Analysis of Sulfur Dioxide Monitoring Data in Whatcom County

Air Quality Technical Report

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Air Quality Technical Report

Air Quality Program

Washington State Department of Ecology

Olympia, Washington

&

Northwest Clean Air Agency

Mount Vernon, Washington

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Acronyms

ANR	Annual (Monitoring) Network Report
AOP	Air Operating Permit
AQS	EPA's Air Quality System
BACM	Best Available Control Measures
CAA	Federal Clean Air Act
CAPs	Criteria Air Pollutants
CFR	Code of Federal Regulations
EPA	U.S. Environmental Protection Agency
FEM	Federal Equivalent Method
FRM	Federal Reference Method
NAA	Nonattainment area
NAAQS	National Ambient Air Quality Standard
NWCAA	Northwest Clean Air Agency
NEI	National Emission Inventory
PM	Particulate Matter
ppb	parts per billion
PTE	Potential to Emit
SIP	State Implementation Plan
SLAMS	State and Local Monitoring Stations
SO_2	Sulfur Dioxide
USG	Unhealthy for Sensitive Groups
WAC	Washington Administrative Code

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Executive Summary

The Washington State Department of Ecology (Ecology) and the Northwest Clean Air Agency (NWCAA) completed an evaluation of the levels of sulfur dioxide (SO_2), a common air pollutant, in the ambient air in Whatcom County.

The majority of the county meets the federal, health-based ambient standard for SO_2 established by the U.S. Environmental Protection Agency (EPA) in 2010. However, we identified one monitoring site in the Cherry Point Industrial Area that recorded levels of SO_2 in violation of the standard, in close proximity to the Alcoa Intalco Works LLC (Intalco) aluminum smelter.

Intalco is the largest source of SO_2 emissions in both the county and the state, emitting roughly 4,000 tons of SO_2 a year. Ecology has been working to collect additional monitoring data near the facility under 2016 EPA guidance that required in-depth assessments of areas near facilities that emit more than 2,000 tons of SO_2 a year. In 2017, Ecology began collecting data from two new ambient SO_2 monitoring sites established near the smelter.

Upon review of data collected from 2017 to 2019, one of the two SO_2 monitors violated the federal standard. The presence of two refineries in the area led Ecology and NWCAA to initiate dispersion modeling analysis to assess contributions to the SO_2 violation.

As Ecology and NWCAA were analyzing modeling results, in April 2020, the aluminum smelter announced its intention to curtail its operations by July 2020 due to unfavorable market conditions. That is, the facility plans complete curtailment, thereby halting operations. Curtailment is not the same as closure; however, the facility will continue to maintain its permits and could restart.

Given the timing of the curtailment, Ecology and NWCAA are providing the monitoring and modeling data compiled in this technical report to EPA to use in making a formal determination on whether Whatcom County, in whole or in part, meets federal SO_2 standards.

EPA is under a court order to issue a determination by December 31, 2020, and plans to do so following a public comment period. If any part of Whatcom County is designated as being in nonattainment, the state, as required by the federal Clean Air Act, will develop a plan by September 2022 to reduce emissions.

In this report, Ecology and NWCAA review the SO_2 monitoring and emissions data in Whatcom County and provide the results of an extensive dispersion modeling analysis around the violating monitoring site. Our review demonstrates that:

1) The Intalco aluminum smelter was located upwind of the monitoring sites when all exceedances were recorded.

2) The SO_2 emissions from the two nearby refineries, BP Cherry Point and Phillips 66, did not cause the elevated levels of SO_2 near the Intalco facility, and their estimated contributions to the levels found at the violating monitor were extremely small. Therefore, the elevated levels of SO_2 at the monitor are not a result of combined emissions.

3) The levels of SO_2 above the standard were observed (via both monitoring and modeling) only in the areas immediately adjacent to the Intalco's property line, within 1 mile of the smelter, and did not reach Ferndale or other nearby residential communities. However, there are a few rural homes within the affected area.

Along with informing EPA's air quality determination, the results of the analysis will help Ecology and NWCAA to develop strategies to improve air quality in the area.

Introduction

This technical review and report contributes to a collaborative effort to characterize concentrations of a common air pollutant – sulfur dioxide (SO_2) – in the ambient air in Washington State. This characterization effort, which is mandatory for all states, began in 2010, when the U.S. Environmental Protection Agency (EPA) established a new National Ambient Air Quality Standard (NAAQS) for sulfur oxides (SO_x). Ecology is joined by the Northwest Clean Air Agency (NWCAA) in collecting data and developing this technical analysis.

NWCAA oversees most air quality activities related to stationary sources within Whatcom County. NWCAA develops air quality rules, identifies hot spots, conducts public education, and is the permitting authority for all stationary air emissions sources except those, like Intalco, specifically assigned to Ecology. In addition to Whatcom County, NWCAA is responsible for enforcing federal, state and local air quality regulations in Island and Skagit counties. Apart from permitting and regulating industrial sources of air pollution, the agency provides services and information related to asbestos, indoor air quality, outdoor burning, wood stoves, and fireplaces. More information about the agency is available at https://nwcleanairwa.gov/.

NWCAA issues air permits for most of the large industrial facilities in Whatcom County. However, under the state law, Ecology is the permitting agency for the Intalco aluminum smelter in Whatcom County, which is the largest source of the SO_2 emissions in the county and the state. The Intalco smelter and the next two largest SO_2 sources in the county – the BP and Phillips66 oil refineries – are located in the Cherry Point Industrial Area in Whatcom County. As shown in **Figure 3**, the SO_2 emissions from the two oil refineries are only a fraction of the emissions from Intalco.

On April 22, 2020, the Intalco smelter announced full curtailment of its operations due to unfavorable market conditions. If the curtailment continues, this is expected to result in reductions in both SO_2 emissions and the monitored SO_2 levels near the facility. However, curtailment is not the same as a permanent shutdown and Intalco may restart operations in the future. Ecology is exploring additional regulatory pathways to reduce emissions and demonstrate attainment of the SO_2 NAAQS if Intalco restarts. This technical report does not include an Ecology policy recommendation to EPA on how to designate the area around the Intalco facility at this time. We offer our data and analysis to support EPA and the public in their determination of the appropriate designation approach for the area.

This technical report provides a detailed air quality analysis of the SO_2 emissions and monitoring data in Whatcom County. We use the collected data to identify a monitoring site that is in violation of the federal standard for SO_2 and report to the public on the exceedances of the standard during 2017-2019. This fulfils the federal law requirements in 42 U.S. Code § 7427 *Public notification* that requires that states provide information to the public about exceedances of the standard in the area in the past calendar year.

Further, we analyze the levels of SO_2 pollution around the violating monitor and identify the concentrations levels both near and further away from the violating monitor. We look at all sources of the SO_2 emissions in the area, geography and location of the facilities, meteorology and winds direction affecting the SO_2 pollution dispersion, and modeling of SO_2 concentrations at the actual emissions levels. This analysis helped us understand if there are any synergistic effects from several sources affecting the violating monitoring site and the area impacted by unhealthy air in violation of the NAAQS. We conclude that the Intalco aluminum smelter is solely responsible for causing a violation of the SO_2 NAAQS in Whatcom County.

Background

About EPA's Air Quality Designation Process

The National Ambient Air Quality Standards (NAAQS) are federal standards for six common air pollutants. These pollutants, referred to as "criteria pollutants," are carbon monoxide, lead, nitrogen oxides, ozone, particulate matter, and sulfur oxides. The federal Clean Air Act requires that EPA establish NAAQS for each criteria pollutant at concentrations protective of public health with an adequate margin of safety to protect vulnerable populations from health impacts. Standards are also to be set at levels that will limit adverse effects on soil, water, crops, buildings, and other impacts separate from public health. There are two types of standards for each criteria pollutant:

- Primary standards - protect public health
- Secondary standards - protect welfare and the environment

EPA evaluates health impacts for each pollutant individually. At this time, the standards do not account for combined (synergistic[1]) effects with other pollutants.

Traditionally, when EPA establishes a new, or revises an existing, standard, states have one year to review available air quality information and then advise EPA whether all areas in the state are in attainment for the standard. EPA reviews the data and feedback from the state before making a final decision as to whether each area of the state is in:

- Attainment (meets the standard)
- Nonattainment (does not meet the standard)
- Unclassifiable (not enough information to determine)

[1] In toxicology, "a synergistic effect" is an interaction in which the combined biological effect of exposure to two or more substances is greater than expected on the basis of the simple summation of the effects of each of the individual substances.

Each area can be designated as being in attainment for some criteria pollutants and not others. According to the federal Clean Air Act and EPA guidance[2], "a nonattainment area should contain the area violating the NAAQS (e.g., the area around a violating monitor or encompassing modeled violations), as well as any nearby areas (e.g., counties or portions thereof) that contain emissions sources contributing to the violation. (See CAA section 107(d)(l)(A)(i))."

A violation of the standard occurs when a monitoring site's Design Value (DV) is greater than the corresponding NAAQS. A DV is a summary statistic calculated annually to compare a site's data to the corresponding NAAQS. The form of the SO_2 standard is the 3-year average of the annual 99th percentile (or 4th highest) of daily maximum 1-hour concentrations. Conversely, the lower the DV, the cleaner the air.

In the air quality regulatory field, an air monitor may record a one-time exceedance of the standard, but this does not necessarily mean the NAAQS was violated. We must calculate the 3-year DV to determine whether there is a NAAQS violation, or nonattainment. EPA and the states pursue a nonattainment designation when the DV is above the standard.

Once a violation of the NAAQS has been calculated, EPA considers county boundaries as the analytical starting point for determining nonattainment area boundaries. However, an evaluation of air quality data and other information for each area may be also considered in determining the geographic scope of a nonattainment area.

When EPA designates an area as being in "attainment" or "unclassifiable," the area can continue to rely on existing permitting programs and control strategies to maintain healthy air. When EPA determines an area as being "nonattainment," the state must come up with a plan to bring the area back into attainment with the federal standards. The important component of the plan is to identify those sources that significantly contribute to the violation. Then the plan often includes the requirements for identified facilities to install additional air pollution prevention controls or to change their practices to reduce emissions. It can also require new and existing facilities located in the nonattainment area to implement controls that allow them to achieve the Lowest Achievable Emission Rate for the pollutant of concern.

In 2011, following the federal requirements, Ecology recommended that EPA designate all areas of the state as "unclassifiable" for the 2010 SO_2 standard (**Appendix A. Correspondence**). At that time, Ecology did not have sufficient ambient air quality data to support SO_2 attainment designations, nor did EPA guidance explain how the states were to evaluate short-term, localized levels of SO_2.

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[2] https://www.epa.gov/sites/production/files/2019-09/documents/round_4_so2_designations_memo_09-05-2019_final.pdf

EPA did not act on the 2011 recommendation. Instead, in August 2016, EPA finalized a new rule: *SO_2 Data Requirements Rule* (DRR).[3] This rule clarified how states were to characterize levels of SO_2 in the ambient air in order to determine an area's attainment status. Under the DRR, EPA established several ways and schedules for the states to carry out SO_2 evaluations through a process of four rounds of designations. Several areas in Washington met criteria to be reviewed in the third and fourth round of designations. In these rounds, EPA required states to characterize air quality around each facility, or a cluster of facilities, emitting 2,000 tons (4 million pounds) or more of SO_2 emissions a year. States were allowed to assess SO_2 levels in the ambient air either using a monitoring or modeling approach. EPA did not require additional SO_2 investigations in the areas where there were no SO_2 sources, or cluster of sources, emitting above the 2,000 tons of SO_2 a year threshold.

In December 2017, EPA completed the third round of designations, in which it designated 36 out of 39 Washington counties after reviewing Ecology's recommendation.[4] Ecology's recommendation letter to EPA is included in **Appendix A. Correspondence**. The following are EPA's 2017 Round 3 designations[5]:

Table 1: Summary of EPA Round 3 designations.

Area/County	Final Area Definition	EPA's Final Designation[3]
Lewis and Thurston Counties	Lewis and Thurston Counties as one designated area	Unclassifiable
Remaining undesignated areas to be designated*	Each full county as a separate designated area	Attainment/ Unclassifiable

* Except for Douglas, Chelan, and Whatcom counties where Ecology began operating a new SO_2 monitoring network in 2017 meeting EPA specifications referenced in the EPA's SO_2 DRR.

In 2016, Ecology notified EPA that Washington elected to use a new SO_2 monitoring network to characterize levels of SO_2 in three counties: Chelan, Douglas, and Whatcom, over the three-year period of 2017-2019. A copy of the notification letter is included in **Appendix A. Correspondence**. EPA must designate these areas in the fourth round of designations, by December 31, 2020. **Table 2** lists the SO_2 emissions sources around which a new, approved monitoring network has been established.

[3] https://www.epa.gov/so2-pollution/final-data-requirements-rule-2010-1-hour-sulfur-dioxide-so2-primary-national-ambient

[4] https://fortress.wa.gov/ecy/publications/documents/1702007.pdf

[5] https://www.epa.gov/sites/production/files/2017-12/documents/42-wa-so2-rd3-final.pdf

Table 2: Round 4 designations: areas and associated sources.

Area	Source(s)
Chelan County and Douglas County	Alcoa Primary Metals Wenatchee Works
Whatcom County	Alcoa Intalco Works LLC

Chelan and Douglas counties are in the eastern part of the state, and Whatcom County is in the western part of the state. The Alcoa smelter in Wentachee curtailed its operations in 2016 and the monitoring data near the facility reflected very low SO_2 levels over the past three years. Ecology posted a notice[6] explaining the collected monitoring data and recommending that EPA recognizes Chelan and Douglas as attaining the standard. A copy of the notice is also included in **Appendix A. Correspondence**.

About Sulfur Dioxide (SO_2)

Sulfur oxides (SO_x) are emitted into air from certain types of natural and human-made sources and are formed in the atmosphere from other airborne compounds. Gaseous SO_x transform in the atmosphere to particulate sulfur compounds, such as sulfates, as they drift away from emission sources. Among the common SO_x compounds in the air, SO_2 is the most prevalent. It has also received the most study and so has the largest body of scientific evidence related to its impacts on health. EPA uses SO_2 as the indicator member of the SO_x group, all of which are intended to be limited by the SO_2 NAAQS.

SO_2 is a highly reactive and water-soluble gas. When inhaled, it is absorbed almost entirely in the upper respiratory tract. Brief exposures to SO_2 can elicit respiratory effects, particularly in people with asthma, but can affect anyone breathing at an elevated rate (for example, during physical exercise).

Fossil fuel combustion is the main human-made source of SO_2 emissions, while volcanoes and landscape fires (wildfires as well as controlled burns) are the main natural sources. Human-made SO_2 emissions originate primarily from point sources, meaning individual facilities. (*Integrated Science Assessment*, section 2.1[7]).

Nationwide, emissions of SO_2 and associated concentrations in ambient air have declined significantly since 2010. According to EPA's estimates, SO_2 emissions have declined throughout the nation by 82% over the period from 2000 to 2016, with a 64% decline from 2010 to 2016. These declines in SO_2 emissions are likely related to the implementation of national control programs developed under the Clean Air Act Amendments of 1990, as well as changes in market conditions, such as a reduction in energy generation from coal-fired power plants. One-hour concentrations of SO_2 in ambient air in the U.S. declined more than 82% from 1980 to

[6] https://fortress.wa.gov/ecy/publications/SummaryPages/2002011ML.html
[7] https://www3.epa.gov/ttn/naaqs/standards/so2/s_so2_cr_isa.html

2016 at locations continuously monitored over this period. Daily maximum 5-minute concentrations have also consistently declined from 2011 to 2016. Washington experienced the same level of decline in SO_2 concentrations in the ambient air as reflected in nationwide trends. However, even as overall SO_2 levels have fallen, the health concerns around repeated short-term, localized or site-specific exposure to SO_2 increased as more health research became available.

The original national primary and secondary NAAQS for SO_2 were codified in Volume 42 of the Code of Federal Regulations, Part 410 (42 CFR 410) on April 30, 1971, (36 FR 81875) and re-codified to 40 CFR 50.4 and 50.5 on November 25, 1971, (36 FR 22384). Under the federal Clean Air Act, EPA must review each NAAQS every five years to ensure each standard reflects the most current scientific understanding about health impacts. EPA proceeded with periodic reviews of the SO_2 health information, but continued to maintain that the 1971 NAAQS were still adequate.

In 1988, EPA lost in a court case[8] in which the American Lung Association and the Environmental Defense Fund challenged EPA's decision not to establish a short-term SO_2 standard. The court held that EPA failed to explain adequately two linked and contrary conclusions that:

1) Repeated short-term SO_2 exposures were significant because there were tens to hundreds of thousands of people in the susceptible subpopulation, and

2) Short-term SO_2 exposures to asthmatics did not constitute a public health problem, so a new standard was unwarranted.

The court remanded the case to EPA to explain how short-term exposure was not a public health problem, or to establish a protective standard.

On May 15, 2006, EPA initiated a review of the air quality criteria for SO_X and the SO_2 primary NAAQS (71 FR 28023[9]). The review of the primary SO_2 NAAQS was focused on the gaseous species of SO_x and did not consider health effects directly associated with particulate matter, which are addressed through NAAQS for particulate matter[10]. This round of review resulted in EPA establishing a new standard in 2010 and phasing out the earlier, 1971, standards.

2010 1-hour Sulfur Dioxide National Ambient Air Quality Standard

On June 2, 2010, EPA established a new 1-hour standard at a level of 75 parts per billion (ppb) in the rule titled "Primary National Ambient Air Quality Standard for Sulfur Dioxide" (75 FR 35520[11]). The new standard is met at an ambient air quality monitoring site when the 3-year

[8] American Lung Association v. EPA, 134 F. 3d 388 (DC Cir. 1998)
[9] https://www3.epa.gov/ttn/naaqs/standards/so2/fr/20080530p31113.pdf
[10] https://www.epa.gov/pm-pollution
[11] https://www.federalregister.gov/citation/75-FR-35520

average of the annual 99th percentile of the daily maximum 1-hour concentrations does not exceed 75 ppb, as calculated in accordance with Appendix T of 40 CFR Part 50 (40 CFR 50.17(a)-(b)). Uniquely to the SO_2 NAAQS, states can rely on air quality modeling, instead of monitoring, to demonstrate attainment of the standard.

EPA has determined that 75 ppb is the level necessary to provide protection of public health, with an adequate margin of safety, especially for children, the elderly and those with asthma. These groups are particularly susceptible to the health effects associated with breathing SO_2. EPA revoked the two prior primary standards of 140 ppb evaluated over 24 hours, and 30 ppb evaluated over an entire year, because the standards will not add additional public health protection given a 1-hour standard at 75 ppb. In addition to revising the level of the NAAQS in 2010, EPA revised the ambient air monitoring and reporting regulations. In addition to the hourly concentrations, EPA required states to report hourly maximum 5-minute SO_2 concentrations.

In 2011, some states and state regulatory agencies, together with corporations and industrial associations, petitioned for review of EPA's new SO_2 standard and of the subsequent denial of petitions for reconsideration of the standard. Petitioners contended that the agency arbitrarily set the maximum SO_2 concentration at a level lower than statutorily authorized. In 2012, the court concluded that EPA did not act arbitrarily in setting the level of SO_2 concentrations and therefore denied that portion of the petitions for review [12].

Moreover, on March 18, 2019, EPA completed its most recent round of review of key aspects of the currently available health effects evidence, quantitative risk and exposure information, advice from the Clean Air Scientific Advisory Committee (CASAC), and public comments. EPA, decided to retain the current standard without revision. Ecology's comment letter and position in support of retaining the existing standard is found in **Appendix A. Correspondence (PDF)**.

[12] https://www3.epa.gov/ttn/naaqs/standards/so2/data/so2-opinion-2010.pdf

Whatcom County and Its Main SO_2 Sources

Whatcom County in Washington State is bordered to the north by Canada; to the west by the Strait of Georgia, which leads to the Pacific Ocean; to the east by Okanagan County; and to the south by Skagit County (**Figure 1**). It encompasses an area of 2,503 square miles. This size makes Whatcom County larger than the combined area of the state of Delaware and the District of Columbia, and is approximately the size of half of the state of Connecticut.

Whatcom County includes a variety of terrain, which influences the patterns of air pollution and creates local air sheds, among other things. To the west, the county is bordered by water and is generally less than 300 feet in elevation. Elevation rises significantly moving eastward. The central part of Whatcom County is home to dramatic peaks like 9,131-foot Mount Shuksan and 10,781-foot Mount Baker.

According to the U.S. Census Bureau[13], the 2019 population of Whatcom County was approximately 229,000. The county seat and the largest city is Bellingham, with a population of approximately 91,000. The majority of the population lives in the western, less mountainous part of the county.

Figure 1: Map of Whatcom County.

The majority of Whatcom County is zoned rural, rural-forestry, agriculture, or forestry. Industrial development is generally concentrated in the western part of the county, along major transportation corridors including Interstate 5 and the deep-water ports along the Strait of Georgia.

The three largest industrial sources of SO_2 emissions in Whatcom County are located in the area called the Cherry Point Industrial Area. We describe the area and the three facilities in details

[13] https://www.census.gov/quickfacts/whatcomcountywashington

below. We discuss all other SO_2 emission sources in the county further down in the document, in the **Whatcom County SO_2 Emissions Data** section.

Cherry Point Industrial Area Description

The Cherry Point Industrial Area (Cherry Point) is located along the shoreline of the Strait of Georgia, which leads to the Pacific Ocean (**Figure 2**). Cherry Point encompasses approximately 7,000 acres, or 11 square miles, and is zoned as a "Major/Port Industrial Urban Growth Area."[14]

Figure 2: Cherry Point Industrial Area in Whatcom County.

The Whatcom County Comprehensive Plan describes Cherry Point as follows:

"The land has long been planned and designated by Whatcom County for industrial development and is currently the site of three[15] major industrial facilities including two oil refineries and an aluminum smelter. Together, these three existing industries own about 4,400 acres of the total Cherry Point industrial lands. A fourth large tract of undeveloped land constituting approximately 1,500 acres is designated for industrial development."[16]

The Whatcom County Comprehensive Plan goes on to state: "The Cherry Point industrial lands have been designated for industrial development and, as a direct result of the industrial designation, incompatible and inappropriate residential development has been curtailed." [17]

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[14] https://www.whatcomcounty.us/DocumentCenter/View/33155/wczcp_oct2017r?bidId=

[15] Other "major" sources permitted under Title V *Air Operating Permit* and Title I *Preventions of Significant Deterioration Permit* in the area are Puget Sound Energy west of BP refinery and Chemco to the east of BP. They are Title V major of Volatile Organic Compounds and methanol (Hazardous Air Pollutants) emissions, and emit almost no SO_2.

[16] May 17, 2018 Whatcom County Comprehensive Plan, Chapter 2 – Land Use page 2-54: https://www.whatcomcounty.us/DocumentCenter/View/34301/Chapter-2-land-use

[17] May 17, 2018 Whatcom County Comprehensive Plan, Chapter 2 – Land Use page 2-58: https://www.whatcomcounty.us/DocumentCenter/View/34301/Chapter-2-land-use

Rural lands border Cherry Point to the north, east, and south, and water to the west. This further limits residential development close to the industrial area. The closest cities to Cherry Point are Blaine, about 10 miles to the north, and Ferndale, about 4 miles to the east. According to the United States Census Bureau, the 2018 population of Blaine was 5,436 and the 2018 population of Ferndale was 14,564.

Cherry Point is a home to the three facilities that emit SO_2:

1) Alcoa Intalco Works LLC (Intalco) aluminum smelter
2) BP Cherry Point oil refinery
3) Phillips 66 oil refinery

All three facilities are located along the shoreline. The BP refinery is located to the north of the Intalco facility and Phillips 66 is located to the south. **Figure 3** shows the long-term emission trends for these three large SO_2 emission sources and we describe each facility in details below.

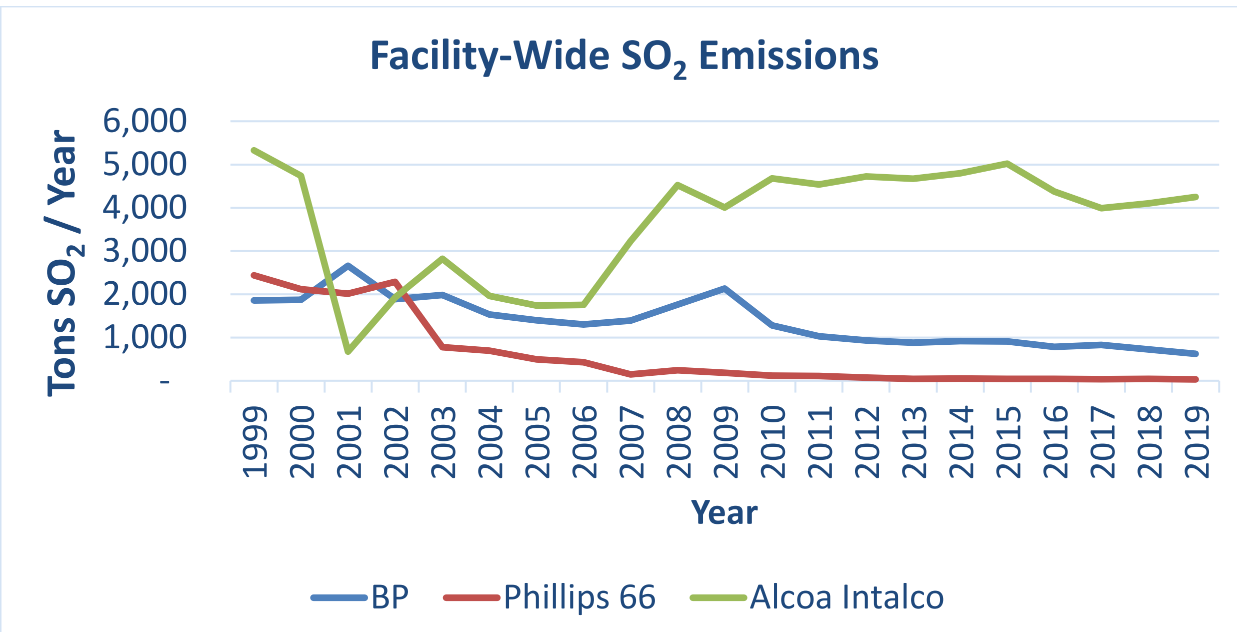

Figure 3: Annual SO_2 emission trends for the Cherry Point Industrial Area 1999-2019.

Intalco Aluminum Smelter

Alcoa, the first American company to produce commercial aluminum, built the Intalco Aluminum LLC aluminum smelter (Intalco) in 1965 in Whatcom County. It began operations in 1966 and currently is the oldest aluminum smelter still operating in the United States. Ecology's

Industrial Section[18] provides permitting and enforcement oversight and regulation for air, water, and waste activities at many of Washington's largest industrial facilities including the Intalco smelter. Permitting activities related to Intalco are available on Ecology's website[19]. Below is an introduction to the aluminum smelting process and resulting SO2 emissions. Further details about the facility's processes are in **Appendix C. About Intalco Primary Metals Works Aluminum Smelter (PDF).**

Feedstock for primary, or molten, aluminum is a sedimentary rock called bauxite. It is mined and processed into alumina (Al_2O_3) near the mining site, typically in Australia, using a caustic process. About four pounds of bauxite results in approximately two pounds of alumina, which in turn produces around one pound of aluminum.

Intalco has 720 electrolytic pots in which the molten aluminum is produced. The pots are arranged in 3 lines called potlines. The potlines are designated as A, B, and C. Each potline has two buildings (A-1 and A-2, B-1 and B-2, and C-1 and C-2) with 120 pots per building and 240 pots per potline. The operating pots run continuously (24 hours a day, 365 days per year). The average pot is operated for 6 years. After a pot is shut down, a new pot is rebuilt in its place.

Intalco has a production cap of 307,000 tons of aluminum/year. Intalco's January 2020 Air Monitoring Report noted that they were producing 546 tons of aluminum/day (199,290 tons/year) and were operating 524 of their 720 pots (73%).

Alumina does not contain sulfur in significant quantities and is not a source of SO_2 emissions. However, the process of reducing alumina to aluminum is very energy intensive and requires the use of electrical anodes. Intalco makes their own carbon anodes onsite using petroleum coke. The petroleum coke contains up to 3% sulfur by weight, which oxidizes to form the primary source of SO_2 emissions from the facility.

Sulfur dioxide emissions are directly proportional to sulfur content in the carbon anodes. Since the anodes are consumed in the process at a fixed rate, reducing the concentration of sulfur in the anodes results in less SO_2 being generated onsite. Alternately, emissions control devices, such as wet scrubbers, can reduce emissions after they are generated.

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18 https://ecology.wa.gov/Regulations-Permits/Permits-certifications/Industrial-facilities-permits
19 https://ecology.wa.gov/Regulations-Permits/Permits-certifications/Industrial-facilities-permits/Intalco

Figure 4: A bird's eye view of Intalco looking northeast across the facility toward Lake Terrell.

Historical SO_2 emissions records for Intalco are found in **Figure 3.** The following curtailments and startups have caused fluctuations in Intalco's SO_2 emissions from 2000 to date:

- Intalco curtailed in 2000 due to the Enron energy crisis.
- 2001 C-line and B-line were restarted. A-line was curtailed.
- 2007 A-line was restarted.
- 2009 B-line was curtailed.
- 2011 B-line restarted.
- 2006 South Half of B-line was curtailed and is still curtailed.

Intalco's SO_2 emissions reported in the Washington State Emission Inventory for 2017 through 2019 are summarized in the table below.

Table 3: Intalco's maximum permit limit for SO_2 emissions and actual emissions in 2017-2019 calendar years (tons per year).

Process	Annual potential emissions	2017 actual emissions	2018 actual emissions	2019 actual emissions
Bake ovens	3968	312	333	334
Potlines-dry and wet scrubbers	5240	3674	3770	3915
Miscellaneous	4	1	1	1
Metal products	1	0.07	0.06	0.06
Metal products	1	0.4	0.35	0.35
Total emissions at Intalco	9213	3987	4103	4249

On April 22, 2020, the Intalco facility announced that it would curtail its operations and stop aluminum production by July 2020, due to the market conditions. Curtailment is different from the facility ceasing operations. A curtailed facility often maintains its permits in order to be able to restart its operations should the market conditions improve. The active permits must comply with the NAAQS and meet other applicable state and federal requirements. However, the facility may exit voluntary agreements.

On April 23, 2020, Ecology received a 30-day written “null and void” notice from the facility about the Agreed Order No. 16449, an agreement to address elevated SO_2 levels recorded near the smelter in recent years. Under the agreement, should EPA designate the area as nonattainment, Intalco was to install a piece of equipment called a wet scrubber in 2022. The scrubber would then capture and remove the SO_2 before it is released into the air. The notice explains that the Intalco facility would not be proceeding with the plan to install new air pollution control equipment to reduce SO_2 emissions due to the curtailment and cites the following language in the Section 4 of the Order, Changed Business Conditions:

"Notwithstanding anything else in this Order, in the event that lntalco announces the closure or curtailment of one of its three potlines (A, B, or C line, or any combination or equivalent measure thereof), then upon thirty days' prior written notice to Ecology, this Order and lntalco's obligations hereunder will become null and void."

As part of the public review process, Ecology collected and responded to the public feedback when the Order was first proposed. The Response to Comments provides additional insights into the SO2 data and analysis in the area and is included, together with the “null and void” notice, in **Appendix D. Response to Comments. Intalco Aluminum Corporation. Air Quality Agreed Order No. 16499 (PDF).** The order can also be accessed online[20].

BP Cherry Point Refinery and Phillips 66 Refinery

The refinery now owned by BP began operating in 1971. According to BP's website, the refinery can process 250,000 barrels of crude oil per day.[21] Based on this production capacity, BP is the largest oil refinery in Washington State.

The refinery now owned by Phillips 66 began operating in 1954. According to Phillips 66's website, the refinery can process 105,000 barrels of crude per day.[22]

Over the years, the BP and Phillips 66 refineries have undertaken a number of projects that resulted in decreased SO_2 emissions. Some projects involved the installation of caustic scrubbers on the exhaust stacks of key process units to remove SO_2 before the release of the gas. Other projects reduce SO_2 by removing sulfur from refinery fuel-gas streams before these gases are burned for energy recovery.

Both BP and Phillips 66 have expanded their SO_2 scrubbing operations and their fuel-gas sulfur removal systems in a modular manner over a series of years. As shown in **Figure 3**, these expansions have reduced refinery SO_2 emissions by thousands of tons each year. The emissions data used for **Figure 3** is included in **Appendix E. Refineries and Intalco SO_2 Emissions 1999-2019 (EXCEL)**.

The operation of the BP and Phillips 66 sulfur removal systems are required by federal regulations. The refineries were also required to obtain air permits for these process units. The combination of federal regulations along with air permits forms a backstop that prevents the refineries from removing these process units and increasing their SO_2 emissions.

Refinery Sulfur Controls: Caustic Scrubbers

Both BP and Phillips 66 installed caustic scrubbers on key exhaust stacks to remove SO_2 before the exhaust gas releases into the atmosphere. Examples of projects in this category include:

- Installation of a caustic scrubber to remove SO_2 from the Phillips 66 fluidized catalytic cracking unit (FCCU) exhaust.
- Installation of caustic scrubbers to remove SO_2 from the exhaust of BP's three coke calciners.

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[20] https://ecology.wa.gov/DOE/files/a2/a2ce7cc7-d840-4517-b47f-23f5172263be.pdf
[21] BP website: https://www.bp.com/en_us/united-states/home/where-we-operate/washington/cherry-point-refinery.html
[22] Phillips 66 website: https://www.phillips66.com/refining/ferndale-refinery

Refinery Fuel-Gas Sulfur Removal System

The removal of sulfur from refinery fuel-gas before the gas is burned requires a number of refinery process units. This system removes sulfur from the gas stream so it is not available to form SO_2 during combustion. As such, the fuel-gas sulfur removal system is a large pollution-prevention device.

The system functions as follows:

- Refinery fuel gas streams leaden with sulfur, generally in the form of hydrogen sulfide (H_2S), are routed to amine absorbers. The amine absorbers contain an aqueous solution that absorbs the sulfur into the liquid phase, thus removing it from the gas stream.
- The sulfur-rich amine solution from the amine absorbers is routed to amine regenerators. Amine regenerators use heat and steam to strip the H_2S from the amine. The steam/gas mixture is cooled to condense the water, and the sulfur-rich gas is sent to the refinery sulfur recovery plant. The cleaned amine solution is sent back to the amine absorbers to be reused.
- At the sulfur recovery plant, the sulfur-rich gas from the amine regenerators is fed through a series of process units that convert H_2S to elemental sulfur. The elemental sulfur is removed as a molten liquid and shipped from the refinery to be used elsewhere.

Specific projects that took place between 1999 and today

The following list includes a sample of specific projects that BP and Phillips 66 undertook to reduce their SO_2. For brevity, the list of refinery projects only includes projects that took place since 1999.

- In 1999, BP installed a scrubber to treat vacuum tail gas generated at the vacuum diesel fractionator and vacuum tower. The sulfur captured by the scrubber is routed to the sulfur recovery plant where it is converted to elemental sulfur.
- In 2002, Phillips 66 installed a scrubber on its fluidized catalytic cracking unit to remove sulfur from the gas stream.
- In 2006, BP installed a second tail gas unit at its sulfur recovery plant to increase the amount of sulfur it removed from the gas stream.
- The emission reductions resulting from these projects, and numerous others, are evident in the refinery emission decreases seen in **Figure 3**.

Whatcom County SO_2 Emissions Data

Emissions Inventory Overview

NWCAA, Ecology, and EPA collect information about SO_2 emissions in Whatcom County, which is included in an annual and triennial emissions inventory (EI). The EI is not based on ambient air quality monitoring observations. Instead, the EI is a collection of annual emissions estimates that are calculated using publicly available information (population, permitted facilities, road activity, registered vehicles, etc.) and EPA models or emission factors usually documented in the Compilation of Air Pollutant Emission Factors[23] (AP-42[24]; e.g., from source test data, material balance studies, and engineering estimates).

The EI is comprised of several categories, each with their own methodology. The categories and methodologies are described below:

- Large point sources report their annual emissions directly to the state.
- Estimates for emissions from commercial ships and port operations are based on the reports developed by the Starcrest Consulting Group, LLC.
- Aircraft emissions are estimated by EPA based on airport activity reports.
- Industrial/commercial/institutional/residential fuel combustion emissions that are not reported in the large point source category are mostly developed by EPA methodology, using federal reports on fuel use and state estimates of residential wood use.
- Locomotive emissions are based on annual fuel use reported by the railroad companies.
- On-road and non-road equipment/vehicle emissions are estimated using the EPA MOVES model, with actual licensed vehicle counts included.
- Recreational boat emissions are based on county-level registered boat licenses and EPA methodology.
- Wildfire emissions are based on the United States Forest Service BlueSky model.
- Residential outdoor burning emissions are based on population estimates and EPA methodology.

[23] https://www.epa.gov/air-emissions-factors-and-quantification/ap-42-compilation-air-emissions-factors
[24] Compilation of Air Pollutant Emission Factors. AP stands for Air Pollutant. The 42 refers to the publication number. 999-AP-42.

EPA works with states to develop the National Emissions Inventory (NEI) every three years. Ecology compiles a comprehensive emissions inventory every three years, matching the NEI cycle, which sometimes includes minor differences relative to the NEI.[25] The most recent complete emissions datasets are for 2017.

Table 4 summarizes estimates of SO_2 emissions from fourteen categories in Whatcom County for 2014 and 2017, in tons per year. Our estimates show that Large Point Sources[26] (e.g. Title V AOP facilities) are the largest and the main source of SO_2 emissions in the county.

Table 4: Whatcom County SO_2 Emissions Inventory (2014 & 2017, tons per year).

Source Category	2014, tpy	2017, tpy
Large point sources	5,785	4,877
Commercial ships	2,256	27.1
Agricultural & prescribed burning	4.3	0.5
On-road mobile vehicles	16.7	6.6
Aircraft	8.6	8.7
Industrial and commercial/institutional fuel combustion (NEC)	40.1	34.0
Locomotives	0.2	0.2
Miscellaneous	0.1	0.1
Non-road equipment & vehicles (NEC)	1.3	0.8
Recreational boats	0.2	0.1
Residential fuel use (non-wood)	12.3	2.6
Residential outdoor burning (trash/yard)	14.5	7.3
Residential fuel use (wood)	9.2	6.8
Wildfires	0.2	3.2
Total	8,149	4,975

Most of these categories show little change in emissions in Whatcom County from 2014 to 2017. Emissions changes for the fuel use and outdoor burning categories are uncertain due to methodology changes. However, there is certainty that changes in large point sources, on-road vehicles, and commercial ship emissions are well-represented. Decreases in large point sources

[25] Depending on the sector and year, Ecology's comprehensive emissions inventory may not completely match the data in the NEI. The NEI has no mechanism for updates after its release. Ecology sometimes finds errors and fixes them, or uses a different methodology from the one used by EPA.

[26] The difference between "Large Point Sources" and other categories is that large sources have Title V Air Operating Permits (AOP). They are required to report their emissions annually because they emit above HAP or CAP thresholds for major sources. Note that select non-majors in Whatcom County also report their emissions annually and are represented in this category.

were mainly from Intalco (807 tons) and the BP Cherry Point refinery (89 tons). The large drop in emissions from commercial ships is due to new regulations that require lower sulfur content fuel to be used by ships near the coast, greatly reducing SO_2 emissions. The fuel used in the Emission Control Area (ECA) was required to be reduced to 0.1% fuel-sulfur level (or equivalent) by 2015.

Whatcom County has the largest SO_2 emissions of any county in Washington, due to the large industrial sources in the Cherry Point Industrial Area. Historically, many counties along the coast and in the Puget Sound have had large SO_2 emissions due to commercial ships. However, now that low-sulfur fuel is used in the ECA zone, human-made SO_2 emissions in the state are only significant at large point sources. Only Whatcom (4,877 tons), Walla Walla (890 tons), Lewis (1,799 tons), Skagit (514 tons), and Cowlitz (616 tons) counties have point source SO_2 emissions over 500 tons per year. SO_2 emissions in the state are relatively small for the other human-made source categories, with the exception of aircraft emissions in King County (523 tons) and ship emissions in Clallam County (133 tons).

Source-Specific Emissions in Whatcom County

In **Table 5**, we list the Air Operating Permit[27] (AOP) sources permitted for Criteria Air Pollutants (CAPs) in Whatcom County along with their 2018 SO_2 emissions. The Intalco smelter is under Ecology's permitting jurisdiction, while all other facilities in **Table 5** are under NWCAA's permitting jurisdiction.

[27] Businesses that emit large amounts of air pollutants are regulated under Title V of the federal Clean Air Act. Each Title V business is required to hold an air-operating permit (AOP). See WAC 173-401-200 (19)(a) and (b).

Table 5: 2018 SO_2 emissions from AOP sources permitted for CAPs in Whatcom County.

Facility Name	2018 SO_2 Emissions (tons/year)
Alcoa Intalco Aluminum Smelter *	4,103
BP Cherry Point Refinery *	726
Phillips 66 Refinery *	43
Northwest Pipeline Sumas	10
Puget Sound Energy – Ferndale	6
Puget Sound Energy – Encogen	2
Puget Sound Energy – Whitehorn *	1
Chemco *	0
Lehigh Northwest Cement	0
MAAX US Corp.	0
Post Point Wastewater Treatment Plant	0

* *Facility located in Cherry Point Industrial Area.*

The only other facility in the area of interest is Petrogas West (Petrogas), which is adjacent to Intalco and shares the same dock with Intalco. Petrogas is not an AOP source as they only burn natural gas and other low-sulfur fuels resulting in low levels of SO_2 emissions. Since 2016, Petrogas only emitted a maximum of 2.8 tons/year of SO_2.

To summarize, except for the Intalco facility, total combined SO_2 emissions from all of the AOP facilities in Whatcom County were about 790 tons. This is substantially below the 2,000-ton threshold for triggering evaluations of the SO_2 concentrations in the ambient air and is unlikely to cause or contribute to potential violations of the standard. Therefore, apart from the area near the Intalco facility, the rest of the county is likely meeting the standard due to low levels of SO_2 emissions.

SO_2 Monitoring in Whatcom County

Washington Air Quality Monitoring Network Introduction

Most of Washington's air quality monitoring network, one of the most extensive and reliable in the nation, is dedicated to characterizing two most prevalent pollutants — fine particulate matter ($PM_{2.5}$) and ozone. The remainder of the network is made up of monitors that measure larger particles (PM_{10}), carbon monoxide (CO), sulfur dioxide (SO_2), oxides of nitrogen, fine particle chemical composition, air toxics, and meteorological parameters.

Ecology's Air Quality Program partners with local clean air agencies, tribes, and federal agencies to operate monitoring sites and collect air quality information for a variety of applications across the state. There is a large variety in the types of monitoring sites operated by Ecology and its partners. Some monitoring sites undergo very stringent and regular quality control activities and are used for making policy and Prevention of Significant Deterioration (PSD) permitting decisions. Other monitoring sites may be operated to track specific problems like community wood smoke impacts or pollution from industrial sites. Still others may be temporary and used to quickly identify, for example, an acute air quality situation like the dispersion of wildfire impacts. Thus, the monitoring data from the Washington State monitoring network serves a variety of needs, including to:

- Determine if air quality is meeting federal standards
- Provide near-real-time air quality information for the protection of public health
- Forecast air quality
- Make daily burn decisions and curtailment calls
- Assist with permitting activities
- Evaluate the effectiveness of air pollution control programs
- Evaluate the effects of air pollution on public health
- Determine air quality trends
- Identify and develop responsible and cost-effective pollution control strategies
- Evaluate air quality models

For simplicity in this discussion, the SO_2 monitoring sites can be thought of as either "regulatory" or "non-regulatory". Regulatory monitoring sites are those that are part of the State and Local Air Monitoring Station (SLAMS) network. Non-regulatory monitoring sites are operated outside of Washington's air monitoring network.

Ecology and local air agencies like NWCAA monitor SO_2 to determine representative pollutant concentrations in areas of high population density, assess general background pollutant concentrations, and identify the impact of significant sources or source categories on pollutant concentrations in the ambient air.

Before the 2010 standard, all areas in the state met the 1971 SO_2 standard and there was no need or requirement for more frequent monitoring. The new short-term standard brought into focus localized impacts near large sources of SO_2 pollution.

Prior to 2017, the closest ambient SO_2 regulatory monitoring site to Whatcom County is located in the City of Anacortes in Skagit County. SO_2 monitoring began at Anacortes in 2011 to assess population exposure and source impacts from industrial and shipping activities. The site observes concentrations of SO_2 well below the SO_2 NAAQS and is considered representative of general, or background, SO_2 concentrations and meteorology in the region, including most of Whatcom County where there is little to no large SO_2 emitters.

NWCAA's regulations require oil refineries to operate non-regulatory SO_2 monitors at or near their fencelines. These industrial monitors have operated with oversight from NWCAA for years and have shown a steady downward trend in SO_2 concentrations. The SO_2 monitoring data from the BP and Phillips 66 refineries in Whatcom County, Cherry Point, is included in **Appendix B. Cherry Point Industrial Area Hourly SO_2 and Meteorology Data 2017-2019 (EXCEL)**. This trend is consistent with the decrease in SO_2 emissions at the corresponding facilities shown in **Figure 3**.

In 2017, Intalco began operating two ambient SO_2 regulatory monitoring sites near the facility. These sites, installed and operated under federal requirements, collect the monitoring data needed to identify the impact of significant sources on ambient SO_2 concentrations and characterize the area's SO_2 compliance status. Of key importance, one of the two monitors recorded a violation of the SO_2 NAAQS over the three year period of 2017-2019. The data from these monitors is discussed in detail below.

In addition, in 2019 NWCAA began monitoring SO_2 at a temporary, non-regulatory, monitoring site on the edge of the City of Ferndale, Washington. The temporary monitor was cited downwind from the Intalco's Ferndale-Mountain View monitoring site, the site with the highest readings. This monitor was used to evaluate SO_2 impacts on the City of Ferndale when the Intalco monitor recorded high SO_2 readings.

When a monitor records a violation of the NAAQS, it triggers an additional analysis to determine the extent of the area impacted by the elevated levels of pollution and identify if the violation is a result of multiple sources or a single-source. We discuss our findings in details below and provide supporting evidence to demonstrate that elevated levels of SO_2 have been found in the areas immediately adjacent to the Intalco facility property line, and do not reach Ferndale and nearby communities.

Intalco SO_2 Monitoring Data Analysis

Regulatory Monitoring Sites

Ecology proposed establishing two new SO_2 sites near Intalco in the 2016 Ambient Air Monitoring Network Plan[28]. Following EPA's concurrence, Intalco installed, and has been operating, two SO_2 monitoring sites near the facility as part of the Washington Ambient Air Monitoring Network (Washington Network) and Ecology's Primary Quality Assurance Organization (PQAO) since January 1, 2017. Shown on the map in **Figure 5** are the monitoring sites, and **Table 6** summarizes their metadata.

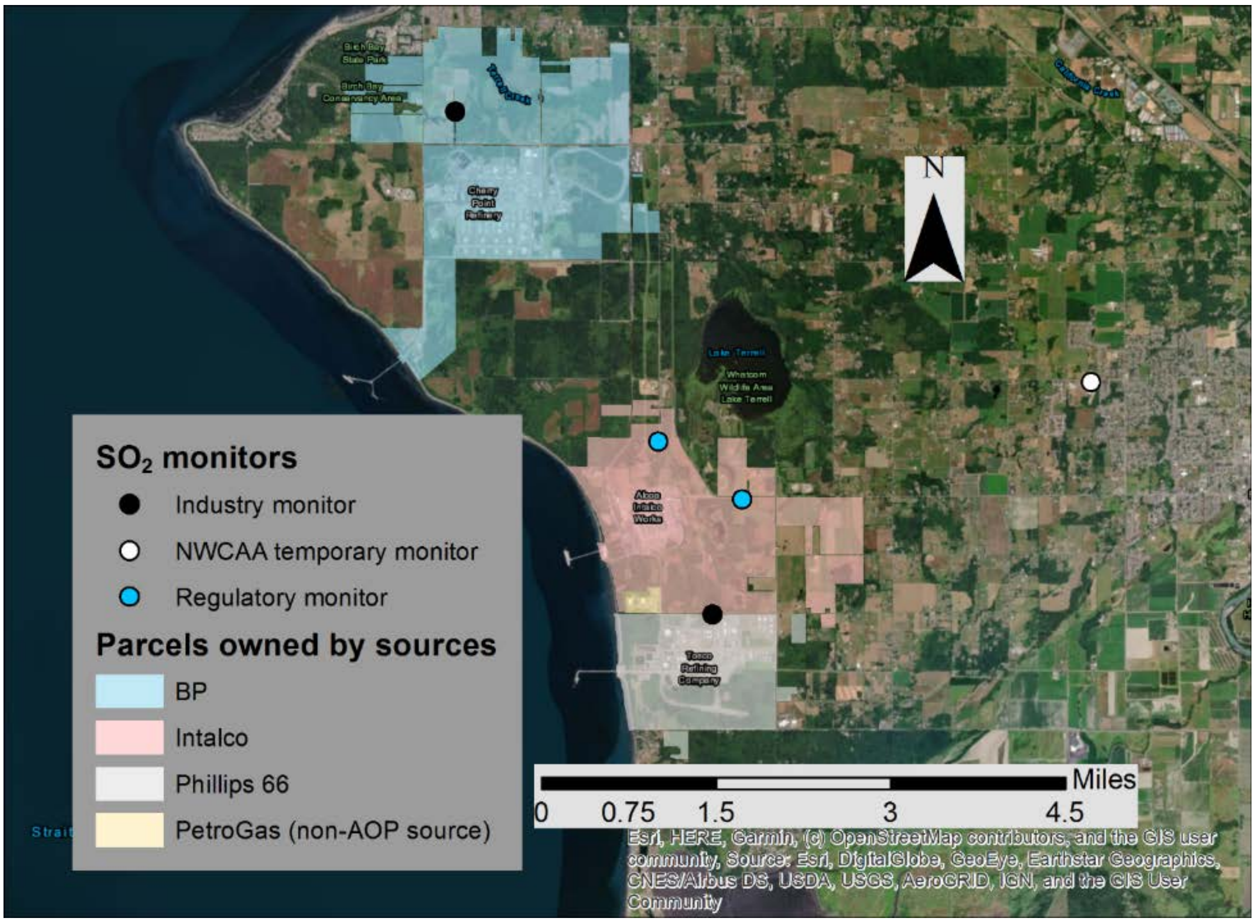

Figure 5: Map of the Cherry Point Industrial Area monitoring sites.

[28] https://www.epa.gov/amtic/washington-2016-annual-network-plan

Table 6: Summary of Ferndale monitoring site metadata.

Site Name	AQS ID	Latitude	Longitude	Parameters Measured
Ferndale-Kickerville Road	53-073-0013	48.855274	-122.704700	SO_2
Ferndale-Mountain View Road	53-073-0017	48.848065	-122.688888	SO_2, Wind Speed, Wind Direction, Ambient Temperature

Both sites are located on Intalco property near the property line and in publicly accessible areas that meet EPA criteria for ambient air as defined in 40 CFR § 50.1(e). These monitoring sites are referred to as Ferndale-Kickerville Road and Ferndale-Mountain View Road sites. Both monitors are sited and operated in accordance with the ambient monitoring network requirements described in 40 CFR § 58, including the Quality Assurance Requirements for Monitors used in Evaluations of National Ambient Air Quality Standards (Appendix A) and the Probe and Monitoring Path Siting Criteria for Ambient Air Quality Monitoring (Appendix E).

Since meteorological measurements made at the Ferndale-Mountain View Road site are used in dispersion modeling for Prevention of Significant Deterioration (PSD) permitting, the procedures followed to ensure they meet data quality objectives of the PSD program are outlined in **Appendix F. Summary of Prevention of Significant Deterioration Quality Assurance Procedures for Meteorological Data at Ferndale-Mountain View Road Monitoring Site (PDF)**.

The Ferndale-Kickerville Road site is located north of the Intalco facility, and the Ferndale-Mountain View Road site is located east of the Intalco facility, near the public Mountain View road. Ecology identified appropriate locations for the two Ferndale monitors in 2015 by running the AERMOD dispersion model using SO_2 actual emissions from BP, Intalco, and Phillips 66. Ferndale-Kickerville was identified as a suitable site due to the historical data record from an industry-monitoring site operated by the Intalco facility as recently as 2014. In addition to the historical record, the Ferndale-Kickerville site is also located downwind of the Intalco facility when winds are blowing from the dominant wind direction. The Ferndale-Mountain View site was added as a new site in the area of highest expected concentrations based on the AERMOD results.

Both monitors record exceedances of the 1-hour SO_2 NAAQS of 75 ppb. Only the Ferndale-Mountain View monitor has recorded a design value above 75 ppb. **Table 7** summarizes the annual 99th percentiles of 1-hour daily maximum concentrations and the 3-year design values. The design value of 106 ppb at the Ferndale-Mountain View monitor violates the 75 ppb 1-hour SO_2 NAAQS.

Table 7: Summary of Intalco-Ferndale annual 99th percentiles and design values (in parts per billion).

Site	2017 99th Percentile (ppb)	2018 99th Percentile (ppb)	2019 99th Percentile (ppb)	2017-2019 Design Value (ppb)
Ferndale-Kickerville Road	70.0	73.7	69.6	71
Ferndale-Mountain View Road	113.6	101.3	104.5	106

We show the annual 99th percentiles in comparison with the 1-hour SO_2 NAAQS in the graph in **Figure 6**.

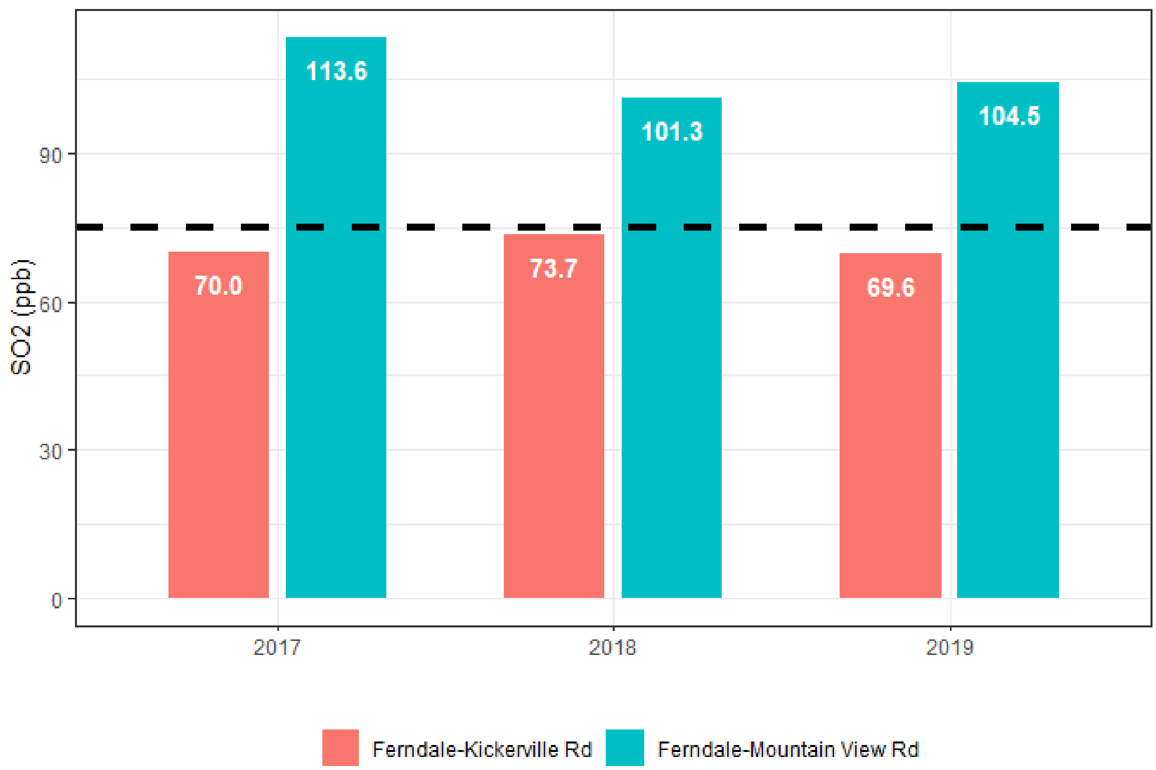

Figure 6: Annual 99th percentile daily maximum 1-hour concentrations.

At the Ferndale-Mountain View Road monitor, exceedances have only occurred during a 60-degree range of wind directions (235-295 degrees) that places the monitor directly downwind of the Intalco facility. The polar plot in **Figure 7** shows the maximum SO_2 concentration observed in 2017-2019 by each unique combination of wind speed and wind direction from the full dataset (regardless of whether those maxima resulted in exceedances). The concentric circles represent wind speed in miles per hour. The location of the colors relative to the origin (center of the plot) represent the angle from which the wind was blowing. The colors represent the maximum SO_2 concentration observed at each unique pair of wind speed and wind direction values. The highest SO_2 values are observed when the wind is blowing from the west between 3 and 8 mph. Elevated SO_2 concentrations are only observed when the Intalco facility is upwind from the monitoring site, as it is located due west of the monitoring site.

Additionally, the monitoring data at the violating monitoring site can be described using the Air Quality Index, which is helpful for evaluating potential public health implications of the SO_2 levels seen in this area. See **Air Quality Index and Number of Exceedances of the Standard** section later in the document for more details.

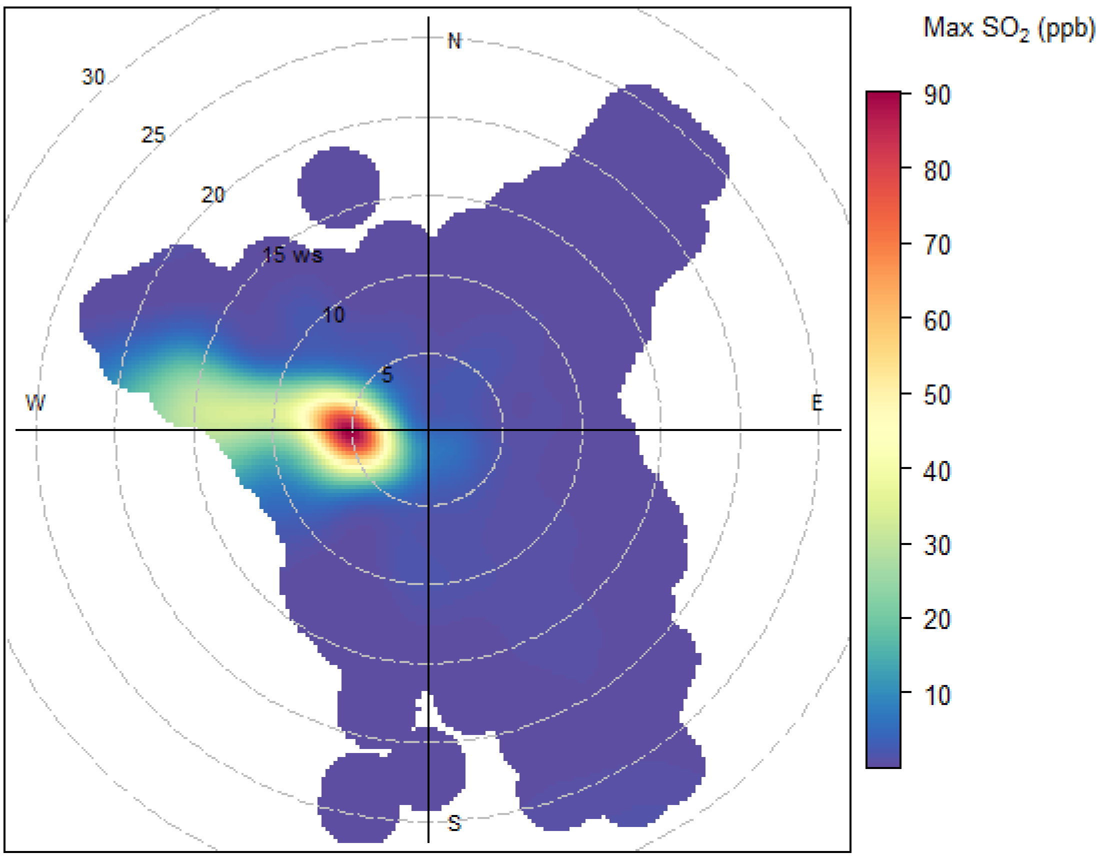

Figure 7: Polar plot of maximum SO_2 concentrations by each unique combination of wind speed and wind direction.

Non-Regulatory SO_2 Monitoring in Cherry Point and the Nearby Area

There are two other ongoing Cherry Point SO_2 monitors, located close to the BP Cherry Point and Phillips 66 refineries. These monitors are operated by the respective facilities. NWCAA requires the refineries to operate these fenceline monitors and audits the monitors to assure data integrity. The readings at both the BP and Phillips 66 SO_2 monitors are well below the SO_2

NAAQS, **Appendix B. Cherry Point Industrial Area Hourly SO_2 and Meteorology Data 2017-2019 (EXCEL)**.

In addition, in June 2019 NWCAA commenced monitoring SO_2 on the edge of the City of Ferndale as a supplemental, temporary monitoring site outside of the Washington Network and Ecology's PQAO. Placed downwind from the Ferndale-Mountain View Road monitor, which recorded the highest values, this temporary monitor helps to understand SO_2 impacts on the City of Ferndale during the times when the wind blows from Intalco towards the Ferndale-Mountain View Road monitor and the city. It is about 2.5 miles east of Cherry Point (**Figure 5**). Though design values cannot be calculated as yet, data collected here indicates that SO_2 concentrations never exceed 60% of the SO_2 NAAQS. This is true even on days such as July 21 and 25, 2019, when the Ferndale-Mountain View Road monitor recorded 1-hour SO_2 readings of 90.8 ppb and 104.5 ppb respectively. This observation that the SO_2 levels above the standard do not reach Ferndale has been also confirmed with modeling, which we discuss later in this report. It is also worthy to note that the temporary site, while recording lower levels of SO_2 impacts, shows the same fluctuations as captured by the Mountain View Road monitor. This suggests that while high SO_2 levels dissipate before reaching the temporary Ferndale monitor, the monitor does observe SO_2 impacts during the times when the wind blows from Intalco.

The monitoring data from the NWCAA temporary monitor are summarized in **Appendix B. Cherry Point Industrial Area Hourly SO_2 and Meteorology Data 2017-2019 (EXCEL)** of this report.

Air Quality Index and Number of Exceedances of the Standard

EPA and state and local agencies use the Air Quality Index (AQI) to display monitoring data using various visualization tools in an accessible way. The AQI is an index for reporting daily air quality. It tells how clean or polluted the air is, and what associated health effects might be a concern.

The AQI has a scale that runs from 0 to 500. The higher the AQI value, the greater the level of air pollution and the greater the health concern. The AQI is divided into six categories explained in the **Table 8**.

An AQI value of 100 generally corresponds to the national air quality standard for the pollutant, which is the level EPA has set to protect public health. Thus, an AQI of 100 for SO2 corresponds to a 1-hour average of 75 ppb of SO2. When AQI values are above 100, air quality is considered to be unhealthy – at first for certain sensitive groups of people, then for everyone as AQI values get higher.

The AQI scale is different from the Design Value (DV) metric and serves different goals. The AQI is often used in public health advisories and reports on real-time levels or forecasts upcoming air quality levels, which may be as the result of human or natural activities. EPA does not use the number of days in various AQI categories to calculate whether an area attains the standard.

A determination of nonattainment implies that the exceedances occurred repeatedly and from human-made sources, while AQI reflects air quality independent of whether the sources of pollution were controllable or not. Some examples of uncontrollable sources would be a volcanic eruption or wildfire events.

Ecology evaluated the highest 1-hour average in each 24-hour period in 2017, 2018, and 2019 at the violating monitor to place each day into the appropriate AQI category. The results are summarized in **Table 9** and indicate that the area appears to experience similar number of days above the standard ("Unhealthy for Sensitive Groups" or USG) each year, and between total of 70 to 93 days (9 to 12 weeks) of air quality being in the "Moderate" category.

Table 8: Explanation for the six AQI ranges and associated air quality conditions and colors.

AQI Range	Level	Color	Description
0-50	Good	Green	Air quality is considered satisfactory, and air pollution poses little or no risk.
51-100	Moderate	Yellow	Air quality is acceptable; however, for some pollutants there may be a moderate health concern for a very small number of people. For example, people who are unusually sensitive to ozone may experience respiratory symptoms.
101-150	Unhealthy for Sensitive Groups (USG)	Orange	Although general public is not likely to be affected at this AQI range, people with lung disease, older adults and children are at a greater risk from exposure to ozone, whereas persons with heart and lung disease, older adults and children are at greater risk from the presence of particles in the air.
151-200	Unhealthy	Red	Everyone may begin to experience some adverse health effects, and members of the sensitive groups may experience more serious effects.
201-300	Unhealthy	Purple	This would trigger a health alert signifying that everyone may experience more serious health effects.
301-500	Hazardous	Maroon	This would trigger health warnings of emergency conditions. The entire population is more likely to be affected.

Table 9: Number of days in each AQI category at the violating monitor.

Year	Good	Moderate	Unhealthy for Sensitive Groups	Unhealthy	Very Unhealthy	Hazardous
2017	262 days	93 days	10 days	None	None	None
2018	268 days	85 days	12 days	None	None	None
2019	285 days	70 days	10 days	None	None	None

It is important to note that the monitoring station represents only one area downwind of the Intalco facility. We can anticipate similar impacts but on different days in other wind directions that we do not capture at the violating monitoring site. As we show in the **Intalco SO_2 Dispersion Modeling Analysis** section below, the modeling analysis suggests that USG levels can be seen during north, northwest, and westerly winds.

Ecology's public health advisories in the area near the Intalco facility and the violating monitor cannot be forecasted real-time at this time due to variable emissions rate and hyper-local meteorological circumstances that often change quickly. However, near-real-time air quality data are available on Ecology's monitoring website at https://fortress.wa.gov/ecy/enviwa/.

Retrospectively, the AQI assessment allows us to characterize general public health advisory for the areas around the Intalco facility. As you will see in the **Intalco SO_2 Dispersion Modeling Analysis** section below, the USG areas have been observed and modeled in the immediate vicinity of the Intalco property line within approximately one mile (600 meters). EPA's public health advisory for each AQI category is summarized in **Table 10**. People with pre-existing conditions may want to consult with their physicians if they may benefit from additional protective actions.

Table 10: EPA Air Quality Index categories and corresponding health advisory.

How can I protect my health at different AQI values?	
AQI Value	**Actions to Protect Your Health**
Good (0-50)	None.
Moderate (51-100)	None.
Unhealthy for Sensitive Groups (101-150)	People with asthma should consider reducing exertion outdoors.
Unhealthy (151-200)	Children, asthmatics, and people with heart or lung disease should reduce exertion outdoors.
Very Unhealthy (201-300)	Children, asthmatics, and people with heart or lung disease should avoid outdoor exertion. Everyone else should reduce exertion outdoors.
Hazardous 301-500	Health warning of emergency conditions: everyone is more likely to be affected and should take protective actions.

Intalco SO_2 Dispersion Modeling Analysis

Introduction to SO_2 Dispersion Modeling

EPA supports the use of air quality modeling when it comes to analyzing SO_2 concentrations in the air and estimating contributions from different sources to those concentrations. A properly executed modeling run is expected to closely match levels recorded at the monitoring sites in the modeling domain. To ensure quality and consistency across different areas, EPA oversees and regulates how states use air quality modeling for evaluating compliance with the NAAQS.

EPA established *Guideline on Air Quality Models* (U.S. EPA, 2017[29]) where it provides EPA's preferred models, recommended techniques, and guidance for how to estimate ambient concentrations of air pollutants. It is incorporated in the Appendix W to 40 CFR part 51. Dispersion modeling uses mathematical formulations to characterize the atmospheric processes that disperse a pollutant emitted by a source. Based on emissions and meteorological inputs, a dispersion model can be used to predict concentrations at selected downwind receptor locations.

States can use EPA's modeling guideline to characterize projected future air quality based on allowable emissions or to retrospectively evaluate how actual emissions in the past contributed to the elevated values at the monitoring site. The latter is the focus of the modeling analysis we discuss in this report. Ecology uses this modeling analysis to answer the following questions:

1) Apart from the violating monitoring site area, what are other areas that might be impacted by the elevated SO_2 concentrations in the area;
2) Which sources contribute to the SO_2 concentrations that are in violation of the health standard and if there is there a combined emissions effect; and
3) Quantify contributions to the violating monitor by all sources in the area.

EPA's preferred near-field dispersion modeling system is American Meteorological Society (AMS)/EPA Regulatory Model or AERMOD. In August 2016, EPA issued a *Technical Assistance Document: SO_2 NAAQS Designations Modeling*[30] also known as SO_2 Modeling TAD. In it, EPA presents recommendations on how an air agency might appropriately and sufficiently model ambient air in proximity to or impacted by an SO_2 emission source(s) to assess compliance with the SO_2 NAAQS. The primary objective of the modeling would be to determine whether an area currently meets the SO_2 NAAQS, and thereby support EPA in their designation process for the area. In the TAD, EPA recommends steps to characterize current air quality based on actual emissions for the most recent years for a source of interest, and for any nearby sources, which

[29] https://www3.epa.gov/ttn/scram/guidance/guide/appw_17.pdf
[30] https://www.epa.gov/sites/production/files/2016-04/documents/so2modelingtad.pdf

may influence the air quality of the area. The TAD also presents recommendations on proper use of modeling inputs, such as emissions, meteorological data, and background concentrations. It differs from modeling conducted for attainment planning and permitting purposes, which often requires modeling future maximum allowable emissions based on the enforceable permit limits.

Since the purpose of this technical report is to evaluate the actual SO_2 data and impacts that occurred in 2017-2019 in the area near the violating monitoring site, Ecology closely followed the SO_2 Modeling TAD to delineate how the dispersion modeling is to be done in the area.

Intalco's Dispersion Modeling

The Intalco facility contracted a consulting firm AECOM to assess the SO_2 concentrations recorded at the monitoring site and the facility's contribution to those levels. In close coordination with Ecology and EPA Region 10, AECOM prepared a modeling protocol and run the EPA-approved AERMOD air dispersion model. In February 2020, AECOM submitted the results of their model run to Ecology for review by Ecology, EPA, NWCAA, and the Washington State Petroleum Association on behalf of the two refineries. In response to the feedback, AECOM followed up with an addendum in March, 2020. The report and addendum are included in **Appendix G. Alcoa SO_2 Modeling Report for Intalco 2020-02-06 and Addendum 2020-03-19 (PDF).** Ecology reviewed the modeling analysis for accuracy and validity. Additionally, Ecology prepared an in-depth analysis of whether or not the emissions from the two refineries mixed with the Intalco's emissions resulting in the violation of the standard. Ecology found that the violation of the SO_2 standard had been triggered by the Intalco's facility emissions only. We discuss our specific findings further down in the report.

AECOM, Ecology, and EPA agreed to use the following inputs and parameters in the model:

- The modeling domain is 41.7 by 47 kilometers, or 25.5 by 29.2 miles. Selection of the modeling domain is important because it defines how many sources to explicitly model and what kind of receptor network to create. Even though SO_2 pollution does not travel far and the monitoring data suggested that a modeling domain of 10 x 10 km would likely cover all area impacted by elevated SO_2 concentrations, we chose larger domain to confirm if higher SO_2 impacts were observed on elevated terrain.

- There are 23,681 modeling receptors in the domain. The receptor network covers the entire modeling domain and the receptor placement is sufficiently dense to provide resolution needed to detect significant gradients in the concentrations, with receptors placed closer together near the source to detect local gradients and placed farther apart away from the source. Additionally, receptors were placed at key locations such as around facilities fence lines (which define the ambient air boundary for a particular source) or monitoring site locations (for comparison to monitored concentrations for model performance evaluation purposes). A higher density of receptors was placed on the elevated terrain of Haynie Hill, Orcas Island, Lummi Island and Bellingham City.

- The model was run based on monthly averages of actual emissions from each SO_2 release point at the Phillips 66 refinery, the BP Cherry Point refinery, and the Intalco smelter, from 2017- 2019. Ecology confirmed that monthly breakdowns of unit-specific emissions data supplied by the respective facilities very closely corresponded with data previously reported to Ecology.
- To characterize wind flows in the model, AECOM used representative, PSD-quality meteorological data measured at the Ferndale-Mountain View Road monitoring site from the concurrent period (**Appendix F. Summary of Prevention of Significant Deterioration Quality Assurance Procedures for Meteorological Data at Ferndale-Mountain View Road Monitoring Site (PDF)**).
- When on- site measurements were missing or failed to meet PSD data quality objectives, they were substituted with official National Weather Service meteorological records collected at Bellingham International Airport.
- The presence of buildings and stacks can affect the initial dispersion of pollutants within the atmosphere. As the wind flows over and around buildings it impacts the dispersion of pollution from nearby stacks. This phenomenon, called building downwash, is important for accurate modeling and Ecology confirmed that the model accounted for it at all facilities.
- We estimated that background SO_2 concentrations from sources not explicitly modeled to be at 3 ppb.

Figure 8 provides a close-up of modeled receptors around the Intalco property to depict the dense receptor network employed in the model.

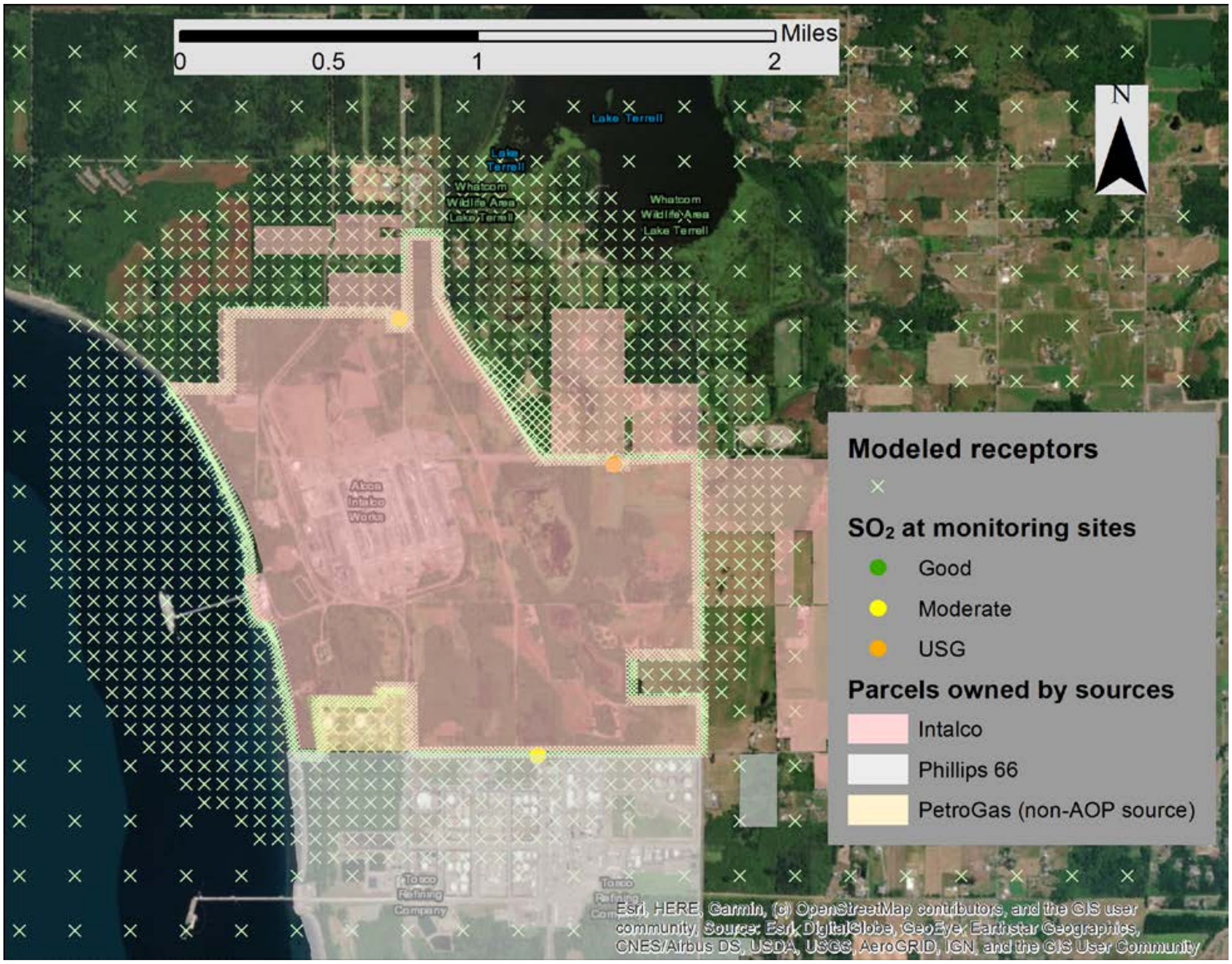

Figure 8: A dense distribution of modeling receptors around the Intalco property line.

Model Performance Evaluation

Model performance is an assessment of how well the modeled SO_2 concentrations match with those observed at the monitoring sites under the same meteorological conditions. The closer the modeling results to the monitoring results, the more accurate and reliable the model is. The model prepared by AECOM matched the measured design values at nearby regulatory monitoring sites, Ferndale-Kickerville Road and Ferndale-Mountain View Road, to within 10%. This indicates that the model performance in the near-field, or in the immediate vicinity of Intalco, is acceptable and can be relied on for evaluating the concentration gradient near the fence line and the extent of the areas that experience SO_2 concentrations above the standard.

The model over-predicted the design values at the BP and Phillips 66 monitoring sites. Because it still showed them well below the SO_2 NAAQS and the monitoring sites demonstrate complete compliance with the SO_2 NAAQS, Ecology accepted modeling results at BP and Phillips 66. For the additional details illustrating the modeled design values at the refineries' fenceline monitoring sites see Figures 5-5 and 5-6 in the **Appendix G. Alcoa SO_2 Modeling Report for Intalco 2020-02-06 and Addendum 2020-03-19 (PDF).**

The 99th percentile of daily maxima measured at NWCAA's temporary SO_2 monitor in Ferndale between June and December of 2019 corresponds closely with the model, based on a partial year of data.

The measured and modeled design values and 99th percentile at the monitoring sites described above are summarized in **Table 11.**

Table 11: Measured and modeled design values at nearby monitors.

SO_2 Design Value, ppb	BP	Phillips 66	Ferndale-Kickerville	Ferndale-Mountain View	Ferndale school (temporary)
Monitored	11	23	71	106	31*
Modeled	25	36	69	97	32

Figure 10 further illustrates the modeling receptors with a design value above the SO_2 NAAQS and their relation to the design values calculated based on the monitoring data at the area's monitoring sites. The design values that were calculated based on monitoring data are grouped into AQI categories and show "Good", "Moderate", and "Unhealthy for Sensitive Groups" in that order, as they get closer to the Intalco facility's property line. The violating receptors are categorized using the AQI ranges as well and range from "Unhealthy for Sensitive Groups" to "Unhealthy". The "Unhealthy" receptors are seen immediately at the facility's border and concentrated in two places downwind of the facility in the directions following prevailing winds. As expected, the model shows the USG concentrations immediately adjacent to either the facility's property line or to the "hot spots" in Unhealthy category. The standard-violating receptors to the northeast of the facility align with the violating monitoring site. There are no violating receptors observed in the areas where the monitoring data also shows compliance.

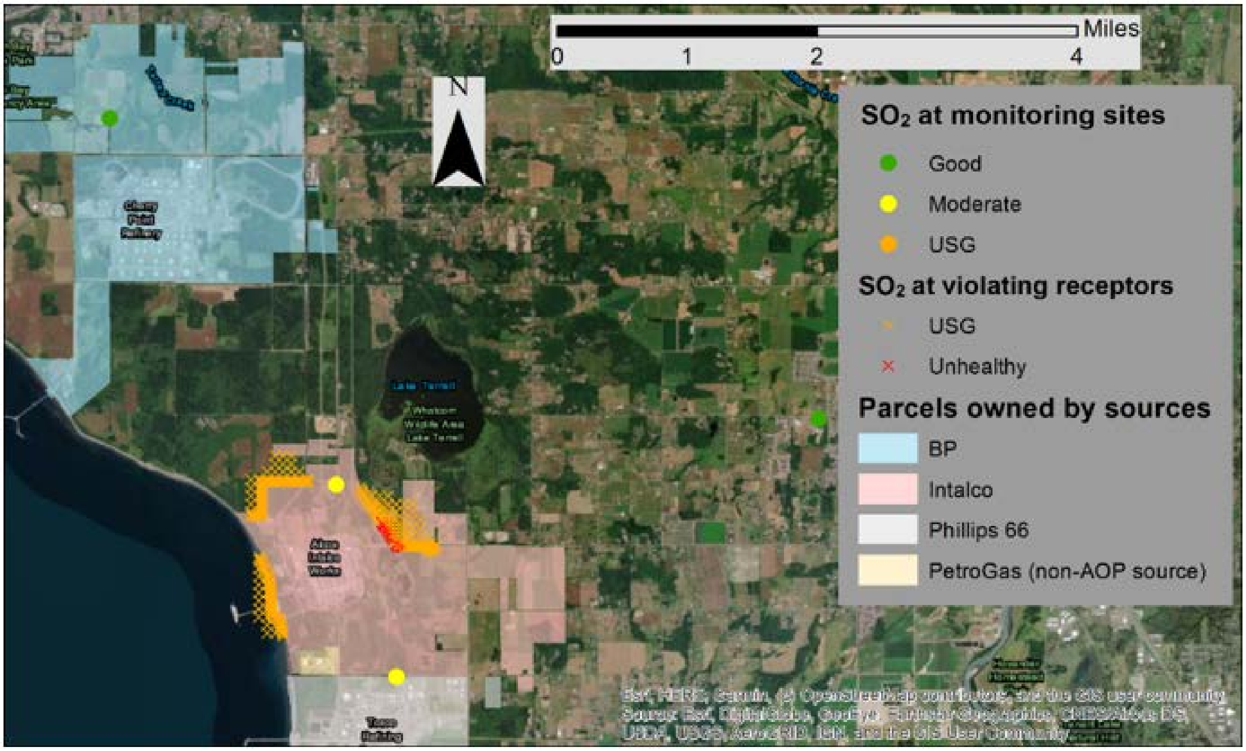

Figure 9: Receptors where modeling showed violations of the SO_2 1-hr NAAQS, overlaid on a map of monitors.

Areas Impacted by SO_2 Concentrations that Violate the SO_2 NAAQS

Furthermore, Ecology prepared a map, shown in **Figure 10**, where modeled SO_2 design values that take into account all SO_2 emission sources in the area as well as background concentrations, are categorized based on the AQI ranges and interpolated to 500 x 500 meters (547 x 547 yards) grids. This exercise allows us to identify all potential “hot spots” in the area. The “Moderate” AQI category represents areas where SO_2 levels are between approximately 35 and 75 ppb of SO_2, meaning they meet the standard.

For comparison, **Figure 11** shows modeled design values that only account of the Intalco facility SO_2 emissions, interpolated to the same grid. At a glance, it asserts two observations: the Intalco’s emissions impact concentrations of SO_2 in the same area as when all sources are combined and that areas where we observe violations remain the same.

Since the model performed acceptably well in the near-field, we were able to establish that the furthest receptor exceeding the SO_2 NAAQS is within 600 meters (0.4 miles) from the Intalco facility’s property boundary (**Figure 12**).

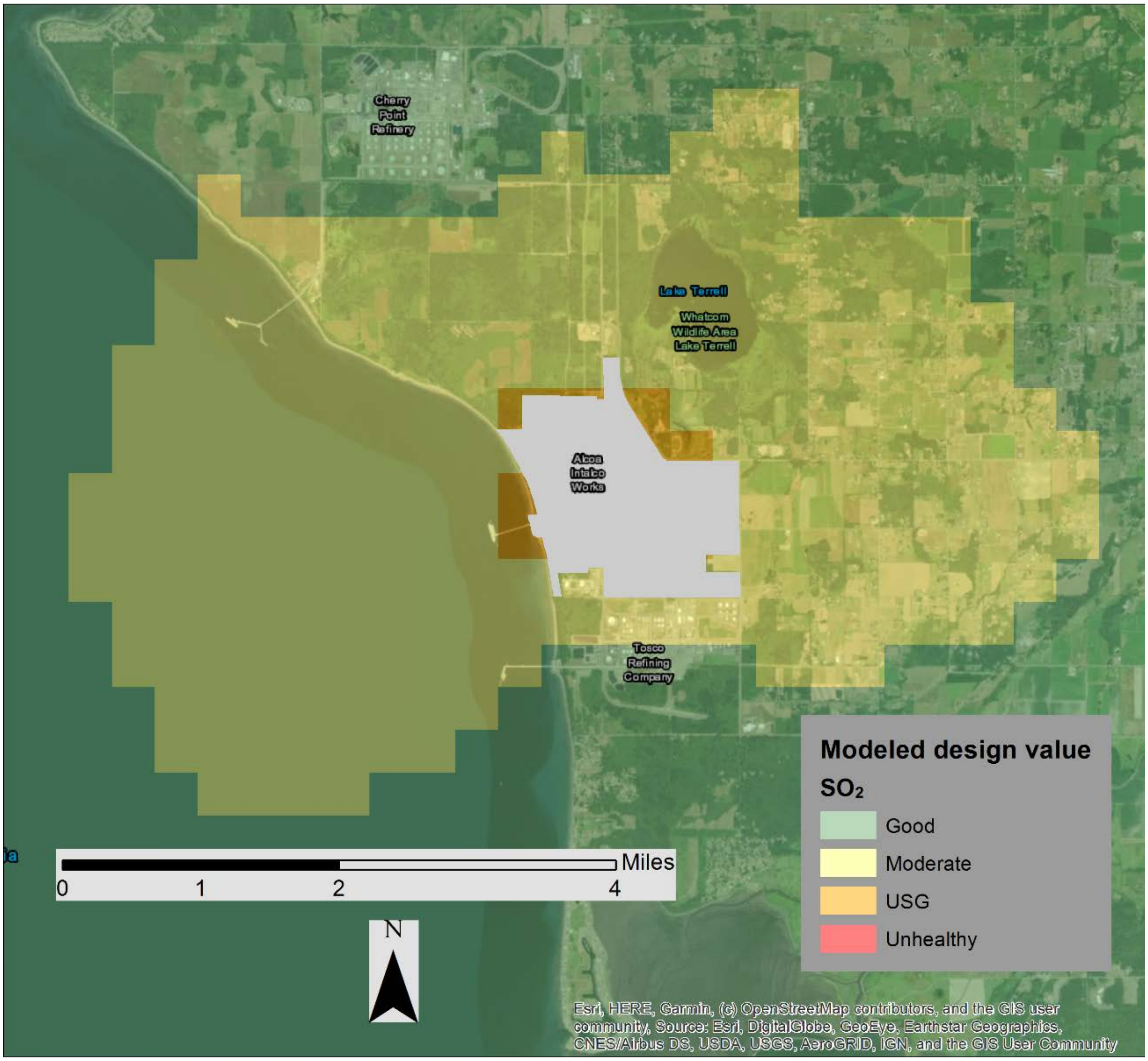

Figure 10: Map of modeled SO_2 design values categorized using the AQI ranges (emissions from all sources plus background).

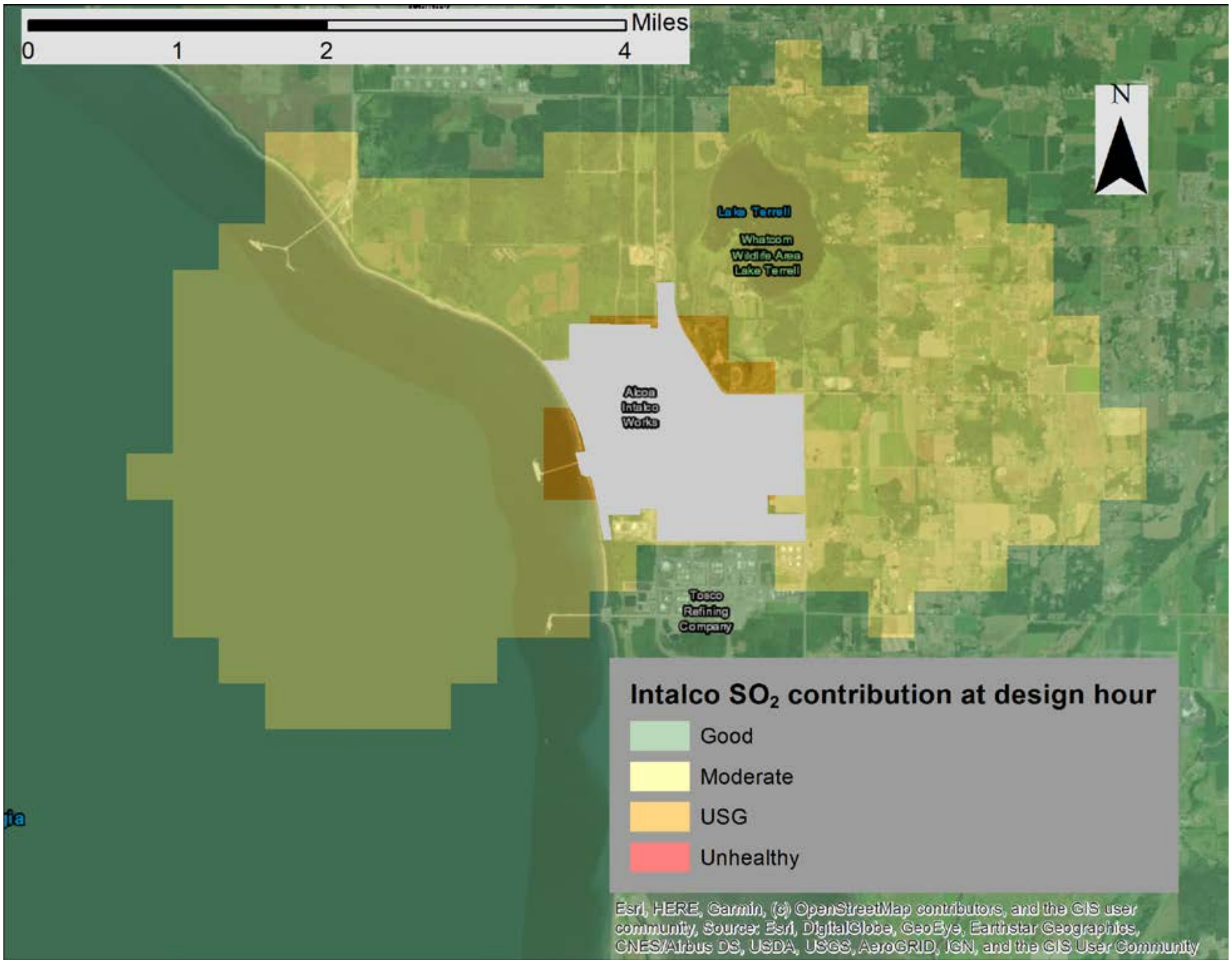

Figure 11: Map of Intalco's SO2 contributions to the design values categorized using the AQI ranges.

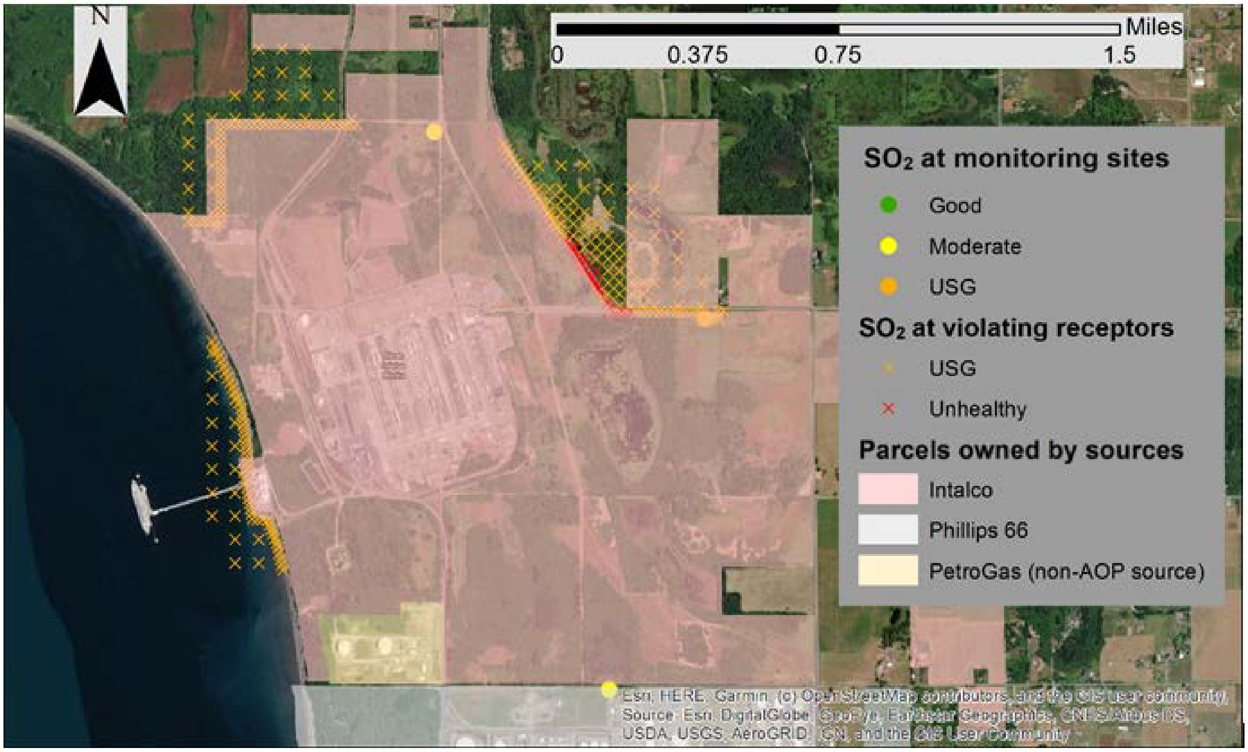

Figure 12: All modeled receptors that violate the SO_2 NAAQS located within 0.4 miles of the Intalco's property line.

As we discussed in the introductory section of the report, SO_2 concentrations are the highest near the emission source and dissipate rather quickly as the plume moves further away from the facility. In the previous figures we focused on the violating receptors to identify areas impacted by unhealthy levels of SO_2. The monitoring data indicates that the concentrations decline quickly. To illustrate the rapid decline of SO_2 concentrations further away from the facility Ecology categorized the modeled design values around the facility using a percentage of the NAAQS scale. This scale offers a more refined breakdown of SO_2 concentrations than the AQI ranges do. Downwind of the fenceline, the concentrations reduce at the rate of between 1.5 to 20 ppb per 100 meters (109 yards). There are a few (mostly fenceline) receptors to the south of the facility where the model showed SO_2 levels between 75% and 90% of the standard. For this reason, we consider that the Petrogas facility is impacted by the elevated SO_2 concentrations.

Figure 13 shows rapid decline in SO_2 levels downwind of the Intalco's facility property line. The map shows the violating receptors (pink). Further downwind concentrations drop to less than 75% of the NAAQS (teal) within a maximum of 0.85 miles from Intalco's fenceline. Downwind of the fenceline, the concentrations reduce at the rate of between 1.5 to 20 ppb per 100 meters. There are a few (mostly fenceline) receptors to the south of the facility where the model showed SO_2 levels between 75% and 90% of the standard. For this reason, the Petrogas facility is considered to be impacted by the elevated SO_2 concentrations.

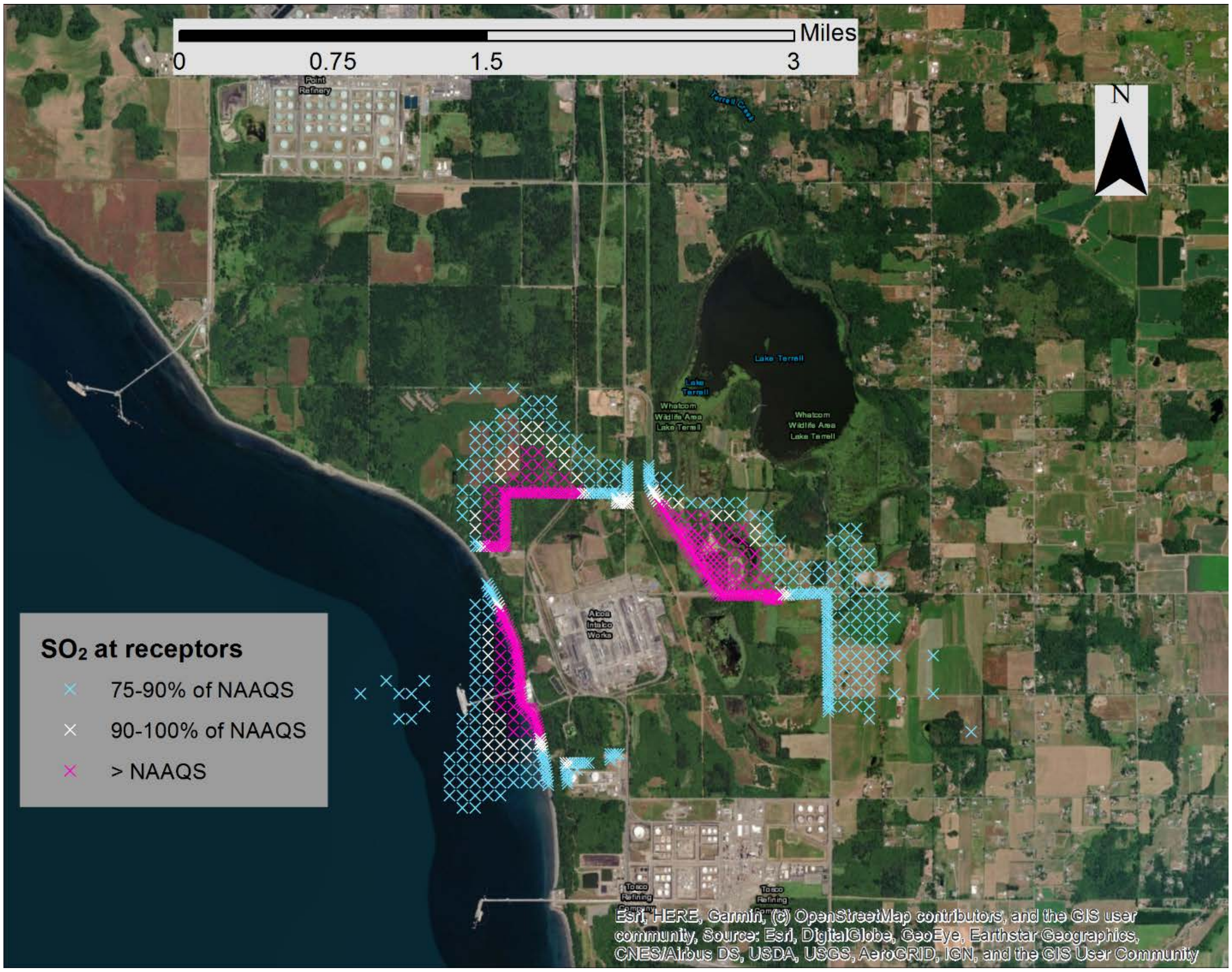

Figure 13: Rapid decline of the SO_2 levels to below 75% of the NAAQS within 0.9 mi of the Intalco property line.

Source Contributions to the Violation of the SO_2 NAAQS

As we demonstrated in the previous sections of this report, the SO_2 emissions from the Intalco facility dominate the areas around the facility and impact the violating monitoring site. Due to the close proximity of two oil refineries to the Intalco facility and the violating monitoring site, there is a concern with the possibility of potentially merging plumes contributing to the elevated levels of SO_2 pollution. Ecology spent a considerable amount of time carefully evaluating the air quality data to identify how much each source in the area contributed to the recorded violation of the public health standard.

Identifying all sources that contribute to the violation of the NAAQS is important for several reasons. First, failing to identify all contributing sources can lead to ineffective control strategies jeopardizing timely improvements in air quality. Secondly, the levels of controls must align with the levels of contributions to the violations. Thirdly, proper identification of significant contributors avoids imposing unnecessary (for the attainment) emission reduction targets on sources that do not cause or contribute to the nonattainment.

Ecology and AECOM grouped the refineries into one source category. The refineries are located in the opposite directions from the Intalco facility, which is located between them. Generally speaking, when the winds come from the north, they first pass the BP refinery, then the Intalco facility, and then a portion of the plumes might reach Phillips 66 (the three sources do not necessarily align in a straight successive line). When the winds come from the south, they first pick up Phillips 66 emissions, then blow over the Intalco's property before reaching BP refinery.

In **Figure 14**, Ecology captures the amount of SO_2 contributed by each group of sources at the hours when the annual fourth highest concentration occurred (also called "design hour") at the violating monitoring site.

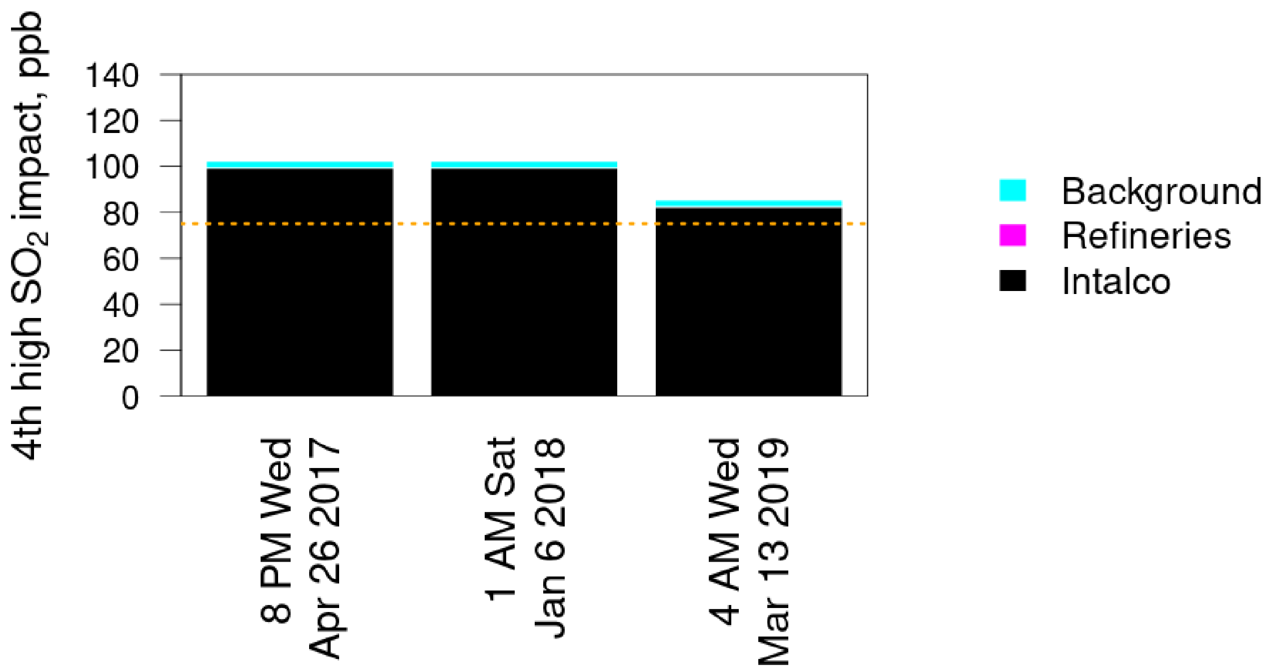

Figure 14: SO_2 contributed by each source group at the hours when the annual fourth highest concentration occurred ("design hour") at the model receptor nearest to the violating monitor.

Ecology found that even if all sources besides the Intalco facility ceased to emit SO2 the monitoring site would continue to be in violation of the SO_2 NAAQS (DV > 75 ppb). The absence of substantial contributions from the refineries can be explained by the meteorological conditions present every time when a NAAQS exceedance occurred at the Mountain View Road monitoring site. As indicated by pollution roses shown in the Intalco's modeling report and in **Figure 7** of this report, west-southwest winds cause the highest concentrations at this monitoring site. Such winds place this monitoring site directly downwind of Intalco's SO_2

release points. This monitoring site is not downwind of the refineries during such wind flows, minimizing their simultaneous contributions to the monitor.

Ecology generated similar plots for all monitoring sites and these plots can be made available upon request. The following section expands this analysis to cover all violating receptors.

Ecology identified 269 receptors where modeled concentrations exceeded 72 ppb (i.e. NAAQS minus 3 ppb background). Receptors that do not violate the SO_2 NAAQS are not considered further as they do not have any regulatory significance. At these violating receptors, we identified and reviewed individual daily maxima above 72ppb – these are the maximum hourly concentrations of each day that define the design value. These exceedances occurred over 789 unique days between January 1, 2017 and December 31, 2019. The source contributions to these 24,685 receptor-days are presented as a stacked bar chart in **Figure 15** (one vertical bar per receptor-day). The y-axis is shown on a logarithmic scale, and there are no spaces or borders between vertical bars for clarity.

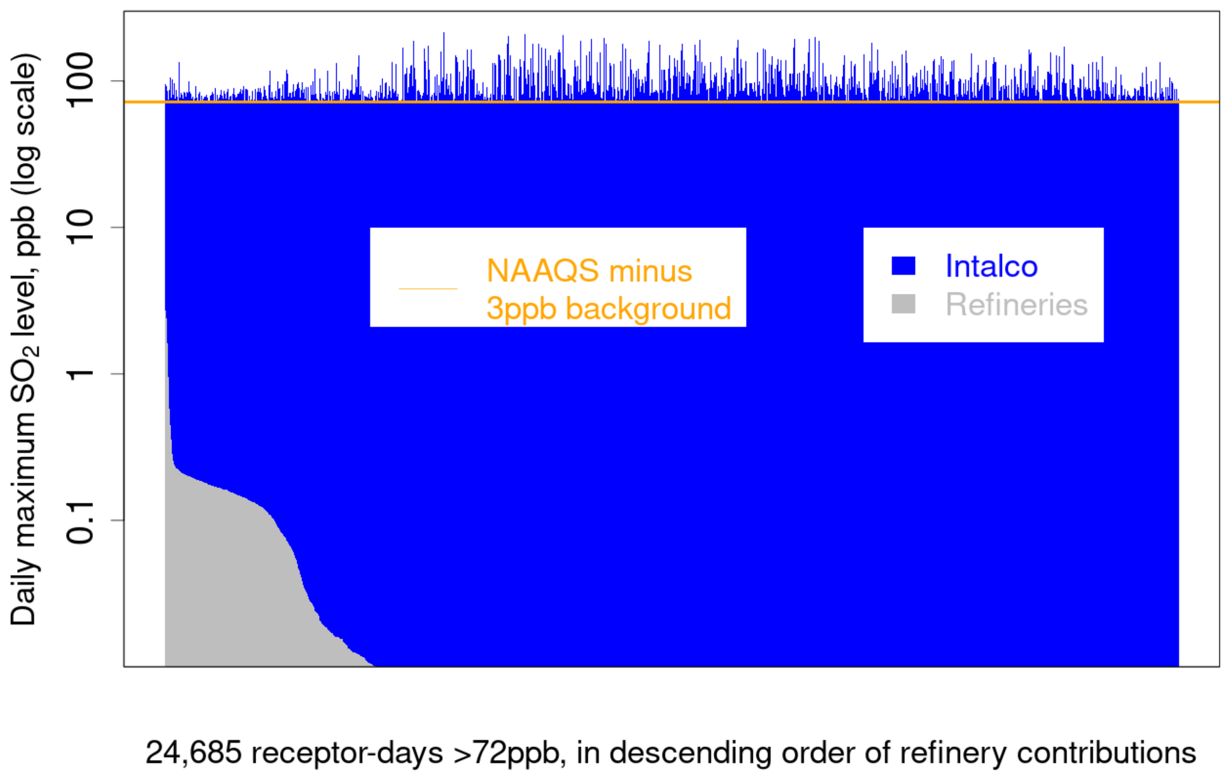

Figure 15: SO_2 contributions at all 269 receptors that violated the NAAQS.

Figure 15 shows that the two refineries contribute only small amounts on a few occasions at a few receptors. 99.5% of the data shown in **Figure 15** indicate refinery's contributions at < 0.5 ppb to a NAAQS-exceedance day, and 89% are below 0.1 ppb. If refinery emissions were ignored completely, only one receptor at the northern periphery of **Figure 9** would return to attainment. The other 268 receptors remain in violation of the standard and their design values drop by a maximum of 0.7 ppb.

To better visualize the conditions and source contributions during hours driving nonattainment, Ecology developed three tables at EPA's request. Table 1 in **Appendix H. Summary Data Tables Illustrating Refinery Contributions during Selected Hours (EXCEL)** shows the source contributions and wind directions associated with the 150 leftmost values in **Figure 15**. These receptors are located along Intalco's fenceline between the Kickerville Road and Mountain View Road monitoring sites (between 489 – 1142 meters (0.3 – 0.7 miles) of the Mountain View Road site). The refinery most likely contributing to the respective daily maximum hour was identified by examining wind directions. Westerly winds were present during four unique hours, suggesting some mixture of refinery impacts.

Table 2 in **Appendix H. Summary Data Tables Illustrating Refinery Contributions during Selected Hours (EXCEL)** shows the yearly design hour contributions at the 50 most impacted receptors, along with wind directions and contributing refineries.

Intalco's contribution to the daily maximum SO_2 concentration was > 72 ppb on all except eight out of the 24,685 receptor-days. To assess the sensitivity of design values to the omission of these 8 data points spread over 6 receptors, design values were updated by removing the hours responsible for these daily maxima. Recalculated design values at the 6 receptors dropped by a maximum of 1.5 ppb, and yet all of them continued to exceed the SO_2 NAAQS when the 3 ppb background was added in. Table 3 in **Appendix H. Summary Data Tables Illustrating Refinery Contributions during Selected Hours (EXCEL)** shows the contributions on each of these days, along with wind directions and the change in design values after this sensitivity test.

In summary, SO_2 emissions from sources surrounding the Intalco facility do not alter the extent of the area violating the standard, nor do they meaningfully affect concentrations responsible for the design values. Omitting them entirely would still result in the violation of the standard within the same area with the very same characteristics.

The fenceline monitor at BP did not record a single exceedance of the 1-hr SO_2 standard. In a BP-only emissions scenario, it produces a maximum design value of 13.8 ppb with receptors located to the north and northwest of Intalco recording impacts > 10 ppb. However these do not coincide in time with any high impacts caused by Intalco, as wind directions do not align correctly for plumes to overlap. As has been shown above, the concurrent contribution from BP during hours > 72 ppb is very small. As such there is no indication that BP refinery contributes to the violation of the standard, nor would additional SO_2 controls at this refinery result in the area attaining the standard.

All design values on Phillips 66 property are < 75% of the SO_2 NAAQS, and the fenceline monitor at Phillips 66 did not record a single exceedance of the standard. As we demonstrated earlier, Phillips 66 is not a significant contributor to the violating monitor or modeled receptors. In a

Phillips 66-only emissions scenario, it produces a maximum design value of 1.7 ppb at a receptor located at the center of Phillips 66’s own facility. Therefore, we do not have evidence that Phillips 66 contributes to the violation of the SO_2 NAAQS.

Conclusion

After in-depth technical evaluation of all available SO_2 data for Whatcom County, Ecology and NWCAA made the following findings:

- ✓ The majority of the county attains, meaning complies with, the federal, health-based ambient standard for SO_2 that EPA established in 2010 at the level of 75 ppb of SO_2.
- ✓ One monitoring site in the Cherry Point Industrial Area near the Intalco aluminum smelter recorded levels of SO_2 in violation of the standard.
- ✓ The nearby city of Ferndale and other communities do not have elevated SO_2 levels above the health standard.
- ✓ SO_2 emissions from the Intalco aluminum smelter caused the violation of the standard.
- ✓ The SO_2 levels in violation of the standard were only observed within 0.4 miles of the Intalco facility property line, in the direction of the prevailing winds: north-west, north, and north-east.
- ✓ High SO_2 levels do not extend far and the concentrations decline to below 75 percent of the standard within less than one mile of the Intalco facility's property line.
- ✓ We did not find evidence suggesting that SO_2 emissions from BP Cherry Point and Phillips 66 refineries located near the Intalco facility contributed to the recorded violation of the standard.

The results of the analysis are intended to inform future policy decisions and strategies to improve air quality in the area. Due to the recent announcement by the Intalco facility advising of the facility's plans to curtail all operations by July 1, 2020, the area may experience a rapid change in the SO_2 concentrations. However, curtailment does not mean closure and Intalco may restart. The ongoing monitoring by the facility with Ecology's oversight will continue to ensure we collect relevant air quality data in the area. In the future, the dispersion modeling protocol used in this report can be employed to evaluate the evolving air quality situation based on the changing levels of emissions or any new permit limits.

Appendices

Appendix A. Correspondence (PDF)

Appendix B. Cherry Point Industrial Area Hourly SO_2 and Meteorology Data 2017-2019 (EXCEL)

Appendix C. About Intalco Primary Metals Works Aluminum Smelter (PDF)

Appendix D. Response to Comments. Intalco Aluminum Corporation. Air Quality Agreed Order No. 16499 (PDF)

Appendix E. Refineries and Intalco SO_2 Emissions 1999-2019 (EXCEL)

Appendix F. Summary of Prevention of Significant Deterioration Quality Assurance Procedures for Meteorological Data at Ferndale-Mountain View Road Monitoring Site (PDF)

Appendix G. Alcoa SO_2 Modeling Report for Intalco 2020-02-06 and Addendum 2020-03-19 (PDF)

Appendix H. Summary Data Tables Illustrating Refinery Contributions during Selected Hours (EXCEL)