BP Cherry Point Refinery
4519 Grandview Road
Blaine, Washington 98230
Telephone 360 371-1500

December 22, 2014

Jeff Johnston
Washington Department of Ecology
300 Desmond Drive
Lacey, Washington 98503

Re: Request to Change PM_{10} Permit Limits for Boilers #6 and #7
BP Cherry Point Refinery

Mr. Johnston:

Construction and operation of Boilers #6 and #7 at BP's Cherry Point Refinery was authorized in November 2007 when the Washington Department of Ecology (Ecology) issued Prevention of Significant Deterioration (PSD) Permit PSD-07-01, and the Northwest Clean Air Agency (NWCAA) issued Order of Approval to Construct (OAC) #1001. Prior to commencing operation, BP requested that the sulfur dioxide (SO_2) emission limits imposed on Boilers #6 and #7 be adjusted to address the variability of sulfur in refinery fuel gas (RFG), and an amended PSD permit was issued in December 2009.

The purpose of this letter is to request a change in the short-term emission limit on particulate matter less than ten microns (PM_{10}) imposed on Boilers #6 and #7 by the PSD permit. No changes to any other air pollutant limits are requested, and no increase in annual PM_{10} emissions is requested. No changes to OAC #1001 are requested, but NWCAA has been provided with a copy of this letter, and will be provided all correspondence related to this matter.[1]

The remainder of this letter provides:

- A summary of the current permit conditions and the basis for the existing permit limit;
- An explanation of why changing the PM_{10} permit is necessary,
- BP's proposed new PM_{10} emission limit for Boilers #6 and #7;
- A discussion of the ambient air quality implications of the proposed change; and
- A confirmation that this request meets the WAC 173-400 criteria for permit modifications.

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[1] NWCAA was the State Environmental Protection Act (SEPA) lead agency when Boilers #6 and #7 were originally permitted. A Determination of Non-Significance (DNS) was issued for the project on May 21, 2007. Because this permit modification request does not involve any physical changes, and has been demonstrated (as documented in this letter) to not have significant adverse environmental impacts, a SEPA checklist has not been prepared. We assume that the original checklist and DNS can be incorporated by reference per WAC 197-11-600.

Additional supporting information is attached.

Current Permit Conditions and Basis for Existing Permit Limit

Condition 1 of the PSD permit limits the fuels combusted in Boilers #6 and #7 to RFG and natural gas. In Condition 4, PM_{10} emissions from each of the boilers are limited to 3.4 pounds per hour (lb/hr) on a calendar day average. The permit does not specify an annual PM_{10} limit, but, if the boilers were operated at maximum capacity throughout the year (8,760 hours), annual emissions based on the daily average emission rate would be 14.8 tons per year (tpy). The permit requires BP to demonstrate initial and continuous compliance with the emission limit in Condition 4 through stack tests conducted by an independent testing vendor, using EPA Methods 5 and 202, or equivalent test method approved by Ecology.

Data from source tests conducted in 2006 on the #1 Reformer heater and Boiler #5, both fired with RFG, were used to develop a PM_{10} emission factor for the initial permit application. Data from 5 source tests were averaged, resulting in an emission factor of 12.7 pounds per million standard cubic foot (lb/MMscf), upon which the current PM_{10} permit limit (3.4 lb/hr) is based.

Rationale for Changing Existing Permit Limit

Initial testing of Boilers #6 and #7 was completed in September 2009, with both boilers demonstrating compliance with the PM_{10} permit limit. To demonstrate ongoing compliance with the limit, annual emission testing is required.[2] Several of the tests conducted since initial testing have produced results that approach the permit limit; the results of valid source tests conducted to date on Boilers #6 and #7 are summarized in Table 1.

Table 1. Boilers #6 and #7 Total PM_{10} Source Test Results

Boiler	Test	Firing Rate (MMBtu/hr)	Emission Factor (lb/MMBtu)	Emission Rate (lb/hr)
#6	2009	334	0.0064	2.13
	Oct. 2010[1]	306	0.0072	2.21
	Dec. 2010	329	0.0043	1.42
	2011	332	0.0093	3.09
	2012	312	0.0043	1.35
	2013	275	0.0108	2.97
#7	2009	335	0.0082	2.74
	2010	306	0.0031	0.95
	2011	330	0.0059	1.95
	2012	313	0.0035	1.09
	Sep. 2013[2]	306	0.0082	2.23
	Dec. 2013	234	0.0117	2.75

[1] Does not include the results of Run 2, which, because of the magnitude of the measured filterable particulate (15.07 lb/hr), is considered an outlier.
[2] Does not include the results of Run 2, which, because of the magnitude of the measured condensable particulate (6.64 lb/hr), is considered an outlier.

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[2] Approval condition 11.1 of PSD-07-01, Amendment 1 allows for testing to be reduced to once every five years after three consecutive years of annual tests that demonstrate compliance. We are not requesting a change to this approval condition.

Typically, elevated values of carbon monoxide (CO) and volatile organic compounds (VOCs) are indicative of incomplete combustion, which can also result in increased PM_{10} emission rates. However, tests conducted on Boilers #6 and #7 show compliance with permit limits, and every indication is that the boilers operate properly. Despite this, according to the test data, there appears to be a high degree of inherent variability in the EPA 5/202 method. This is due, in part, to extremely small quantities of filterable and condensable filterable matter collected during each test. A seemingly insignificant mishandling of equipment or a slight deviation from test procedure can introduce error and produce a test result that appears to be out of compliance. In addition, we suspect that the elevated condensable fraction result could be caused by salts created from unreacted ammonia injected into the exhaust to control oxides of nitrogen (NO_X).

The #2 Hydrogen Plant Steam Methane Reformer (SMR) furnace, which was permitted in October 2010, combusts a combination of off gases from the #2 Hydrogen Plant Pressure Swing Absorber (PSA) and natural gas, both generating fewer PM_{10} emissions than RFG. However, because the #2 Hydrogen Plant SMR furnace uses ammonia injection to reduce NO_X emissions, it received a PM_{10} permit limit of 0.01 lb/MMBtu, the same limit imposed on other emission units at the facility that combust RFG but do not use ammonia injection. Boilers #6 and #7 combust RFG and use ammonia injection, which suggests that an emission factor greater than 0.01 lb/MMBtu is warranted.

A review of the Reformer #1 heater and Boiler #5 source test results reveals that variability within the results was considerable, with values ranging from 3.52 lb/MMscf to 35.8 lb/MMscf. As was discussed in the April 2009 letter requesting the change in the SO_2 permit limit, using an emission factor based on an average to calculate a short-term emission rate, and then basing a permit limit on that emission rate, is likely to result in out-of-compliance operation approximately half of the time. Our proposed solution is to revise the 24-hour PM_{10} permit limit to account for short-term variability.

Proposed New Limit

BP has a responsibility to continuously comply with applicable environmental regulations. As discussed in the previous section, the Boiler #7 source test that demonstrated compliance with the PM_{10} permit limit was conducted with the boiler operating at 80 percent of full steam production capacity. To maintain compliance with the limit, BP has limited operation of Boiler #7 to no more than 80 percent of full capacity since the December 2013 source test. The motivation for BP to request this modification of the PM_{10} permit limit is to enable full-capacity operation of Boilers #6 and #7, which is needed for the Cherry Point refinery to achieve production targets.

The current PM_{10} permit limit for Boilers #6 and #7 are appropriate for annual average PM_{10} emissions from those emission units, and this request will not affect annual PM_{10} emissions. We propose that the 24-hour PM_{10} permit limit for Boilers #6 and #7 be based on the results of the source tests conducted to date on those boilers, and a new limit of 5.0 lb/hr for each boiler be established. This emission rate is based on an emission factor of 0.014 lb/MMBtu, which is approximately equivalent to the average of the emission factors calculated from all the source tests conducted to date on Boilers #6 and #7,[3] plus 2.5 standard deviations.[4]

BP additionally requests that approval condition 8.3 be amended to allow use of 40 CFR 60 Appendix A Method 5i as a “front half” test method in addition to Method 5. Method 5i is designed for improved accuracy, and may be provide a means for eliminating sample contamination issues that may have affected previous test results.

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[3] Except Run 2 of the October 2010 test on Boiler #6, and Run 2 of the September 2013 test ion Boiler #7; because of the magnitude of the measured particulate matter, these runs are considered outliers.
[4] Adding 2.5 standard deviations corresponds to a 99 percent upper (one-sided) confidence interval.

Ambient Air Quality Implications of Requested Change

Because no changes will be made to the operation of the boilers[5] or to the composition of the RFG combusted in the boilers, there will be no actual air quality impact as a result of the proposed permit limit increase. However, potential ambient 24-hour average PM_{10} concentrations attributable to emission from Boilers #6 and #7 will increase as a result of the increase in the 24-hour PM_{10} permit limit. To assess compliance with ambient air quality standards with the proposed permit limit, revised air quality modeling analyses were prepared. Ambient concentrations in local Class II areas were evaluated using AERMOD, and concentrations in regional Class I areas were evaluated by scaling CALPUFF results from the original permit application. The potential for impacts on Air Quality Related Values (AQRVs) in regional Class I areas was evaluated using a screening analysis not available at the time the original permit application was submitted.

Class II Modeling Analysis

The proposed short-term PM_{10} emission limit increases for Boiler 6 and Boiler 7 require a re-evaluation of compliance with the PSD increments and the National (and Washington) Ambient Air Quality Standards (NAAQS and WAAQS). Only the 24-hour average PM_{10} standard and increment were evaluated because no change in the maximum potential annual PM_{10} emission rate is proposed.

In the 2007 Application, the boilers and contemporaneous emission increases (from prior projects) were included in the modeling for comparison with EPA Significant Impact Levels (SILs). For this proposal, the 2007 Application modeling was updated using the most current model versions and guidance, as well as the proposed 24-hour PM_{10} permit limits for Boilers #6 and #7. Emission increases resulting from changes made after the 2007 Application were not included in the modeling update.

A report outlining the modeling methodology and summarizing the results of the analyses, is attached. The modeling analysis results predicted a maximum ambient concentration of 1.59 $\mu g/m^3$, which is less than the 24-hour average PM_{10} SIL (5 $\mu g/m^3$). A predicted concentration less than the SIL indicates that the proposed change in permit limits does not have the potential to cause or contribute to the exceedance of the associated ambient standard or increment, and no further analysis is required.

Class I Modeling Analysis

PSD regulations require an evaluation of impacts to certain national parks and wilderness areas deemed “Class I” areas. Air pollutant impacts to Class I areas were evaluated extensively in the 2007 Application. Because PM_{10} is one of the pollutants examined in Class I assessments, the proposal to increase PM_{10} emissions requires reconsideration of potential impacts. Rather than repeat the entire analysis, however, we offer two abbreviated evaluations that assess the potential for the proposed PM_{10} permit limit increase to have a significant adverse effects on Class I areas.

Federal Land Managers (FLMs) use a screening metric to determine whether or not a given project has the potential to impact AQRVs in nearby Class I areas. The screening metric is total project emissions (Q),[6] in tons per year (tpy), divided by the distance between the facility and each Class I

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[5] No change in operation is proposed as compared to the original permit application and current permit. BP proposes to eliminate the 80 percent limit on maximum boiler capacity imposed to maintain compliance with current permit limits.

[6] The total project emission rate (Q) is the sum of the 24-hour average emission rates of NO_X, SO_2, PM_{10}, and H_2SO_4, extrapolated to year-round operation (8,760 hr/yr).

area (D), in kilometers (km). If the metric, often referred to as “Q over D” (Q/D) is less than 10, an AQRV analysis is typically not required.

For the analysis associated with the SO_2 permit limit increase, the total project emission rate (Q) was 255.5 tpy. Following recalculation using the proposed PM_{10} emission limit (5 lb/hr each for Boilers #6 and #7), the updated total project emission rate (Q) is 269.5 tpy. The closest Class I area is the North Cascades National Park, which is approximately 78 km from BPCP (D). The Mt. Baker Wilderness Area is approximately 56 km from BPCP (D), and, while it is not a Class I area, the FLMs typically request that it be included in Class I analyses. The Q/D metric, updated to reflect the proposed PM_{10} permit limit, is 3.5 for the North Cascades National Park, and 4.8 for the Mt. Baker Wilderness area. Based on these results, no AQRV analysis is required.

While the FLMs typically accept the results of the Q/D screening analysis to determine whether or not a Class I AQRV analysis is required, Ecology and the USEPA do not accept the results of a Q/D analysis as a screening tool for criteria pollutant impacts at Class I area receptors. Because revising the Class I analysis would be an extremely time- and resource-intensive process, the ratio of the proposed single-boiler PM_{10} permit limit (5 lb/hr) and the 24-hour average single-boiler PM_{10} emission rate from the 2007 Application (2.7 lb/hr) were used to scale the PM_{10} Class I area modeling results presented in the 2007 Application. The results of the scaling operation are presented in Table 2. Based on these results, the proposed change in permit limits does not have the potential to cause or contribute to the exceedance of the associated ambient standard or increment in nearby Class I areas, and no further analysis is required

Table 2. Class I Area PM_{10} Modeling Results Scaled to Reflect Proposed Permit Limit

Class I Area	Maximum 24-Hour Average Concentration
Alpine Lakes Wilderness	0.036
Glacier Peak Wilderness	0.028
Goat Rocks Wilderness	0.025
Mount Adams Wilderness	0.019
Mount Baker Wilderness[1]	0.060
Mount Rainier National Park	0.046
N Cascades National Park	0.036
Olympic National Park	0.091
Pasayten Wilderness	0.026
Maximum Class I Area / Mt. Baker	0.060 / 0.091
EPA SIL[2]	0.3
FLM Recommended SIL[2]	0.27
Class I Area PSD Increment[3]	8

[1] Mount Baker Wilderness Area is not a Class I area, it is included in the analysis because FLMs have requested its inclusion in previous permit applications.
[2] SIL = Significant Impact Level; EPA proposed and FLM recommended from the Federal Register, Vol. 61, No. 142, p. 38292, July 23, 1996.
[3] PSD = Prevention of Significant Deterioration; from 40 CFR 52.21(c), adopted by reference in WAC 173-400-720(4)(a)(v)

It should be recognized that this methodology is conservative because the results reflect the contribution of PM_{10} emissions from not only Boilers #6 and #7, but all the other contemporaneous emission increases (and decreases) that were included in the modeling. When the results are scaled, the contemporaneous increases (and decreases) are similarly scaled. Because the contemporaneous emission increases are significantly greater than the decreases (by a factor of more than 20), there is no risk that scaling the decreases along with the increases will significantly

diminish the conservatism of the analysis. The annual average concentration results were not included because the proposed permit limit change will not increase annual PM_{10} emissions.

Compliance with PSD Permit Modification Request Requirements

WAC 173-400-750 addresses modifications to PSD permits, and indicates that Ecology may approve proposed changes under certain conditions:

a) The change in conditions will not cause the source to exceed an emission standard established by regulation.

NWCAA Section 455.11 limits PM emissions from gaseous fuel burning equipment (such as the boilers, hydrogen heaters, and process heaters) to 0.05 grains per dry standard cubic foot of exhaust (gr/dscf) at 7 percent oxygen. WAC 173-400-050 establishes a limit of 0.1 gr/dscf at 7 percent oxygen for combustion units and general process units. All past source test results have been less than these limits, and the proposed PM_{10} limit (5 lb/hr), assuming the boiler is operating at or near maximum capacity, is equivalent to approximately 0.01 gr/dscf, which is also less than these regulatory limits.

b) No ambient air quality standard or PSD increment will be exceeded as a result of the change.

The modeling results discussed in the previous section indicate compliance with PM_{10} ambient standards and PSD increments in all Class II and Class I areas. Compliance with the annual PM_{10} standard and PSD increment will not change because annual PM_{10} emissions will not increase.

c) The change will not adversely impact the ability of Ecology to determine compliance with an emissions standard.

BP proposes to maintain the same routine compliance requirements that are required in the existing permit. Consequently, the ability to confirm compliance remains unaffected by the increase in short-term emission rates.

d) The revised PSD permit will continue to require BACT, as defined at the time of the original PSD permit, for each new or modified emissions unit approved by the original PSD permit.

Consistent with previous applications, BP's Application determined that BACT for the two new boilers was use of good combustion practices and gaseous fuel. None of the information related to that BACT analysis has changed. Furthermore, there has been no change in the way RFG is processed at the Cherry Point refinery; the proposed change in the emission limit simply reflects the potential for higher PM_{10} emission rates over short time periods.

e) The revised PSD permit continues to meet the requirements of WAC 173-400-112(2) and 173-400-113, as applicable.

WAC 173-400-112(2) applies to new sources in non-attainment areas, so this provision does not apply to our situation. WAC 173-400-113 requires that a modified source in an attainment area meet NSPS and NESHAPS requirements, apply BACT, and address WAC 173-460 for toxic air pollutants (TAPs). Because Boilers #6 and #7 combust RFG exclusively, the NSPS (Subpart Db and Ja) and NESHAP (Subpart DDDDD) that apply to these emission units do not impose any PM_{10} limits. Compliance with BACT requirements have been addressed (see (d) above), and PM_{10} is not a TAP listed in WAC 173-460-150.

Closing

A list identifying those receiving copies of this letter is attached. Thank you for your attention to this request for a revised permit limit. Please feel free to call me at 360.371.1530 if you have any questions about this matter.

Sincerely,

Scott Inloes
Senior Environmental Engineer

cc: Agata McIntyre, Northwest Clean Air Agency

2015 BPSP Boilers 6 Proposed PM10 Permit Limit Calculations

Boiler #6

Filterable Particulate (lb/hr)						
Test Date	**Run 1**	**Run 2**	**Run 3**	**Run 4**	**Run 5**	**Run 6**
2013	1.871	2.481	1.446			
2012	0.63	0.46	0.43			
2011	0.41	0.18	0.13	0.25	0.2	0.21
Dec-10	0.46	0.34	0.23			
Oct-10	0.52	15.07	1.72			
2009	1.05	0.76	0.83			

Condensable Particulate (lb/hr)						
Test Date	**Run 1**	**Run 2**	**Run 3**	**Run 4**	**Run 5**	**Run 6**
2013	1.66	0.63	0.83			
2012	0.82	0.74	0.98			
2011	1.54	2.83	2.24	2.91	4.93	2.69
Dec-10	1.34	0.95	0.93			
Oct-10	1.07	0.27	1.1			
2009	1.076	1.158	1.511			

Total Particulate (lb/hr)							
Test Date	**Run 1**	**Run 2**	**Run 3**	**Run 4**	**Run 5**	**Run 6**	**Average**
2013	3.53	3.11	2.276				2.97
2012	1.45	1.2	1.41				1.35
2011	1.95	3.01	2.37	3.16	5.13	2.9	3.09
Dec-10	1.8	1.29	1.16				1.42
Oct-10	1.59		2.82				2.21
2009	2.126	1.918	2.341				2.13

Firing Rate (MMBtu/hr)	**O2 (%)**
275.1	4.8
311.6	2.33
331.5	2.68
329.2	2.79
307.5	2.27
333.8	2.31

Boiler #7

Filterable Particulate (lb/hr)						
Test Date	**Run 1**	**Run 2**	**Run 3**			
Dec-13	0.4	0.43	0.13			
Sep-13	1.232	0.906	1.135			
2012	0.48	0.62	0.24			
2011	0.93	0.77	0.41			
2010	0.23	0.22	0.21			
2009	0.62	0.33	0.28			

Condensable Particulate (lb/hr)						
Test Date	**Run 1**	**Run 2**	**Run 3**			
Dec-13	3.15	2.12	2.14			
Sep-13	1.13	6.64	0.97			
2012	0.81	0.46	0.66			
2011	1.799	0.035	1.914			
2010	1.18	0.1	0.92			
2009	2.789	2.484	1.727			

Total Particulate (lb/hr)							
Test Date	**Run 1**	**Run 2**	**Run 3**				**Average**
Dec-13	3.55	2.55	2.14				2.75
Sep-13	2.36		2.1				2.23
2012	1.29	1.08	0.9				1.09
2011	2.729	0.805	2.324				1.95
2010	1.41	0.32	1.13				0.95
2009	3.409	2.814	2.007				2.74

Firing Rate (MMBtu/hr)	**O2 (%)**
233.8	2.28
307.5	2.9
312.5	2.03
329.8	2.16
306.3	1.72
334.5	1.91

Boiler 6		EF (lb/MMBtu)		
		Filterable	Cond.	Total
Test Date		0.007	0.004	0.011
2013		0.002	0.003	0.004
2012		0.001	0.009	0.009
2011		0.001	0.003	0.004
Dec-10		0.019	0.003	0.007
Oct-10		0.003	0.004	0.006
2009	Avg	0.005	0.004	0.007
	Std Dev	0.007	0.002	0.003
Boiler 7				
Test Date		Filterable	Cond.	Total
Dec-13		0.001	0.011	0.012
Sep-13		0.004	0.009	0.007
2012		0.001	0.002	0.003
2011		0.002	0.004	0.006
2010		0.001	0.002	0.003
2009		0.001	0.007	0.008
	Avg	0.0017	0.0059	0.0066
	Std Dev	0.0010	0.0037	0.0032

Boiler	Date	MMBtu/hr	lb/hr	lb/MMBtu	
#6	2013	275.1	3.0	0.011	
#6	2012	311.6	1.4	0.004	
#6	2011	331.5	3.1	0.009	
#6	Dec-10	329.2	1.4	0.004	
#6	Oct-10	307.5	2.2	0.007	
#6	2009	333.8	2.1	0.006	
#7	Dec-13	233.8	2.7	0.012	
#7	Sep-13	307.5	2.2	0.007	
#7	2012	312.5	1.1	0.003	
#7	2011	329.8	2.0	0.006	
#7	2010	306.3	1.0	0.003	
#7	2009	334.5	2.7	0.008	
			Average	0.007	lb/MMBtu
			Std Dev	0.003	lb/MMBtu
			Avg + 2.5 SD	0.0139	lb/MMBtu
				363	MMBtu/hr
				5.0	lb/hr
		No. Std. Deviations		2.5	
Normal distribution confidence interval				0.99	

BP Cherry Point Refinery

Modeling Report
Boiler #6 and #7 PM_{10}
Permit Limit Revision

Prepared for:
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4519 Grandview Road
Blaine, Washington 98230

Prepared by:
ENVIRON International Corporation
Lynnwood, WA

Date:
December 2014

Project Number:
29-30623G

ENVIRON

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1 Introduction

The BP Cherry Point Refinery is located in northwest Washington State approximately two miles south of the community of Birch Bay and five miles west of the town of Ferndale. The location of the facility and surrounding vicinities is shown in Figure 1. Construction and operation of Boilers #6 and #7 at BP was authorized in November 2007 when the Washington Department of Ecology (Ecology) issued Prevention of Significant Deterioration (PSD) Permit PSD-07-01, and the Northwest Clean Air Agency (NWCAA) issued Order of Approval to Construct (OAC) #1001.

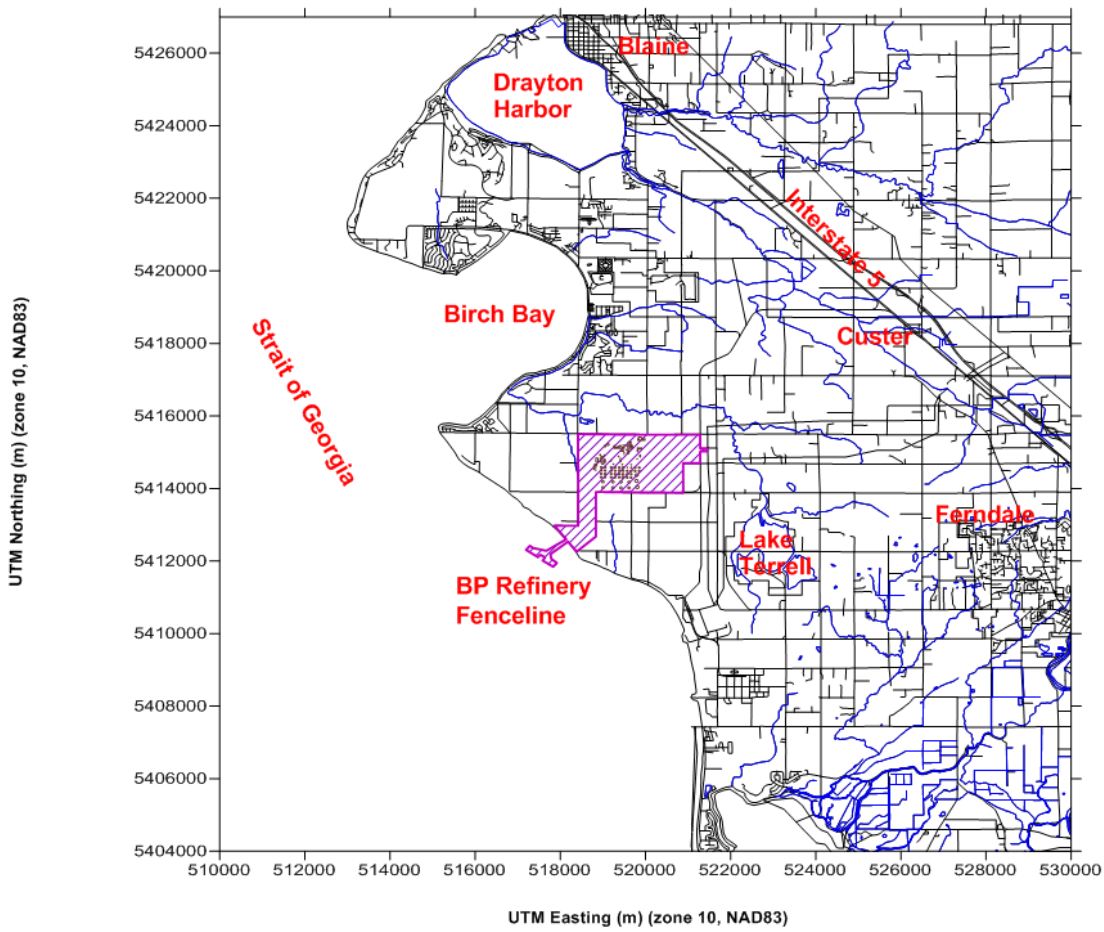

Figure 1. Facility location and vicinity map.

BP is requesting that Ecology increase the current limit on the 24-hour average emission rate of particulate matter less than ten microns (PM_{10}) imposed by the PSD permit on Boilers #6 and #7. The purpose of the modeling analyses described in this report is to assess the potential for compliance with the National or Washington State ambient air quality standards (NAAQS and WAAQS, respectively) if Ecology agrees to modify the permit limit as requested. PSD Permit PSD-07-01 currently includes a Boiler 6 & 7 PM_{10} emission limit of 3.4 pounds per hour (lb/hr) each. BP is requesting that the permit limit be increased to 5.0 lb/hr for each boiler.

Air quality dispersion modeling was conducted for two scenarios:

1. A “base” scenario that used all emission units and PM_{10} emission rates from the modeling analysis submitted in support of the original PSD permit application in 2007, but using the current version of AERMOD (Version 14134) and the most recent five years of meteorological data to predict the maximum ambient PM_{10} impacts for comparison to regulatory thresholds. Source parameters (stack temperature and velocity only) were also updated to comply with current source tests. The purpose of this scenario was to assess whether the maximum PM_{10} impacts predicted were less than the Significant Impact Level (SIL), consistent with the maximum predicted concentrations presented in the original PSD permit application.

2. A “new proposed emission limit” scenario that was identical to the base scenario, except that the proposed new permit limit on PM_{10} was used as the emission rate for both Boiler #6 and #7.

The results of the two modeling scenarios demonstrated that:

1. The maximum PM_{10} impacts predicted for the base scenario were less than the Significant Impact Level (SIL) for 24-hour PM_{10}, which is consistent with the conclusions drawn from the original PM_{10} modeling, and

2. The maximum PM_{10} impacts predicted for the new proposed emission limit scenario were less than the SIL for 24-hour PM_{10}, which indicates that the proposed limit on PM_{10} emissions from Boilers #6 and #7 will not cause or contribute to exceedances of the WAAQS or NAAQS.

The remainder of this document is a description of the modeling methodology used and the results of the modeling analyses.

2 Methodology and Setup

ENVIRON applied computer-based modeling techniques to simulate dispersion of air pollutant emissions attributable to the Project. The modeling results are used to assess compliance with National (and Washington) Ambient Air Quality Standards (NAAQS and WAAQS).

The dispersion modeling techniques employed in the analysis follow EPA regulatory guidelines (40 CFR Part 51, Appendix W; referred to as "the Guidelines"). The Guidelines includes recommendations for model selection, data preparation, and model application, but allows flexibility on a case-by-case basis.

2.1 Dispersion Model Selection

ENVIRON based its selection of dispersion models on the characteristics of the emission points and dispersion phenomena that might produce the maximum ground level concentrations. The highest model-predicted concentrations tend to occur when plumes impact elevated terrain and when buildings or structures affect plume dispersion. The modeling domain with local terrain is shown in Figure 2. A Good Engineering Practice (GEP) stack height analysis indicates building downwash would occur under some meteorological conditions. AERMOD includes the PRIME downwash algorithms to estimate effects of surrounding buildings on the dispersion of plumes.

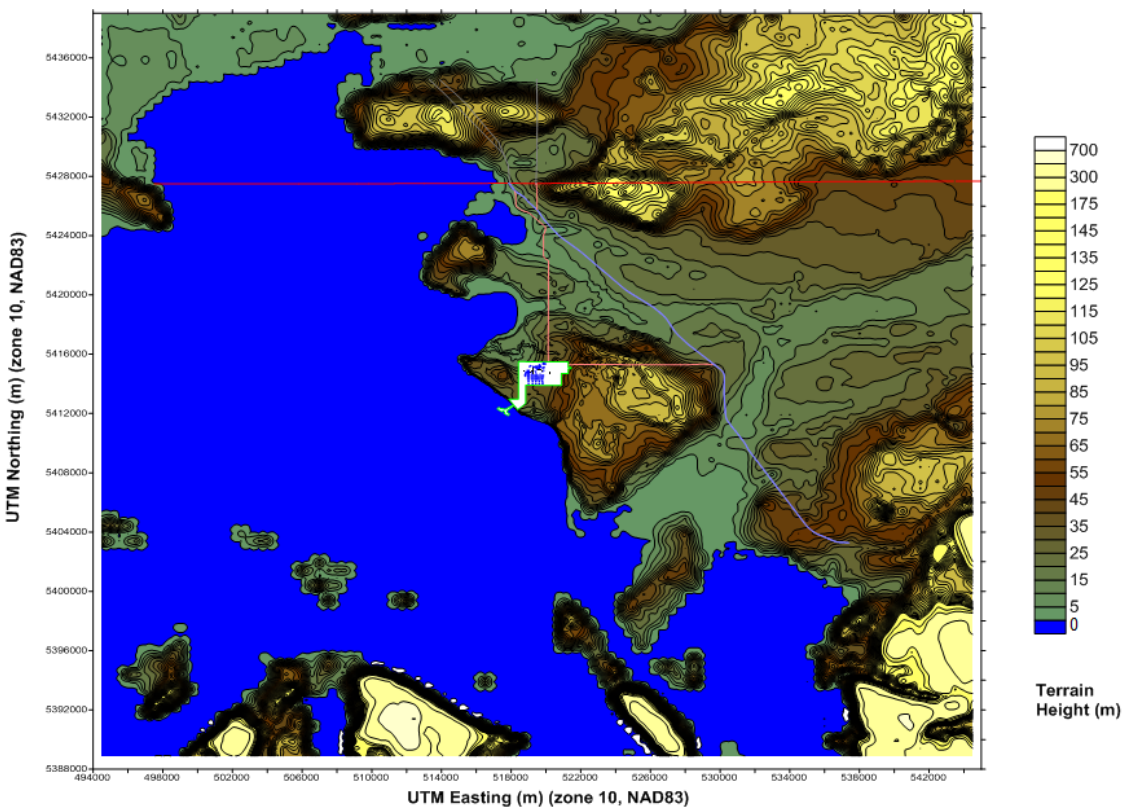

Figure 2. Facility Location and Surrounding Topography.

The Guidelines recommend the use of the AERMOD dispersion model to estimate ground-level concentration of air pollutants in areas containing both simple and complex terrain and is therefore appropriate for this evaluation.

2.2 Model Application

AERMOD (Version 14134) was applied using the regulatory defaults in addition to the options and data discussed in this section. Note that the non-regulatory default ADJ_U* beta option was used for meteorological pre-processing in AERMET for reasons described in Section 2.2.2.

2.2.1 Receptor Locations

A 50-kilometer (km) by 50-km modeling domain was used, with receptor locations as shown in Figure 3. Terrain elevations for receptors and emission units were prepared using the National Elevation Dataset (NED) 1/3rd arc-second (~10 m) resolution dataset developed by the United States Geological Survey (USGS).[1]

The receptor set includes receptors spaced 500 m apart covering the outermost portion of the simulation domain. Nested grids of 250-m and 50-m spaced receptors cover 15-km and 7.5-km wide square areas, respectively, centered on the facility. Receptors were also located at 25-m intervals along the facility property boundaries. Preliminary tests revealed the possibility of local maxima occurring at two locations: high terrain east of Blaine and high terrain on Orcas Island in the vicinity of Mt. Constitution. Additional receptor grids at 100-m spacing were placed at these locations to improve the resolution of the analysis in these high-terrain regions. The final modeling did not result in substantial local maxima in these regions so further receptor grid refinement was not warranted. The base elevation and hill height scale for each receptor were determined using AERMAP (version 11103).

[1] Data accessed through http://viewer.nationalmap.gov/viewer/

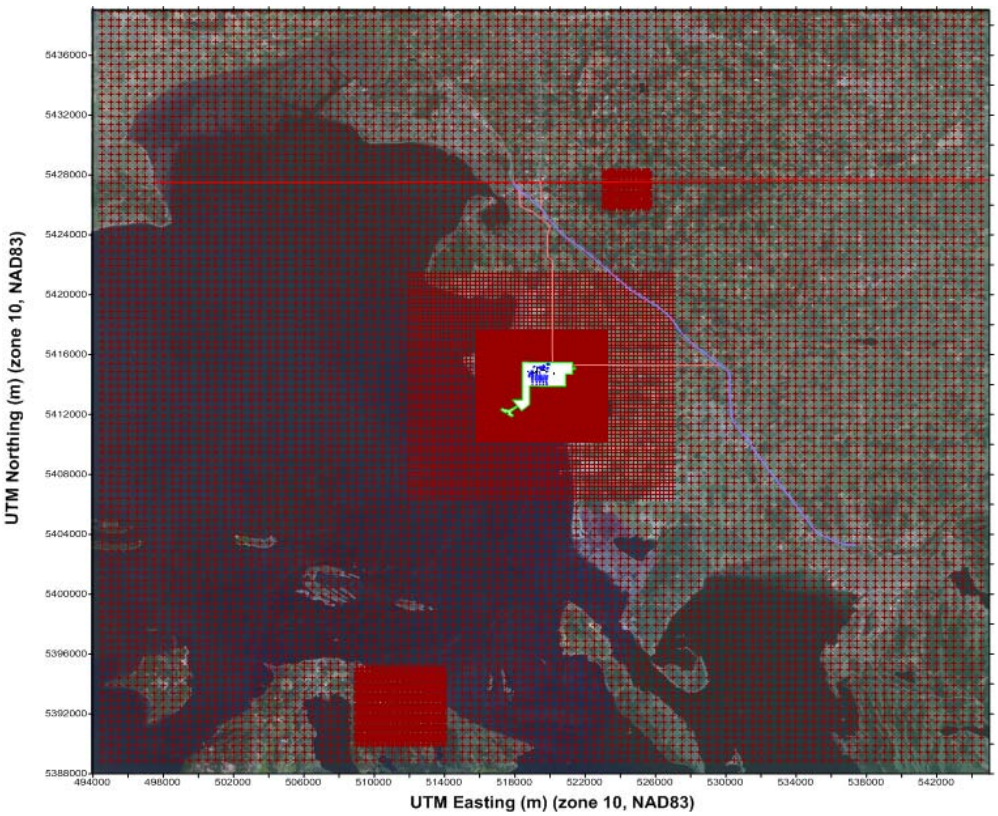

Figure 3. Receptor grids.

2.2.2 Meteorology

A five-year meteorological database (2009 – 2013) was constructed using available surface and upper air data for the dispersion modeling analysis. The meteorological data set was prepared using surface data observations from sensors on the PSD-quality 10-meter (m) meteorological tower operated by BP. The tower is located immediately north of the refinery on Safsten Road, approximately 1,500 feet north of Grandview Road; due to its proximity to emission units at the facility, it is considered “on-site”.

The meteorological tower has been operated within the strict guidelines of the USEPA On-Site Meteorological Program Guidance for Regulatory Modeling Applications[2] since the 1980s. Data collected include wind speed, wind direction, standard deviation of wind direction, temperature at two levels, temperature difference between the two levels (10 m minus 2 m), and solar radiation. The data meet all PSD QA/QC requirements, and have been used in dispersion

[2] USEPA On-Site Meteorological Program Guidance for Regulatory Modeling Applications (EPA-450/4-87-013, Revised June 1987).

modeling analyses developed in support of previously submitted PSD permit applications. Quarterly audit reports for the tower instrumentation are available upon request.

The onsite data were supplemented with National Weather Service (NWS) surface data observations from Bellingham, Washington, which were obtained from the National Climatic Data Center (NCDC) Integrated Surface Database in TD-3505 format. Upper air data from the Quillayute, WA (KUIL) sounding station for the period 2009 – 2013 was also obtained. The meteorological data were processed using the AERMOD meteorological preprocessor, AERMET (version 14134). A wind-rose plot describing the wind speed and wind direction data recorded at the BP meteorological site over the five-year period is shown in Figure 4.

The wind rose illustrates the bimodal pattern of winds prevalent in Western Whatcom County: a south-southeast mode of winds that typically occur during periods of marine onshore flow and a northeasterly mode of winds that typically occur during periods of warm summer offshore flow and strong winter arctic outflow from the Fraser Valley.

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 scaling parameters used by AERMOD. Seasonal surface parameters were determined for the BP meteorological site using the AERMET preprocessor, AERSURFACE (version 08009) and EPA guidance.

The AERMET configuration used for the air quality analysis used the ADJ_U* beta option to correct known deficiencies of the model during low windspeed conditions. Due to a “bug” in AERMET, the ADJ_U* option cannot be used with the Bulk-Richardson (BULKRN) option for calculating atmospheric parameters using onsite meteorology. As an alternative, Bellingham Airport (KBLI) cloud data was used in AERMET. Use of cloud data for determining stability parameters is the default method when onsite meteorology is not available. The justification for this configuration and demonstration of compliance with Appendix W requirements is included in the attached memorandum[3].

[3] “Proposed AERMET settings for air quality impacts analysis modeling”, Memorandum submitted to the Dept. of Ecology from ENVIRON as Appendix G to the BP Cherry Point Coker Heaters Replacement PSD permit application. Dated May 7, 2014.

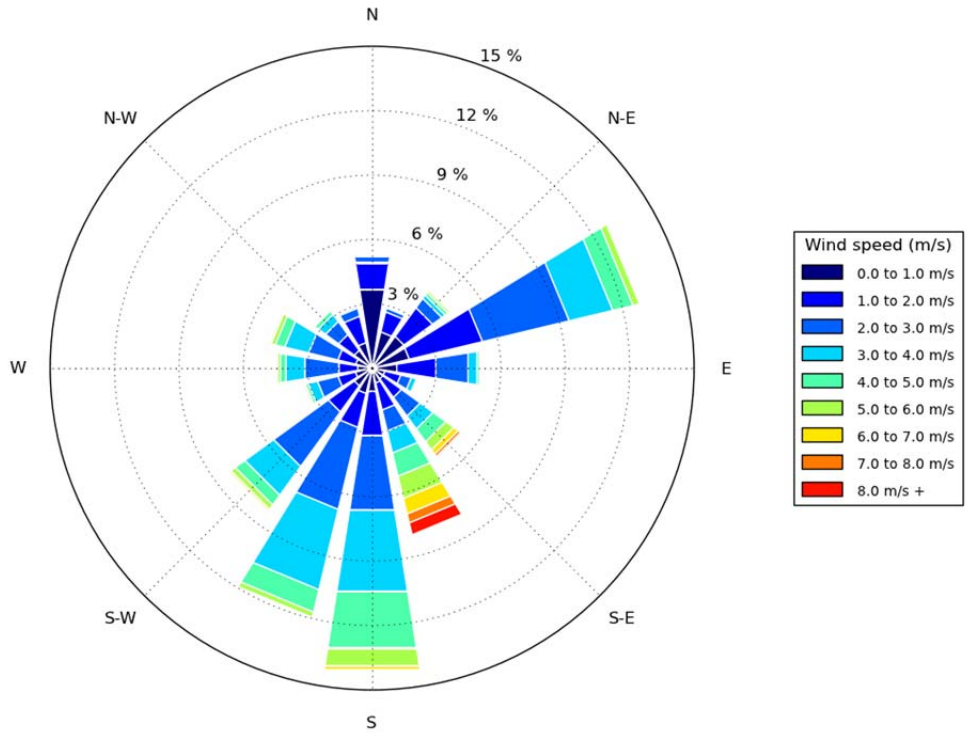

Figure 4. BP-Cherry Point Onsite Meteorological Data Windrose (2009-2013)

2.2.3 Surface Characteristics

Additional meteorological variables and geophysical parameters are required for use in the AERMOD dispersion modeling analysis to estimate the surface energy fluxes and construct boundary layer profiles. Seasonal surface characteristics including albedo, Bowen ratio, and surface roughness length were determined for the area surrounding the BP meteorological station and the Bellingham International Airport using the AERMET surface characteristic preprocessor, AERSURFACE (Version 13016), the USGS 1992 National Land Cover (NLCD92) land use data set,[4] and EPA guidance.[5]

EPA guidance specifies that surface roughness length should be evaluated within directional sectors with arcs no smaller than 30 degrees that extend 1 km from the measurement site. Guidance also recommends that Albedo and Bowen Ratio should be the geometric mean of values over a 10-km-by-10-km area centered on the measurement site. The domains used for these calculations are shown in Figure 5, and AERSURFACE was applied using the following assumptions:

[4] The USGS NLCD92 data set is described and can be accessed at http://landcover.usgs.gov/natllandcover.php.

[5] The AERMOD Implementation Guide (EPA, 2009) and the AERSURFACE User's Guide (EPA-454/B-08-001, January 2008).

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

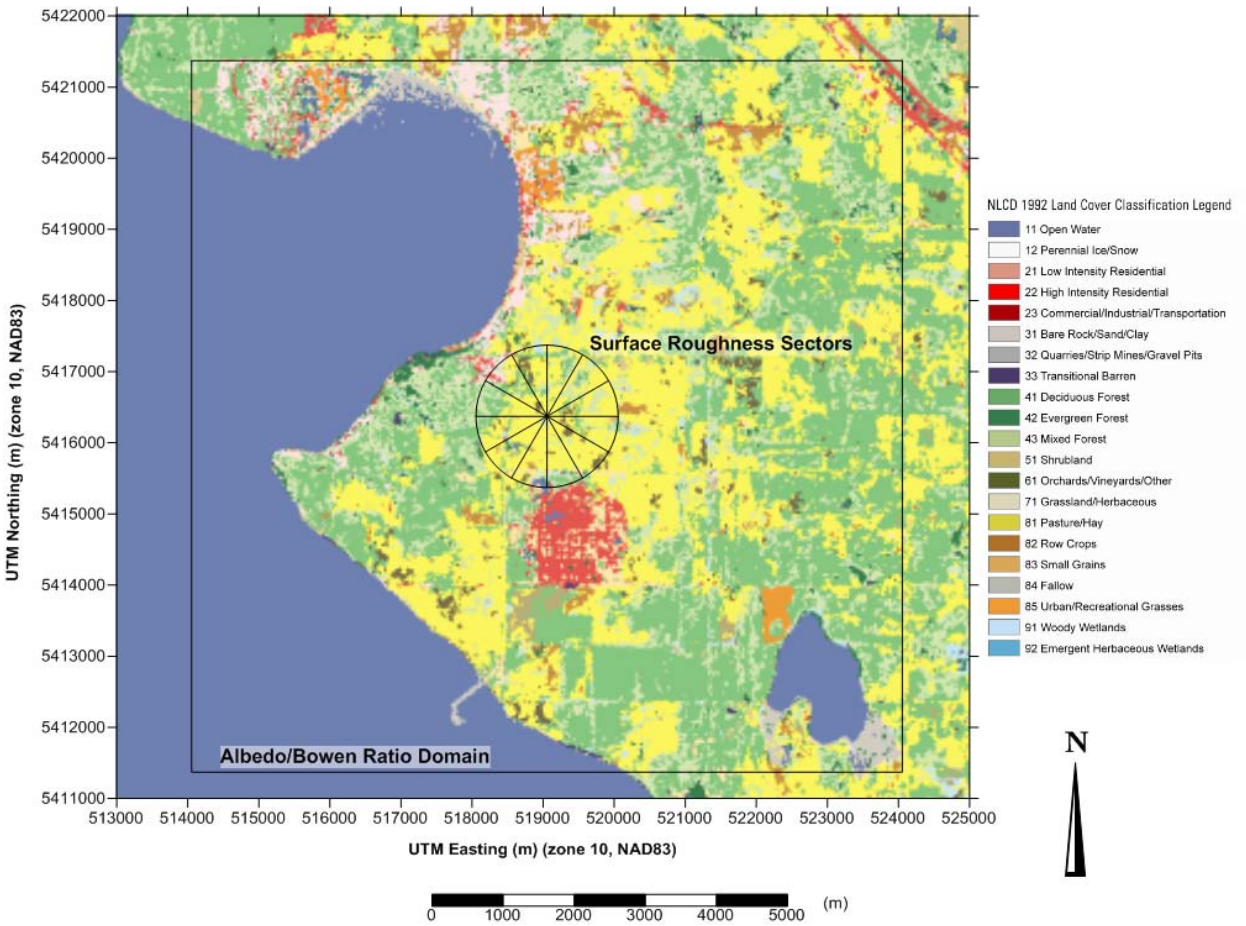

Figure 5. Land use and surface roughness AERSURFACE domains.

2.2.4 Emission Unit Release Parameters

AERMOD requires stack release parameters to determine how pollutant emission will interact with meteorological conditions, receptor locations, and onsite structures. Parameters for all emission units, summarized in Table 1, were assigned based on parameters used in the original PSD permit application. Some stack velocity and temperatures parameters were updated to align with newer source test data. Source locations in the original application were specified in

NAD27 UTM coordinates. All BP Cherry Point units, buildings, and fence locations have been updated to NAD83 UTM coordinates.

In addition, the stack locations and building location and dimensions were provided to AERMOD to assess potential downwash effects. Wind direction-specific building profiles were prepared using the EPA's "Prime" version of the Building Profile Input Program (BPIP-PRIME).

Table 1. Emission unit stack parameters.

BP-ID[a]	Unit	Model ID	UTM X[b] (m)	UTM Y[b] (m)	Elevation (m)	Stack Height (m)	Exhaust Temp. (K)	Exit Velocity (m/s)	Stack Diameter (m)
30-1607	No. 6 Boiler	Boiler06	519574.1	5414986.9	33.2	45.72	460.93	12.65	1.830
30-1608	No. 7 Boiler	Boiler07	519603.4	5414986.7	33.0	45.72	460.93	12.65	1.830
Decom.	No. 1 Boiler	boil1	519465.2	5415066.4	32.0	45.90	439.00	8.36	2.032
Decom.	No. 3 Boiler	boil3	519494.7	5415066.4	32.0	45.90	439.00	8.36	2.032
25	Tail Gas Unit 2	tgu2	519169.4	5414966.3	32.8	50.29	319.26	8.53	0.914
29-111	LP Flare	lpflare	518856.7	5414889.8	28.4	70.01	1273.00	31.09	0.610
29-110	HP Flare	hpflare	518763.2	5414890.8	27.2	69.86	1273.00	31.09	0.610
20-1401	#2 DHDS Charge Heater	dhds2	519689.0	5414910.4	32.7	30.50	627.59	6.10	1.524
15-1452	2nd Stage HC Frac Reblr	hyck2sfr	519234.6	5414900.8	32.8	47.32	421.79	3.53	2.880
10-1451	South Vacuum Heater	vachts	519563.1	5414825.3	32.9	48.91	484.18	3.38	2.477
15-1401	R-1 HC Reactor Heater	hyckr1	519239.8	5414992.8	32.8	43.19	686.49	2.99	1.997
13-1401	#1 DHDS Charge Heater	dhdsch	519502.4	5414829.0	32.9	41.04	592.43	0.75	1.159
13-1402	#1 DHDS Stabilizer Reboiler	dhdssr	519447.9	5414829.1	32.8	31.29	699.63	5.09	1.349
30-1606	No. 5 Boiler	boil5	519468.4	5415060.4	32.0	45.72	422.04	16.98	2.060
10-1401	Crude Heater	crudeht	519560.3	5414734.0	32.9	60.39	497.34	6.72	3.616
10-1452	North Vacuum Heater	vachtn	519562.6	5414846.2	32.8	41.64	486.35	1.40	1.867
11-1403,4	Reformer heaters	refh1a	519315.9	5414740.8	32.9	61.05	617.82	10.94	3.108
11-1405,6	Reformer heaters	refh1b	519325.1	5414740.2	32.8	61.05	615.82	10.94	3.108
21-1421,24	#2 Reformer heaters	refh2	519598.9	5414907.9	32.9	33.56	770.73	3.59	2.299
11-1401	Naphtha HDS Charge Heater	nhdsch	519366.8	5414731.9	32.8	30.68	698.11	2.81	1.854
11-1402	Naphtha HDS Stripper Reboiler	h2ssr	519353.7	5414731.8	32.8	30.76	641.37	3.41	1.530
15-1451	1st Stage HC Frac Reblr	hyck1sfr	519234.6	5414917.9	32.9	49.00	408.80	2.19	3.216
15-1402	R-4 HC Reactor Heater	hyckr4	519239.7	5414980.3	32.8	45.77	787.53	8.20	1.073
12-1401-01	Coker Charge Heater #1	coker1	519234.2	5414763.5	32.4	53.49	550.54	3.70	2.654
12-1401-02	Coker Charge Heater #2)	coker2	519234.1	5414751.2	32.8	53.49	557.49	4.21	2.527
14-1401	#1 Reforming furnace	h2h1	519504.9	5414993.3	32.8	26.37	585.14	15.43	1.737
14-1401	#1 Reforming furnace	h2h2	519504.9	5414985.8	32.8	26.37	576.77	15.43	1.737
14-1402	#2 Reforming furnace	h2h3	519504.7	5414948.1	32.9	26.37	578.69	15.79	1.737
14-1402	#2 Reforming furnace	h2h4	519504.4	5414940.5	32.9	26.37	618.41	15.79	1.737
30-1604	No. 4 Boiler	boil4	519503.5	5415055.0	32.1	18.29	460.94	12.65	1.829
45-1402	ISOM Heater	isoh2n	519654.2	5414714.0	32.8	33.53	632.05	2.12	0.813
Decom.	No. 2 Boiler	boil2	519479.8	5415066.4	32.0	45.72	439.26	8.14	2.060
20-70	Calciners #1 & #2	calciner	519092.5	5414786.7	32.1	71.93	386.00	29.24	1.676
20-71	Calciner #3	calcin2	519090.2	5414744.8	32.7	60.96	352.61	11.73	2.591
(fugitive)	Coke Handling	ckhand	519120.5	5414914.9	33.0	1.00	0.00	0.00	1.000
17-1482	Sulfur Recovery Unit	sulfpi	519189.8	5414878.3	33.0	91.64	561.00	19.81	1.048
33-151	Truck Loading Rack VCU	trkrkvc	518813.4	5414774.0	31.1	10.67	922.05	7.43	2.438
Ship	Crude Ship Pumping North	tankerw	517383.6	5412290.2	0.0	50.00	427.00	6.08	1.200
Ship	Crude Ship Pumping South	tankere	517749.0	5412026.8	0.0	50.00	427.00	6.08	1.200
35-161	Dock VCU	dockvc	517677.1	5412226.0	0.2	29.75	1033.16	5.90	3.851

[a] "Decom.": Units have been decommissioned, included in modeling to account for emission reduction credit.
[b] UTM coordinates, Zone 10, Datum NAD83

2.2.5 Good Engineering Practice Stack Height and Building Downwash Analyses

A good engineering practice (GEP) stack height design analysis was conducted based on the specifications of the refinery buildings according to EPA procedures (EPA 1985a). Releases below the GEP stack height are potentially subject to building wake effects, which 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. ENVIRON used the EPA's Building Profile Input Program for the PRIME algorithm (BPIP PRIME, version 04274) for the GEP analysis.

ENVIRON also used BPIP PRIME to prepare the wind direction-specific building profile information required by the dispersion model. The configuration of emission points and significant structures are presented in Figure 6; the heights of significant structures, expressed in meters, are superimposed on the structure outlines in the Figure. BPIP PRIME assesses the area of influence for each structure based on the wind direction, structure heights, and the projected structure widths. BPIP PRIME also applies EPA guidance for multi-tiered structures and assesses whether structures are sufficiently close to be considered a single structure.

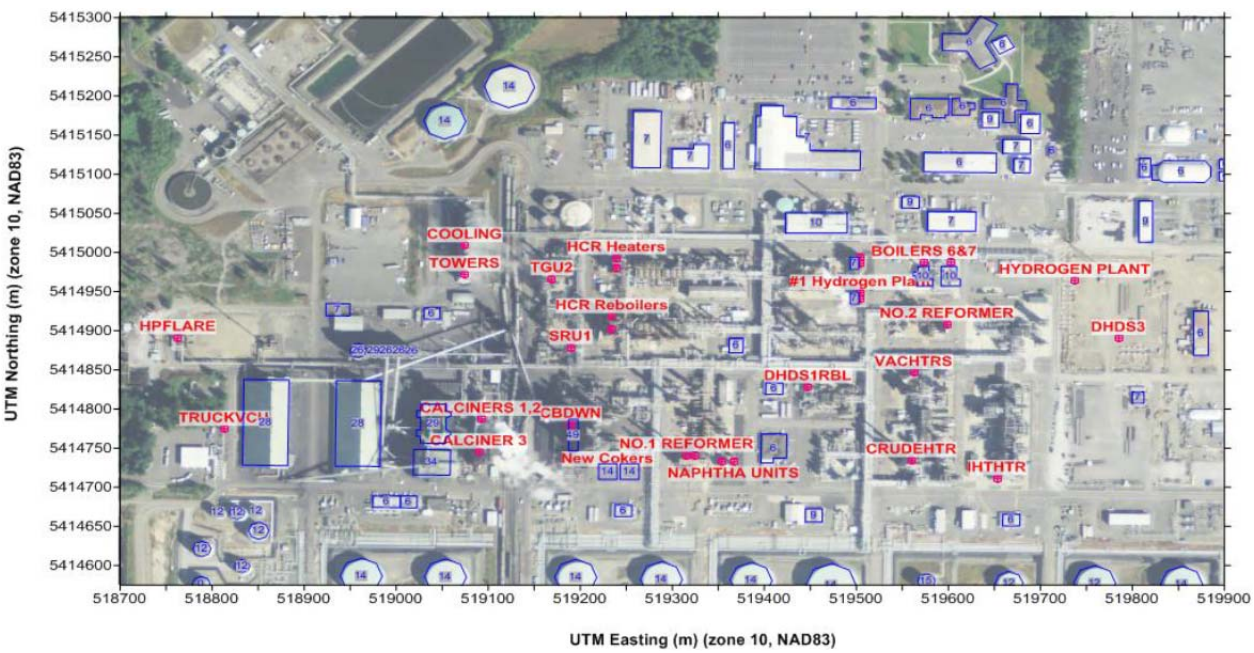

Figure 6. Point source and significant structure locations and structure heights.

2.3 Emission Rates

The current permit limit on PM_{10} emissions from Boiler #6 and #7 is 3.4 lb/hr from each boiler. BP is requesting the permit be revised to allow Boiler #6 and #7 to each emit 5.0 lb/hr of PM_{10}. Because the requested permit modification would affect only the 24-hour average permit limit on PM_{10} emissions, the modeling simulations evaluated only 24-hour average PM_{10} impacts.

Potential project emissions were based on the assumption that the units will be operated continuously (i.e., 24 hours per day, every day of the year).

As stated in Section 1, the modeling analyses used the same assumptions and emission rate increases (or, in some cases, decreases) presented in the original permit application for each unit, except in Scenario 2, where the proposed 24-hour average PM_{10} permit limit for Boilers #6 and #7 was used. The emission rates for each unit represented in the modeling are listed in Table 2.

Table 2. PM_{10} emission rates.

Model ID	PM_{10} Emission Rate (g/s)
Boiler06	0.42839[a]
Boiler07	0.42839[a]
boil1	-0.02877
boil3	-0.02877
tgu2	0.00864
lpflare	0.00000
hpflare	0.00058
dhds2	0.03734
hyck2sfr	0.08127
vachts	0.10277
hyckr1	0.03799
dhdsch	0.04365
dhdssr	0.02205
boil5	0.46815
crudeht	0.00026
vachtn	0.00003
refh1a	0.00075
refh1b	0.00075
refh2	0.00000
nhdsch	0.00012
h2ssr	0.00012
hyck1sfr	0.00008
hyckr4	0.00003
coker1	0.00006
coker2	0.00006
h2h1	0.00001
h2h2	0.00001
h2h3	0.00001
h2h4	0.00001
boil4	0.00005
isoh2n	0.00346
boil2	-0.01438
calciner	0.00007
calcin2	0.00014
ckhand	0.00031
sulfpi	0.00001
trkrkvc	0.00000
tankerw	0.00015
tankere	0.00015
dockvc	0.00000

[a] Boiler #6 & #7 current permit limit; the proposed emission limit is 0.63 g/s for each boiler.

3 Results

National and Washington ambient air quality standards (NAAQS and WAAQS) have been established by EPA and Ecology, respectively. 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.

In the original PSD application, the air quality impact assessment demonstrated that maximum PM_{10} ambient air quality impacts were below the PSD Significant Impact Level (SIL). A predicted concentration less than the SIL indicates that proposed emission increases do not have the potential to cause or contribute to the exceedance of the NAAQS/WAAQS, as promulgated under EPA/Ecology. The Class II PSD 24-hour average SIL for PM_{10} is 5 µg/m^3.

The updated AERMOD modeling reported in this document was used to demonstrate that predicted PM_{10} concentrations are below the SIL under both the original permitted Boiler #6 and #7 emission limits and proposed higher emission limits scenarios.

3.1 Existing Limit Scenario

AERMOD modeling was conducted using the five-year meteorological dataset described in Section 2.2.2 for the existing limit scenario. This scenario was conducted to account for possible changes in ambient concentration predictions from the previous PSD application modeling due to upgrades in the AERMOD modeling system and the use of the most recent years of meteorological data. The maximum 24-hour average PM_{10} concentration for this scenario is reported in Table 3 as being less than the applicable SIL.

Table 3. Exisiting-limit scenario results

Pollutant	Averaging Period	Maximum Concentration (µg/m^3)	Location of Maximum Concentration			Period of Maximum Concentration	SIL[b] (µg/m^3)
			UTM X[a] (m)	UTM Y[a] (m)	Elevation (m)		
PM_{10}	24-Hour	1.26	519200.0	5415700.0	16.28	09-11-15	5.0

[a] UTM coordinates, Zone 10, Datum NAD83

[b] SIL = Significant Impact Level, from WAC 173-400-113

3.2 Proposed Emission Limit Scenario

AERMOD modeling was conducted using the 5-year meteorological dataset described in Section 2.2.2 for this "proposed emission limit" scenario. This scenario was conducted using the proposed Boilers #6 & #7 PM_{10} emission limit of 5.0 lbs/hr for each boiler, which equates to an emission rate of 0.63 g/s. The maximum 24-hour average PM_{10} concentration for this scenario is reported in Table 4. The maximum value, which reflects the proposed PM_{10} limit, is less than the applicable SIL.

Table 4. Proposed emission limit results

Pollutant	Averaging Period	Maximum Concentration ($\mu g/m^3$)	Location of Maximum Concentration			Period of Maximum Concentration	SIL ($\mu g/m^3$)
			UTM X[a] (m)	UTM X[a] (m)	UTM X[a] (m)		
PM_{10}	24-Hour	1.59	519200.0	5415700.0	16.28	09-11-15	5.0

[a] UTM coordinates in NAD83 projection, Zone 10

Contours of the maximum 24-hour averaged concentration are plotted in Figure 7. Maximum ambient concentrations occur along the north side of the facility fence-line. Given the receptor spacing in this vicinity, it is assumed that additional modeling would not improve the accuracy of the predicted maximum by a significant degree.

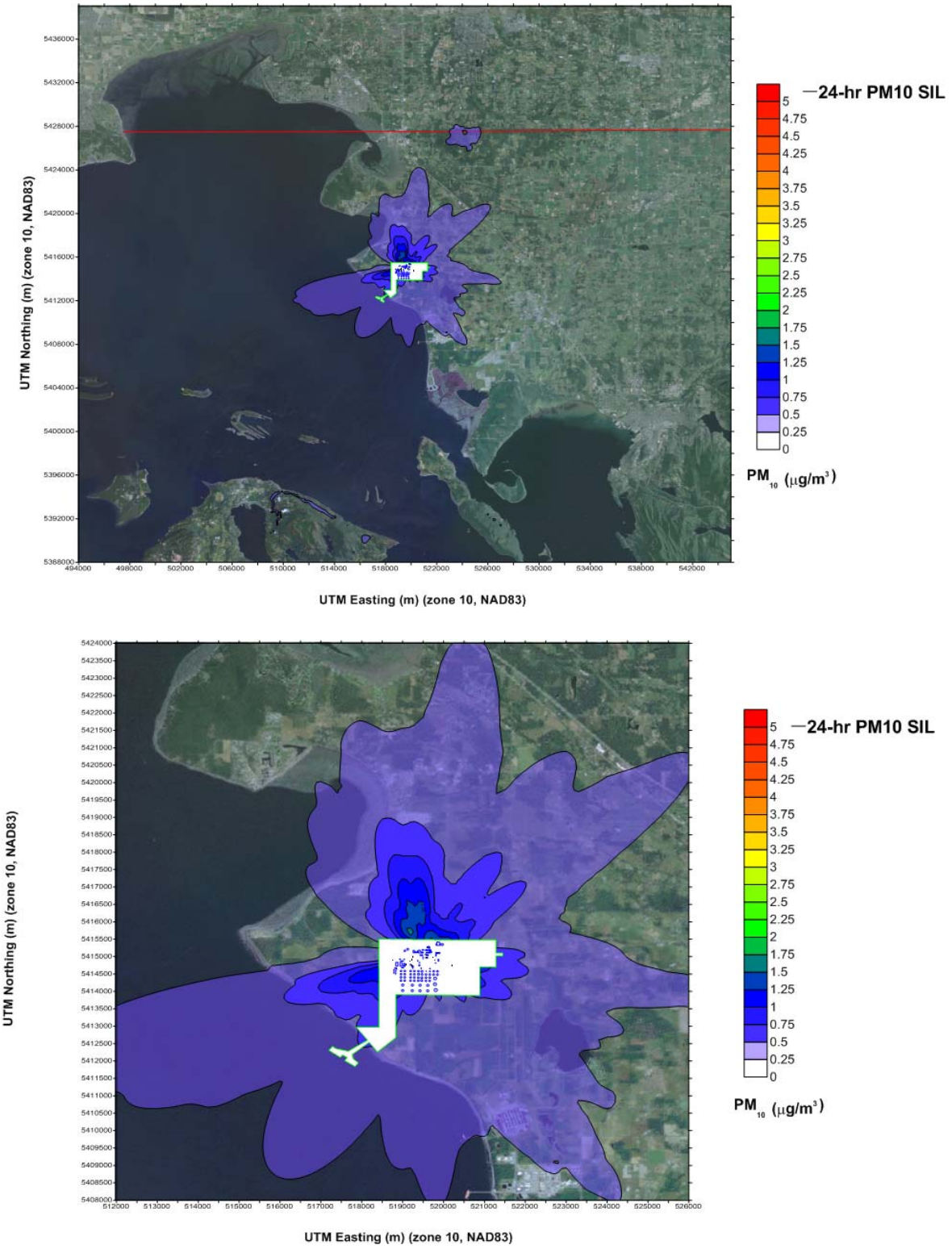

Figure 7. 24-hour average maximum PM_{10} ambient concentrations predicted by AERMOD, domain wide (top) and near-facility view (bottom).