	8.90E-05
2.75"	H163, 2.75-inch Rocket with M151 High Explosive Warhead	H163	4.00E-01	5.60E-03	2.40E-01	1.20E-01			7.00E-01	1.20E-02
Bombs	M023, M112 Demo Block Charge	M023	2.10E-02	6.30E-03	2.10E-02	1.50E-02	1.20E-04		6.30E-01	1.30E-03
Bombs	M030, 1/4-lbs Demo Block Chg (TNT)	M030	2.00E-02	1.20E-02	5.00E-02	1.90E-02	3.20E-04		1.40E+00	2.00E-05
Trintonal Surrogate[1]	Tritonal	NA	3.98E-03	1.54E-04	3.69E-01	3.69E-01	1.58E-04	2.63E-04	5.25E-01	NA
Signal smoke (BDU)	M4A2 Floating HC Smoke Pot	K867	5.30E-01	2.80E-03	3.00E+01	2.30E+01	3.2s-3	2.20E-02	5.30E-01	NA

Source: EPA, 2009a

CO = carbon monoxide; GBU = guided bomb unit; lb = pounds; mm = millimeter; NEW = net explosive weight; NO_x = nitrogen oxides; $PM_{2.5}$ = particulate matter with an aerodynamic diameter of 2.5 microns or less; PM_{10} = particulate matter with an aerodynamic diameter of 10 microns or less; SO_x = sulfur oxides

[1]Source: U.S. Army, 1996. Characterization of Emissions Produced by the Open Burning/Open Detonation of Complex Munitions.

Emissions calculation:

*Pollutant Emissions = EF*NEW*Qty/2,000*

Where

pollutant emissions = emissions for the associated pollutant (i.e., CO or NO_x) (tons/yr)

EF = emissions factor for the pollutant (lb/lb NEW)

NEW = net explosive weight (lb NEW/item)

Qty = quantity (item/year)

2,000 = conversion from pounds to tons (1 ton = 2,000 pounds)

D.1.2.10 Generator Emissions

Available emissions factors (AP-42, Compilation of Air Pollutant Emission Factors) were utilized (EPA, 1996). These factors were then multiplied by the total number of hours of operation for each generator by size class. The annual number of pounds of each emission was then converted to tons. Annual emissions for each generator were then summed to calculate total generator emissions annually.

Emissions calculation:

*Emissions = (HR*EF)/2000*

Where:

Emissions = Ordnance Emissions (tons per year)

HR = Hours of generator operation per year

EF = Emissions factor

Table D-8. Emission Factors for Diesel and Turbine Engines

Pollutant	Emission Factor (lb/hp-hr)	Emission Factor (LB/MMBtu)
NOx		
Uncontrolled	0.024	3.2
Controlled	0.013	1.9
CO	5.50E-03	0.85
SO_x[1]	8.09E-03	1.01
CO_2e	1.16	165
PM	0.0007	0.1
TOC	7.05E-04	0.09
CH_4[2]	7.05E-04	0.09

Source: EPA, 1996. AP-42, Fifth Edition, Volume I Chapter 3: Stationary Internal Combustion Sources

1 SOx mult times S1= % sulfur in fuel oil

2 Based on data from 1 engine, TOC is by weight 9% methane and 91% nonmethane

D.2 NATIONAL EMISSIONS INVENTORY

The NEI is operated under the EPA's Emissions Factor and Inventory Group, which prepares the national database of air emissions information with input from numerous state and local air agencies, tribes, and industries. The database contains information on stationary and mobile sources that emit criteria air pollutants and hazardous air pollutants (HAPs). The database includes estimates of annual emissions, by source, of air pollutants in each area of the country on a yearly basis. The NEI includes emissions estimates for all 50 states, the District of Columbia, Puerto Rico, and the Virgin Islands. Emissions estimates for individual point or major sources (facilities), as well as county-level estimates for area, mobile, and other sources, are currently from an extract of EPA's NEI database. The current version of the NEI is the 2014 NEI Database, last updated October 6, 2016. Data were extracted in October 2016.

Criteria air pollutants are those for which the EPA has set health-based standards. Four of the six criteria pollutants are included in the NEI database:

- Carbon monoxide (CO)
- Nitrogen oxides (NO_x)
- Sulfur dioxide (SO_2)
- Particulate matter (PM_{10} and $PM_{2.5}$)

The NEI also includes emissions of VOCs, which are ozone precursors, emitted from motor vehicle fuel distribution and chemical manufacturing, as well as other solvent uses. VOCs react with nitrogen oxides in the atmosphere to form ozone. The NEI database defines three classes of criteria air pollutant sources:

Point sources. Stationary sources of emissions, such as an electric power plant, that can be identified by name and location. A "major" source emits a threshold amount (or more) of at least one criteria pollutant and must be inventoried and reported. Many states also inventory and report stationary sources that emit amounts below the thresholds for each pollutant.

- *Area sources*. Small point sources such as a home or office building or a diffuse stationary source such as wildfires or agricultural tilling. These sources do not individually produce sufficient emissions to qualify as point sources. Dry cleaners are one example; for instance, a single dry cleaner within an inventory area typically will not qualify as a point source, but collectively the emissions from all of the dry cleaning facilities in the inventory area may be significant and therefore must be included in the inventory.
- *Mobile sources*. Any kind of vehicle or equipment with a gasoline or diesel engine (such as an airplane or ship).

The following are the main sources of criteria pollutant emissions data for the NEI:

- For electric generating units, EPA's Emissions Tracking System/Continuous Emissions Monitoring Data and Department of Energy fuel use data.

- For other large stationary sources, state data and older inventories where state data were not submitted.
- For on-road mobile sources, the Federal Highway Administration's estimate of vehicle miles traveled and emissions factors from EPA's MOVES 2014a Model.
- For non-road mobile sources, EPA's MOVES 2014a Model.
- For stationary area sources, state data, EPA-developed estimates for some sources, and older inventories where state or EPA data were not submitted.
- State and local environmental agencies supply most of the point source data. EPA's Clean Air Market program supplies emissions data for electric power plants.

D.2.1 Greenhouse Gases

GHGs are chemical compounds in the earth's atmosphere that trap heat. Gases exhibiting greenhouse properties come from both natural and human sources. Water vapor, carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O) are examples of GHGs that have both natural and manmade sources, while other gases such as those used for aerosols are exclusively manmade. In the United States, GHG emissions come mostly from energy use. These are driven largely by economic growth, fuel used for electricity generation, and weather patterns affecting heating and cooling needs.

Typically, GHG emissions are represented as CO_2 equivalents (CO_2e) based on the molecule's global warming potential or ability to trap heat in the atmosphere relative to CO_2 (EPA, 2005). Therefore, all GHG emissions calculations and analysis in this document are represented in CO_2e.

The Air Force has adopted guidance that recommends that any activity that generates more than 75,000 tons of GHGs is significant. Any GHG analysis contained in this document was prepared in accordance with the *Air Force Air Quality Environmental Impact Analysis Process (EIAP) Guide – Fundamentals, Volume I and Volume II – Advanced Assessments*. The potential effects of GHG emissions from the Proposed Action are by nature global. Given the global nature of climate change and the current state of the science, it is not useful at this time to attempt to link the emissions quantified for local actions to any specific climatological change or resulting environmental impact. Nonetheless, the GHG emissions from the No Action Alternative and the Proposed Action Alternatives have been quantified to the extent feasible in this LEIS for information and comparative purposes.

D.2.1.1 GHG Construction Emissions

Combustion of fossil fuels by construction equipment and constructions workers' vehicles during commutes to and from the site would contribute to increased GHG emissions. Construction equipment emits approximately 22.2 pounds of CO_2 per gallon of diesel and worker vehicles emit 19.4 pounds of CO_2 per gallon of gasoline (EPA, 2009b). These emission rates can be decreased with less idling and improved maintenance of equipment. Of 250 potential working days, 90.5 percent (or 238 days) are suitable for construction activities (i.e., no precipitation greater than 0.10 inches) (National Weather Service, 2016). These vehicles were assumed to each combust 4 gallons of diesel per hour (Fusetti and Monahan, 2008).

Stationary sources for construction were also included in the analysis. It was assumed that a number of small diesel-fueled generators would be operated during working hours. Each generator was assumed to combust one gallon per hour of operation.

It was assumed that construction workers would be required to commute each day for 238 work days. ACAM estimates the average commute to be 25 miles one-way, and 23.9 miles per gallon average was assumed for commuter vehicles (EPA, 2009b).

D.2.1.2 GHG Operational Emissions

Combustion of fuels during flight operations would also cause GHG emissions. Emissions were calculated using the same methodology and operational parameters as for the criteria pollutants discussed above. The emissions factors for were also obtained from ACAM Version 5.0.7. Calculations were based on the estimated annual sorties for each aircraft under each alternative as discussed above for aircraft criteria pollutant emissions.

GHG emissions from munitions use were calculated using emissions factors on a per item basis as outlined in AP-42 (EPA, 2009a).

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