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HITEST SAND NEWPORT

PSD MODELING PROTOCOL

RAMBOLL ENVIRON

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ACRONYMS AND ABBREVIATIONS

AERMOD	Air quality dispersion modeling system used in this analysis. The AERMOD modeling system consists of two pre-processors and a dispersion model. The meteorological preprocessor (AERMET) provides meteorological information, and a terrain pre-processor (AERMAP) characterizes terrain, and generates receptor grids for the dispersion model (AERMOD).
Ambient air quality standard	Health-based standard representing a pollutant concentration in the ambient air usually over some averaging period like 1-hour, intended to protect the health and welfare of people with a margin of safety
Ambient air	the air in outdoor locations to which the public has access, e.g., outside the property boundary of the emissions source
Attainment/Nonattainment	a determination and classification made by EPA indicating whether ambient air quality in an area complies with (i.e., attains) or fails to meet (i.e., nonattainment) the requirements of one or more **NAAQS**
Averaging time	a specific length of time (e.g., 1 hour, 24-hours, 1 year) over which measured or model-calculated concentrations of an air pollutant are averaged for comparison with the **NAAQS** based on the same averaging period. Note that some NAAQSs are also based on multi-year averages of certain percentiles of measured or calculated concentrations.
AQIA	Air quality impact assessment
AQRV	Air quality related values: acid deposition flux and visibility impairment
BART	Best available retrofit technology
CMAQ	Community multi-scale air quality model, a photochemical grid model
CO	carbon monoxide, a criteria air pollutant
CO_2	carbon dioxide
Criteria air pollutant	an air pollutant specifically governed by the Federal Clean Air Act for which ambient air quality standards have been set. Criteria air pollutants include carbon monoxide, particulate matter, sulfur dioxide, nitrogen dioxide, ozone, and lead.
Dispersion model	A computerized calculation tool used to estimate pollutant concentrations in the ambient air based on numeric simulations that consider the locations and rates of pollutant emissions and the effects of meteorological conditions, usually over specific averaging times (e.g., 8-hours)

Ecology	Washington State Department of Ecology
EPA	US Environmental Protection Agency
Fugitive dust	Potential air pollutant in the form of dust (or other pollutant) emitted from a non-point or non-mobile source such as dust from a road or from a storage pile caused by wind
H1H, H2H	Highest first-high, highest second-high. The first "highest" is over time, the second over space.
MERP	Modeled emission rates for precursors
Meteorological data set	a compilation of meteorological data representing conditions over some period of time and including such things as wind speed and wind direction, and formatted as required by the dispersion model being used. This analysis used a meteorological data set covering 5 years.
Micrometer/Micron	one millionth of a meter; typically used to distinguish particle size; typical human hair is 100 about microns in diameter
MMIF	Mesoscale model interface program, which converts meteorological model outputs to dispersion model inputs
Modeling domain	the area included in the **dispersion-modeling** analysis
Modeling receptor	a theoretical (i.e., often non-specific) location used in computer modeling at which air pollutant concentrations are calculated. Modeling may also use site-specific receptors representing individual locations.
NAAQS	National Ambient Air Quality Standard
NO_2	nitrogen dioxide, a **criteria** air pollutant
Nonattainment area	An area delineated by regulatory agencies including US EPA and the Washington Department of Ecology in which an ambient air quality standards have been violated and where there is a program in place designed to reduce air pollution so that the standard attained.
NOx	oxide of nitrogen, a general class of air pollutant without a specific air quality standard but used in monitoring air quality
Particulate matter (PM)	air pollutant comprised of solid or liquid particles; PM is usually characterized based on the particle size. See also PM_{10} and $PM_{2.5}$.
PM_{10}	"Coarse" inhalable particulate matter with an aerodynamic size less than or equal to 10 micrometers (**microns**)
$PM_{2.5}$	"Fine" inhalable particulate matter with an aerodynamic size less than or equal to 2.5 micrometers (**microns**)
SCC	Source Classification Code
SO_2	Sulfur dioxide, a **criteria air pollutant**

SPECIATE	A database giving fractions of particulate matter sub-species
TAP	Toxic air pollutant
tpy	tons per year, an estimate of annual emissions
$\mu g/m^3$	micrograms per cubic meter (a metric used in quantifying concentrations of air pollutants)
Volume source	an emission source type defined in AERMOD. Volume sources emit diffuse air pollutants from a three-dimensional area. Line sources, such as emissions from transiting trains, can be simulated using multiple, adjacent volume sources.
WAAQS	Washington Ambient Air Quality Standards
WRF	The weather research and forecast model, a meteorological model

1. INTRODUCTION

HiTest Sand, LLC (HiTest) proposes to construct a facility near Newport, Washington to produce very high purity metallic silicon. The proposed facility boundary would be adjacent to the Washington-Idaho border, as shown in **Figure 1**. Primary (worker) access would be via a road to be constructed on the Washington side, while truck delivery access of raw materials would be from the Idaho side, via an extension of Idaho Landfill Road.

HiTest owns and operates a similar facility near Golden, British Columbia (BC) Canada, but that facility can only process about one third of the annual permitted production rate from their mine east of Golden. The deposit being mined contains very high purity sand (silicon dioxide) with nearly no other minerals or organic matter mixed in.

The sand would be brought by rail from the mine in BC to near the proposed facility, as would low sulfur coal, and would be brought the last few miles by truck. Local wood chips would be brought to the facility by truck.

An electric submerged arc furnace process would then be used to oxidize the carbon in the coal and wood, essentially moving the O_2 from each SiO_2 atom to create CO_2, leaving metallic Si. Because of the high temperatures in the arc furnace process, NOx is created as a by-product. The sulfur in the coal reacts to form SO_2, and particulate matter (PM) is also produced as a by-product.

A baghouse will be used to reduce PM from the furnaces, but as a result of the back pressure created by these systems, additional safety concerns are introduced. Additionally, the high concentrations of water vapor in the off-gas from the process would interfere with efficient operations of typical scrubbers. The common methods to control NOx and SO_2 are not technically feasible and have never been implemented in this industry.

Current plans call for construction of two furnaces, but the proposed facility layout would leave room for two additional furnaces to potentially be constructed in the future. Future market forces and availability of capital will control whether the two additional furnace lines will be built.

Other emission units planned for the facility include an emergency generator, and several baghouses to control particulate matter emissions.

HiTest intends to submit a permit application to obtain an Order of Approval to Construct, and a Preventions of Significant Deterioration (PSD) permit from the Washington Department of Ecology (Ecology).

1.1 Project Emissions and Regulatory Analysis

The facility will fall under Standard Industrial Classification (SIC) code 3339, "Primary Smelting and Refining of Nonferrous Metals, Except Copper and Aluminum."[1] As such, it will not be one of the 28 named sources found at 40 CFR 51.166(b)(1).

The proposed project area is either attainment or unclassifiable for all National Ambient Air Quality Standards (NAAQS).

Emission calculations for the proposed facility will be based on Best Available Control Technology (BACT), engineering calculations, fuel usage, and operating hours. Potential emission calculations for the two furnaces are based on continuous operation (24 hours per day, 365 days per year). Emissions calculations for the emergency generators are based on weekly test runs of no more than one hour per run (up to 100 hours per year of operation). HiTest plans to use water misting technology for dust containment at all discharge and drop points, and to keep the wood chips saturated with moisture. Inside storage will be used for coal and charcoal. Four (4) baghouses would also control fugitive dust from handling of the wood chips and coal/charcoal.

1.1.1 Criteria Pollutant Emissions

Preliminary calculations of the PSD pollutant emission increases attributable to the proposed project are presented in Table 1, with the applicable Significant Emission Rates (SERs). These preliminary calculations indicate the project's NOx, CO, SO_2, PM_{10}, $PM_{2.5}$, and greenhouse gas emission increases are expected to be greater than the applicable SERs. Because NOx and SO_2 emission increases are above the SERs, an analysis of the proposed source contribution to secondary $PM_{2.5}$ and ozone increases will be required.

[1] https://www.osha.gov/pls/imis/sic_manual.display?id=304&tab=description

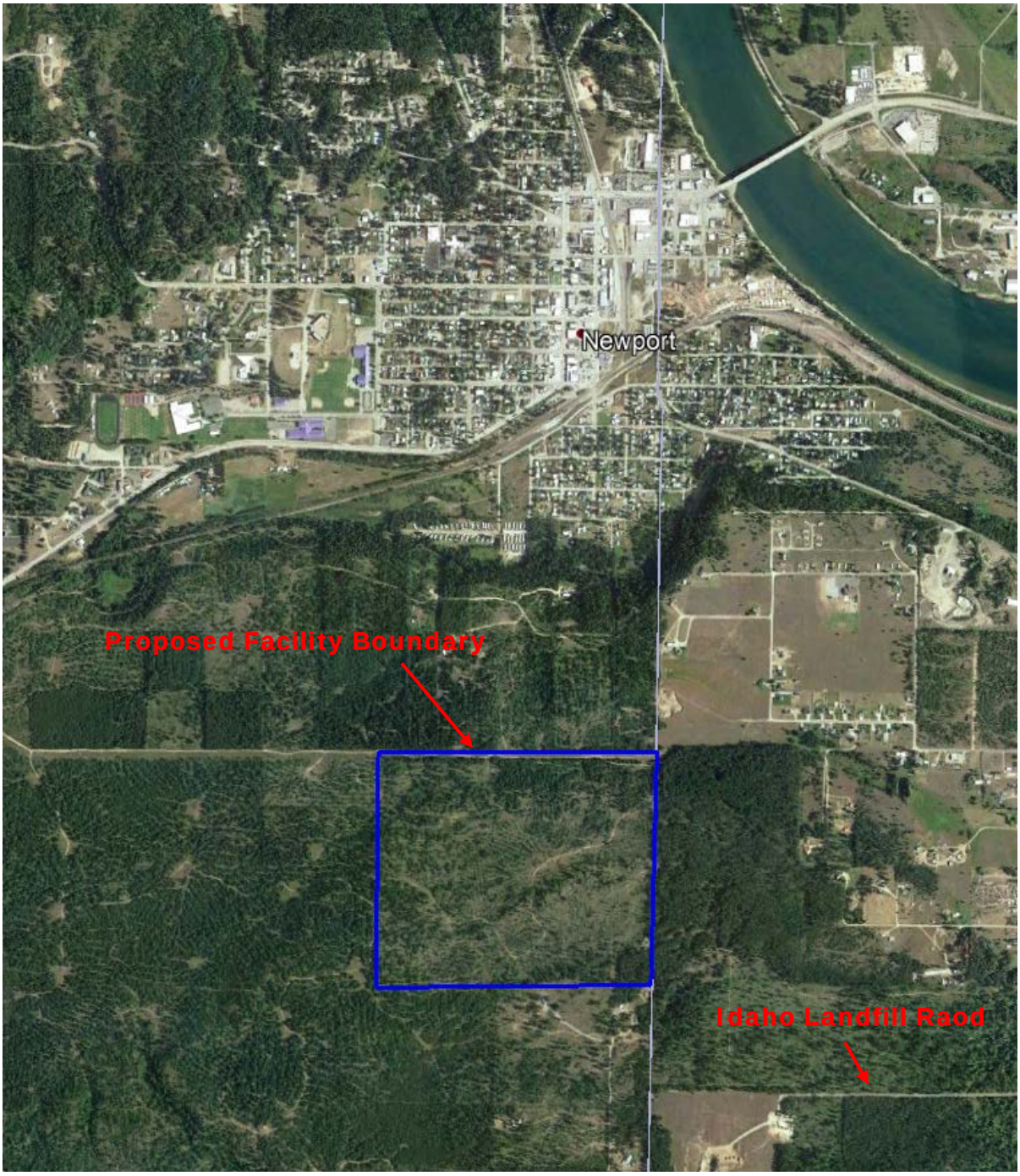

Figure 1. HiTest Facility Location and Property Boundary

Table 1: Preliminary Project Emissions Increases

PSD Pollutant	Preliminary Project Emission Increases (tpy)	PSD Significant Emission Rate (tpy)	Triggers PSD?
NOx	700	40	Yes
CO	601	100	Yes
SO_2	760	40	Yes
PM	111	25	Yes
PM_{10}	89	15	Yes
$PM_{2.5}$	85	10	Yes
VOC	20	40	No
Pb	0.1	0.6	No
Fluorides	1	3	No
H_2SO_4	1	7	No
Greenhouse Gases	320,256	75,000	Yes
Total HAPs	23	25	No
Max of any HAP	8	10	No

WAC-173-460 requires the evaluation Toxic Air Pollutant (TAP) emission increases from new and modified sources. The new furnaces will emit small quantities of TAPs. Emissions of TAPs will be estimated based on the BACT for Toxics (T-BACT) analysis and emission factors from EPA's AP 42 reference guide.

2. CLASS II MODELING METHODOLOGY

Air quality impact assessments (AQIAs) are performed using dispersion modeling techniques in accordance with the EPA's Guideline on Air Quality Models (codified as Appendix W to 40 CFR Part 51, hereafter referred to as the Guideline). The results of a modeling analysis can exempt the applicant from ambient air monitoring or cumulative source modeling.

The local AQIA will include emissions attributable to the proposed emission units. The purpose of the AQIA is to assess potential impacts of the proposed project on

air quality in the area surrounding the proposed site. Computer-based dispersion modeling techniques will be applied to simulate criteria and toxic air pollutant releases from the facility to assess compliance with PSD Increments, the NAAQS and WAAQS, and Ecology's Acceptable Source Impact Levels (ASILs) for toxic air pollutants. This section describes the techniques for the AQIA. The AQIA focuses on the prediction of concentrations of pollutants directly emitted by the proposed and affected emission units.

Dispersion modeling techniques are also used to assess potential impacts to Class I areas, including degradation of visibility and other air-quality-related values (AQRVs). The "regional" AQRV analysis is described in Section 3 of this modeling protocol.

2.1 Dispersion Model Selection

The rationale for the dispersion modeling approach is based on the Guideline, considerations of the local terrain, and the emission unit characteristics. AERMOD is currently the preferred dispersion model recommended by the Guideline for complex source configurations, emission units subject to exhaust plume downwash, and situations where there is the potential for exhaust plumes to interact with complex terrain.

AERMOD is proposed for the modeling analysis primarily because it is the most up-to-date near-field dispersion model currently available. Additionally, the modeling domain and source configuration suggests the potential for exhaust plume downwash and plume impacts on intermediate and complex terrain.

2.2 Modeling Methodology

AERMOD will be applied to calculated emissions using the regulatory defaults in addition to the options and data discussed in this section.

2.2.1 Model Setup

The most recent version of AERMOD (currently version 16216r) would be applied with the default options for dispersion that depend on local meteorological data, regional upper air data, and the local physical characteristics of land use surrounding the primary meteorological site. AERMOD contains several options for urban dispersion that were not selected for these analyses due to the rural characteristics of the area in which the facility is proposed.

2.2.2 Meteorology

A five-year meteorological (MET) database will be constructed using available surface and upper air data for the dispersion modeling analysis. A meteorological data set will be prepared for the period 2012 – 2016, using surface data observations from a 10-meter meteorological tower operated by the Idaho Department of Transportation (ID41, mesowest ITDA8, Old Town[2]) treated as "on-site" data, and National Weather Service (NWS) surface data observations from Deer Park, Washington. Upper air data will be prepared using NWS data from Spokane, Washington. The meteorological data will be processed using the AERMOD meteorological preprocessor, AERMET (version 16216r).

The ID41 meteorological tower data includes wind speed, wind direction, temperature, and relative humidity; and was installed near the end of 2013. There appears to be buildings and trees located relatively close to the ID41 tower (i.e. less than perfect siting of the tower with respect to upwind fetch, see **Figure 2**). However, this tower is located only 1.9 km from the proposed facility, much less than the 35.5 km to the Deer Park site and is likely more representative of local meteorological conditions.

A wind rose describing the wind speed and wind direction data recorded at the ID41 (ONSITE) meteorological site over the available years, 2014 - 2016, is shown in **Figure 3**. A similar wind rose for the Deer Park Airport KDEW (SURFACE) site is shown in **Figure 4**. The average wind speed at ID41 is almost half that at KDEW, and the maximum wind speed recorded during the period is 60% that of KDEW. Comparing the two wind rose plots, it is evident that ID41 has a far larger percentage of hours with wind speeds less than 2.0 m/s. These are the hours that feature the least dispersion, and will likely lead to higher predicted concentrations than if the ID41 site were not being used. The differences in wind character between ID41 and KDEW are possibly related to the siting of ID41, with buildings and trees in the immediate vicinity – the site is in the lee of obstructions in nearly all directions. KDEW is adjacent to a regional airport, with the landing strip to its west and ~250m to some sparse trees to the east. Even with its drawbacks, the ID41 site will be used due to its proximity to the proposed HiTest facility.

[2] http://lb.511.idaho.gov/idlb/cameras/camera.jsf?id=122&view=state&text=m&textOnly=false

Figure 2. The area surrounding the ID41 MET tower (circled)

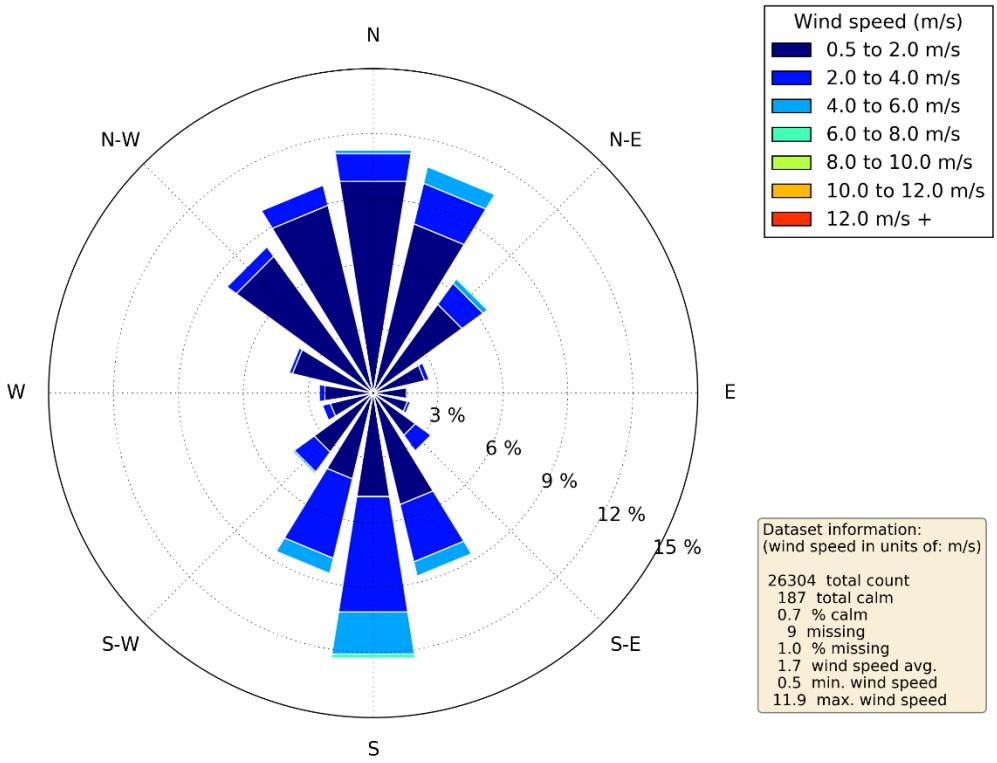

Figure 3. Wind rose plot for 2014-2016 for the ID41 "Old Town" site

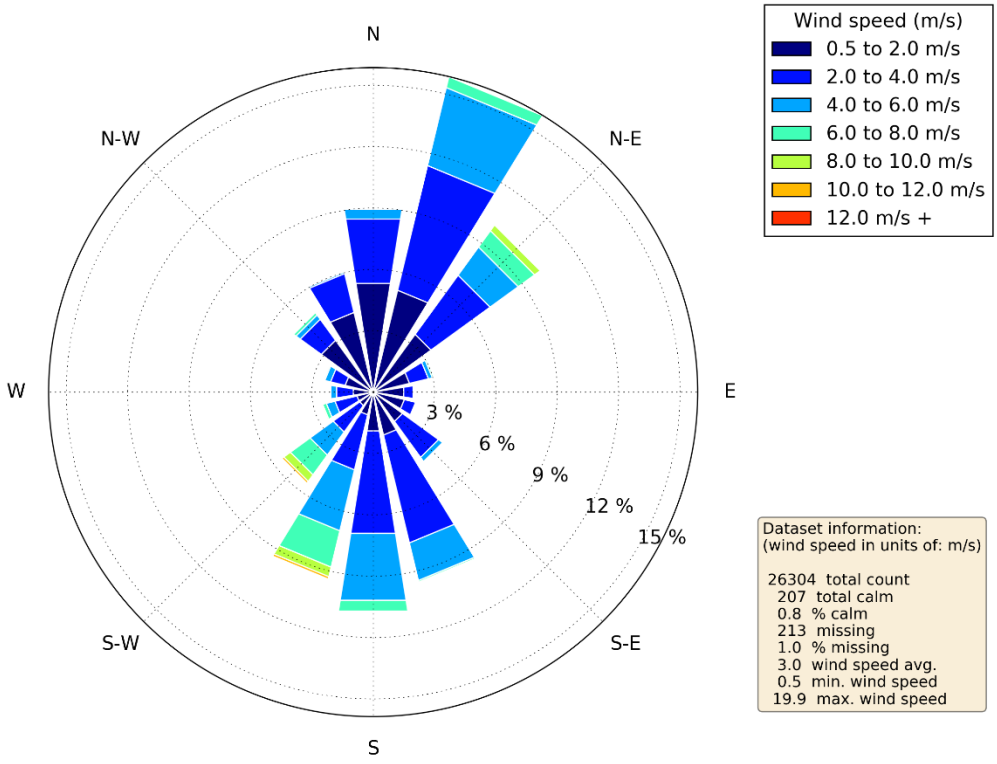

Figure 4. Wind rose plot for 2014-2016 for the KDEW "Deer Park" site

EPA guidance indicates that surface parameters (albedo, Bowen ratio, and surface roughness) surrounding the meteorological site should be used in AERMET to construct the meteorological profiles used by AERMOD. Seasonal surface parameters will be calculated for both the ID41 site and for the Deer Park NWS site using the preprocessor AERSURFACE (version 13016) and EPA guidance.[3] The guidance recommends surface roughness at the measurement site should be estimated using AERSURFACE applying directional sectors with arcs no smaller than 30°, extending to 1 km from the measurement site. AERSURFACE computes the surface roughness for each sector using an inverse-weighted geometric mean of typical roughness values assigned to each land-use category supplied by the NLCD92 dataset available on the Internet. The guidance recommends the Bowen ratio and albedo should be estimated using a geometric mean of values over a 10 km by 10 km region using typical values assigned to each land use category per season. AERSURFACE will be applied using the following assumptions:

- Seasonal temporal resolution
- No continuous winter snow cover, given the low frequency of snow cover events in the Pend Orielle County lowlands.
- Site location not at an airport – the ID41 onsite meteorological dataset is not at located an airport or similar area with land-use that would qualify for use of the "airport" surface roughness adjustment algorithm used within AERSURFACE. The Deer Park NWS is located at an airport.
- Average surface moisture characteristics over the 5-year period of the meteorological database.

2.2.3 Receptor Network and Terrain

The 20 km by 20 km modeling domain proposed for the AQIA is shown in **Figure 5.** Terrain elevations for receptors and emission units will be prepared using available 1/3 arc-second (~10m) data from the National Elevation Dataset (NED) developed by the United States Geological Survey (USGS).

An initial receptor set has been developed to be used for the AQIA. The initial receptor set includes receptors spaced 500 m apart covering the outermost portion of the simulation domain. Nested grids of 50-m and 250-m spaced receptors will

[3] The AERMOD Implementation Guide (EPA 2009 [Last Revised: August 3, 2015]) and the AERSURFACE User's Guide (EPA-454/B-08-001, January 2008 [Last Revised: January 16, 2013]).

cover 2-km and 6-km square areas centered on the facility. Maximum AERMOD-predicted concentrations located in coarse receptors areas (i.e., receptor spacing greater than 50 m) would be further investigated using a localized fine receptor grid. Receptors will also be located at 10-m intervals along the facility property boundaries. The initial receptor locations are shown in **Figure 5**. The base elevation and hill height scale for each receptor will be determined using AERMAP (version 11103).

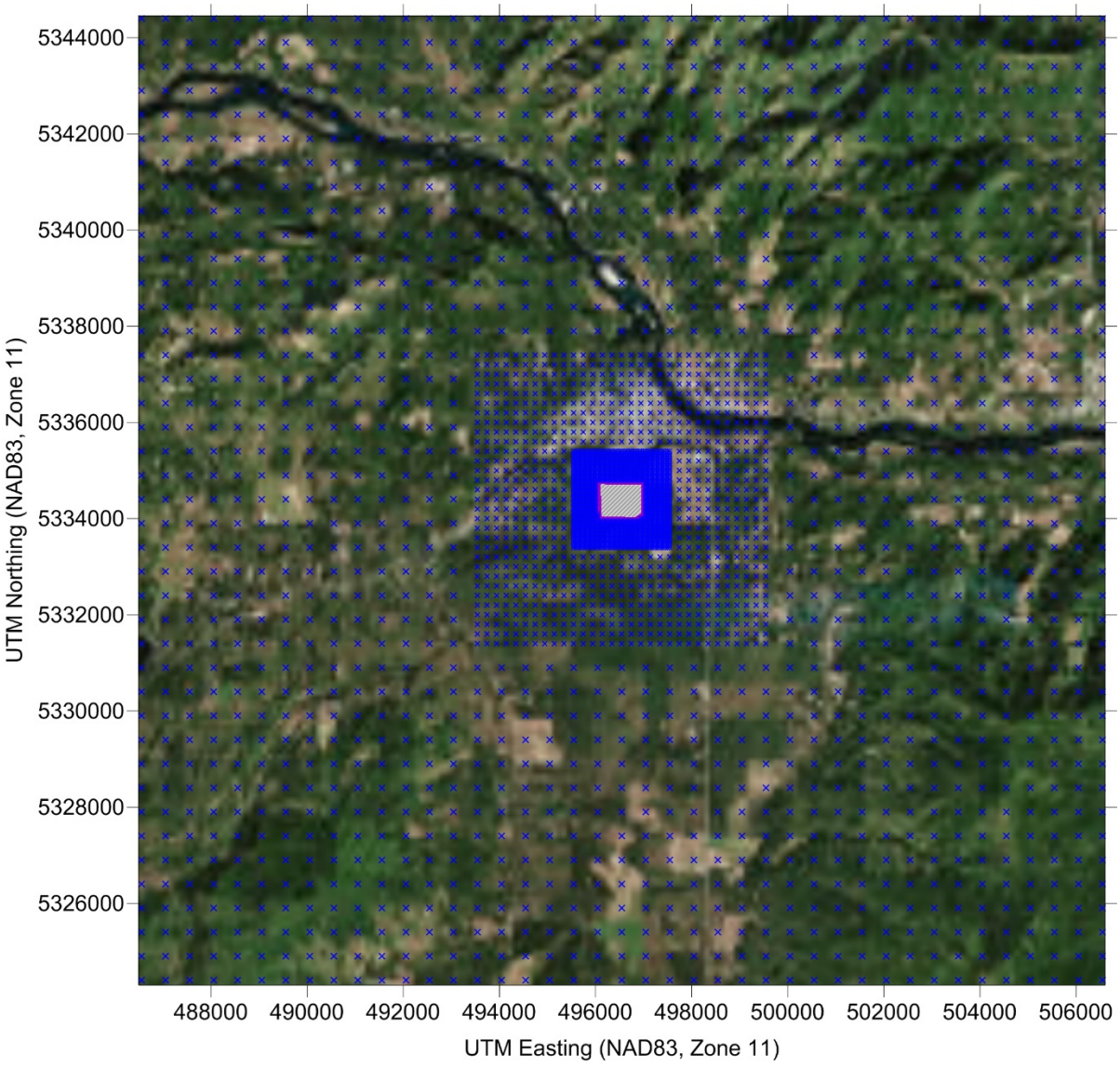

Figure 5. 20 km by 20 km Receptor Grid

2.2.4 Emission Unit Parameters

The AQIA requires estimates of the stack heights and other stack exit parameters to characterize the exhaust flow from the emission units. Stack parameters for the proposed facility will be obtained from vendors and included in the permit application.

In addition, the stack locations and building locations with dimensions will be provided to AERMOD to assess potential downwash effects. Wind direction-specific building profiles will be prepared by using the EPA's Prime version of the Building Profile Input Program (BPIP PRIME). The base elevation of each emission unit will be estimated using AERMAP.

2.2.5 Good Engineering Practice Analysis

A good engineering practice (GEP) stack height design analysis will be conducted based on the specifications of the buildings according to EPA procedures (EPA 1985a). Releases below the GEP stack height are potentially subject to building wake effects that can result in relatively high ground level predictions from the EPA's regulatory models. For the purposes of PSD review, the EPA does not allow credit for the added dispersion associated with releases above the GEP stack height and restricts the simulated heights in the modeling to the GEP stack height.

A GEP stack height determination will be made for the proposed exhaust stacks for each new emission unit. GEP stack height is equal to the height of the building which has the dominant wake effect ("zone of influence") on the stack plume plus 1.5 times the lesser of (1) that building's maximum projected width, or (2) the building height. This GEP stack height is expressed in the following equation:

$$Hg = H + 1.5\,L \qquad \text{(Equation 1)}$$

where

- Hg = GEP stack height
- H = Building height
- L = Lesser of the maximum projected building width or height

Use of a stack with the GEP stack height removes the plume completely from the building wake zone.

The cavity height is the stack height required to prevent the stack plume from entering the cavity region of the building. Pollutant plumes which are entrained into the cavity region of a building often produce extremely high concentrations. EPA defines cavity height by the following equation:

$$Hc = H + 0.5\ L \qquad \text{(Equation 2)}$$

where

Hc = Cavity height
H = Building height
L = Lesser of the maximum projected building width or height

EPA's BPIP Prime program will be used for the GEP analysis once the final building and stack locations for the new facility are available.

2.2.6 NO to NO_2 Chemical Transformations

We will follow EPA Guidance[4] for NO-to-NO_2 transformations. Initially, the Tier 1 approach of full conversion will be assumed. If the predicted NO_2 concentrations exceed the SIL or NAAQS, the Tier 2 Ambient Ratio Method (ARM) or Ambient Ratio Method 2 (ARM2) will be applied to predict the percentage of NOx that is NO_2 (equivalently, the percentage of NO converted to NO_2). At this time, we do not anticipate needing to use a Tier 3 method (Plume Volume Molar Ratio [PVMRM] or Ozone Limiting Method [OLM]).

2.3 Criteria Pollutant Significant Impact Level Assessment

Ambient concentrations of criteria pollutants due to emission releases from the proposed project will be predicted using AERMOD. Maximum short-term concentrations and annual average concentrations will be obtained for comparison with Significant Impact Levels.

Significant Impact Levels (SILs) have been established for various criteria pollutants, and are listed in Table 2. If pollutant concentrations exceed the SILs,

[4] Clarification on the Use of AERMOD Dispersion Modeling for Demonstrating Compliance with the NO_2 National Ambient Air Quality Standard, EPA/OAQPS, September 30, 2014. https://www3.epa.gov/scram001/guidance/clarification/NO2_Clarification_Memo-20140930.pdf

then further evaluation is required to compare the project's concentrations to the Class II PSD Increments, the NAAQS, and WAAQS. However, if all ambient impact concentrations modeled for facility operations are less than the SILs then no further analysis would be required. Additionally, under PSD regulations, only facilities with impacts in excess of SILs are required to include the impacts of other facilities or consider collecting background ambient air quality information.

For 1-hour NO_2 and 1-hour SO_2 EPA's interim SIL (4 percent of the NAAQS) has been assumed to apply.[5] On January 22, 2013, the $PM_{2.5}$ Significant Impact Levels (SILs) and significant Monitoring Concentration (SMC) were vacated by the United States Court of Appeals for the District of Columbia Circuit. On August 1, 2016, EPA issued for public comment some draft guidance for $PM_{2.5}$, justifying suggested replacement SILs and SMC. Although that guidance has not been finalized, we propose to use the SILs it suggests.

On December 02, 2016, EPA issued draft guidance on the use of Model Emission Rates for Precursors (MERPs) to estimate near-field secondary PM, and updated the guidance on February 23, 2017. Using the same reference source as will be used for the ozone analysis discussed in Section 2.9, we will calculate the contribution to near-field total $PM_{2.5}$ from primary NOx (converted to ammonium nitrate) and primary SO_2 (converted to ammonium sulfate). This MERP contribution will be applied to all Class II receptors, but not to the Class I receptors discussed in Section 3.1. This methodology follows the 2017 updates to the Guideline, which we believe supersedes the draft guidance on air quality impact assessments issued on March 4, 2013.[6]

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[5] General Guidance for Implementing the 1-hour NO_2 National Ambient Air Quality Standard in Prevention of Significant Deterioration Permits, Including an Interim 1-hour NO_2 Significant Impact Level. June 28, 2010 EPA Memorandum.
General Guidance for Implementing the 1-hour SO_2 National Ambient Air Quality Standard in Prevention of Significant Deterioration Permits, Including an Interim 1-hour SO_2 Significant Impact Level.. August 23, 2010 EPA Memorandum

[6] Available at http://www.epa.gov/ttn/scram/guidance/guide/Draft_Guidance_for_PM25_Permit_Modeling.pdf

Table 2: Applicable Class II PSD Air Quality Standards

Pollutant	Significant Impact Levels ($\mu g/m^3$)	Monitoring De Minimus Conc. ($\mu g/m^3$)	PSD Class II Increment ($\mu g/m^3$)	NAAQS / WAAQS [a] ($\mu g/m^3$)
CO 8-hour	500	575	None	10,000
CO 1-hour	2,000	None	None	40,000
NO_2 annual	1	14	25	100
NO_2 1-hour [b]	7.5	None	None	188
SO_2 Annual	1	None	20	52
SO_2 24-hour	5	13	91	365
SO_2 3-hour	25	None	512	1300
SO_2 1-hour [c]	7.8	None	None	196
$PM_{2.5}$ annual [d]	0.2	None	4	12
$PM_{2.5}$ 24-hour [d]	1.2	4	9	35
PM_{10} 24-hour	5	10	30	150
O_3 8-hour [e]	2 (1 ppb)	None	None	137 (70 ppb)

Notes:

[a] The ambient air quality standards shown are the most stringent of the WAAQS and NAAQS. EPA has revoked the annual PM_{10}, annual SO_2, and 24-hour SO_2 standards.

[b] For the 1-hour NO_2 standard (188 $\mu g/m^3$, or 100 ppb), EPA provided an interim SIL of 7.5 $\mu g/m^3$ (1-hr)

[c] For the 1-hour SO_2 standard (196 $\mu g/m^3$, or 75 ppb), EPA provided an interim SIL of 7.8 $\mu g/m^3$ (1-hr)

[d] The $PM_{2.5}$ significance and monitoring de minimus levels were vacated on January 22, 2013 from the Federal PSD regulations. Draft SILs were released on August 1, 2016

[e] For the 8-hour O_3 standard (137 $\mu g/m^3$, or 70 ppb), EPA proposed a draft SIL of 1 ppb (1.96 $\mu g/m^3$) on August 1, 2016

2.4 Significant Impact Area Determination

If modeling results exceed the significance levels, the Significant Impact Area (SIA) will be determined for that pollutant and averaging period. The SIA is a circular area around the source with a radius equal to the distance to the farthest receptor with a concentration exceeding the significance level. It should be noted that the SIA will not exceed 50 km due to constraints of the dispersion model. The SIA is utilized to define the inventory for the full impact analysis if required; inventory data will be gathered for all sources within up to 50 km of the SIA.

Only those receptors within the SIA where significance results are predicted to exceed the relevant SIL will be used in any full impact analysis. Only at those receptors could the facility potentially significantly contribute to a modeled NAAQS exceedance.

2.5 Preconstruction Monitoring Analysis

Pre-construction ambient monitoring may be required for any regulated pollutant that triggers PSD review. If the AERMOD-predicted maximum concentration for the project exceeds a monitoring de minimus concentration, ambient monitoring may be required unless existing ambient monitoring data are deemed representative of local conditions. The applicable monitoring de minimus concentration values are presented in Table 2.

2.6 PSD Class II Increment Consumption

For any pollutant/averaging time with a significant impact analysis concentration above the SIL, a Class II increment consumption analysis will be performed if an increment has been established for that pollutant/averaging time. The modeling assessment will include other sources with the potential to significantly consume increment within the SIA plus up to 50 km. Should such an analysis be required, Ramboll will obtain off-property emission sources from Ecology and Idaho DEQ. The appropriate baseline date for the pollutant will be established and actual emissions changes from the baseline date will be estimated for offsite sources. The proposed facility will be modeled using potential emissions as they will be new emission units.

Ramboll believes the major source baseline date for region has not yet been triggered for any criteria pollutant, and requests confirmation from Ecology. Any PSD increment consumption analysis will be conducted using emissions increases

from all major and minor new or modified sources permitted after the major and minor source baseline dates, respectively.

For increments with an annual averaging period, the highest model prediction will be compared to the applicable PSD increment. For shorter averaging periods, the highest second-high model-prediction will be compared to the applicable PSD increment.

2.7 Criteria Pollutant Ambient Air Quality Standards Assessment

NAAQS have been established by EPA and are presented in Table 2. Some of the criteria pollutants are subject to both "primary" and "secondary" federal standards. Primary standards are designed to protect human health with a margin of safety. Secondary standards are established to protect the public welfare from any known or anticipated adverse effects associated with these pollutants, such as soiling, corrosion, or damage to vegetation.

A NAAQS assessment will be based on AERMOD simulations of HiTest emissions and other industrial sources with the potential to significantly impact the same receptors as the proposed facility. As with the Class II increment analysis, Ramboll will obtain emission inventory data from Ecology for other industrial sources. Emissions from all sources may be based on allowable emissions or maximum potential to emit estimates, or may be based on 2-year average actual/representative emissions. Data will be verified as necessary with other public records and any refinements will be documented in the modeling report. Only those receptors inside the SIA that exceed the SILs will be used in the NAAQS analysis, and only those averaging periods whose concentrations exceed the SILs will be considered.

If a NAAQS compliance demonstration is required, we will include applicable background pollutant concentrations from the nearest monitoring stations. **Table 3** contains preliminary background concentrations, obtained from Washington State University's Northwest Airquest online tool[7]. This online application provides spatially interpolated design values of criteria pollutants for the years of 2009-2011 for Idaho, Washington and Oregon. Ramboll may also develop seasonal or hour-of-day background values for the NAAQS assessment.

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(7) Washington State University. NW Airquest Design Value Lookup Tool. http://www.lar.wsu.edu/nw-airquest/lookup.html

Table 3: Background Concentrations

Pollutant	Averaging Time	Averaging Method	NW Airquest Background Value
NO_2	1-hour	3-year avg. of 98th percentile of daily maxes.	10 μg/m^3
	Annual	Annual mean	1.7 μg/m^3
$PM_{2.5}$	24-hour	3-year average of the 98th percentile 24-hr averages.	14 μg/m^3
	Annual	3-year avg. of annual mean	4.6 μg/m^3
PM_{10}	24-hour	3-year avg. of 2nd highs	100 μg/m^3
SO_2	1-hour	3-year avg. of 99th percentile of daily max. 1-hour averages.	1.2 μg/m^3
	3-hour	2nd high	1.2 μg/m^3
	24-hour	2nd-high	0.83 μg/m^3
	Annual	Annual mean	0.3 μg/m^3

2.8 Toxic Air Pollutant Small Quantity Emission Rate Assessment

New and modified sources of TAPs are regulated on the state level by WAC 173-460. Under these regulations, emissions of TAPs from new emission units must be evaluated to ensure compliance with WAC 173-460-070. Additionally, new emission units must use Best Available Control Technology for toxics (T BACT). T BACT applies to each TAP or a mixture of TAPs that is discharged, taking into account the potency, quantity, and toxicity of each TAP.

Under these air toxic regulations, an initial evaluation is conducted and the results are compared to the Small Quantity Emission Rates. TAP emissions exceeding the corresponding Small Quantity Emission Rates (SQER) are then required to undergo air dispersion modeling for an Acceptable Source Impact Level (ASIL) analysis following WAC 173-460.

2.9 Ozone and Secondary PM2.5 Assessment

Initial proposed NOx and SO_2 emission increases from the facility are above the SERs, triggering an analysis of the facilities' potential contribution to ozone and secondary $PM_{2.5}$ formation. Although proposed VOC emission increases are not above the SER, VOC emissions are incorporated into ozone Model Emission Rates for Precursors (MERP) calculations as a conservative approach.

Following the draft Guidance on the use of MERPs for PSD permitting, Tier I methodologies were used to calculate the contributions to ozone and $PM_{2.5}$ associated with facility emission increases. **Table 4** presents the most conservative MERP values for highest maximum daily 8-hour ozone, daily maximum $PM_{2.5}$, and annual average $PM_{2.5}$ in the eastern, central, and western United States (adapted from Table 7-1 in the draft MERP guidance). If proposed emission increases are below the most conservative MERP values, no additional calculations are required to demonstrate that proposed emissions will result in ozone and $PM_{2.5}$ increases below the critical air quality threshold (SILs). For $PM_{2.5}$, NOx and SO_2 emissions must be considered together, along with NOx and VOC emissions for ozone.

Table 4: Most Conservative Illustrative MERP Values (TPY)

Precursor	Area	8-hr O_3	Daily $PM_{2.5}$	Annual $PM_{2.5}$
NOx	CUS	126	1693	5496
	EUS	170	2295	10144
	WUS	184	1075	3184
SO2	CUS	-	238	839
	EUS	-	628	4013
	WUS	-	210	2289
VOC	CUS	948	-	-
	EUS	1159	-	-
	WUS	1049	-	-

The conservative Western US NOx and SO_2 MERP values for 8-hr O_3 and daily $PM_{2.5}$, respectively, are lower than proposed NOx and SO_2 emissions so further analysis is required to estimate the impact of proposed emissions on 8-hr O_3 and daily $PM_{2.5}$. When proposed NOx and SO_2 emissions are considered together, the combined emissions are well below (55%) the combination of conservative NOx and SO_2

MERP values for annual average $PM_{2.5}$ in the Western US. Therefore no further analysis is required to demonstrate that the proposed emissions will not increase annual average $PM_{2.5}$ concentrations by more than the SIL (0.2 µg/m^3).

For 8-hr ozone and daily $PM_{2.5}$, the relationship between precursor emissions and secondary chemistry formation from a modeled hypothetical source in Morrow, OR (source 18) with a high stack height (90 m) and 500 TPY emission rates was used in Tier I calculations. Figure A-3 in the draft Guidance shows the locations of modeled hypothetical sources. Modeled hypothetical sources in Yellowstone, MT (source 11) and Klickitat, WA (source 23) were also considered and source 18 was chosen to be conservative, as it resulted in the highest estimated ozone and $PM_{2.5}$ increases.

Table 5 shows the ozone and $PM_{2.5}$ increases associated with the hypothetical source in Morrow, OR.

Table 5: MERP analysis results for $PM_{2.5}$ and ozone.

Precursor	Daily $PM_{2.5}$ (µg/m^3)	8-hr O_3 (ppb)
NOx	0.15	1.94
SO_2	0.19	-
VOC	-	0.46
Sum	0.34	2.40

The daily maximum $PM_{2.5}$ increases from NOx and SO_2 emissions associated with source 18 are used to calculate the daily maximum secondary $PM_{2.5}$ increase from the proposed facility in the following equation:

$$\frac{700\ TPY\ NOx\ from\ proposed\ facility}{500\ TPY\ NOx\ from\ source\ 18} \cdot 0.15 \frac{\mu g}{m^3} + \frac{760\ TPY\ SO_2\ from\ proposed\ facility}{500\ TPY\ SO_2\ from\ source\ 18} \cdot 0.19 \frac{\mu g}{m^3} = 0.50\ \frac{\mu g}{m^3}$$

It is estimated that the NOx and SO_2 emissions from the proposed facility will lead to an 0.34 µg/m^3 increase in daily maximum secondary $PM_{2.5}$. Although not described in detail here, a similar approach was used to estimate an annual average secondary $PM_{2.5}$ increase of 0.02 µg/m^3 from the proposed facility. Estimated total (primary+secondary) $PM_{2.5}$ increases associated with the facility will be compared to the SIL.

The daily maximum 8-hour ozone increases from NOx and VOC emissions associated with source 18 are used to calculate the daily maximum 8-hour ozone increase from the proposed facility in the equation below:

$$\frac{700\ TPY\ NOx\ from\ proposed\ facility}{500\ TPY\ NOx\ from\ source\ 18} \cdot 1.94\ ppb + \frac{20\ TPY\ VOC\ from\ proposed\ facility}{500\ TPY\ VOC\ from\ source\ 18} \cdot 0.46\ ppb = 2.7\ ppb$$

This calculation suggests that the proposed facility will increase daily maximum 8-hour ozone by 2.7 ppb, which is above the proposed SIL (1 ppb). This increase in largely driven by proposed NOx emissions, which are over an order of magnitude higher than proposed VOC emissions.

Because the Tier 1 methodology of using the MERP guidance did not predict an ozone concentration below the proposed SIL, we will work with Ecology to develop an appropriate Tier 2 demonstration following the guidance in 40 CFR 51 Appendix W Section 5.3.2. For other recent PSD applications, this has included running a photochemical grid model such as CMAQ for a specific ozone episode. By running CMAQ twice (with and without the proposed source) and subtracting the two results, the incremental impact of the increase in ozone precursors can be assessed.

3. CLASS I MODELING METHODOLOGY

PSD regulations require an analysis to address both Class I PSD increments, and Class I Air Quality Related Values (AQRV). Ecology is responsible for reviewing the former, while the Federal Land Managers (FLMs) are responsible for reviewing the latter.

3.1 Class I PSD Increment Assessment Methodology

The Spokane Indian Reservation has been redesignated a Class I area under the PSD program. The Spokane Tribe of Indians has not requested AQRV protections, only the added protection of the Class I PSD increments. Similarly, the Kalispel Tribe of Indians sent a letter to USEPA (on May 11, 2017) proposing to redesignate the Kalispel Indian Reservation a Class I area under the PSD program. Like the Spokane Tribe, the Kalispel Tribe has not requested AQRV protections, only the added protection of the Class I PSD increments. We assume that EPA will act to redesignate the Kalispel Indian Reservation before this PSD permit is granted, and will treat it as a Class I area.

The Kalispel Indian Reservation is approximately 22 km from the proposed site, while the distance to the Spokane Indian Reservation is approximately 53 km (Figure 6). Additionally, as shown in Section 3.2, there is one federally mandated Class I area within 100 km of the facility (the Cabinet Mountain Wilderness Area at approximately 94 km) and ten federally mandated Class I areas within 300 km of the facility. FLAG (2010) presents a "Q/D" screening methodology to select which Class I areas must be included in an assessment, but that applies only to the AQRV assessment. Ramboll believes the PSD regulations apply when selecting which Class I area to include in the increment analysis, which means only those within 100 km need to be included. We request concurrence from Ecology.

Table 6 summarizes the applicable Class I PSD increments and proposed Class I SILs. At this point, there are two sets of Class I SILs, those proposed by USEPA and those recommended by the FLMs. These proposed and recommended SILs were obtained from the Federal Register, Vol. 61, No. 143, p. 38292, July 23, 1996; and from the draft guidance of August 1, 2016 (revised August 18, 2016).

Because the distance is less than 50 km, we will perform the Class I PSD increment analysis for the Kalispel Indian Reservation using AERMOD. We will mostly follow the modeling methodology detailed in Section 2, with the exception of not including the MERP-based near-field secondary PM2.5 contribution. We assert that the MERP guidance applies to Class II areas only. Modeling receptors will be placed at 200 m intervals within the boundaries of the Reservation with additional receptors placed along the perimeter at 100 m spacing, resulting in 1363 receptors.

Initially, an AERMOD technique will be applied to assess Class I PSD increments at the Spokane Indian Reservation (SPOK) and the Cabinet Mountains WA (CAMO). A series of arcs of receptors will be placed at 50 km radius from the proposed facility, using the minimum and maximum angles between the facility and the Class I receptors, plus 20°. The receptor arc will use elevations and hill heights set at ten (10) equal intervals between the minimum and maximum elevations within the Class I area. Each Class I area will have its own set of receptors, specific to the range of elevations found within it.

Should the AERMOD-with-arcs technique predict H2H values that exceed the SILs, CALPUFF will be used in screening mode. The CALPUFF modeling will mostly follow the modeling methodology detailed in Section 3.2, with the exception of turning

"off" the chemistry and deposition schemes which have never been officially accepted by EPA. The FLM-specified receptors will be used for CAMO. For the Spokane Indian Reservation, we will use an interior receptor spacing of 1 km with no receptors placed along the boundaries (the same approach as the FLM-specified receptors) resulting in 638 receptors.

Table 6. Class I Area Significant Levels and Increments

Pollutant	Averaging Period	PSD Class I Increment	USEPA SIL [a]	FLM SIL [a]
PM_{10}	Annual	4	0.2	0.08
	24-hour	8	0.3	0.27
$PM_{2.5}$	Annual	1	0.05 [b]	--
	24-hour	2	0.27 [b]	--
SO_2	Annual	2	0.1	0.03
	24-hour	5	0.2	0.07
	3-hour	25	1	0.48
NO_2	Annual	2.5	0.1	0.03

Notes:

a – SIL = Significant Impact Level; USEPA proposed and FLM recommended from the Federal Register, Vol. 61, No. 142, p. 38292, July 23, 1996.

b – The Class I PM2.5 SILs were vacated on January 22, 2013. New SILs have been circulated for public comment, which we propose to use.

If CALPUFF predicts H2H values that exceed the SILs, then we propose use a screening technique that uses the Northwest International Air Quality Environmental Science and Technology Consortium (NW-AIRQUEST) design value Lookup Tool[8] to address the Class I PSD increment. This tool uses a 2009 emissions inventory. We will use EPA State-wide inventories of SO_2 to show the decrease in SO_2 emissions since 2009, indicating that using the Lookup Tool without scaling is conservative. The 2009 emissions inventory contains all other nearby sources of SO_2, both increment-consuming sources and those built before any baseline trigger date. Therefore the concentrations from the Lookup Tool can be added to the concentrations predicted by AERMOD (maximum over the arc) and compared to the

[8] See http://lar.wsu.edu/nw-airquest/lookup.html

Class I PSD increments. If the sum is below the increment, that will indicate compliance.

3.2 Class I Air Quality Related Values Methodology

PSD guidance requires an analysis of potential impacts to Air Quality Related Values (AQRVs) in Federal Class I areas within 100 km of the project. However, the FLMs have in the past requested analyses of AQRV impacts for additional Class I areas within 300 km of the site. Starting with FLAG (2010), there is no maximum distance when considering which Class I areas to include – inclusion is triggered by having a "Q/D" screening value that exceeds 10. There are ten federally mandated Class I areas with 300 km of the proposed facility. **Figure 6** displays the location of the site with a 300-km ring encircling it, and shows the closest Class I areas along with the two relevant Reservations.

The "Q/D" screening method is used to choose which Class I areas should be included in the modeling. Because neither the Kalispel Tribe nor the Spokane Tribe of Indians has requested AQRV protections, they will not be included in the AQRV analysis, regardless of their Q/D values.

Table 7 lists the approximate distance between the site and the Class I areas, as well as the initial Q/D values (total emissions in tons per year, divided by the distance in km). The preliminary net emission increase (Q) is based on the sum of the maximum 24-hour NO_X, SO_2, PM_{10}, and H_2SO_4 emissions from the proposed facility, expressed in tons per year. Note that a Q/D screening value of 10 is the screening threshold currently under consideration by the FLMs. With such a low potential for Class I impacts, we believe an AQRV analyses other than for the Cabinet Mountains WA may not be required. In the event that FLMs still require an AQRV assessment, we are providing this protocol to define our assessment methodology.

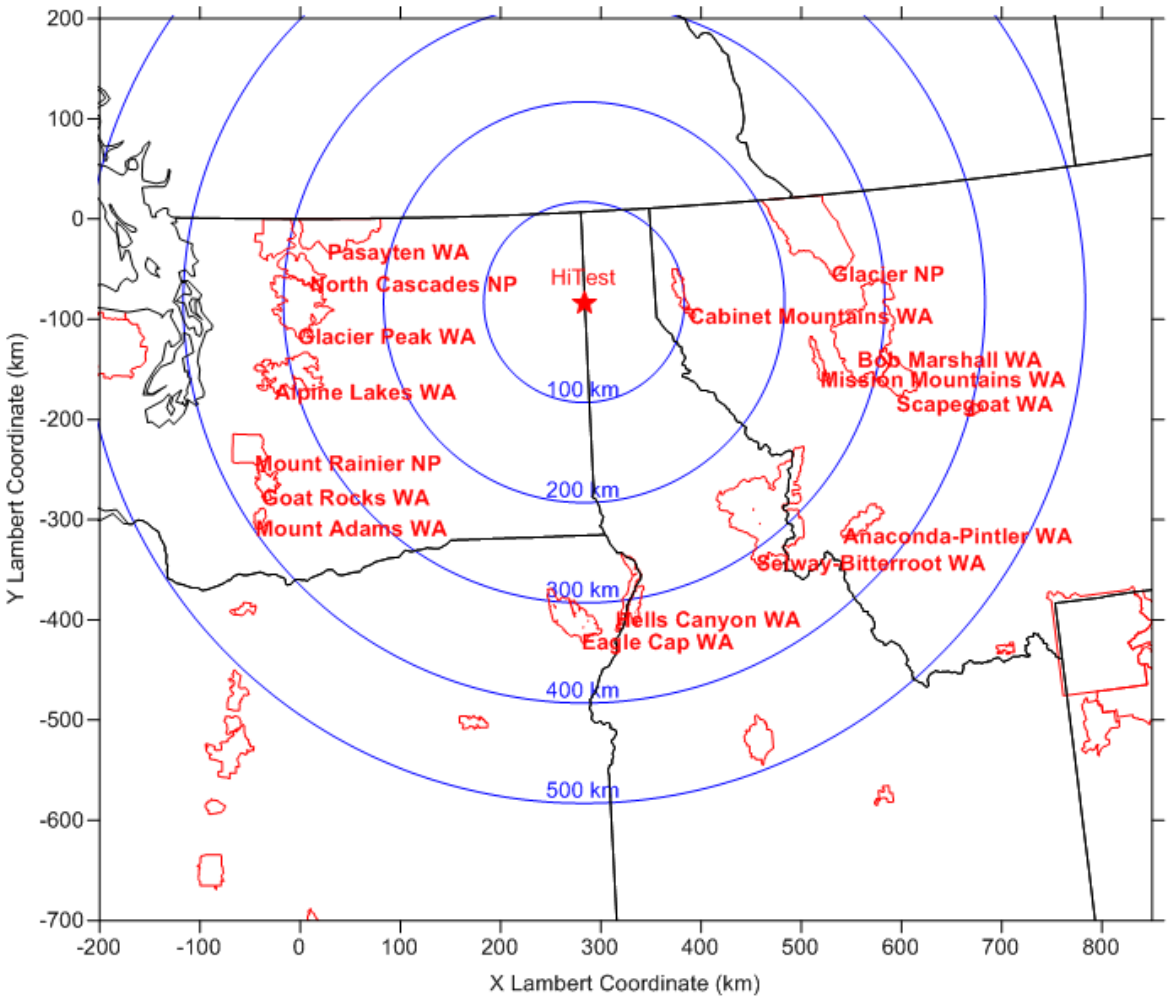

Figure 6. Mandatory Class I Areas within 300 km of the proposed facility

The proposed modeling domain shown in Figure 7 includes a buffer of at least 50 km around the Cabinet Mountains WA boundary and a buffer of at least 100 km around the proposed facility. If any FLM requests that another Class I area be included in the analysis, the modeling domain will be expanded using the same 50 km buffer criteria.

The proposed modeling domain also includes the Spokane Indian Reservation, to allow for the possibility of using CALPUFF as a screening model to address Class I PSD increments there.

Table 7. Mandatory Class I Areas Within 300km, with initial Q/D

ID	Name	Approximate distance to closest part of Class I area (km)	Preliminary Q/D Value (tpy/km)
CAMO	**Cabinet Mountains WA**	**90**	**17.22**
GLAC	Glacier NP	205	7.56
PASA	Pasayten WA	217	7.14
MIMO	Mission Mountains WA	229	6.77
SELW	Selway-Bitterroot WA	235	6.59
BOMA	Bob Marshall WA	248	6.25
GLPE	Glacier Peak WA	251	6.17
HECA	Hells Canyon WA	255	6.08
NOCA	North Cascades NP	259	5.98
ALLA	Alpine Lakes WA	272	5.70
EACA	Eagle Cap WA	289	5.36

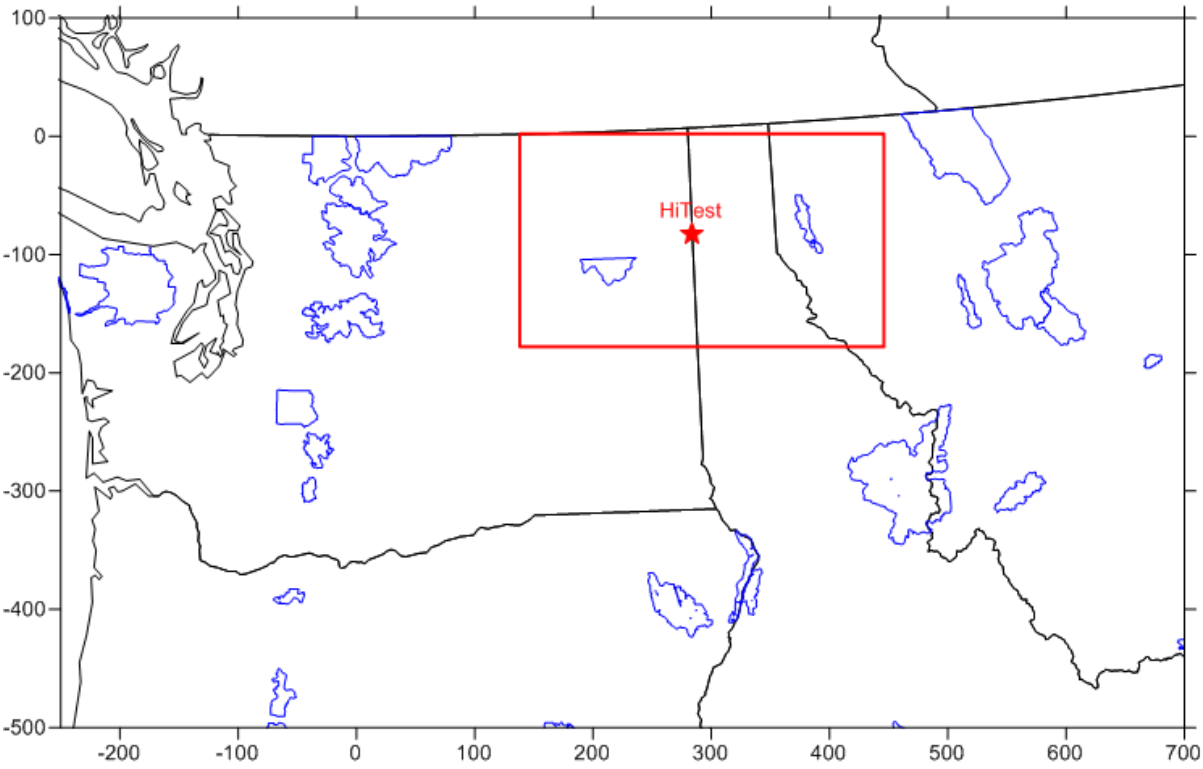

Figure 7. Proposed CALPUFF Modeling Domain

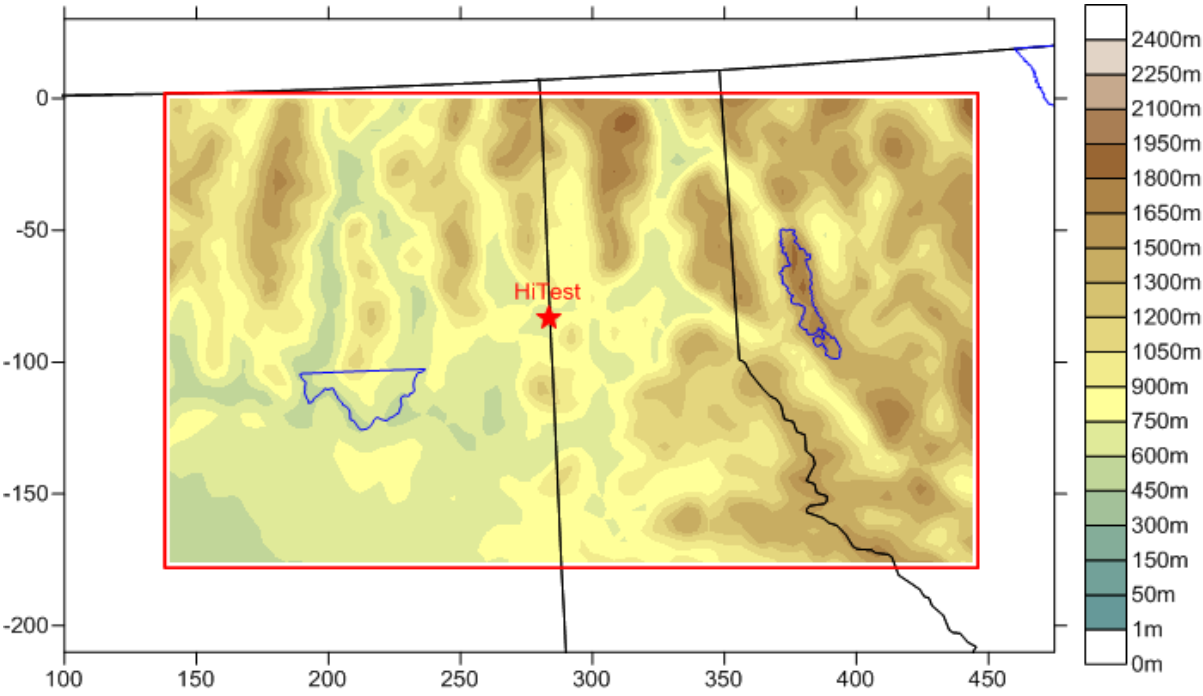

Figure 8. Proposed Domain with 4km Resolution Terrain

3.2.1 Dispersion Model Selection

On April 15, 2003, EPA adopted the CALPUFF modeling system as the EPA's preferred model for long-range transport assessments and for evaluating potential impacts to Class I areas by including CALPUFF in Appendix A of the EPA's Guideline on Air Quality Models (codified as Appendix W to 40 CFR Part 51). Features of the CALPUFF modeling system include the ability to consider secondary aerosol formation; gaseous and particle deposition; wet and dry deposition processes; and complex three-dimensional wind regimes.

On May 22, 2017, revisions to the Guideline became effective that (among other changes) removed CALPUFF from Appendix A. However, as detailed in the preamble of the proposed rulemaking, this action does not affect the use of CALPUFF under the FLM's guidance regarding AQRV assessments (FLAG 2010).

Ramboll will use CALPUFF version 5.8.5, dated December 14, 2015. This was the most recent "official" EPA version of CALPUFF, and corrects several errors present in the previous versions of CALPUFF, as detailed in Model Change Bulletins E, F, G, and H. CALPOST version 6.221, level 080724 will be used for post processing. As detailed in Section 3.2.5, we will use the latest version of Mesoscale Model Interface program (MMIF) in place of CALMET.

3.2.2 Modeling Methodology Summary

The modeling procedures will follow Federal Land Managers' Air Quality Related Workgroup (FLAG) and Interagency Workgroup on Air Quality Modeling (IWAQM) recommendations, in particular, FLAG (2000, revised October 2010)[9] and IWAQM (1998) guidance documents. FLAG (2010) revises some procedures in the FLAG (2000) report, the most significant revisions are related to visibility impact calculations. The general CALPUFF modeling approach is summarized here:

- Regulatory Options: CALPUFF will be run in the regulatory mode (MREG =1).
- Modeling Period: Three years will be modeled (2014, 2015, 2016) using 4 km resolution output from the WRF meteorological model, processed by MMIF.

[9] The FLAG 2000 and 2010 documents can be found at http://www.nature.nps.gov/air/Permits/flag/.

- Modeling Domain and Grid Resolution: The modeling domain will include each of the Class I areas for which Q/D exceeds 10, in their entireties, and extend 50 km beyond the far edge of each Class I area.
- Background Ammonia: Past AQRV studies of other regional sources have used a conservative 17 ppb ammonia concentration.
- Background Ozone: Hourly surface ozone will be extracted from the USEPA's AQS database, using all stations within 50km of the modeling domain. A conservative value of 60 ppb will be used when none of the supplied ozone stations have valid data.
- Receptors: High spatial density National Park Service/Forest Service (NPS/FS) receptors[10] in the Class I areas will be used. High spatial density receptors will also be placed inside the Spokane Indian Reservation.
- Visibility Impact Assessment: Visibility impacts will be calculated using the FLAG (2010) recommended Method 8 included as the default option in CALPOST. We propose to use the annual average natural conditions tables in FLAG (2010) for monthly species background concentrations and relative humidity adjustment factors.

3.2.3 Characterization of Emissions

The Class I AQRV modeling analysis includes incremental increases in NO_X, PM_{10}, $PM_{2.5}$, and SO_2 emissions. There are no Class I area deposition flux thresholds associated with CO or VOCs, and neither CO nor VOCs contribute to visibility impairment in CALPUFF. Therefore, CO and VOCs are not included in any of the AQRV analyses.

Data characterizing the chemical composition and size distribution of the PM_{10} and $PM_{2.5}$ emissions are needed for the AQRV analysis using the CALPUFF modeling system. Particulate emissions must be divided into these six species:

- Soot or elemental carbon (EC)
- Organic carbon (OC)
- Fine soil particles (PMF)
- Coarse particles (PMC)
- Sulfate (SO_4)
- Nitrate (NO_3)

[10] Class I receptors can be found at http://www.nature.nps.gov/air/maps/Receptors/index.cfm.

Ramboll plans to use $PM_{2.5}$ fractions following the methodology used by Ecology to provide $PM_{2.5}$ fractions use in BART modeling analyses. The $PM_{2.5}$ fractions are based on profiles recommended by the EPA for the Community Multi-Scale Air Quality (CMAQ) model – the preferred regulatory model for $PM_{2.5}$ and regional haze simulations. The CMAQ profile database is indexed by Source Classification Code (SCC), and relies in the SPECIATE database. We will use the most recent version of the CMAQ/SPECIATE database for the $PM_{2.5}$ speciation.

3.2.4 Chemical Transformations

The NO_X chemistry in CALPUFF depends on the ambient ammonia concentration to establish the equilibrium between gaseous nitric acid and ammonium nitrate. However, ambient ammonia concentrations are not explicitly simulated by CALPUFF and the user must select an appropriate background concentration. The IWAQM Phase II Recommendations suggest typical ammonia concentrations are: 10 parts per billion (ppb) for grasslands, 0.5 ppb for forests, and 1 ppb for arid lands during warmer weather.

For the current analysis, we propose to use 17 ppb for the background ammonia concentration. This conservative concentration was recommended for Pacific Northwest BART simulations and is based on measurements in southern British Columbia. This relatively high background ensures the conversion of NO_X to ammonium nitrate is not limited by a lack of ammonia for the range of NO_X concentrations predicted in this study.

Reaction rates in the CALPUFF chemistry algorithms are also influenced by background ozone concentrations. Hourly ozone monitoring data will be extracted from the USEPA's AQS database and formatted for use in this analysis. A background of 60 ppb will be used during periods of missing data.

3.2.5 Meteorological Data

USEPA has supplied Ramboll with a prognostic meteorological data set from the University of Washington[11] (UW). It is based on numerical simulations of Pacific Northwest weather with the National Center of Atmospheric Research's Weather Research and Forecast Model (WRF). The AQRV analysis will use three years of

[11] See http://www.atmos.washington.edu/wrfrt

hourly 4-km horizontal mesh size prognostic model output data from January 2014 through December 2016.

Based on recent communication with Tim Allen (USFWS), we propose to use the most recent version of the USEPA's Mesoscale Model Interface program (MMIF v3.4) in place of the meteorological pre-processor CALMET. In addition to specifying the three-dimensional wind field, MMIF also estimates the boundary layer parameters used to characterize diffusion and deposition by the dispersion model. Major features of the MMIF application and input data preparation are as follows:

- The proposed model domain is shown in **Figure 7**. The horizontal mesh size will be 4 km and the domain will cover an area of 308 km-by-180 km.
- There will be ten vertical levels, ranging geometrically from the surface to 4,000 m, using the FLM default layers (MMIF default).
- A Lambert Conformal Conic coordinate system will be used with an origin of 49ºN, 121ºW and standard latitudes of 30ºN and 60ºN (matching the UW prognostic dataset).
- Land use and terrain data will be inherited (passed through by MMIF) from the USGS-based datasets included in the WRF distribution. Figure 8 shows the 4-km mesh size terrain to be used in the simulations.
- The MMIF-default Golder method for calculating Pasquill-Gifford stability class will be used.
- The MMIF-default WRF-supplied mixing layer heights will be used.

MMIF will be run in monthly segments using the UW WRF prognostic data.

3.2.6 Meteorological Model Performance Evaluation

The WRF dataset will be subjected to a model performance evaluation using the freely-available program METSTAT.[12] METSTAT reads both observational data and the WRF output, and performs paired-in-time statistics that indicate the error and bias of the WRF output. Currently, METSTAT assumes the observations have no error or bias, and are representative of the grid cell in which they fall.

Surface weather observations will be obtained from the National Climatic Data Center dataset DS-3505 for stations in and around the domain. Observations from

[12] Available at http://www.camx.com/getmedia/56bef1b3-00ee-4cd7-b814-b1dcf0dc9304/metstat-9dec13.tgz.aspx

other datasets (e.g. the AgriMet network) may also be included, after extra quality control as they are generally not sited as well as the first-order sites found in DS-3505.

The PSD application will present a METSTAT analyses of both the full 4 km WRF domain and the subset CALPUFF domain. Individual WRF and observed wind rose plots will also be shown and discussed.

3.2.7 Receptors and Terrain

The CALPUFF dispersion model simulations will assess AQRVs within each Class I area at discrete receptors obtained from the NPS. In addition to the discrete receptors, a receptor grid with 4-km spacing may also be used throughout the CALPUFF modeling domain for AQRV predictions. The 4-km mesh size receptors can be used to construct plots showing the spatial variation of the calculated parameters throughout the modeling domain. These plots can be used for diagnostic purposes, as well as to develop figures that may be presented in the permit application. Comparisons with AQRV criteria will be based on the discrete receptor locations and elevations rather than the domain-wide gridded receptors.

3.2.8 Post-Processing Procedures

The CALPUFF modeling system will be used to predict criteria pollutant concentrations (if CALPUFF is used in screening mode to address Class I PSD increments), concentrations of PM_{10} species that contribute to regional haze, total (wet and dry) deposition fluxes for nitrogen-containing pollutant species, and total deposition fluxes for sulfur species. For each emission case considered, three annual simulations will be performed in parallel for each of the three modeling years. A sample CALPUFF input file is included with this submittal.

The CALPUFF utility POSTUTIL will be used to manipulate the large CALPUFF output files and calculate a number of the parameters needed to assess AQRVs in the areas of interest. Specifically, POSTUTIL will be used to:

- Adjust the nitric acid/ammonium nitrate equilibrium to account for possible overlapping plumes using the MNITRATE=1 option. Initially the post-processing will be performed without this option. The option may be employed if AQRV criteria related to nitrate formation are exceeded.
- Sum the sulfur and nitrogen portions of the deposited gaseous and particle compounds to estimate the total sulfur and nitrogen deposition fluxes. The nitrogen in the ammonium nitrate and ammonium sulfate, including the

portion that might be from the background ammonia, will be incorporated in the total.

- If needed for the PSD increment analysis, sum the individual PM_{10} and $PM_{2.5}$ species together after accounting for the differences in molecular weight between the species in the CALPUFF output files and the actual component species of PM_{10} and $PM_{2.5}$.

Following the application of POSTUTIL, the CALPOST post-processor will be used to summarize the modeling results.

Predicted annual sulfur and nitrogen deposition fluxes will be used as a measure to assess potential impacts to soils and vegetation in regional Class I areas. The FLMs have established Deposition Analysis Thresholds (DATs) for nitrogen and sulfur of 0.005 kilograms per hectare per year (kg/ha/yr).[13] These "thresholds" are based on natural background deposition estimates culled from various research efforts, a variability factor, and a safety factor that accounts for cumulative effects. The nitrogen and sulfur DATs are not adverse impact thresholds, but are intended as conservative screening criteria that allow the FLMs to identify potential deposition fluxes that require their consideration on a case-by-case basis.

The FLAG workgroup recommends procedures for estimating the visibility impacts due to proposed new sources at Class I areas using refined CALMET/CALPUFF modeling (FLAG, 2010). The FLAG visibility metric is the estimated maximum 24-hour change in extinction (Δb_{ext}) over clean natural visibility conditions (Natural Conditions) at the Class I area. The interpretation of the FLAG thresholds for extinction change over natural background is as follows:

- If the source's visibility impact is < 5% on all days, the FLM will likely not object to the permit.
- If there are days with the source's visibility impact > 10%, the FLM may object to the permit.
- If there are days in which the source's visibility impact are above 5% the frequency, magnitude and duration of the visibility impacts are used to make a significance determination.

[13] *Guidance on Nitrogen and Sulfur Deposition Analysis Thresholds*, available on the FLAG internet site at http://www2.nature.nps.gov/ard/flagfree/NSDATGuidance.htm

If a source exceeds a specific threshold at a Class I area, then the frequency, magnitude and duration of the impacts and the reliability and accuracy of the modeling are examined to interpret the modeling results.

The FLAG (2010) procedures employ the IMPROVE extinction equation to calculate b_{ext} (Method 8, invoked with MVISCHECK=1 in CALPOST). This equation for extinction uses monthly relatively humidity adjustment factors with relative humidity capped at 95%. It uses annual background aerosol concentrations recommended by the FLMs for the Class I area of concern, and assesses the visibility using the 98th percentile modeled values at each receptor. In order to use Method 8, CALPOST Version 6.221 (Level 080724) will be used to post-process the CALPUFF output files.

For FLAG 2010, a Project's extinction is calculated using the revised IMPROVE reconstructed mass extinction equation as follows:

$$\begin{aligned} b_{project} = {} & 2.2 \times f_S(RH) \times [\text{Small Sulfate}] + 4.8 \times f_L(RH) \times [\text{Large Sulfate}] \\ & + 2.4 \times f_S(RH) \times [\text{Small Nitrate}] + 5.1 \times f_L(RH) \times [\text{Large Nitrate}] \\ & + 2.8 \times [\text{Small Organic Mass}] + 6.1 \times [\text{Large Organic Mass}] \\ & + 10 \times [\text{Elemental Carbon}] \\ & + 1 \times [\text{Fine Soil}] \\ & + 0.6 \times [\text{Coarse Mass}] \\ & + 1.7 \times f_{SS}(RH) \times [\text{Sea Salt}] \\ & + \text{Rayleigh Scattering (Site Specific)} \\ & + 0.33 \times [NO_2 \text{ (ppb)}] \text{ \{or as: } 0.1755 \times [NO_2 \text{ (}\mu g/m^3\text{)}]\} \end{aligned}$$

Where:

[ ] indicates concentrations in $\mu g/m^3$
$f_S(RH)$ = Relative humidity adjustment factor for small sulfate and nitrate
$f_L(RH)$ = Relative humidity adjustment factor for large sulfate and nitrate
$f_{SS}(RH)$ = Relative humidity adjustment factor for sea salt
For Total Sulfate < 20 $\mu g/m^3$:
[Large Sulfate] = ([Total Sulfate] / 20 $\mu g/m^3$) × [Total Sulfate]
For Total Sulfate ≥ 20 $\mu g/m^3$:
[Large Sulfate] = [Total Sulfate]

And:

[Small Sulfate] = [Total Sulfate] – [Large Sulfate]

To calculate large and small nitrate and organic mass, substitute ({Large, Small, Total} {Nitrate, Organic Mass}) for Sulfate.

The visibility related AQRVs will be summarized for each area of interest in a series of tables showing the number of days the 5 percent change to extinction was exceeded and showing the extinction budgets for the top 8 days in each year of the simulation and any day with a change to extinction greater than 5 percent. Time series plots will be used to display the seasonality of the modeling results and contour plots of the predicted maximum 24-hour extinction coefficients will be used to examine spatial variability.