# CONTENTS

Acronyms and Abbreviations ........................................................................................................ iii

## 1. Introduction ................................................................................................................................. 1
  1.1 Project Emissions and Regulatory Analysis.......................................................................... 2
      1.1.1 Criteria Pollutant Emissions .............................................................................. 3
      1.1.2 Toxic Pollutant Emissions ............................................................................. 3

## 2. Class II Modeling Methodology ................................................................................................. 6
  2.1 Dispersion Model Selection ................................................................................................. 6
  2.2 Modeling Methodology .......................................................................................................... 7
      2.2.1 Model Setup ....................................................................................................... 7
      2.2.2 Meteorology ...................................................................................................... 7
      2.2.3 Receptor Network and Terrain ...................................................................... 8
      2.2.4 Emission Unit Parameters ............................................................................. 8
      2.2.5 Good Engineering Practice Analysis ................................................................ 9
      2.2.6 NO to NO\(_2\) Chemical Transformations ......................................................... 11
  2.3 Criteria Pollutant Significant Impact Level Assessment .................................................... 11
  2.4 Significant Impact Area Determination ............................................................................. 14
  2.5 Preconstruction Monitoring Analysis ................................................................................ 14
  2.6 PSD Class II Increment Consumption .............................................................................. 14
  2.7 Criteria Pollutant Ambient Air Quality Standards Assessment .................................... 15
  2.8 Toxic Air Pollutant Small Quantity Emission Rate Assessment ..................................... 16
  2.9 Ozone and Secondary PM\(_{2.5}\) Assessment .................................................................. 17

## 3. CLASS I Modeling Methodology .............................................................................................. 24
  3.1 Class I PSD Increment Assessment Methodology ......................................................... 24
  3.2 Class I Air Quality Related Values Methodology ........................................................... 26
      3.2.1 Dispersion Model Selection ............................................................................. 31
      3.2.2 Modeling Methodology Summary .................................................................. 31
      3.2.3 Characterization of Emissions ..................................................................... 32
      3.2.4 Chemical Transformations ........................................................................ 33
      3.2.5 Meteorological Data ................................................................................... 33
      3.2.6 Receptors and Terrain ................................................................................. 34
      3.2.7 Post-Processing Procedures ......................................................................... 34

## 4. References ................................................................................................................................. 38
TABLES

Table 1. Preliminary Project Emissions Increases ........................................................... 5
Table 2. Applicable Class II PSD Air Quality Standards .................................................. 13
Table 3. Background Concentrations ........................................................................... 17
Table 4. Most Conservative Illustrative MERP Values (TPY) ............................................ 18
Table 5. MERP analysis results for PM$_{2.5}$ and ozone .................................................. 19
Table 6. Ozone Design Values at Green Bluff, WA ......................................................... 22
Table 7. Class I Area Significant Levels and Increments ................................................. 26
Table 8. Mandatory Class I Areas Within 300 km, with initial Q/D .................................. 29

FIGURES

Figure 1. PacWest Facility Location and Property Boundary ........................................... 4
Figure 2. 20 km by 20 km Receptor Grid ................................................................... 10
Figure 3. Location of Green Bluff AQS Monitoring Site............................................... 21
Figure 4. Class I Areas within 300 km of the proposed facility ...................................... 28
Figure 5. Proposed CALPUFF Modeling Domain ....................................................... 30
Figure 6. Proposed Domain with 4 km Resolution Terrain ............................................ 30
ACRONYMS AND ABBREVIATIONS

AERMOD .............................. Air quality dispersion modeling system used in this analysis. The AERMOD modeling system consists of two preprocessors 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

ARM/ARM2 ........................... Ambient Ratio Method/Ambient Ratio Method 2; Tier 2 NO-to-NO\textsubscript{2} chemical transformation methods

ASIL ................................. Acceptable Source Impact Level

BACT ................................. Best available control technology

BART ................................. Best available retrofit technology

BPIP PRIME .......................... EPA’s Prime version of the Building Profile Input Program

CALPUFF .............................. Air quality dispersion modeling system typically used for long-range (greater than 50 km) transport assessments. The meteorological preprocessor (CALMET) provides meteorological information for the dispersion model (CALPUFF). The CALPOST post-processor can be used in conjunction with the CALPUFF utility POSTUTIL to summarize modeling results

CO ................................. Carbon monoxide, a criteria air pollutant
CO₂ ........................................... 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

DAT ........................................... Deposition Analysis Threshold, typically in units of kilograms per hectare per year

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 ........................................... U.S. Environmental Protection Agency

FLAG ....................................... Federal Land Managers’ Air Quality Related Workgroup

FLMs ......................................... Federal Land Managers

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

GEP stack height ...................... Good engineering practice stack height; the height at which a stack must be to avoid building wake effects on emissions during dispersion analysis

H₁H, H₂H ................................. Highest first-high, highest second-high. The first “highest” is over time, the second over space

IDAPA ...................................... Idaho Administrative Code

IWAQM ..................................... Interagency Workgroup on Air Quality Modeling

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; a 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.

MPE........................................ Model Performance Evaluation
NAAQS................................. National Ambient Air Quality Standard
NED........................................ National Elevation Dataset
NO₂........................................ 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 standard has been violated and where there is a program in place designed to reduce air pollution so that the standard can be attained
NOx........................................ Oxides of nitrogen, a general class of air pollutant without a specific air quality standard but used in monitoring air quality
NPDES................................. National Pollutant Discharge Elimination System
NPS/FS..................................... National Park Service/Forest Service
NWS........................................ National Weather Service
O₃........................................... ozone
OLM ........................................ Ozone Limiting Method; Tier 3 NO-to-NO₂ chemical transformation method
Particulate matter (PM)......... Air pollutant comprised of solid or liquid particles; PM is usually characterized based on the particle size. See also PM₁₀ and PM₂.₅
PM₁₀...................................... "Coarse" inhalable particulate matter with an aerodynamic size less than or equal to 10 micrometers (microns)
PM₂.₅..................................... "Fine" inhalable particulate matter with an aerodynamic size less than or equal to 2.5 micrometers (microns)
ppb ....................................... Parts per billion
PSD........................................ Prevention of Significant Deterioration
PVMRM .................................. Plume Volume Molar Ratio Method; Tier 3 NO-to-NO₂ chemical transformation method
RAWS.................................... Remote Automated Weather Stations
SCC........................................ Source Classification Code
SCR........................................ Selective Catalytic Reduction
SER........................................ Significant Emission Rate
SIA.......................................... Significant Impact Area
SIC........................................... Standard Industrial Classification
SIL........................................... Significant Impact Level
<table>
<thead>
<tr>
<th>Acronym</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>SMC</td>
<td>Significant Monitoring Concentration</td>
</tr>
<tr>
<td>SO₂</td>
<td>Sulfur dioxide, a criteria air pollutant</td>
</tr>
<tr>
<td>SPECIATE</td>
<td>A database giving fractions of particulate matter sub-species</td>
</tr>
<tr>
<td>SQER</td>
<td>Small Quantity Emission Rate</td>
</tr>
<tr>
<td>TAP</td>
<td>Toxic Air Pollutant</td>
</tr>
<tr>
<td>T-BACT</td>
<td>Best available control technology for toxic air pollutants</td>
</tr>
<tr>
<td>tpy</td>
<td>Tons per year, an estimate of annual emissions</td>
</tr>
<tr>
<td>µg/m³</td>
<td>Micrograms per cubic meter (a metric used in quantifying concentrations of air pollutants)</td>
</tr>
<tr>
<td>USFS</td>
<td>U.S. Forest Service</td>
</tr>
<tr>
<td>USFWS</td>
<td>U.S. Fish and Wildlife Service</td>
</tr>
<tr>
<td>USGS</td>
<td>U.S. Geological Survey</td>
</tr>
<tr>
<td>VOC</td>
<td>Volatile organic compound</td>
</tr>
<tr>
<td>Volume source</td>
<td>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</td>
</tr>
<tr>
<td>WAAQS</td>
<td>Washington Ambient Air Quality Standards</td>
</tr>
<tr>
<td>WAC</td>
<td>Washington Administrative Code</td>
</tr>
<tr>
<td>WRF</td>
<td>The Weather Research and Forecast model, a meteorological model</td>
</tr>
</tbody>
</table>
1. INTRODUCTION

PacWest Silicon, Inc. (PacWest, formerly called HiTest Silicon) proposes to construct a facility near Newport, Washington to produce very high-quality silicon. The proposed facility boundary would be adjacent to the Washington-Idaho border, as shown in Figure 1. Primary access for both employees and truck deliveries would be via a road to be constructed under or near the electric lines that run east-to-west along the north boundary of the property, out to Washington Highway 2 west of the property. A rail loop would also be constructed to the west of the main facility, to facilitate the delivery of certain raw materials. The details of the road and rail lines are not final at this time, but will be presented in the Prevention of Significant Deterioration (PSD) application.

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

The sand/quartz would be brought by rail from the mine in BC to the rail loop adjacent to the proposed facility, as would low-sulfur coal, and would be unloaded and moved via conveyor belt to storage on-site. Local wood chips and charcoal would be brought to the facility by truck and stored on-site. All raw materials would be stored in enclosed sheds, not open piles, to reduce fugitive emissions.

An electric submerged arc furnace process would then be used to reduce the silica in the quartz, essentially removing the O$_2$ from each SiO$_2$ atom to create CO$_2$, leaving solid Si as the main product. SiO gas formed in the process sublimates to produce SiO$_2$ in the form of amorphous silica fume, releasing oxygen-free radicals which, given the high temperatures, react with atmospheric nitrogen to form NOx. The sulfur in the coal reacts to form SO$_2$, and particulate matter (PM) is also produced as a by-product.

A large baghouse would be used to reduce PM from the furnaces and from the refining/casting room. Because most of this PM is actually high-grade silica fume, the main baghouse filtrate would be bagged and sold as a product. Smaller bag houses would control PM from the crushing/screening operation, and from material handling (moving materials from the storage sheds to the furnaces). All conveyance
systems would be covered, as would the rail and truck offload stations. PM emissions would be controlled by misting.

Other emission units planned for the facility include an emergency generator, and an emergency water pump.

The common methods to control NOx and SO$_2$ have never been implemented in the silicon smelting industry. Traditional wet scrubber systems to control SO$_2$ would produce more wastewater than the Newport wastewater treatment plant National Pollutant Discharge Elimination System (NPDES) permit allows and would require more water be input than is available. Traditional selective catalytic reduction (SCR) can control NOx but produces ammonium nitrate as a byproduct which must be filtered via a baghouse. Because PacWest does not want ammonium nitrate mixed with their silicon dust product, SCR would have to be introduced into the flue gas stream after the main baghouse, where the temperature of the flue gas makes SCR much less efficient. A Best Available Control Technology (BACT) analysis will be presented that details each of these possible control methods.

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 ever be built.

PacWest intends to submit a permit application to obtain an Order of Approval to Construct, and a 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 in attainment or unclassifiable for all National Ambient Air Quality Standards (NAAQS).

Emission calculations for the proposed facility will be based on 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). PacWest has invested considerable effort in a refined design of the furnaces and hoods, using detailed computational fluid dynamics modeling. The results indicate a considerable reduction in the emission factor for NOx (lb. per ton Si produced) compared to the most recent similar facility constructed in the United States. By blending the use of charcoal with coal as the source of carbon, the SO\(_2\) emission factor can also be reduced – as well as reducing the CO\(_2\) from fossil fuels (as opposed to carbon already in the biosphere).

Emission 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). PacWest plans to use water misting technology for dust containment at all partially enclosed discharge and drop points, and to keep the wood chips saturated with moisture. Covered storage will be used for quartz, coal, and charcoal. Baghouses would control fugitive dust from material handling.

1.1.1 Criteria Pollutant Emissions

Preliminary calculations of the PSD pollutant emissions attributable to the proposed project are presented in Table 1, and compared to the applicable Significant Emission Rates (SERs). These preliminary calculations indicate the project’s NO\(_x\), CO, SO\(_2\), PM\(_{10}\), PM\(_{2.5}\), and greenhouse gas emission increases are expected to be greater than the applicable SERs. Because NO\(_x\) 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.

1.1.2 Toxic Pollutant Emissions

Washington Administrative Code (WAC) 173-460 requires the evaluation Toxic Air Pollutant (TAP) emission increases from new and modified sources. Preliminary estimates indicate that the new furnaces will emit small quantities of TAPs. Emissions of TAPs will be estimated based on the BACT for Toxics (T-BACT) analysis, emission factors from the U.S. Environmental Protection Agency’s (EPA’s) AP-42 reference guide, and publicly available source tests from other similar silicon smelters.
Figure 1. PacWest Facility Location and Property Boundary
### Table 1. Preliminary Project Emissions Increases

<table>
<thead>
<tr>
<th>PSD Pollutant</th>
<th>Preliminary Project Emission Increases (tpy)</th>
<th>PSD Significant Emission Rate (tpy)</th>
<th>Triggers PSD?</th>
</tr>
</thead>
<tbody>
<tr>
<td>NOx</td>
<td>935</td>
<td>40</td>
<td>Yes</td>
</tr>
<tr>
<td>CO</td>
<td>307</td>
<td>100</td>
<td>Yes</td>
</tr>
<tr>
<td>SO(_2)</td>
<td>649</td>
<td>40</td>
<td>Yes</td>
</tr>
<tr>
<td>PM</td>
<td>45</td>
<td>25</td>
<td>Yes</td>
</tr>
<tr>
<td>PM(_{10})</td>
<td>36</td>
<td>15</td>
<td>Yes</td>
</tr>
<tr>
<td>PM(_{2.5})</td>
<td>34</td>
<td>10</td>
<td>Yes</td>
</tr>
<tr>
<td>VOC</td>
<td>90</td>
<td>40</td>
<td>Yes</td>
</tr>
<tr>
<td>Pb</td>
<td>0.1</td>
<td>0.6</td>
<td>No</td>
</tr>
<tr>
<td>Fluorides</td>
<td>1</td>
<td>3</td>
<td>No</td>
</tr>
<tr>
<td>H(_2)SO(_4)</td>
<td>1</td>
<td>7</td>
<td>No</td>
</tr>
<tr>
<td>Greenhouse Gases</td>
<td>766,131</td>
<td>75,000</td>
<td>Yes</td>
</tr>
<tr>
<td>Total HAPs</td>
<td>23</td>
<td>25</td>
<td>No</td>
</tr>
<tr>
<td>Max of any HAP</td>
<td>8</td>
<td>10</td>
<td>No</td>
</tr>
</tbody>
</table>
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, the Washington Ambient Air Quality Standards (WAAQS), and Ecology’s Acceptable Source Impact Levels (ASILs) for toxic air pollutants. This section describes the techniques for the AQIA. This analysis will focus on the prediction of concentrations of pollutants directly emitted by the proposed and affected emission units, but also addresses near-field secondary pollutants.

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 units’ 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 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 18081) will be applied with the default options for dispersion that depend on representative meteorological data, regional upper air data, and the local physical characteristics of land-use. 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 10-meter meteorological (MET) tower operated by the Idaho Department of Transportation (ID41, mesowest ITDA8, Old Town) is located just east of the site. However, the Idaho Department of Transportation does not perform any audits or other quality control on their meteorological towers. This precludes its use in a PSD permit. Additionally, there appear to be significant obstructions within 10 times the mast height (100 m).

A Remote Automated Weather Station (RAWS) station is located approximately 24 km southeast of the site (HOOI1, Blanchard - Hoodoo). The site is located in a small circular clearing within a stand of trees, with a radius of approximately 35 m. Many RAWS meteorological sites use a 3 m mast, so the nearest obstruction (a tree) is not within 10 times the height of the mast. Furthermore, RAWS sites are typically audited/calibrated only every few years.

The closest National Weather Service (NWS) meteorological station is at Deer Park (KDEW), approximately 36 km southwest of the proposed site. The Deer Park airport is known as a haven for glider plane enthusiasts, due to the relatively higher wind speeds in the region. This region of high wind speeds does not extend to the Newport area, such that KDEW would not be a “representative” site in the terms discussed in Appendix W, Section 8.3.

---


3 [http://mesowest.utah.edu/cgi-bin/droman/station_total.cgi?stn=HOOI1&unit=0](http://mesowest.utah.edu/cgi-bin/droman/station_total.cgi?stn=HOOI1&unit=0)
PacWest did not install its own meteorological tower in anticipation, so no on-site data exists. With no nearby representative meteorology of suitable quality for a PSD permit available, we propose to follow Appendix W and rely on meteorological data produced by a prognostic weather model.

A three-year meteorological database will be constructed using the Weather Research and Forecasting (WRF) model. WRF outputs will be processed using the Mesoscale Model Interface (MMIF) processor to create an ONSITE datafile and a file that mimics the output of AERSURFACE. The AERMOD meteorological preprocessor, AERMET (version 18081) will be used to process these files.

A WRF Model Performance Evaluation (MPE) and justification of the use of WRF data for the situation was submitted with this Protocol.

### 2.2.3 Receptor Network and Terrain

The 20 km by 20 km modeling domain proposed for the AQIA is shown in [Figure 2](#). 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 cover 2-km and 6-km square areas centered on the facility. Maximum AERMOD-predicted concentrations located in coarse receptor areas (i.e., receptor spacing greater than 50 m) will 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 2](#). The base elevation and hill height scale for each receptor will be determined using AERMAP (version 18081).

### 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:

\[ H_g = H + 1.5 L \]  

(Equation 1)
Hg is the GEP stack height, H is the building height, and L is the 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:

\[ H_c = H + 0.5L \quad \text{(Equation 2)} \]

Hc is the Cavity height, H is the building height, and L is the 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\textsubscript{2} Chemical Transformations
We will follow EPA Guidance\textsuperscript{4} for NO-to-NO\textsubscript{2} transformations. Initially, the Tier 1 approach of full conversion will be assumed. If the predicted NO\textsubscript{2} concentrations exceed the Significant Impact Level (SIL) or NAAQS, the Tier 2 Ambient Ratio Method 2 (ARM2) will be applied to predict the percentage of NOx that is NO\textsubscript{2} (equivalently, the percentage of NO converted to NO\textsubscript{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 SILs.

\textsuperscript{4} Clarification on the Use of AERMOD Dispersion Modeling for Demonstrating Compliance with the NO\textsubscript{2} National Ambient Air Quality Standard, EPA/OAQPS, September 30, 2014. [https://www3.epa.gov/scram001/guidance/clarification/NO2_Clarification_Memo-20140930.pdf]
SILs have been established for various criteria pollutants, and are listed in Table 2. If pollutant concentrations exceed the SILs, then further evaluation is required to compare the project’s concentrations to the Class II PSD Increments, the NAAQS, and the WAAQS. However, if all modeled ambient impact concentrations modeled for facility operations are less than the SILs then no further analysis will 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$_{2.5}$ 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. That guidance was finalized on April 17, 2018, and we propose to use the SILs it suggests.

On December 2, 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 NO$_X$ (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 is more relevant than the guidance on air quality impact assessments issued on May 20, 2014.\(^6\)

---


# Table 2. Applicable Class II PSD Air Quality Standards

<table>
<thead>
<tr>
<th>Pollutant</th>
<th>Significant Impact Levels (µg/m³)</th>
<th>Monitoring De Minimus Conc. (µg/m³)</th>
<th>PSD Class II Increment (µg/m³)</th>
<th>NAAQS / WAAQS (a) (µg/m³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO 8-hour</td>
<td>500</td>
<td>575</td>
<td>None</td>
<td>10,000</td>
</tr>
<tr>
<td>CO 1-hour</td>
<td>2,000</td>
<td>None</td>
<td>None</td>
<td>40,000</td>
</tr>
<tr>
<td>NO₂ annual</td>
<td>1</td>
<td>14</td>
<td>25</td>
<td>100</td>
</tr>
<tr>
<td>NO₂ 1-hour (b)</td>
<td>7.5</td>
<td>None</td>
<td>None</td>
<td>188</td>
</tr>
<tr>
<td>SO₂ Annual</td>
<td>1</td>
<td>None</td>
<td>20</td>
<td>52</td>
</tr>
<tr>
<td>SO₂ 24-hour</td>
<td>5</td>
<td>13</td>
<td>91</td>
<td>365</td>
</tr>
<tr>
<td>SO₂ 3-hour</td>
<td>25</td>
<td>None</td>
<td>512</td>
<td>1300</td>
</tr>
<tr>
<td>SO₂ 1-hour (c)</td>
<td>7.8</td>
<td>None</td>
<td>None</td>
<td>196</td>
</tr>
<tr>
<td>PM₂.₅ annual (d)</td>
<td>0.2</td>
<td>None</td>
<td>4</td>
<td>12</td>
</tr>
<tr>
<td>PM₂.₅ 24-hour (d)</td>
<td>1.2</td>
<td>4</td>
<td>9</td>
<td>35</td>
</tr>
<tr>
<td>PM₁₀ 24-hour</td>
<td>5</td>
<td>10</td>
<td>30</td>
<td>150</td>
</tr>
<tr>
<td>O₃ 8-hour (e)</td>
<td>2 (1 ppb)</td>
<td>None</td>
<td>None</td>
<td>137 (70 ppb)</td>
</tr>
</tbody>
</table>

**Notes:**

(a) The ambient air quality standards shown are the most stringent of the WAAQS and NAAQS. EPA has revoked the annual PM₁₀, annual SO₂, and 24-hour SO₂ standards.

(b) For the 1-hour NO₂ standard (188 µg/m³, or 100 ppb), EPA provided an interim SIL of 7.5 µg/m³ (1-hr).

(c) For the 1-hour SO₂ standard (196 µg/m³, or 75 ppb), EPA provided an interim SIL of 7.8 µg/m³ (1-hr).

(d) The PM₂.₅ 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 O₃ standard (137 µg/m³, or 70 ppb), EPA proposed a draft SIL of 1 ppb (1.96 µg/m³) 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 would normally 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 proposes to use data from Washington State University’s Northwest International Air Quality Environmental Science and Technology Consortium’s NW-AIRQUEST online tool (see Table 3) as a surrogate. The emissions inventory in the NW-AIRQUEST tool includes all increment-consuming and non-increment-consuming sources, and summing it with PacWest’s predicted impacts would be a conservative demonstration of compliance with the Class II PSD increments.
Should such an analysis prove to be too conservative for some species, Ramboll will obtain off-property emission sources from Ecology and Idaho Department of Environmental Quality. 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.

According to data available on Ecology’s website for Pend Oreille county, the minor source baseline dates are:

- SO$_2$ June 28, 1981
- TSP/PM$_{10}$ March 20, 1979
- PM$_{2.5}$ None (not yet triggered)
- NOx None (not yet triggered)

This PSD permit will likely establish the minor source baseline dates for PM$_{2.5}$ and NOx. Any PSD increment consumption analysis should consider 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 PacWest emissions and other industrial sources with the potential to significantly impact the same

---

7 [https://ecology.wa.gov/Air-Climate/Air-quality/Air-quality-targets/Air-emissions-inventory](https://ecology.wa.gov/Air-Climate/Air-quality/Air-quality-targets/Air-emissions-inventory)
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 or from Washington State University’s Northwest International Air Quality Environmental Science and Technology Consortium’s NW-AIRQUEST online tool\(^8\). Table 3 contains preliminary background concentrations, obtained from the NW-AIRQUEST site. 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.

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 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 ASIL analysis following WAC 173-460.

\(^8\) Washington State University. NW AIRQUEST Design Value Lookup Tool. Available at http://www.lar.wsu.edu/nw-airquest/lookup.html
Because the facility borders the State of Idaho, an analysis using Idaho Administrative Code (IDAPA) 58.01.01.585 and 58.01.01.586 will also be performed, to insure compliance with both State’s toxics programs.

The full TAPs assessment will be included in the PSD Application.

### Table 3. Background Concentrations

<table>
<thead>
<tr>
<th>Pollutant</th>
<th>Averaging Time</th>
<th>Averaging Method</th>
<th>NW-AIRQUEST Background Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>NO₂</td>
<td>1-hour</td>
<td>3-year avg. of 98&lt;sup&gt;th&lt;/sup&gt; percentile of daily maxes.</td>
<td>10 μg/m³</td>
</tr>
<tr>
<td></td>
<td>Annual</td>
<td>Annual mean</td>
<td>1.7 μg/m³</td>
</tr>
<tr>
<td>PM&lt;sub&gt;2.5&lt;/sub&gt;</td>
<td>24-hour</td>
<td>3-year average of the 98&lt;sup&gt;th&lt;/sup&gt; percentile 24-hr averages.</td>
<td>14 μg/m³</td>
</tr>
<tr>
<td></td>
<td>Annual</td>
<td>3-year avg. of annual mean</td>
<td>4.6 μg/m³</td>
</tr>
<tr>
<td>PM&lt;sub&gt;10&lt;/sub&gt;</td>
<td>24-hour</td>
<td>3-year avg. of 2&lt;sup&gt;nd&lt;/sup&gt; highs</td>
<td>100 μg/m³</td>
</tr>
<tr>
<td>SO₂</td>
<td>1-hour</td>
<td>3-year avg. of 99&lt;sup&gt;th&lt;/sup&gt; percentile of daily max. 1-hour averages.</td>
<td>1.2 μg/m³</td>
</tr>
<tr>
<td></td>
<td>3-hour</td>
<td>2&lt;sup&gt;nd&lt;/sup&gt; high</td>
<td>1.2 μg/m³</td>
</tr>
<tr>
<td></td>
<td>24-hour</td>
<td>2&lt;sup&gt;nd&lt;/sup&gt; high</td>
<td>0.83 μg/m³</td>
</tr>
<tr>
<td></td>
<td>Annual</td>
<td>Annual mean</td>
<td>0.3 μg/m³</td>
</tr>
</tbody>
</table>

### 2.9 Ozone and Secondary PM<sub>2.5</sub> Assessment

Initial proposed NOₓ and SO₂ emission increases from the facility are above the SERs, triggering an analysis of the facility’s potential contribution to ozone (O₃) and secondary PM<sub>2.5</sub> formation. Although proposed VOC emission increases are not above the SER, VOC emissions are incorporated into ozone 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<sub>2.5</sub> associated with preliminary 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.

The conservative Western US NOx and SO$_2$ MERP values for 8-hr ozone 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 (58%) 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$^3$).

<table>
<thead>
<tr>
<th>Precursor</th>
<th>Area</th>
<th>8-hr O$_3$</th>
<th>Daily PM$_{2.5}$</th>
<th>Annual PM$_{2.5}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>NOx</td>
<td>CUS</td>
<td>126</td>
<td>1693</td>
<td>5496</td>
</tr>
<tr>
<td></td>
<td>EUS</td>
<td>170</td>
<td>2295</td>
<td>10144</td>
</tr>
<tr>
<td></td>
<td>WUS</td>
<td>184</td>
<td>1075</td>
<td>3184</td>
</tr>
<tr>
<td>SO$_2$</td>
<td>CUS</td>
<td>-</td>
<td>238</td>
<td>839</td>
</tr>
<tr>
<td></td>
<td>EUS</td>
<td>-</td>
<td>628</td>
<td>4013</td>
</tr>
<tr>
<td></td>
<td>WUS</td>
<td>-</td>
<td>210</td>
<td>2289</td>
</tr>
<tr>
<td>VOC</td>
<td>CUS</td>
<td>948</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>EUS</td>
<td>1159</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>WUS</td>
<td>1049</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

Notes:
“CUS” = Central United States, “EUS” = Eastern United States, “WUS” = Western United States
Source: Adapted from Table 7-1 in the draft MERP guidance

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 County, MT (source 11) and Klickitat County, 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.

The daily maximum PM$_{2.5}$ increases from NO$_x$ 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:

\[
\frac{935 \text{TPY NO}_x \text{ from proposed facility}}{500 \text{TPY NO}_x \text{ from source 18}} \cdot 0.15 \frac{\mu g}{m^3} + \frac{649 \text{TPY SO}_2 \text{ from proposed facility}}{500 \text{TPY SO}_2 \text{ from source 18}} \cdot 0.19 \frac{\mu g}{m^3} = 0.53 \frac{\mu g}{m^3}
\]

<table>
<thead>
<tr>
<th>Precursor</th>
<th>Daily PM$_{2.5}$ (μg/m$^3$)</th>
<th>8-hr O$_3$ (ppb)</th>
</tr>
</thead>
<tbody>
<tr>
<td>NO$_x$</td>
<td>0.15</td>
<td>1.94</td>
</tr>
<tr>
<td>SO$_2$</td>
<td>0.19</td>
<td>-</td>
</tr>
<tr>
<td>VOC</td>
<td>-</td>
<td>0.46</td>
</tr>
<tr>
<td>Sum</td>
<td>0.34</td>
<td>2.40</td>
</tr>
</tbody>
</table>

It is estimated that the NO$_x$ and SO$_2$ emissions from the proposed facility will lead to a 0.53 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 NO$_x$ 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:

\[
\frac{935 \text{TPY NO}_x \text{ from proposed facility}}{500 \text{TPY NO}_x \text{ from source 18}} \cdot 1.94 \text{ ppb} + \frac{90 \text{TPY VOC from proposed facility}}{500 \text{TPY VOC from source 18}} \cdot 0.46 \text{ ppb} = 3.7 \text{ ppb}
\]
This calculation suggests that the proposed facility will increase daily maximum 8-hour ozone by 3.7 parts per billion (ppb), which is above the proposed SIL (1 ppb). This increase is 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, further analysis is needed to ensure that facility ozone increases do not lead to ozone NAAQS exceedances. Estimated ozone contributions associated with the proposed facility (3.7 ppb) are roughly 4 times the proposed ozone SIL (1 ppb). In accordance with recent EPA guidance⁹, the estimated ozone contribution is close enough to the proposed ozone SIL to allow for a qualitative assessment of the cumulative impacts of ozone in the region surrounding the proposed facility.

In this assessment, the estimated ozone contribution from the proposed facility is added to representative regional background ozone concentrations and compared to the difference between the ozone NAAQS and SIL (i.e., 75 ppb – 1 ppb = 74 ppb).

The closest EPA Air Quality System (AQS) monitoring site to the proposed PacWest facility is located in Green Bluff, Washington, roughly 40 kilometers southwest of Newport. Figure 3 shows the location of the Green Bluff AQS monitoring site.

⁹ Presentation by Tyler Fox at AWMA Specialty Modeling Conference (November 14, 2017, Research Triangle Park, NC).
Figure 3. Location of Green Bluff AQS Monitoring Site

The ozone design values (3-year average of 4\textsuperscript{th} highest daily 8-hour maximum ozone concentrations) from 2009 to 2016 range from 57 to 62 ppb, as shown in Table 6.
The AQS ozone design values at Green Bluff, WA are generally consistent with the 2009-2011 ozone design values (55 ppb) from the NW-AIRQUEST\textsuperscript{10} website for the coordinates of the proposed Facility (48.162584°, -117.046194°).

If the maximum ozone design value (62 ppb) from Table 6 is used to represent recent background ozone concentrations in the region, the combination of background ozone and predicted Facility ozone increases (65.7 ppb) is still well below the difference between the current ozone NAAQS and proposed SIL (74 ppb).

### Table 6. Ozone Design Values at Green Bluff, WA

<table>
<thead>
<tr>
<th>Years</th>
<th>Ozone Design Value (ppb)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2007-2009</td>
<td>60</td>
</tr>
<tr>
<td>2008-2010</td>
<td>58</td>
</tr>
<tr>
<td>2009-2011</td>
<td>57</td>
</tr>
<tr>
<td>2010-2012</td>
<td>59</td>
</tr>
<tr>
<td>2011-2013</td>
<td>60</td>
</tr>
<tr>
<td>2012-2014</td>
<td>62</td>
</tr>
<tr>
<td>2013-2015</td>
<td>62</td>
</tr>
<tr>
<td>2014-2016</td>
<td>60</td>
</tr>
</tbody>
</table>

\textsuperscript{10} NW-AIRQUEST daily 8-hr maximum ozone Design Values from 2009-2011 at coordinates 48.162584°, -117.046194° were obtained from: http://lar.wsu.edu/nw-airquest/lookup.html
Mountains, the closest and probably climatically most similar mandatory Class I area.
3. CLASS I MODELING METHODOLOGY

PSD regulations require an analysis to address both Class I PSD increments, and Class I AQRVs. 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 but 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 EPA (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 4). 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. See Section 3.2 for a “Q/D” screening methodology following the Federal Land Managers’ (FLMs) Air Quality Related Workgroup (FLAG) 2010 guidance to select which Class I areas must be included in the assessment.

Table 7 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 EPA 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), respectively.

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 follow the modeling methodology detailed in Section 2, and include the MERP-predicted contributions for PM$_{2.5}$. Modeling receptors will be placed at 200 m intervals within the boundaries of the Kalispel Indian Reservation with additional receptors placed along the perimeter at 100 m spacing, resulting in 1363 receptors. If initial...
modeling results show a steep gradient, then a nest of finer receptors will be added and the model re-run to insure the model is not “missing” the highest value.

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 respective AERMOD analyses for the Kalispel and Spokane Indian Reservations predict highest second high (H2H) values that exceed the Class I SILs, then we propose adding model predictions to the design values from the NW-AIRQUEST design value Lookup Tool\(^{11}\) to address the Class I PSD increment.

The NW-AIRQUEST tool uses a 2009 emissions inventory. We will use EPA State-wide inventories of \(\text{SO}_2\) to show the decrease in \(\text{SO}_2\) emissions since 2009, indicating that using the Lookup Tool without scaling is conservative. The 2009 emissions inventory contains all other nearby sources of \(\text{SO}_2\), both increment-consuming sources and those built before the baseline trigger date. Therefore, adding the concentrations from the Lookup Tool to the predicted concentrations will be a conservative over-estimate of the Class I PSD increment consumption. If the sum is below the increment, that will indicate compliance.

Should the AERMOD-with-arcs technique for CAMO predict H2H values that exceed the Class I 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 CALPUFF screening run.

\(^{11}\) Available at [http://lar.wsu.edu/nw-airquest/lookup.html](http://lar.wsu.edu/nw-airquest/lookup.html)
Table 7. Class I Area Significant Levels and Increments

<table>
<thead>
<tr>
<th>Pollutant</th>
<th>Averaging Period</th>
<th>PSD Class I Increment</th>
<th>EPA SIL $^a$</th>
<th>FLM SIL $^a$</th>
</tr>
</thead>
<tbody>
<tr>
<td>PM$_{10}$</td>
<td>Annual</td>
<td>4</td>
<td>0.2</td>
<td>0.08</td>
</tr>
<tr>
<td></td>
<td>24-hour</td>
<td>8</td>
<td>0.3</td>
<td>0.27</td>
</tr>
<tr>
<td>PM$_{2.5}$</td>
<td>Annual</td>
<td>1</td>
<td>0.05 $^b$</td>
<td>--</td>
</tr>
<tr>
<td></td>
<td>24-hour</td>
<td>2</td>
<td>0.27 $^b$</td>
<td>--</td>
</tr>
<tr>
<td>SO$_2$</td>
<td>Annual</td>
<td>2</td>
<td>0.1</td>
<td>0.03</td>
</tr>
<tr>
<td></td>
<td>24-hour</td>
<td>5</td>
<td>0.2</td>
<td>0.07</td>
</tr>
<tr>
<td></td>
<td>3-hour</td>
<td>25</td>
<td>1</td>
<td>0.48</td>
</tr>
<tr>
<td>NO$_2$</td>
<td>Annual</td>
<td>2.5</td>
<td>0.1</td>
<td>0.03</td>
</tr>
</tbody>
</table>

Notes:
$^a$ SIL = Significant Impact Level; EPA proposed and FLM recommended from the Federal Register, Vol. 61, No. 142, p. 38292, July 23, 1996.
$^b$ The Class I PM$_{2.5}$ SILs were vacated on January 22, 2013. New SILs have been circulated for public comment, which we propose to use.

3.2 Class I Air Quality Related Values Methodology

PSD guidance requires an analysis of potential impacts to 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 4 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, their reservations will not be included in the AQRV analysis, regardless of their Q/D values. Note however visibility in the...
Kalispel Indian Reservation will be addressed in the Additional Impact Analysis, see Section 2.10.

Table 8 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\textsubscript{x}, SO\textsubscript{2}, PM\textsubscript{10}, and H\textsubscript{2}SO\textsubscript{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 analysis 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.

At the request of the National Park Service, we will include Glacier NP in the analysis.
Figure 4. Class I Areas within 300 km of the proposed facility

The proposed modeling domain shown in Figure 5 includes a buffer of at least 50 km around the Glacier NP 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 8. Mandatory Class I Areas Within 300 km, with initial Q/D

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

Note: **Bolded** areas indicate required AQRV analysis based on Q/D value
Figure 5. Proposed CALPUFF Modeling Domain

Figure 6. Proposed Domain with 4 km 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 is 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 FLAG and Interagency Workgroup on Air Quality Modeling (IWAQM) recommendations, in particular, FLAG (2000, revised October 2010)\textsuperscript{12} 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, and 2016) using 4 km resolution output from the WRF meteorological model, processed by MMIF.

\textsuperscript{12} The FLAG 2000 and 2010 documents are available at http://www.nature.nps.gov/air/Permits/flag/.
• **Modeling Domain:** 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\(^\text{13}\) 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, sub-mode 5 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\(_3\))

\(^{13}\) Class I receptors are available at [http://www.nature.nps.gov/air/maps/Receptors/index.cfm](http://www.nature.nps.gov/air/maps/Receptors/index.cfm).
At the request of USFS’ Bret Anderson, rather than using the SPECIATE database to speciate PM into the above components, Ramboll will speciate PM into only PMC and PMF, where PMF = PM\(_{2.5}\) and PMC = PM\(_{10}\) – PM\(_{2.5}\).

### 3.2.4 Chemical Transformations

The NOx 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 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. It has been used for most, if not all, PSD modeling in the region since then. This relatively high background ensures the conversion of NOx to ammonium nitrate is not limited by a lack of ammonia for the range of NOx 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

The AQRV analysis will use three years of hourly 4 km horizontal mesh size prognostic WRF model output data from January 2014 through December 2016. This is the 4 km domain from the same WRF simulation whose 1.33 km domain will supply the meteorology for the Class II modeling analysis presented in Section 2.2.2.

A Model Performance Evaluation justifying its use for the AQRV analysis has been submitted simultaneously with this Modeling Protocol.

Based on recent communication with Tim Allen (USFWS), we propose to use the most recent version of the EPA’s MMIF version 3.4 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. The proposed MMIF application setup and input data preparation are as follows:

- The proposed model domain is shown in Figure 5. The horizontal mesh size will be 4 km and the domain will cover an area of 524 km by 356 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 (LCC) coordinate system will be used with an origin of 40ºN, 97ºW and standard latitudes of 33ºN and 45ºN (the so-called Regional Planning Organization or “RPO” projection).
- Land use and terrain data will be inherited (passed through by MMIF) from the USGS-based datasets included in the WRF distribution. Figure 6 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 WRF prognostic data.

3.2.6 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 to construct plots showing the spatial variation of the calculated parameters. 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.

3.2.7 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 deposition fluxes (wet and dry) 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 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.

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). 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 CALPUFF modeling (FLAG, 2010). The FLAG visibility metric is the estimated maximum 24-hour change in extinction ($\Delta b_{ext}$) 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.

---

14 Guidance on Nitrogen and Sulfur Deposition Analysis Thresholds, available on the FLAG internet site at [http://www2.nature.nps.gov/ard/flagfree/NSDATGuidance.htm](http://www2.nature.nps.gov/ard/flagfree/NSDATGuidance.htm)
• If there are days in which the source’s visibility impact is above 5%, the frequency, magnitude and duration of the visibility impacts are used to make a significance determination.

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 $b_{\text{ext}}$ (Method 8, sub-mode 5, invoked with MVISCHECK=1 in CALPOST). This equation for extinction uses monthly relative 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, sub-mode 5, 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:

$$b_{\text{project}} = 2.2 \times f_S(RH) \times [\text{Small Sulfate}] + 4.8 \times f_L(RH) \times [\text{Large Sulfate}] + 2.4 \times f_S(RH) \times [\text{Small Nitrate}] + 5.1 \times f_L(RH) \times [\text{Large Nitrate}] + 2.8 \times [\text{Small Organic Mass}] + 6.1 \times [\text{Large Organic Mass}] + 10 \times [\text{Elemental Carbon}] + 1 \times [\text{Fine Soil}] + 0.6 \times [\text{Coarse Mass}] + 1.7 \times f_{SS}(RH) \times [\text{Sea Salt}] + \text{Rayleigh Scattering (Site Specific)} + 0.33 \times [\text{NO}_2 \text{ (ppb)}] \{\text{or as: } 0.1755 \times [\text{NO}_2 \text{ (μg/m}^3)]\}$$

Where:

- \([\ ]\) indicates concentrations in μg/m$^3$
- $f_S(RH) = \text{Relative humidity adjustment factor for small sulfate and nitrate}$
- $f_L(RH) = \text{Relative humidity adjustment factor for large sulfate and nitrate}$
- $f_{SS}(RH) = \text{Relative humidity adjustment factor for sea salt}$

For Total Sulfate < 20 μg/m$^3$:

- \([\text{Large Sulfate}] = ([\text{Total Sulfate}] / 20 \text{ μg/m}^3) \times [\text{Total Sulfate}]\)

For Total Sulfate $\geq$ 20 μg/m$^3$:

- \([\text{Large Sulfate}] = [\text{Total Sulfate}]\)
And:

\[ \text{[Small Sulfate]} = \text{[Total Sulfate]} - \text{[Large Sulfate]} \]

To calculate large and small nitrate and organic mass, substitute \((\text{[Large, Small, Total]} \ \text{Nitrate, Organic Mass})\) 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.
4. REFERENCES