Alaska Department of Environmental Conservation

Amendments to: State Air Quality Control Plan

Vol. II: Analysis of Problems, Control Actions

Section III. Area Wide Pollutant Control Program
Subsection K. Regional Haze

DRAFT

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III.K.13.A PURPOSE AND SCOPE OF THE ALASKA REGIONAL HAZE STATE IMPLEMENTATION PLAN

1. OVERVIEW

A State Implementation Plan (SIP) is developed and implemented by states as required by the federal Clean Air Act (CAA), with formal approval and administration by the U.S. Environmental Protection Agency (EPA). A SIP consists of narrative overviews, background information, strategy plans, technical data, data analyses, and implementation plans for complying with CAA requirements. In Alaska, the Air Quality Control Plan (AK SIP), which contains the required SIPs for Alaska, is incorporated by reference into state regulations at 18 AAC 50.030.

This chapter of the AK SIP addresses the federal rules for protection of visibility specifically related to regional haze. These federal rules were adopted to fulfill requirements of Sections 169A and B of the CAA, which have their purpose to protect and improve visibility at specified federal land units identified as Class I areas.

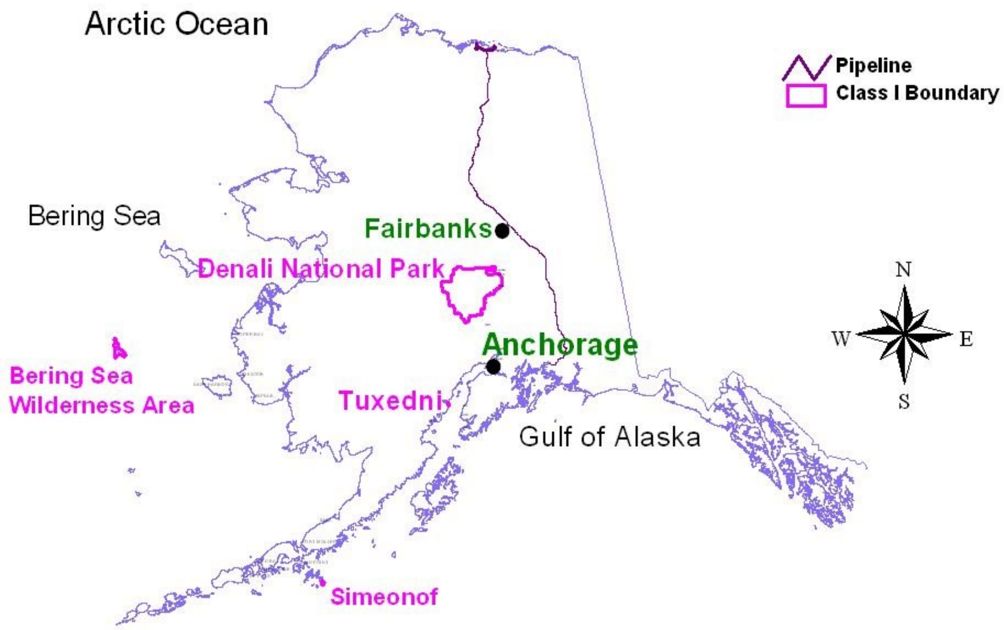
Despite Alaska's many national parks, forests, wildlife refuges, and wilderness areas, Alaska has only four such mandatory areas because most of these areas were set aside after the inclusion of the Class I areas in the 1977 CAA. Table III.K.13.A-1 lists the four federal Class I areas located within the state: Denali National Park (Denali NP), Tuxedni National Wildlife Refuge/National Wilderness Area (Tuxedni), Simeonof National Wildlife Refuge/National Wilderness Area (Simeonof), and the Bering Sea National Wildlife Refuge/National Wilderness Area (Bering Sea) (see Figure III.K.13.A-1); as also shown in the table, no federal Class I areas located outside of the state are affected by emissions produced within Alaska.[1]

Table III.K.13.A-1
Class I Federal Areas Located Inside and Outside of Alaska
Impacted by Emissions Produced Within Alaska

Class I Federal Area	Located in Alaska	Located Outside of Alaska
Denali National Park	Yes	-
Tuxedni National Wildlife Refuge/National Wilderness Area	Yes	-
Simeonof National Wildlife Refuge/National Wilderness Area	Yes	-
Bering Sea National Wildlife Refuge/National Wilderness Area	Yes	-
None	-	Yes

[1] By distance, the Class I Areas nearest to Alaska would be either the Olympic National Park (1,426 miles) or the North Cascades National Park (1,462.06 miles) in the state of Washington. This is measured using Chisik Island (Tuxedni National Wildlife Refuge) as the AK point of reference.

Figure III.K.13.A-1
Alaska Class I Areas



This Regional Haze Plan[2] (RH SIP or RH Plan) describes how the State of Alaska will meet federal requirements to measure and monitor visibility, aerosols, and air pollution at Alaska's four Class I areas, how Alaska will evaluate the factors reducing visibility at each site, and how Alaska plans to identify and implement air pollution control measures to reach natural visibility conditions by 2064, the date identified in the 1999 RH Rule for achieving natural visibility conditions. This plan includes both the characterizations of the baseline air quality at each of Alaska's Class I areas and Alaska's strategy toward meeting the interim goals to be attained by 2028. All pollutants and aerosols affecting visibility are considered by this plan, including those entering Alaska at its borders. Air pollution sources, transport, and atmospheric precursors of aerosols originating within Alaska and entering Alaska from Asia, Europe, and Canada are considered in the SIP.

Each of the 50 states is required to address the Regional Haze Rule (RH Rule) alongside other statutory obligations under the 1971 Clean Air Act (CAA) and its subsequent amendments. But, haze is inherently a regional, and frequently even international, phenomenon. Coordinated technical services, modeling, data management, and consulting have been provided by regional planning organizations. For Alaska, the Western Regional Air Partnership (WRAP) has served this function. Technical tool development, emission inventories, and air quality modeling have been conducted on a regional basis by the WRAP to support the efforts of all of the western states. Alaska has participated actively in WRAP projects and uses WRAP technical products applicable to Alaska in this plan.

The RH Rule, promulgated pursuant to the CAA and its amendments, specifically regulates visibility. The aerosols and pollutants that reduce visibility also impact human health and ecosystems in Alaska. Consequently, the implementation of this RH Plan will impact Alaska's people and ecosystems in a broader manner. Alaska receives air pollutants across all its boundaries, from many international sources. Many of these sources are subject to their own nations' environmental regulations which differ from those of the United States and the State of Alaska. In addition, natural sources contribute to visibility impairment, but natural emissions cannot be realistically controlled or prevented by the states. The analysis of Alaska's air for the development of this plan gives us greater understanding of how our air quality is affected by international sources as well as natural sources.

[2] The term "Regional Haze Plan" is used to refer specifically to this plan to address the requirements of the Regional Haze Rule; however, the term "RH Plan" and "RH SIP" may be used interchangeably.

2. WHY VISIBILITY?

Visibility is reduced, or impaired, when particles and gases in the atmosphere reflect, scatter, or absorb light. The visual range, or distance that we can see, is limited by very small particles in the air. The particles absorb and scatter sunlight, creating haze. Haze affects the color, contrast, and clarity of the vistas, wildlife, forests, seascapes, and ecosystems we can see. Good visibility is important to the enjoyment of national parks and scenic areas.

Many different types of particles and gases are released into the atmosphere through human activities. Not only do the pollutants released directly reduce visibility, but also the pollutants can react chemically with each other to create new types of pollutants which also affect visibility. The individual pollutants that create haze are measurable, for instance as sulfates, nitrates, organic carbon, elemental carbon, soil dust, or sea salt. But while many different types of pollutants contribute to impaired visibility, visibility is a single measure that includes the effects of many pollutants.

3. EPA'S VISIBILITY REGULATIONS AND THE REGIONAL HAZE RULE

A. History of the Regional Haze Rule

In 1977, Congress amended the CAA to include provisions to protect the scenic vistas of the nation's national parks and wilderness areas. In these amendments, Congress declared as a national visibility goal:

> *The prevention of any future, and the remedying of any existing, impairment of visibility in mandatory Class I Federal areas which impairment results from manmade air pollution.* (Section 169A)

At that time, Congress designated all wilderness areas over 5,000 acres and all national parks over 6,000 acres as "mandatory federal Class I areas". These Class I areas receive special visibility protection under the CAA. Figure III.K.13.A-2 shows the 156 national parks and wilderness areas designated as Class I areas.

The 1977 CAA amendments charged Federal Land Managers (FLMs) with an advisory and consultation role to protect the air quality and related values (including visibility) in areas of great scenic importance (that is, Class I areas) and to consider, in consultation with the EPA, whether proposed industrial facilities will have an adverse impact on these values. States were required to determine whether existing industrial sources of air pollution must be retrofitted to reduce impacts on Class I areas to acceptable levels. The EPA was tasked to report to Congress regarding methods for achieving greater visibility and to issue regulations towards that objective.

Figure III.K.13.A-2: Mandatory Class I Areas Map in the United States.

Part C of the 1977 CAA amendments stipulated requirements to prevent significant deterioration of air quality and, in particular, to preserve air quality in national parks, national wilderness areas, national monuments, and national seashores. The Prevention of Significant Deterioration (PSD) program includes area-specific (Class I, II, and III) increments or limits on the maximum allowable increase in air pollutants (particulate matter or sulfur dioxide) and a preconstruction permit review process for new or modifying major sources that allows for careful consideration of control technology, consultation with FLMs on visibility impacts, and public participation in permitting decisions.

Under CAA Section 169A(b), Congress established new requirements on major stationary sources in operation within a 15-year period prior to enactment of the 1977 amendments. Such sources to which visibility impairment can be reasonably attributed must install best available retrofit technology (BART) as determined by the State. In determining BART, the State must take into consideration the costs of compliance, the energy and non-air quality environmental impacts of compliance, any existing pollution control technology in use at the source, the remaining useful life of the source, and the degree of improvement in visibility which may reasonably be anticipated to result from the use of such technology.

On December 2, 1980, the EPA outlined a phased visibility program to ensure progress in achieving the national goal set forth by Congress. Regulations promulgated for Phase I of the program (under 40 CFR §51.300 through 307) required Alaska, 34 other states, and 1 territory with mandatory Class I areas to revise their SIPs to include visibility protection.

Phase I of the visibility regulations focused on "reasonably attributable visibility impairment" (RAVI) and required states to:

- Coordinate SIP development with the appropriate FLMs.
- Develop programs to assess and remedy Phase I visibility impairment from existing major sources and to prevent visibility impairment from new sources.
- Develop a long-term strategy to address reasonable progress toward the national visibility goal.

- Develop a visibility monitoring strategy to collect information on visibility conditions.
- Consider in all aspects of visibility protection any "integral vistas" (important views of landmarks or panoramas that extend outside of the boundaries of the Class I area) identified by the FLMs or states as critical to the visitors' enjoyment of the Class I areas. (An integral vista that is adopted into regulation can be afforded the same level of protection from visibility impairment as the Class I area itself or any lesser level of protection, as determined by a state on a case-by-case basis.)

In response to EPA's Phase I visibility rules, the Alaska Department of Environmental Conservation (DEC) adopted regulations and SIP revisions in 1982 that identified visibility special protection areas including the mandatory Class I areas, two integral vistas within Denali NP, and a visibility protection program for mandatory Class I areas through DEC's PSD permitting program. This SIP was approved by EPA in the Federal Register on July 5, 1983.

B. Summary of the 1999 Federal Regional Haze Rule

The 1990 amendments to the CAA established a new Section 169(B) to address regional haze. Since regional haze and visibility problems do not respect state and tribal boundaries, the amendments also authorized EPA to establish visibility transport regions as a way to combat regional haze. The 1990 amendments also established a visibility transport commission to investigate and report on regional haze visibility impairment in the Grand Canyon National Park and nearby Class I areas. EPA adopted "Phase II" visibility rules in 1999, the RH Rule.

The RH Rule requires states to adopt regional haze SIPs that focus on improving the most impaired days (the worst 20%) and protecting the clearest days (the best 20%). The RH Rule lays out the mechanisms by which states define long-term paths to improve visibility, with the goal of achieving visibility that reflects natural conditions by 2064. Unlike criteria pollutant SIPs, which require specific targets and attainment dates, the RH Rule requires states to establish a series of interim goals to ensure continued progress. The first planning period set reasonable progress goals (RPGs) for improving visibility in Class I areas by 2018 and the second planning period sets RPGs to be achieved through the year 2028.

C. Summary of the 2017 Regional Haze Rule Update

In January 2017, the EPA released an update to the 1999 RH Rule in preparation for the submission of SIPs for the second implementation period and following progress report. Additionally, EPA has released several pieces of technical guidance to assist states in their regional haze planning for this implementation period.

One of the notable stipulations of the January 2017 RH Rule was the extension of state submission deadlines from 2018 to July 2021, allowing an additional three years for states to respond to new measurement protocols for visibility impairment calculations. These new protocols include a recalculation of visibility conditions on days with low visibility impairment (clearest days) and high visibility impairment (most impaired days/MID). As a result of this extended deadline for SIP submission, the progress report to EPA was moved to January 31, 2025.

In addition, the 2017 RH Rule extended the window for FLMs to review a state's draft SIP to 120 days, or four months. This provides FLMs with the opportunity to provide detailed feedback on proposed visibility approaches prior to the draft SIP being released for public review and comments.

The 2017 RH Rule includes a provision that allows states to propose an adjustment to the glidepath to account for impacts from anthropogenic sources outside the United States, if the adjustment has been developed through scientifically valid data and methods. The EPA's visibility guidance[3] states "to calculate the proposed adjustment(s), the State must add the estimated impact(s) to the natural visibility condition and compare the baseline visibility condition for the most impaired days to the resulting sum." Alaska challenged these stipulations in federal district court, arguing that it was the responsibility of EPA to provide the methodology by

[3] EPA, 2018. Technical Guidance on Tracking Visibility Progress for the Second Implementation Period of the Regional Haze Program, EPA-454/R-18-010, https://www.epa.gov/sites/production/files/2018- 12/documents/technical_guidance_tracking_visibility_progress.pdf, December 2020.

which DEC could estimate the contribution of international sources at Class I areas. The issue of international contribution will be discussed elsewhere in this plan.

D. Specification Under the Second Implementation Period

The 2017 RH Rule lays out specific requirements to ensure improvements in the anthropogenic components of visibility. Some of these requirements carry over into the second implementation period without application to additional Class I areas or stationary facilities:

- One of the core requirements of the first RH Plan was the implementation of the BART requirements, which addressed larger industrial sources identified to have begun operations before the 1977 PSD Rules. Under the 2017 RH Rule, BART stipulations remain in place for those facilities where it was applied in the first round of planning, but they are not applied to new facilities.

- The reasonable progress demonstration requires setting goals for the 20% clearest and most impaired days in each Class I area, based on an evaluation of how emissions reduction strategies including best practices and control technologies along with future modeling of individual and source sectors will improve or protect visibility conditions.

- States are required to conduct four-factor analyses on sources and groups of sources which could reasonably be identified as influencing Class I areas on their most impaired days. Conducting a four-factor analysis does not imply the application of emissions reduction techniques on stationary sources or source categories. These reviews can be a full review, meaning that state air agencies coordinate with stationary source owners to discuss control options. Alternatively, DEC’s interpretation of the EPA rules and guidance is that these analyses can be a limited review, which can be an in-house review of source emissions and control options using available data submitted for permitting and yearly compliance.

4. CLASS I AREAS IN ALASKA

Figure III.K.13.A-1 shows the locations of Alaska Class I areas, with Denali National Park in the Interior, Tuxedni and Simeonof Wilderness Areas as coastal, and the Bering Sea Wilderness Area far offshore. Due to Alaska’s status as a non-contiguous state, together with its physical distance from the continental United States and its small population and industrial base, DEC has determined that there are no Class I areas in other states affected by its emissions. The state is heavily impacted by international emissions generated in the Russian Far East and Siberia, East Asia, Canada, and Europe, along with international marine traffic conducting trade between North America and Asia.

A. Denali National Park and Preserve

Denali National Park and Preserve (Denali NP) is a large park in the interior of Alaska. It has kept its integrity as an ecosystem because it was set aside for protection fairly early in Alaska’s history. Denali NP headquarters lies 240 miles north of Anchorage and 125 miles southwest of Fairbanks, in the center of the Alaska Range. The park area totals more than 6 million acres. Denali, at elevation 20,320 feet, is the highest mountain in North America and is a prominent feature in the park and throughout Alaska. Denali NP accommodates a wide variety of visitor uses. The Alaska Range divides the park into two geographic zones by blocking warm moist air from the Gulf of Alaska from getting to the interior inland side of the park. The park has many vegetation types associated with the variety of aspects and elevations within the park; elevations range from 2000 feet to over 20,000 feet above sea level. The park contains numerous glaciers, permafrost and high mountains. The tree-line in Denali NP is typically around 3,000 feet above sea level. Denali NP is the only Class I area in Alaska that is easily accessible and connected to the road system. Denali NP has the most extensive air monitoring of Alaska’s Class I areas, so more detailed examinations of long-term and seasonal air quality trends are possible for this site.

B. Simeonof National Wildlife Refuge/National Wilderness Area

Simeonof National Wildlife Refuge/National Wilderness Area (Simeonof) consists of 25,141 acres located in the Aleutian Chain, 58 miles from the mainland. It is one of 30 islands that make up the Shumagin Group on the western edge of the Gulf of Alaska. Access to Simeonof is difficult due to its remoteness and the unpredictable weather. It is home to greater than 55 species of birds as well as sea otters, hair seals, walruses, Arctic foxes, ground squirrels, and at least 17 species of whales. The vegetation is naturally treeless with wetlands mixed in with coastal cliff, meadow, and dune environments. There are 188 taxa of lichens in the park. Winds are mostly from the north and northwest as part of the midlatitude westerlies. Occasionally winds from Asia blow in from the west.

The island is isolated and the closest air pollution sources are marine traffic in the Gulf of Alaska, the North Pacific Ocean, and the community of Sand Point.

C. Tuxedni National Wildlife Refuge/National Wilderness Area

Tuxedni National Wildlife Refuge/National Wilderness Area (Tuxedni) is located on a fairly isolated pair of islands in Tuxedni Bay off of Cook Inlet in Southcentral Alaska. There is little human use of Tuxedni except for a few kayakers and some backpackers. There is an old cannery built near Snug Harbor on Chisik Island which is not part of the wilderness area; however it is a jumping off point for ecotourists staying at Snug Harbor arriving by boat or plane. Set nets are installed around the perimeter of the island and in Tuxedni Bay during fishing season.

Along with commercial fishing, Cook Inlet has reserves of gas and oil that are currently under development. Gas fields are located at the Kenai area and farther north. The inlet produces 30,000 barrels of oil a day and 485 million cubic feet of gas per day. Pipelines run from Kenai to the northeast and northeast along the western shore of Cook Inlet starting in Redoubt Bay. The offshore drilling is located north of Nikiski and the West McArthur River. All of the oil is refined at a refinery in Nikiski for use in Alaska and overseas.

D. Bering Sea National Wildlife Refuge/National Wilderness Area

The Bering Sea National Wildlife Refuge/National Wilderness Area (Bering Sea) is located off the coast of Alaska about 350 miles southwest of Nome. Hall Island is at the northern tip of the larger St Matthew Island. St Matthew Island is remote with arctic foxes and insular voles joined by the occasional polar bear that comes in off the pack ice. Ringed seals and Steller sea lions haul themselves up on the shore. 125 species of birds are present on the tundra and rock covered island. There is trawling for king crab offshore. Lichen species were heavily overgrazed when the Coast Guard introduced reindeer to the island in 1944; mosses, forbs, and shrubs took over leaving about 10% of the lichen cover. The reindeer are gone, but 22 years later the lichens are only very slowly growing back.

5. ELEMENTS OF THE REGIONAL HAZE PLAN

Each RH SIP must provide a comprehensive analysis of natural and human-caused sources of haze for each Class I area. It must also contain strategies to control the sources and reduce the emissions that contribute to haze. The intent is to focus on reducing anthropogenic emissions, while achieving a better understanding and quantification of the natural causes of haze.

RH SIPs must contain many technical elements and analyses, as well as background information. The required elements of the plan are explained briefly in this section, and then detailed in the sections outlined below.

- Monitoring Strategy (Section III.K.13.C)
- Determination of baseline, current and natural visibility conditions (Section III.K.13.D)
- Base year and future year emission inventories – Section III.K.13.E
- Long-term strategy for regional haze (Section III.K.13.H)
- Progress-to-date and the uniform rate of progress (Section III.K.13.I)

- Reasonable progress goals (Section III.K.13.I)
- Consultation with states, tribes, and federal land managers (Section III.K.13.K)

In addition to the required elements, this RH SIP includes analysis of controllable sources within Alaska (Section III.K.13.F) and modeling analyses to support selection of controllable sources and development of RPGs (Section III.K.13.G).

A. Monitoring Strategy

The RH SIP includes a monitoring plan for measuring, estimating, and characterizing air quality and visibility impairment at Alaska's four Class I Areas. The haze species concentrations are measured as part of the Interagency Monitoring of Protected Visual Environments (IMPROVE) monitoring network deployed throughout the United States. Alaska uses four IMPROVE monitoring stations representing three of the four Class I areas. There is no air monitoring being conducted for the Bering Sea Class I area due to its remote location. Monitoring and additional research addressing transboundary sources of pollution in Denali NP are described in Section III.K.13.C.

B. Determination of Baseline, Current, and Natural Visibility Conditions

Baseline and current visibility include haze pollutant contributions from human-caused (anthropogenic) sources as well as those from natural sources, using the actual pollutant concentrations measured at IMPROVE monitors during the baseline period of 2000-2004 and the current period of 2014-2018 (Tuxedni current data is from 2012-2014 and 2016-2018, further described in Section III.K.13.D). The state must describe existing (current) visibility conditions on the suite of days that represent the most impaired and clearest days. The state must also establish what the most impaired and clearest days would be like on days when only natural sources affect visibility, without any human-caused impairment. Achieving natural conditions for visibility on the most impaired days by the year 2064 and ensuring no degradation in visibility for the clearest days since the baseline period is the overall goal of the Regional Haze Program (RH Program).

C. Statewide Emissions Inventory of Haze-Causing Pollutants

As with any air quality analysis, a good understanding of the sources of haze pollutants is critical. For the purposes of this RH SIP, DEC will be using one current and one future forecasting inventory. Current inventory to be used is the 2016 inventory compiled by the EPA and multi-jurisdictional planning organizations (MJOs), which was built off the 2014 National Emissions Inventory (NEI). The state will be using the 2028 future forecasting inventory that is built off the 2016 inventory. This inventory uses the most recent emissions data available to project emissions at the end of the second Regional Haze planning period in 2028. Both 2016 and 2028 emission inventories are described in Section III.K.13.E, Emissions Inventories of Alaskan Controllable Sources.

D. Long-Term Strategy

The RH SIP also describes the long-term strategy (LTS) that provides the necessary emission reductions to achieve the RPGs established for each Class I area within Alaska. The LTS contains the state's 10-15 year strategy for making reasonable progress toward remedying existing and preventing future visibility impairment. Federal law mandates a periodic review and, if necessary, revision of the LTS section of the plan at least every five years. This review is incorporated into the 5-year progress report, which will be submitted to the EPA by January 31, 2025, for the second implementation period. Section III.K.13.H describes the measures included in Alaska's LTS.

E. Analysis of Controllable Sources within Alaska

The 1999 RH Rule included a BART requirement to implement a federal mandate to retrofit certain very old sources that pre-date the 1977 CAA amendments by up to 15 years. If it was demonstrated that the emissions from these sources cause or contribute to visibility impairment in any Class I area, then the BART must be installed.

The determination of BART in the original plan took into consideration the costs of compliance, the energy and non-air quality environmental impacts of compliance, any existing pollution control technology in use at the source, the remaining useful life of the source, and the degree of improvement in visibility which may reasonably be anticipated to result from the use of such technology. In Alaska, there were seven facilities that fit the initial BART-eligible criteria. The systematic BART analysis carried out by DEC is detailed in the original 2011 Plan in Section III.K.6, which remains in effect. The 2017 RH Rule does not have a BART requirement for new sources to be added to BART lists.

The new RH Rule requires that states utilize source emissions data from emissions inventories to conduct visibility analyses of sources located near designated Class I areas. These four-factor analyses should be the basis by which states determine which sources need additional controls or measures to meet RPGs. These reviews can be in-depth reviews involving cooperation with sources and detailed analyses to determine which is the best control mechanism based on source visibility contribution. With current visibility at Class I areas in the state, DEC has instead opted to conduct limited four-factor reviews primarily using available data submitted as part of state permitting requirements. These four-factor reviews use much the same criteria as the prior BART requirements. For more information about the facilities and the four-factor analysis conducted, see Section III.K.13.F.

F. Progress-to-date, the Uniform rate of Progress, and Reasonable Progress Goals

RPGs are established by each state for each Class I area as a deciview level to be achieved by the end of the second planning period. The RPGs must assure that the most impaired days get less hazy and that visibility does not deteriorate on the clearest days, when compared with the baseline period. DEC has prepared technical analyses to assess future visibility and provide the context to establish RPGs for the Class I areas during the second planning period.

States must also compare their RPGs to the level of visibility improvement that would be achieved if perfectly linear progress between the current period and expected natural conditions in 2064 were to occur. This linear rate of progress is known as the uniform glide path or uniform rate of progress. The uniform glide path is not a fixed standard that must be met; instead, it simply provides a basis for evaluating the selected 2028 goals. Many factors come into play in determining whether the uniform glide path can be achieved in the current planning period, including the cost and feasibility of controls as well as the appropriateness of the level set for natural conditions in 2064. The RPGs for each Alaska Class I area are presented in Section III.K.13.I.

G. Consultation with States, Tribes, and Federal Land Managers

Preparation of the RH Plan and selection of RPGs requires consultation among states, FLMs, and affected tribes since haze pollutants can be transported across state lines, as well as international and tribal borders. In Alaska, Class I areas are managed by the National Park Service (NPS) and the U.S. Fish and Wildlife Service (FWS). The draft SIP must be available to the FLMs at least 120 days before the public hearing on the final Plan. This allows time to identify and address any comments from the FLMs in the final RH Plan in advance of the public hearing.

Participation in the WRAP has helped to foster a regionally consistent approach to haze planning in the western states and provided a sound mechanism for consultation. DEC has also consulted directly with FLMs during the development of this SIP. The consultation process is explained in detail in Section III.K.13.K.

6. MID-COURSE REVIEW OF PROGRESS, REVISIONS, AND TIMELINES

Following submittal of the initial RH Plan, and every ten years after that, a revised plan must be submitted for the following ten-year period. In the interim, each state is required to submit a five-year progress report to the EPA. Inventory and monitoring data updates, as well as a progress report on emission reductions, are prepared for the mid-course review. As in the initial plan, at the mid-course review Alaska will work and consult with other states through a regional planning process, as funding allows.

The mid-course review also allows each state to assess progress towards its RPGs. As explained in Section III.K.13.H, Alaska's strategy for improving visibility is related to ongoing activities to reduce emissions of criteria pollutants. The current control measures and incentive programs for stationary, area, and mobile sources contribute measurably to reductions in haze. The second implementation period mid-course review is due in January 31, 2025, and will provide an opportunity to reassess progress in light of these and future programs.

III.K.13.B VISIBILITY AND IMPROVE PROGRAM

1. OVERVIEW

Visibility refers to the visual quality of a vista with respect to detail, color rendition, and contrast. It can refer to the maximum distance at which an object can be seen under prevailing conditions, and it is sometimes known as "visual range." When molecules and small particles in the air reflect (scatter) and absorb light in the atmosphere, this extinguishes light and prevents it from reaching a viewer's eye; this "light extinction" affects visibility. Haze is the reduction in visibility caused when sunlight encounters tiny particles in the air. The term "regional haze" refers to the air pollution released by human activities or natural sources, whether local or from a long distance, that reduces visibility in specific national parks and wilderness areas identified as Class I areas under the CAA.

EPA has identified two general causes of visibility impairment in Class I areas:

- Impairment due to smoke, dust, colored gas plumes, or layered haze emitted from stacks which obscure the sky or horizon and are relatable to a single stationary source or a small group of stationary sources (e.g., plume blight); and

- Impairment due to widespread, regionally homogeneous haze from a multitude of sources that impairs visibility in every direction over a large area.

While this RH Plan may address visibility impacts associated with visible plumes, its primary focus is to reduce regional, homogeneous haze coming from a variety of sources. Alaska's Class I areas are more typically subject to the latter cause of visibility impairment, both from natural and anthropogenic sources.

2. VISIBILITY IMPAIRING POLLUTANTS

The direct and precursor pollutants that can impair visibility include sulfur dioxide (SO_2), nitrogen oxides (NO_x), fine and coarse particulate matter (PM), volatile organic compounds (VOC), and ammonia. EPA 2019 RH SIP guidance states that when selecting sources for analysis of control measures, a state may focus on the PM species that dominate visibility impairment at the Class I areas affected by emissions from the state and then select only sources with emissions of those dominant pollutants and their precursors. Also, it may be reasonable for a state to not consider measures for control of the remaining pollutants from sources that have been selected on the basis of their emissions of the dominant pollutants.

Haze-causing PM species are classified by whether they were released directly or were formed in the atmosphere. Fine or coarse particulate matter ($PM_{2.5}$ or PM_{10}) emitted directly into the atmosphere is referred to as primary particulate, which includes crustal materials (soil), elemental carbon (EC), sea salt, and coarse mass (CM). PM produced in the atmosphere from photochemical reactions of gas-phase precursors and subsequent condensation to form secondary particulates is referred to as secondary particulate, which includes ammonium nitrate (NH_4NO_3) and ammonium sulfates ($(NH_4)_2SO_4$). Organic mass carbon (OMC) can be either primary or secondary. Secondary $PM_{2.5}$ is generally smaller size distribution than primary $PM_{2.5}$, and because the ability of $PM_{2.5}$ to scatter light depends on particle size with light scattering for fine particles being greater than for coarse particles, secondary $PM_{2.5}$ plays an especially important role in visibility impairment. Secondary NH_4NO_3 and $(NH_4)_2SO_4$ $PM_{2.5}$ are also hygroscopic, and their extinction efficiency increases as they take on water so the light scattering efficiency increases with increasing relative humidity. Moreover, the smaller secondary $PM_{2.5}$ can remain suspended in the atmosphere for longer periods and is transported long distances, thereby contributing to regional-scale impacts of pollutant emissions on visibility.

3. SOURCES OF VISIBILITY IMPAIRMENT

Pollutants that cause haze may be naturally occurring (e.g., from windstorms, wildfire, or volcanic activity), or they may be released directly or indirectly as the result of human activities (referred to as human-caused or anthropogenic sources). Natural sources contribute to visibility impairment, but natural emissions cannot be realistically controlled or prevented by the states. Anthropogenic emissions can be generated or originate within the boundaries of the state (referred to as “state-origin”), or they can be generated outside the boundaries of the United States and then transported into a state. Although they contribute to visibility impairment, international-origin emissions cannot be regulated, controlled, or prevented by the states. This is especially true in Alaska, where Arctic haze, Asian dust, and international pollutant transport are known sources of visibility impairment at the state’s Class I areas.[1] Nevertheless, their impact on visibility can be significant so it is important to assess their contribution to impairment.

A. Natural Sources

Natural sources of visibility impairment are those not directly attributed to human activities. Natural events (for example, biological activities, ocean spray, windstorms, wildfire, volcanic activity) create aerosols that contribute to haze in the atmosphere. Natural visibility conditions are not constant; they vary with changing natural processes throughout the year. Specific natural events can lead to high short-term concentrations of visibility-impairing PM and its precursors. Natural emission impacts from within Alaska are seasonally driven with wildfire smoke in the summer, windblown dust in the spring and summer, and oceanic dimethyl sulfide (DMS; natural source of sulfate) in summer. Volcano eruptions are episodic while volcano off-gassing can occur year-round. Natural sources outside of Alaska can also contribute to visibility impairment at Alaska Class I areas. They are also seasonally driven with impacts in the winter (Eurasian Arctic haze), spring (Asian dust), and summer (fires).

Therefore, natural visibility conditions, for the purpose of Alaska’s RH program, are represented by a long-term average of conditions expected to occur in the absence of emissions normally attributed to human activities. Natural visibility conditions reflect the contemporary vegetated landscape, land-use patterns, and meteorological/climatic conditions. Current methods of

[1] Alaska Transboundary Pollution Monitoring Report, June 2012, study, available at: https://dec.alaska.gov/air/anpms/original-regional-haze/ (Accessed 11/15/2021).

analyzing monitoring data do not distinguish between natural and anthropogenic emissions, but seasonal patterns and event timelines can provide insight into the relative contributions of natural sources of visibility impairment.

B. Human-Caused (Anthropogenic) Sources

Anthropogenic or human-caused sources of visibility impairment include anything directly attributable to human activities that produce emissions of visibility-impairing pollutants. Some examples of this include transportation, power generation, agricultural activities, mining operations, industrial fuel combustion, and dust from soils disturbed by human activities.

Anthropogenic effects on visibility are not constant; they vary with changing human activities throughout the year. As noted previously, international and natural caused emissions cannot be regulated, controlled, or prevented by the states. Any reductions in international origin anthropogenic emissions would fall under the purview of the EPA through international diplomatic activities.

4. MEASURING OR QUANTIFYING VISIBILITY IMPAIRMENT

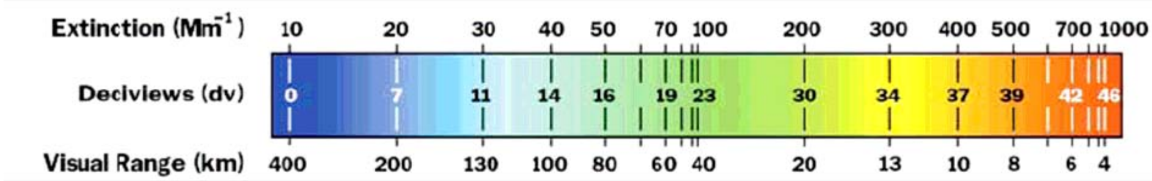
Visibility-impairing pollutants, so called haze species, reflect, scatter, and absorb light in the atmosphere. Each haze species has a different light extinction capability. Light extinction is the term used to describe light that is prevented from reaching a viewer's eyes by pollutants in the atmosphere. Light extinction can be measured by passing a light beam of known strength through a chamber of air and measuring the light attenuation by the gases and particles. Light that is scattered or absorbed by pollutants does not reach the other side of the chamber.

Molecules naturally found in the atmosphere also reflect, scatter, and absorb light even in the absence of $PM_{2.5}$. The interaction of light with very small molecules in the atmosphere causes "Rayleigh scattering," which also affects visibility.

Establishing the link between individual haze species and visibility impairment is the key to understanding regional haze. Light extinction caused by haze species can be calculated using the extinction coefficient and the measured concentration of the pollutant in the air. Light extinction is measured in inverse Megameters (Mm^{-1}). The specific visibility measurement unit used in the RH Rule to track visibility levels is the deciview (dv). The deciview is the natural logarithm of light extinction and is unitless. While the deciview value describes overall visibility levels, light extinction calculations can describe the contribution of each component haze species to measured visibility.

The relationship between units of light extinction (Mm^{-1}), haze index (measured in dv), and visual range (km) are indicated by the scale below (Figure III.K.13.B-1). Visual range is the distance at which a given object can be seen with the unaided eye. The deciview scale is zero for pristine conditions and increases as visibility degrades. Each deciview change represents a perceptible change in visual air quality to the average person. Generally, a one deciview change in the haze index is likely perceptible by a person regardless of background visibility conditions.

Figure III.K.13.B-1.Visibility measurement scale.



As the scale indicates, the deciview value gets higher as the amount of light extinction increases. The ultimate goal of the RH program is to reduce the amount of light extinction caused by haze species from anthropogenic emissions, until the deciview level for natural conditions is reached. That level is the deciview level corresponding to emission levels from natural sources only. The haze species concentrations are measured as part of the IMPROVE network deployed throughout the United States. Four IMPROVE sites are operated in Alaska: Denali Headquarters, Trapper Creek, Tuxedni/Kenai Peninsula Borough and Simeonof (more details in Section III.K.13.C Monitoring Strategy).

A. IMPROVE Program

The IMPROVE program was established in the mid-1980s to measure visibility impairment at Class I areas throughout the United States. This was part of the larger 1977 CAA Amendments reforms initiated to reduce air pollution and improve air quality throughout the United States and at designated national parks and wilderness areas. The monitoring sites are operated and maintained through a formal cooperative relationship among the EPA, NPS, FWS, Bureau of Land Management (BLM), and U.S. Forest Service (USFS). In 1991, several additional organizations joined the effort: State and Territorial Air Pollution Program Administrators and the Association of Local Air Pollution Control Officials (now National Association of Clean Air Agencies/NACAA), Western States Air Resources Council (WESTAR), Mid-Atlantic Regional Air Management Association (MARAMA), and Northeast States for Coordinated Air Use Management (NESCAUM). The primary monitoring data available within Alaska's Class I areas are from the IMPROVE program.

There are several objectives of the IMPROVE program: to establish current visibility and aerosol conditions in mandatory Class I areas; to identify chemical species and emission sources responsible for existing man-made visibility impairment; to document long-term trends for assessing progress towards the national visibility goal; and to provide regional haze monitoring representing all visibility-protected federal Class I areas where practical. The data collected at the IMPROVE monitoring sites are used by land managers, industry planners, scientists, public interest groups, and air quality regulators to better understand and protect the visual air quality resource in Class I areas. Most importantly, the IMPROVE Program scientifically documents for American citizens the visual air quality of their wilderness areas and national parks.

Detailed information regarding the IMPROVE program, including history, sampling protocols, standard operating procedures, and data availability can be found on the IMPROVE web site (http://vista.cira.colostate.edu/improve/).

B. IMPROVE Measurements

The IMPROVE program has used three monitoring approaches: scene monitoring with automated cameras (discontinued, but still a reference to range of conditions); measurement of optical extinction with transmissometers; and the measurement of the composition and concentration of the particles that produce the extinction with aerosol monitors. The IMPROVE monitoring network consists of aerosol, light scatter, light extinction, and scene samplers in a large number of national parks and wilderness areas. The IMPROVE monitor sample filters are analyzed for 47 different compounds including fine mass ($PM_{2.5}$), total mass (PM_{10}), optical absorption, elements, ions, and organics. Light extinction is estimated from measurements of PM components (sulfate, nitrate, organic carbon), light absorbing carbon, fine soil, sea salt, and coarse material; assumptions about relative humidity at the monitoring site; and the use of the "revised" (also called "second") IMPROVE equation[2]. The parameters used in regional haze analysis are described in Table III.K.13.B-1, in terms of both mass and extinction.

Table III.K.13.B-1. IMPROVE Parameters Contributing to Regional Haze and Descriptions

Code	Description
aerosol_bext	Total Aerosol Extinction
ALf	Aluminum (Fine)
ammNO3f	Ammonium Nitrate (Fine)
ammSO4f	Ammonium Sulfate (Fine)
AnthBext	Anthropogenic Extinction
AnthEammNO3	Anthropogenic ammNO3 extinction
AnthEammSO4	Anthropogenic ammSO4 extinction
AnthECM	Anthropogenic CM extinction
AnthELAC	Anthropogenic ELAC extinction
AnthEOMC	Anthropogenic OMC extinction
AnthESoil	Anthropogenic Soil extinction
C_Rat	C Rat
CAf	Calcium (Fine)
CBEXT	Carbon Extinction
CHLf	Chloride (Fine)
CLf	Chlorine (Fine)
CM_calculated	Mass, PM2.5 - PM10 (Coarse)
DUSTBEXT	Dust Extinction
dv	Deciview
E_Rat	E Rat
ammNO3f_bext	ammNO3 Extinction (Fine)
EammNO3_AM	Annual Mean Of ammNO3 Extinction
ammSO4f_bext	ammSO4 Extinction (Fine)

[2] Pitchford, M., W. Malm, B. Schichtel, N. Kumar, D. Lowenthal and J. Hand, 2007. Revised algorithm for estimating light extinction from IMPROVE particle speciation data, J. Air & Waste Manage. Assoc., 57, 1326-1336.

Code	Description
EammSO4_AM	Annual Mean Of ammSO4 Extinction
EC1f	Carbon, Elemental Fraction 1 (Fine)
EC2f	Carbon, Elemental Fraction 2 (Fine)
EC3f	Carbon, Elemental Fraction 3 (Fine)
CM_bext	Coarse Mass Extinction
ECf_bext	Carbon, Elemental Extinction (Fine)
OMCf_bext	Organic Mass Extinction (Fine)
EpiBext	Sum of Episodic Extinction
EpiCarbon	Episodic Carbon
EpiCarbon95Min	Lowest Annual 95th Percentile For OMC + LAC extinction
EpiDust	Episodic Dust
EpiDust95Min	Lowest Annual 95th Percentile For soil + CM extinction
EpiECM	Episodic CM extinction
EpiELAC	Episodic ELAC extinction
EpiEOMC	Episodic OMC extinction
EpiESoil	Episodic soil extinction
EpiRoutBext	Episodic Routine Extinction
EpiRoutDv	Episodic Routine Dv
SeaSaltf_bext	Sea Salt Extinction (Fine)
ESeaSalt_AM	Annual Mean Of sea salt extinction
SOILf_bext	Soil Extinction (Fine)
FEf	Iron (Fine)
flRH	Relative Humidity Factor, Large Particle Size
fRHgrid	Relative Humidity Factor (Climatological Monthly)
fsRH	Relative Humidity Factor, Small Particle Size
fssRH	Relative Humidity Factor, Sea Salt
Haze_Dv	Haze Dv
Impairment	Impairment
ECf	Carbon, Elemental Total (Fine)
ammNO3f_Large	Ammonium Nitrate (Fine), Large Fraction
ammSO4f_Large	Ammonium Sulfate (Fine), Large Fraction
OMCf_Large	Organic Carbon Mass (Fine), Large Fraction
MF	Mass, PM2.5 (Fine)
MT	Mass, PM10 (Total)
NC2SiaEammNO3	Natural Conditions 2 annual mean Ammonium Nitrate Extinction
NC2SiaEammSO4	Natural Conditions 2 annual mean Ammonium Sulfate Extinction
NC2SiaECM	Natural Conditions 2 annual mean Coarse Extinction

Code	Description
NC2SiaEEC	Natural Conditions 2 annual mean Elemental Carbon Extinction
NC2SiaESoil	Natural Conditions 2 annual mean Fine Soil Extinction
NC2SiaEOC	Natural Conditions 2 annual mean Organic Extinction
NO3f	Nitrate (Fine)
NonEpiECM	Non Episodic CM extinction
NonEpiECM_AM	Non Episodic CM extinction annual mean
NonEpiELAC	Non Episodic LAC extinction
NonEpiELAC_AM	Non Episodic LAC extinction annual mean
NonEpiEOMC	Non Episodic OMC extinction
NonEpiEOMC_AM	Non Episodic OMC extinction annual mean
NonEpiESoil	Non Episodic soil extinction
NonEpiESoil_AM	Non Episodic soil extinction annual mean
O_Rat	O Rat
OC1f	Carbon, Organic Fraction 1 (Fine)
OC2f	Carbon, Organic Fraction 2 (Fine)
OC3f	Carbon, Organic Fraction 3 (Fine)
OC4f	Carbon, Organic Fraction 4 (Fine)
OMCf	Carbon, Organic Mass (Fine) (1.8*OC)
OPf	Carbon, Organic Pyrolized (Fine), by Reflectance
RoutBext	Routine Extinction
RoutDv	Routine Deciview
RoutEammNO3	Routine ammNo3 extinction
RoutEammSO4	Routine ammSo4 extinction
RoutECM	Routine CM extinction
RoutELAC	Routine LAC extinction
RoutEOMC	Routine OMC extinction
RoutESeaSalt	Routine sea salt extinction
RoutESoil	Routine soil extinction
SeaSaltf	Sea Salt (Fine); 1.8 x [Chloride], or 1.8 x [Chlorine]if the chloride measurement is below detection limits, missing or invalid.
Sf	Sulfur (Fine)
SIf	Silicon (Fine)
ammNO3f_Small	Ammonium Nitrate (Fine), Small Fraction
ammSO4f_Small	Ammonium Sulfate (Fine), Small Fraction
OMCf_Small	Organic Carbon Mass (Fine), Small Fraction
SO4f	Sulfate (Fine)
SOILf	Soil (Fine)
S_Rayleigh	Site Rayleigh

Code	Description
SVR	Standard Visual Range
total_bext	Total extinction, aerosol + rayleigh
TIf	Titanium (Fine)

C. IMPROVE Equation

EPA's 2003 guidance on tracking progress and estimating natural conditions was based on the first IMPROVE algorithm[3]. Limitations of the original IMPROVE algorithm led to the development of a second IMPROVE algorithm which has been used for all analyses in this document.

The revised IMPROVE equation uses PM species concentrations and relative humidity data to calculate visibility impairment or beta extinction (Bext) in units of inverse megameters (Mm^{-1}):

Bext_Total = Bext_AmmSO4 + Bext_AmmNO3 + Bext_OA + Bext_EC +
Bext_Soil + Bext_Seasalt + Bext_CM + Bext_Rayleigh

where the light scattering efficiency each PM species is:

Bext_AmmSO4 = 2.2 x fs(RH) x [Small Sulfate] + 4.8 x fL(RH) x [Large Sulfate]
Bext_AmmNO3 = 2.4 x fs(RH) x [Small Nitrate] + 5.1 x fL(RH) x [Large Nitrate]
Bext_OA = 2.8 x {Small Organic Mass] + 6.1 x [Large Organic Mass]
Bext_EC = 10 x [Elemental Carbon]
Bext_Soil = 1 x [Fine Soil]
Bext_Seasalt = 1.7 x fss(RH) x [Sea Salt]
Bext_CM = 0.6 x [Coarse Mass]
Bext_Rayleigh = Rayleigh Scattering (site specific)

and fs(RH) = the unitless site-specific water growth factor for small particles as a function of relative humidity (RH),
fL(RH) = the site-specific water growth for large particles,
fss(RH) = the water growth factor for sea salt,
[ ] = particulate matter concentrations in $\mu g/m^3$.

Ammonium sulfate, ammonium nitrate, and organic mass are split into small and large modes based on their mass. For masses less than 20 $\mu g/m^3$, the fraction in the large mode is estimated by dividing the total concentration of the component by 20 $\mu g/m^3$. Rayleigh is the scattering of sunlight off the gas molecules of the atmosphere and is not measured by the IMPROVE monitors and is assumed to be constant but vary by site.

[3] EPA. 2003. Guidance for Estimating Natural Visibility Conditions Under the Regional Haze Rule; EPA-454/B-03-005; U.S. Environmental Protection Agency: Washington, DC, September 2003. Web Access: https://www.epa.gov/sites/production/files/2021-03/documents/tracking.pdf

The second IMPROVE algorithm has been used for all Alaska RH analyses. The limitations of the original IMPROVE algorithm are especially relevant to Alaska's remote and coastal Class I areas. The original IMPROVE algorithm tended to underestimate light extinction for the highest haze conditions and overestimate it for the lowest haze conditions. Alaska has very low haze levels compared to the rest of the United States. The original IMPROVE algorithm used a ratio of organic compound mass to total carbon mass of 1.4, though the literature indicated that the ratio is higher especially in remote areas, such as Alaska. The original algorithm also didn't include a term for sea salt, which is important for sites near the coasts. Other limitations include use of a single Rayleigh scattering estimate for all sites, and flawed assumptions used to estimate 20% best and worst conditions. The second IMPROVE algorithm addressed these limitations, so it is used here.

III.K.13.C. MONITORING STRATEGY

Title 40 CFR §51.308(f)(6) of the RH Rule requires a monitoring strategy for measuring, characterizing, and reporting regional haze visibility impairment that is representative of the Class I areas within Alaska. Alaska complies with this requirement through participation in the IMPROVE program. Alaska works with EPA and the FLMs to ensure that monitoring networks provide data that are representative of visibility conditions in each affected Class I area within the state. Along with monitoring strategies for the Class I areas, the RH SIP must include a determination of whether additional monitoring sites or equipment are needed to establish if progress goals are being achieved. Alaska has determined the state has met the requirements of analysis of visibility monitoring data.

IMPROVE monitoring within each of Alaska's Class I area is provided below. This is followed by a brief discussion of monitoring considerations particularly relevant to Alaska's Class I areas and conditions. Alaska used IMPROVE data provided by federal agencies for inclusion in this RH SIP. More analysis of data is found in other sections throughout this RH SIP.

1. MONITORING AT CLASS I AREAS IN ALASKA

A. Denali National Park and Preserve

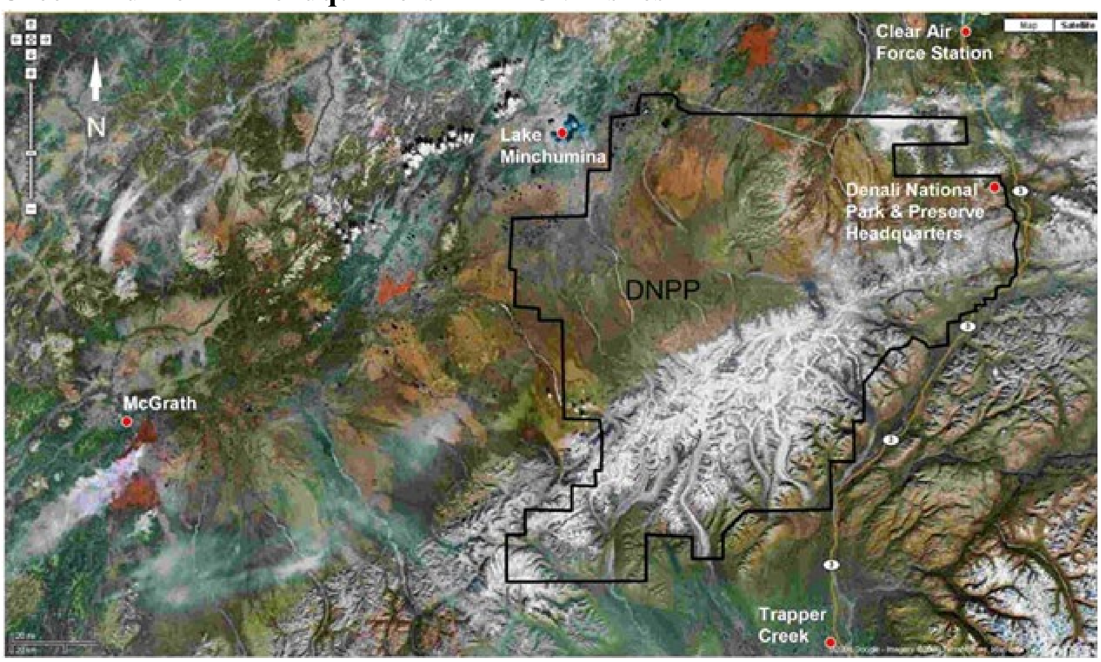
IMPROVE monitoring data are available from the Denali NP Headquarters site (DENA1) from March 1988 to the present, and at the Trapper Creek site (TRCR1) from 2001 to the present.

The Denali NP Headquarters site is located near the eastern end of the Park Road from park headquarters, approximately 250 yards from headquarters area buildings (see Figure III.K.13.C-1). The site (elevation of 2,125 feet) sits above the main road (elevation 2,088 feet). The side road to the monitoring site winds uphill for 130 yards, providing access to the monitoring site and a water treatment facility. The hill is moderately wooded, but the monitoring site sits in a half-acre clearing. The site is 2 miles west of the Nenana River and 3.2 miles south of the Healy Ridge, which rises to 6,000 feet at its highest point. It is located in an east-west valley, between the Healy Ridge and the main Alaska Range, which is about two miles wide at the monitoring station and gets wider to the west towards the Sanctuary and Savage Rivers. The site was previously the official IMPROVE site for Denali NP. Due to topographical barriers, such as the Alaska Range, it was determined that the headquarters site was not adequately representative of the entire Class I area. The headquarters site still operates as an IMPROVE protocol site.

A second, newer site, known as "Trapper Creek"/TRCR1, has been the official Denali IMPROVE site as of September 10, 2001. The site is located to the south of the park, 100 yards east of the Trapper Creek Elementary School, west of Trapper Creek, and a quarter mile south of Petersville Road (see Figure III.K.13.C-1). The site was established in September 2001 to evaluate the long-range transport of pollution into the Park from more densely populated and industrialized areas to the south. The elementary school experiences relatively little traffic during the day, about 4 buses and 50 automobiles. The school is closed June through August. This site was selected because it has year-round access to power, is relatively open, and is not directly impacted by local sources. It should be noted that DEC and the National Park Service disagree on which IMPROVE site, DENA1 or TRCR1, is the official IMPROVE site and which is the protocol site. Data from both sites is of value and included in this RH SIP. DEC is developing further documentation related to the attributes of the TRCR1 site and its differences from the DENA1 site. When complete, this documentation will be provided to EPA and the National Park Service as supplemental information related to the SIP.

In addition to the IMPROVE network, several other monitoring networks have sites at the Denali NP headquarters monitoring site. These include the Clean Air Status and Trends Network (CASTNet) monitor, the National Atmospheric Deposition Program, and NPS's meteorological monitoring equipment.

Figure III.K.13.C-1. Map of Denali National Park and Preserve with locations of Trapper Creek and Denali Headquarters IMPROVE sites



B. Simeonof Wilderness Area

The FWS has placed an IMPROVE air monitor in the community of Sand Point to represent the Simeonof Class I area. The community is on a nearby more accessible island approximately 60 miles north west of Simeonof. This monitor, SIME1, has been operating since September 2001. The location was selected to provide representative data for regional haze conditions at the wilderness area. The IMPROVE site has more potential for local pollution impact than a site located at the Class I area, but it is not possible or practical to service such a remote site.

C. Tuxedni National Wildlife Refuge

The current official IMPROVE site for the Tuxedni Class I area is located on the Kenai Peninsula to monitor visibility at the wilderness on Chisik Island, across Cook Inlet. The monitor, referred to as the Kenai Peninsula Borough (KPBO1) was moved from the former Tuxedni monitoring site, TUXE1, on the western side of the inlet in 2015 after the fishing lodge it was located near shut its doors.

The TUXE1 monitor was built next to a seasonal fishing lodge which was used by destination backpackers and fishing guides. This meant that the site was exposed to very little direct local stationary emissions and limited amounts of mobile emissions. The monitoring site was operated from the baseline period until 2014, when the lodge owner notified the EPA and DEC that they would be closing the lodge. As DEC personnel utilized the lodge to access and maintain the monitoring site, it was necessary to move the monitoring site to continue providing data to the EPA IMPROVE network and to keep track of visibility per the RH Rule. Several options were put forward as potential replacements for the closed Tuxedni monitoring site.

The NPS and FWS air monitoring staff requested assistance from DEC in selecting a replacement site location. The NPS and FWS air staff offices are located in Denver, Colorado, and with budget consideration in mind they asked DEC staff to do the site reconnaissance work prior to visiting the proposed locations. DEC staff reviewed several possible locations and provided FWS and NPS with site photos and information. As access to the west side of Cook Inlet is too costly, a site on the east side of the inlet was selected. The replacement site (KPBO1) south of the community of Ninilchik was selected because of ease of access and option for accessing power. The site has been active since mid-2015. There was a resulting gap between the close of the TUXE1 and KPBO1 monitoring site which was initially backfilled with information from the Trapper Creek monitoring station south of Denali NP. DEC rejected this data backfilling as this area was not considered a suitable replacement for data from the Tuxedni site.

This change in monitoring sites resulted in an emissions profile shift that was significant enough to result in a data discrepancy which led the DEC and EPA to treat the KPBO1 and TUXE1 sites as different sites and not as a continuation. The primary reason for this is the presence of large population centers, electrical generation, and industrial sites on the eastern side of Cook Inlet. TUXE1 was located on the western side of the inlet, where the population is much smaller than on the Kenai Peninsula. Along the Kenai Peninsula there are larger natural gas-fired power plants, and the Alaska state highway runs between Homer, Kenai, Soldotna, and Anchorage. This highway brings a significant amount of mobile source emissions compared with the old site, which had only a few All-Terrain Vehicles (ATVs) and limited small boat traffic near Chisik Island.

In addition, the Homer Spit is a common anchorage point for large international and domestic cargo vessels and tankers entering Cook Inlet. Most international maritime traffic anchors off the Homer Spit to allow for a U.S. Coast Guard (USCG) inspection prior to continuing north. Most vessels are either transiting north to the Nikiski Oil Refinery or further north to the Port of Anchorage. The Nikiski facility, along with a number of off-shore oil drilling platforms, including the recent Bluecrest Cosmopolitan Platform, appear to impact the KPBO1 site more than the TUXE1 site.

As discussed elsewhere in this RH SIP, the IMPROVE MID visibility metric is used to track visibility progress at Class I areas. The IMPROVE MID were based on an analysis of 2000-2014 IMPROVE observations, so they are available for the TUXE1 monitor whose last full year was 2014, but not for the KPBO1 whose first full year was 2016.

D. Bering Sea Wilderness Area

There is no air monitoring being conducted or planned for the Bering Sea Class I area due to its remote location and its inaccessibility.

2. ADDITIONAL MONITORING CONSIDERATIONS

One of the monitoring issues that Alaska has identified is the logistical difficulty of monitoring at remote locations. Remote locations make it challenging to provide power for instrumentation. If a monitor is located at the nearest power source, such as a town, it is also near local sources of emissions, and therefore is less likely to be representative of the Class I area. Remote sampling in Class I areas may be needed to verify that data from an off-site IMPROVE monitor are representative. The Davis Rotating-drum Universal-size-cut Monitoring (DRUM) sampler utilizing fluorescent monodisperse aerosols provided an opportunity early on to verify visibility impacts at remote Class I areas like Simeonof and Tuxedni, but the use of these samplers still proved problematic and challenging. The challenges for ongoing air and visibility monitoring in Alaska are transportation and site maintenance. Sites are remote, access may be only by air or water, and electrical power may be lacking. In many places winter temperatures are extreme, often dipping well below zero Fahrenheit for weeks at a time.

III.K.13.D. ASSESSMENT OF AMBIENT DATA FOR CLASS I AREAS

The RH Rule requires that states improve visibility at Class I areas to levels defined as "natural conditions," which are defined as the conditions that would prevail in the absence of any human impacts on visibility. The specific requirement is that states improve the 20% most impaired days (MID) while maintaining no worsening in visibility of the clearest days. To address the requirements of the RH Rule, states must determine natural conditions as defined by the RH Rule; natural conditions are the endpoint goal by 2064. To meet this goal, states must demonstrate continued progress towards the endpoint without visibility degradation on the clearest days. States must also measure initial, baseline visibility conditions; this defines the starting point from which improvement is measured.

This section describes the determination of baseline, natural and current visibility conditions at each IMPROVE monitor representing Alaska Class I areas. The current conditions are defined by the 5 most recent years of available data which cover the period 2014-2018 except for TUXE1 and KPBO1. The TUXE1 IMPROVE site stopped operating in 2014 and the KPBO1 site came online later; the 3 most recent years of available data (2012 to 2014 for TUXE1 and 2016 to 2018 for KPBO1) are used instead. Due to the remote location of the Bering Sea Class I area, there is no representative IMPROVE monitoring site, so no baseline is established for this Class I area. Available IMPROVE measurement periods for Alaska Class I areas are listed in Table III.K.13.D-1.

Table III.K.13.D-1. Period of IMPROVE measurements.

Class I Area	IMPROVE Site	Operating Period	Baseline Period	Current Period
Denali National Park and Preserve	Denali Headquarters Site (DENA1)	2000 - Present	2000 - 2004	2014 - 2018
	Trapper Creek Site (TRCR1)	2002 - Present	2002 - 2004	2014 - 2018
Simeonof National Wildlife Refuge/National Wilderness Area	Simeonof (SIME1)	2002 - Present	2002 - 2004	2014 - 2018
Tuxedni National Wildlife Refuge/National Wilderness Area	Tuxedni (TUXE1)	2002 - 2014	2002 - 2004	2012 – 2014
	Kenai Peninsula Borough (KPBO1)	2016 - Present	Not available	2016 – 2018

1. VISIBILITY REQUIREMENT

The required content of RH SIPs is specified in 40 CFR §51.308(f), which was revised in 2017. The RH Rule established the concept of state-set RPGs for the 20% most anthropogenically impaired days as a regulatory construct promulgated to implement the statutory requirements for visibility protection. These RPGs reflect the visibility conditions that are projected to be achieved by the end of the applicable implementation period as a result of its own and other states' long-term strategies.

The 2017 RH Rule requires states to determine the rate of improvement in visibility that would need to be maintained during each implementation period in order to reach natural conditions by 2064 for the 20% MID, given the starting point of the 2000-2004 baseline visibility condition. The "glidepath," or Uniform Rate of Progress (URP), is the amount of visibility improvement that would be needed to stay on a linear path from the baseline period to natural conditions in 2064. Progress is tracked using ambient concentration measurements from the IMPROVE network expressed in units of deciview (dv) which is proportional to the logarithm of the atmospheric light extinction (Bext, in units of inverse megameters [Mm^{-1}]):

$$\text{Deciview index} = 10 \ln (\text{Bext}/10 \text{ Mm}^{-1})$$

The 2017 RH Rule also requires states to determine the baseline (2000-2004) visibility condition for the 20% clearest days and requires that the LTS and RPGs ensure no degradation in visibility for the clearest days since the baseline period.

Title 40 CFR §51.308(f)(1)(i)-(vi) contains three metrics of visibility for either the MID or the clearest days:

- baseline conditions are the average of the five annual averages for the period 2000 to 2004;
- current conditions represent the average of the five annual averages for the most recent period (e.g., 2014-2018) for which data are available; and
- natural conditions are the average of individual values of daily natural visibility unique to each Class I area.

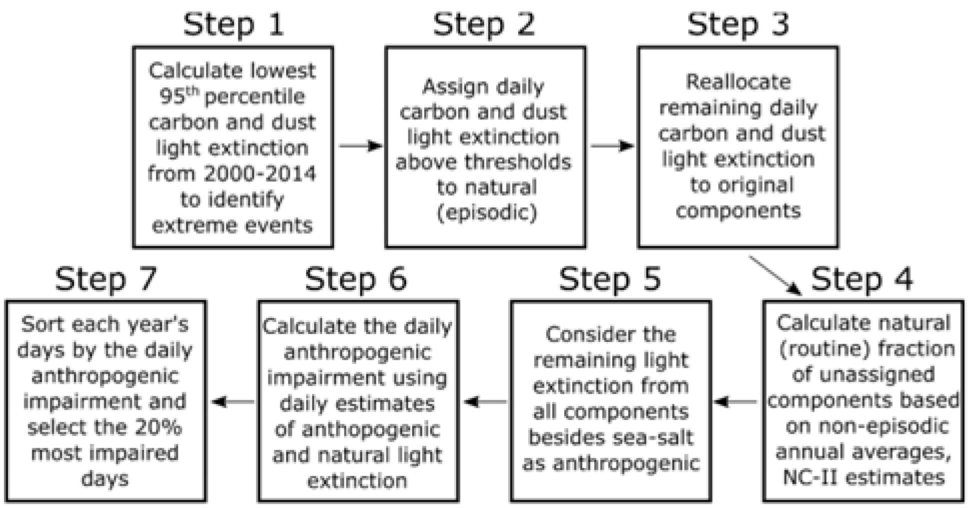
Under the 2017 RH Rule revisions, states must select the MID each year at each Class I area based on daily anthropogenic impairment. The MID are those days with the highest anthropogenic visibility impairment defined as:

$$\Delta\, dv_{\text{anthropogenic visibility impairment}} = dv_{\text{total}} - dv_{\text{natural}}$$

where dv_{total} is the overall deciview value for a day, and $dv_{natural}$ is the natural portion of the deciview value for a day. The EPA 2018 Technical Guidance describes how these values are determined.

In general, the recommended approach to splitting daily light extinction into natural and anthropogenic fractions is to estimate the natural contribution to daily light extinction and then attribute the remaining light extinction to anthropogenic sources. The natural contributions are grouped into two types - "episodic" and "routine." The episodic natural contributions are those that occur relatively infrequently and likely result from extreme events like wildfires and dust storms that are identified by a site-specific threshold of carbon (organic mass + elemental carbon) and dust (fine soil + coarse mass) based on observed IMPROVE 95th percentile values from 2000 through 2014. The non-episodic extinction values for each day are then allocated to the routine natural conditions based on the ratio of the Natural Conditions II (NC-II) estimates and non-episodic annual average for each chemical species. Any remaining extinction after removing the episodic and routine natural extinction is considered anthropogenic in origin. The 20% MID have the highest anthropogenic extinction relative to the natural extinction. The steps in determining the 20% MID are summarized in Figure III.K.13.D-1.

Figure III.K.13.D-1. Flow chart of the 7 steps involved in calculating the 20% most impaired days.



EPA offered as a starting point a "default" natural visibility target for each Class I area. These default conditions are based on broad regional estimates and data analysis with an expectation that the estimates would be refined over time. Glidepaths based on EPA's default natural condition estimates are termed 'default glidepaths' in this RH SIP.

The 2017 RH Rule includes a provision that allows states to propose an adjustment to the URP to account for impacts from anthropogenic sources outside the United States, if the adjustment has been developed through scientifically valid data and methods. EPA's visibility guidance[1] states "to calculate the proposed adjustment(s), the State must add the estimated impact(s) to the natural visibility condition and compare the baseline visibility".

[1] EPA, 2018. Technical Guidance on Tracking Visibility Progress for the Second Implementation Period of the Regional Haze Program. Web access: https://www.epa.gov/sites/production/files/2018-12/documents/technical_guidance_tracking_visibility_progress.pdf

A. Alternative MID

In the EPA approach, the MID are selected by screening out days with estimated high fire (using specific threshold of carbon) and dust contributions and identifying the 20% days that are most likely impaired by anthropogenic emissions under the assumption that ammonium sulfate and ammonium nitrate are mainly anthropogenic in origin. However, multiple volcanoes located near the Alaska IMPROVE sites are active providing episodic natural events impacting visibility similar to fire and dust contributions. To account for these episodic natural emissions, Alaska has adopted a modified approach which mirrors the draft/ad hoc EPA approach for Hawaii's two Class I areas with similar episodic visibility impairment.[2] This modified approach does not affect the 20% clearest days. Appendix III.K.13.I will apply the same sulfate-screening method to Alaska and discuss how that impacts the URP.

2. NATURAL VISIBILITY CONDITIONS

Natural visibility conditions represent the long-term degree of visibility estimated to exist in the absence of anthropogenic impairment. Natural events such as windstorms, wildfires, volcanic activity, biogenic emissions, and even sea salt from sea breezes introduce particles from natural sources that contribute to haze in the atmosphere. Individual natural events can lead to high short-term concentrations of visibility-impairing pollutants.

EPA, states, and regional planning organizations have progressed in their efforts to improve the approach for determining natural conditions in Class I areas. New research is examining the increasing prevalence of wildfires in the western United States. The frequency of dust storms and their impact on areas disturbed by human vs. wildlife activities are being investigated, as well as global transport of dust from natural desert storms in Africa and Asia. The EPA initially calculated default natural visibility conditions for all Class I areas but allowed states to develop more refined calculations. Alaska has an interest in understanding international emissions and their impact on the State. Section III.K.13.I describes how Alaska accounts for international contributions to visibility in the 2064 MID endpoint.

The natural conditions for the 20% clearest days are given as the NC-II values and can be obtained from the IMPROVE Committee website.[3] The natural conditions for the 20% MID were obtained from the 2064 Endpoint File[4] on the same website. The natural visibility conditions for the 20% most anthropogenically impaired days and for the 20% clearest days for each IMPROVE site are summarized in **Table III.K.13.D-2**.

Table III.K.13.D-2. Natural haze indices (dv) for all Alaska IMPROVE sites.

[2] U.S. Environmental Protection Agency, 2020. Technical Support Document for EPA's Updated 2028 Regional Haze Modeling for Hawaii, Virgin Islands, and Alaska. Office of Air Quality Planning and Standards. July.

[3] http://vista.cira.colostate.edu/IMPROVE/Data/NaturalConditions/nc2_4_20.csv (April 2020).

[4] http://vista.cira.colostate.edu/DataWarehouse/IMPROVE/Data/SummaryData/Endpoint/glideslope_and_2064_endpt_4_20_2.csv (April 2020).

Class I Area	IMPROVE Site	Clearest Day Haze Index	Most Impaired Haze Index
Denali National Park and Preserve	DENA1	1.8	4.7
	TRCR1	2.7	6.4
Simeonof National Wildlife Refuge/ National Wilderness Area	SIME1	5.3	8.5
Tuxedni National Wildlife Refuge/ National Wilderness Area	TUXE1	3.1	7.0
	KPBO1	4.6	Not available

3. BASELINE VISIBILITY CONDITIONS

Baseline visibility is calculated using the actual pollutant concentrations measured at the IMPROVE monitors for the period of 2000-2004. The 20% MID deciviews (roughly corresponding to the 24 days having the worst visibility after excluding data with high wildfire and windblown dust impacts) are averaged each year. These five yearly values are then averaged to determine the MID's visibility in deciviews for the 2000-2004 baseline period. The same process is used to get the clearest day baseline visibility value in deciviews from the annual 20% clearest days over the baseline years.

For several Alaska Class I area sites, monitoring began in late 2001. Therefore, only three complete years of monitoring data, 2002-2004, are available to define the baseline period (see Table III.K.13.D-1).

The movement of the IMPROVE monitor representing the Tuxedni Class I area from TUXE1 to KPBO1 has resulted in an emissions profile shift that was significant enough to result in a data discrepancy between the two monitors. ADEC has determined it is most appropriate to treat the KPBO1 and TUXE1 sites as different sites and not as a continuation. The change in deciview readings at the KPBO1 site, along with the different Weighted Emissions Potential (WEP) and Area of Influence (AOI) readings presented in Section III.K.13.G, provides the requisite data for the state to argue that the two monitoring sites should not be treated as a continuation on the same glideslope and instead should be recalculated moving into the progress report and the next implementation period.[5] In this RH SIP, ADEC used the available data from the TUXE1 site to

[5] For more information regarding this discrepancy in TUXE1-KPB01 emissions profiles, see III.K.13.G.4.E.iv (Tuxedni), and refer to III.K.13.G.4 for general discussion of TUXE1-KPB01 discrepancy.

construct an analysis which would meet EPA requirements under the RH Rule. It should be noted that, because the TUXE1 site has been offline for five years and a new baseline will be established for the progress report in three years, the TUXE1 glideslope will not be used after this report.

As the KPBO1 monitor has only been in operation since mid-2015, there are not enough years of data to allow for the establishment of a new baseline for the Second Implementation Period or for the calculation of the MID visibility metric. (See Table III.K.13.D-3 through Table III.K.13.D-7 for baseline haze indices.)

Table III.K.13.D-3. Baseline haze indices (dv) for the Denali IMPROVE site (DENA1).

Year	Clearest Day Haze Index	Most Impaired Haze Index
2000	2.7	6.8
2001	2.5	6.8
2002	2.3	7.7
2003	2.2	7.7
2004	2.5	6.3
Average	2.4	7.1

Table III.K.13.D-4. Baseline haze indices (dv) for the Trapper Creek IMPROVE site. (TRCR1).

Year	Clearest Day Haze Index	Most Impaired Haze Index
2000	Not available	Not available
2001	Not available	Not available
2002	3.4	9.5
2003	3.2	9.6
2004	3.7	8.2
Average	3.5	9.1

Table III.K.13.D-5. Baseline haze indices (dv) for the Simeonof IMPROVE site (SIME1).

Year	Clearest Day Haze Index	Most Impaired Haze Index
2000	Not available	Not available
2001	Not available	Not available
2002	7.8	14.1
2003	6.8	13.4
2004	8.3	13.5
Average	7.6	13.7

Table III.K.13.D-6. Baseline haze indices (dv) for the Tuxedni IMPROVE site (TUXE1).

Year	Clearest Day Haze Index	Most Impaired Haze Index
2000	Not available	Not available

2001	Not available	Not available
2002	4.2	10.3
2003	3.8	10.9
2004	4.0	10.2
Average	4.0	10.5

Table III.K.13.D-7. Baseline haze indices (dv) for all Alaska IMPROVE sites.

Class I Area	IMPROVE Site	Clearest Day Haze Index	Most Impaired Haze Index
Denali National Park and Preserve	DENA1	2.4	7.1
	TRCR1	3.5	9.1
Simeonof Wilderness Area	SIME1	7.6	13.7
Tuxedni National Wildlife Refuge	TUXE1	4.0	10.5
	KPBO1	Not available	Not available

4. CURRENT VISIBILITY CONDITIONS

The current visibility period (2014-2018) represents the most up-to-date visibility data for all Class I areas in Alaska. Similar to the baseline conditions, the 20% MID deciviews are averaged each year during the current period. As shown in Table III.K.13.D-1, data for the TUXE1 monitor during the current visibility period is only available for 2014 so period 2012-2014 is used. Data for the KPBO1 monitor is available from 2015 through the end of the current visibility period in 2018. This three-year timeframe is the start of the baseline reset for the Tuxedni glideslope after the move from the old TUXE1 monitoring station near Chisik Island.

Using the available years (2016-2018), the current cleanest days baseline at KPBO1 is six deciviews, a decline of two deciviews compared with the baseline visibility condition at the TUXE1 monitoring site. This reflects the changed conditions at the KPBO1 site of local population size, community sizes, and industrial activities. It will be possible for the state to establish a formalized baseline, glideslope, and URP for clearest and MID at KPBO1 by the progress report in three years. (See Table III.K.13.D-8 for the current haze indices for all IMPROVE sites.)

Table III.K.13.D-8. Current haze indices (dv) for all Alaska IMPROVE sites.

Class I Area	IMPROVE Site	Clearest Day Haze Index	Most Impaired Haze Index
Denali National Park and Preserve	DENA1	2.2	6.6
	TRCR1	3.4	8.8

Simeonof Wilderness Area	SIME1	7.7	13.9
Tuxedni National Wildlife Refuge	TUXE1	3.9	10.0
	KPBO1	6.0	Not available

5. ANNUAL AND SEASONAL SPECIATION TREND

This section presents 2000-2018 annual average light extinction by species and 2014-2018 seasonal light extinction by species for each IMPROVE site in Alaska.

a. Denali– DENA1

Figure III.K.13.D-2 shows that the largest fractions of total light extinction on the MID at DENA1 are $(NH_4)_2SO_4$ and OMC, with CM and EC contributing to a lesser extent. DENA1 is adjacent to a local coal-fired electrical generating plant (i.e., the Healy Power Plant), which produces significant amounts of $(NH_4)_2SO_4$ and NH_4NO_3. DENA1 has a greater presence of OM than other Class I areas in the state due to the park location in Southcentral Alaska with large forests surrounding the area so is more influenced by secondary organic aerosol from biogenic emissions and wildfires.

Except for an increase in extinction in 2009, there was no noticeable decline in extinction during 2000-2018 at DENA1. The 2009 increase in visibility extinction was noted as a result of the local wildfire and volcano activities that year which impacted the overall air quality in the Class I area for the year. Comparing the baseline with the current visibility period, local visibility has improved slightly, with visibility falling towards five deciviews by the end of the current visibility period. This downward trend in visibility degradation indicates that haze-causing species, $(NH_4)_2SO_4$ predominantly, have improved since the baseline period.

Other than $(NH_4)_2SO_4$, local EC has fallen compared to where it was measured at the start of the baseline period. This indicates that either wildfire activity has not generated the same level of EC or that other potential sources of this haze species have declined since 2000. CM remained relatively consistent, potentially indicating that any increases in local tourist activity over unpaved roads within the parks have not caused significant visibility declines.

Light extinction on the clearest days at DENA1 shown in Figure III.K.13.D-3 indicates improvement between the baseline period and current visibility period, with $(NH_4)_2SO_4$ levels falling to roughly 0.5 Mm^{-1} light extinction. OMC showed a slight increase during 2010-2012, but it otherwise remained at consistent levels through all three monitoring periods. CM showed reductions from the baseline through current visibility period.

Figure III.K.13.D-2. 2000-2018 Annual average light extinction on most impaired days at DENA1

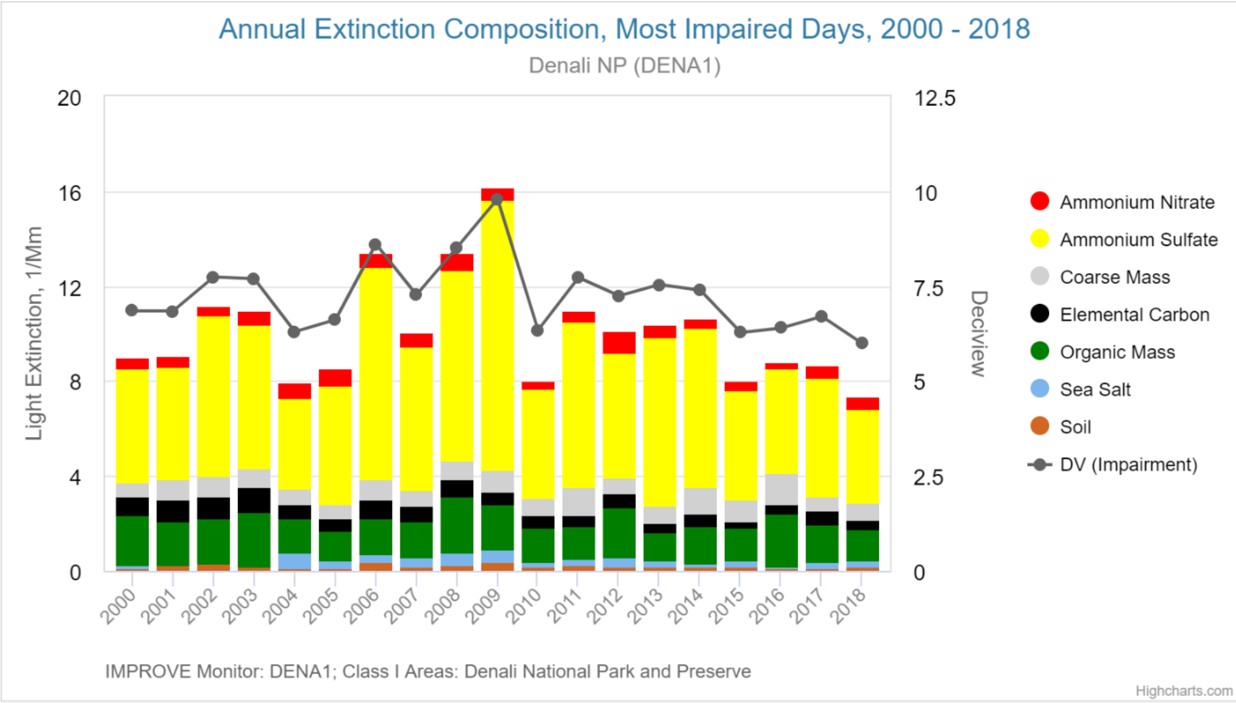
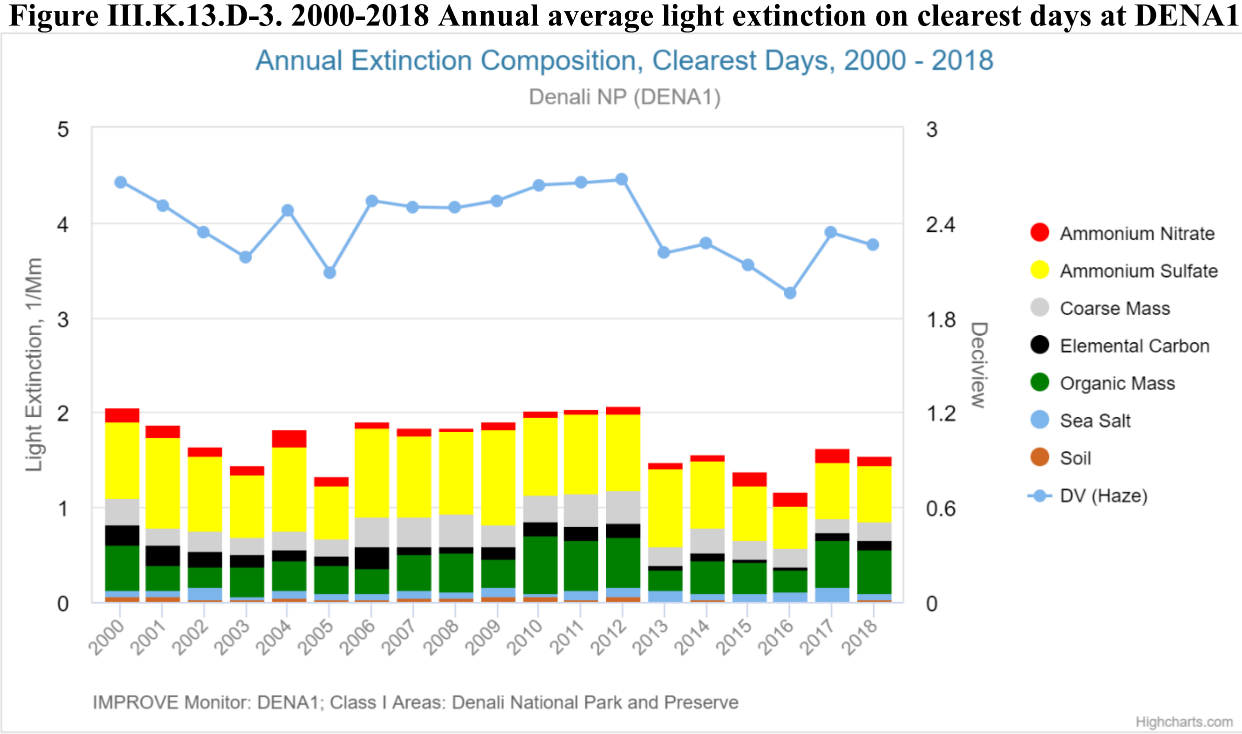


Figure III.K.13.D-3. 2000-2018 Annual average light extinction on clearest days at DENA1



During spring and summer months when wildfire activity is at its peak, both OMC and $(NH_4)_2SO_4$ levels on MID demonstrate the role these fires play in visibility degradation. High

OMC levels recorded during summer are likely associated with wildfire activities. For example, during 2015, 5.14 million acres burned throughout the state and caused significant air quality issues. It is likely that this OMC made it through the statistical procedures for screening out days influenced by wildfires in defining the IMPROVE MID and caused the higher extinction readings on the MID during summer of 2015 (e.g., June 14 and July 20). (Figure III.K.13.D-4). Wildfires likely account for elevated $(NH_4)_2SO_4$ levels on these days too.

The reading of higher CM could be caused by local unpaved road traffic in the national park, especially as tourist activity tends to peak during July and August with large numbers of tourists arriving in state. While during fall and winter, increased precipitation in the form of rain and snow suppresses dust from all sources. (Figure III.K.13.D-5)

$(NH_4)_2SO_4$ levels between spring and summer are almost identical. $(NH_4)_2SO_4$ levels further fell during fall and winter. The presence of NH_4NO_3 in the Denali airshed can be connected with anthropogenic sources.

Figure III.K.13.D-4. 2014-2018 Seasonal light extinction composition on most impaired days at DENA1

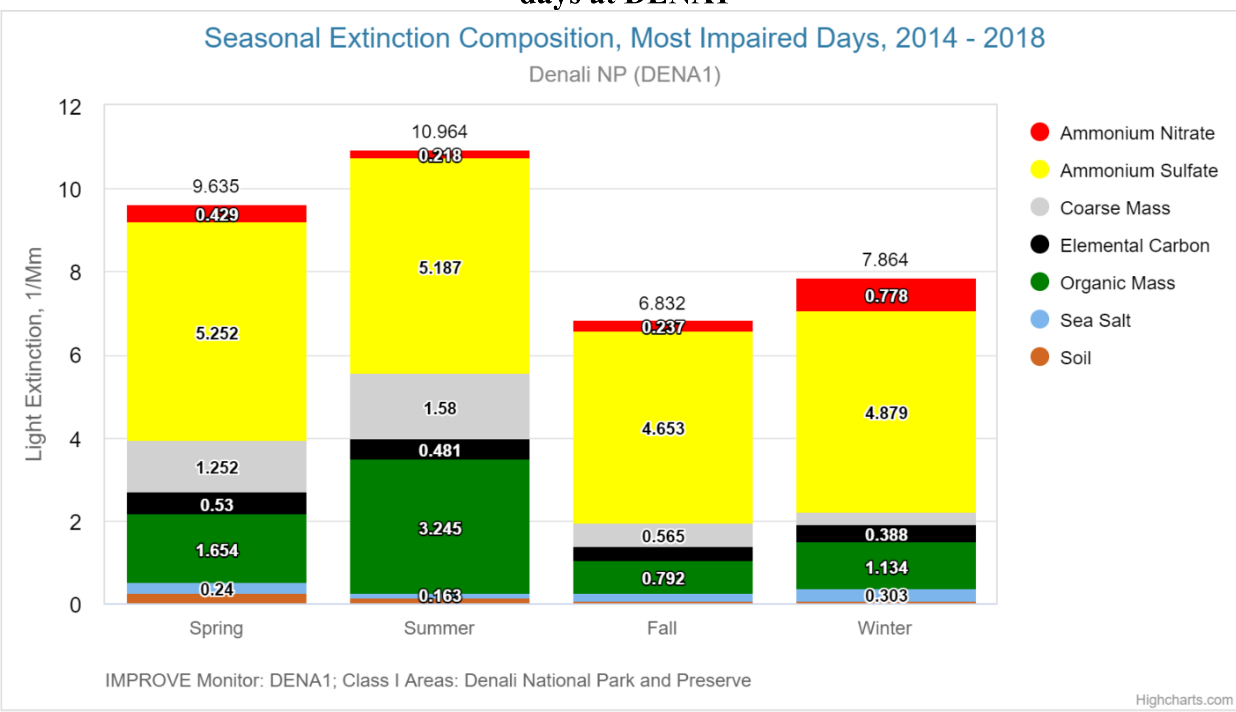
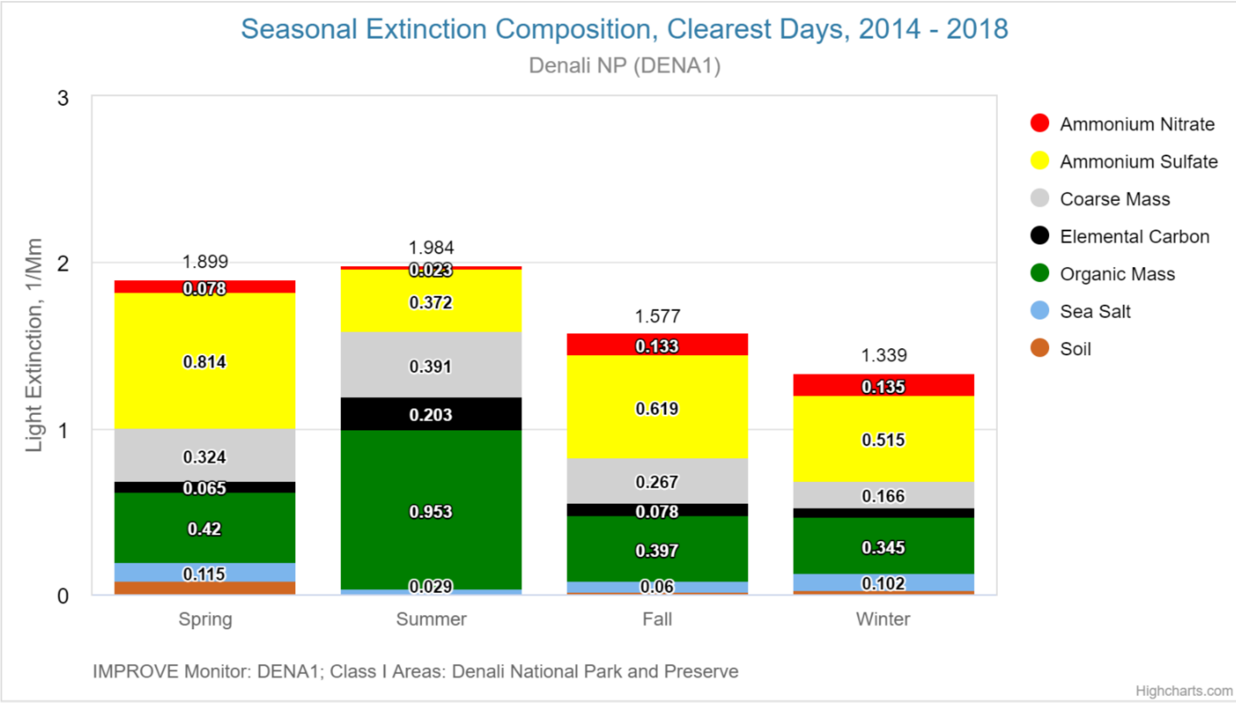


Figure III.K.13.D-5. 2014-2018 Seasonal light extinction composition on clearest days at DENA1



B. Trapper Creek – TRCR1

Like other Class I areas in the state, the primary haze species of concern for TRCR1 is $(NH_4)_2SO_4$, and its levels track closely with those detected at the DENA1 monitoring station (Figure III.K.13.D-6). Unlike DENA1, TRCR1 is not near coal-fired power plants. However, Denali is located equidistant between large military installations in Anchorage and Fairbanks, which includes extremely active flight lines, and emissions are generated above the surface mixing layer which limits visibility impacts.

Two large yearly annual increases in 2006 and 2009 match up with significant wildfire years in the Alaska interior and are mirrored at the DENA1 monitoring site. 2009, the year with the highest MID extinction, is a significant fire year in the Alaska interior when some 2.9 million acres burned. 2009 was also a peak record of volcanic activities, including the eruption of the Redoubt volcano.

Visibility at the TRCR1 monitor during the current visibility period MID averaged roughly between eight and nine deciviews, or 13 Mm^{-1} extinction. The highest extinction readings were in 2009 and 2014; most of which came from high $(NH_4)_2SO_4$ levels. Extinction levels for 2015-18 were roughly 11 Mm^{-1}, which can be considered an improvement compared to baseline years (e.g., almost 15 Mm^{-1} in 2002 and 2003).

Clearest days levels remained near or below 3 Mm^{-1} light extinction and approached estimated natural conditions for the monitoring site (Figure III.K.13.D-7).

Figure III.K.13.D-6. 2002-2018 Annual average light extinction on most impaired days at TRCR1

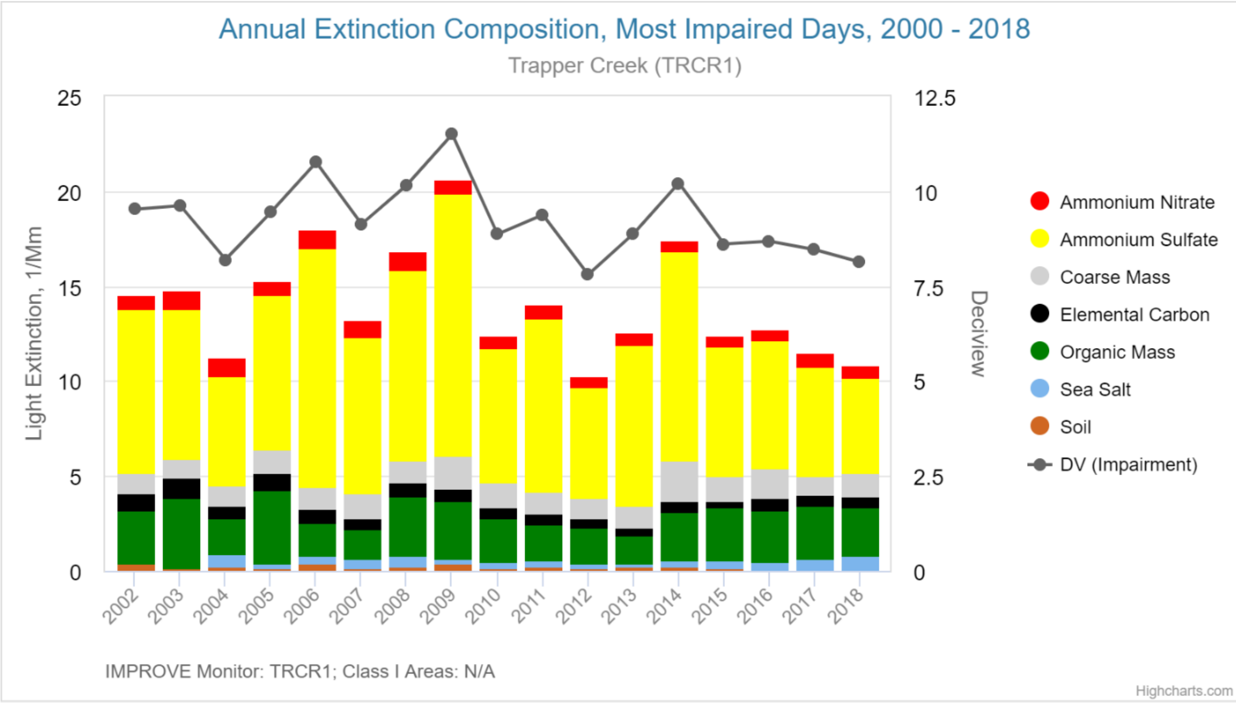
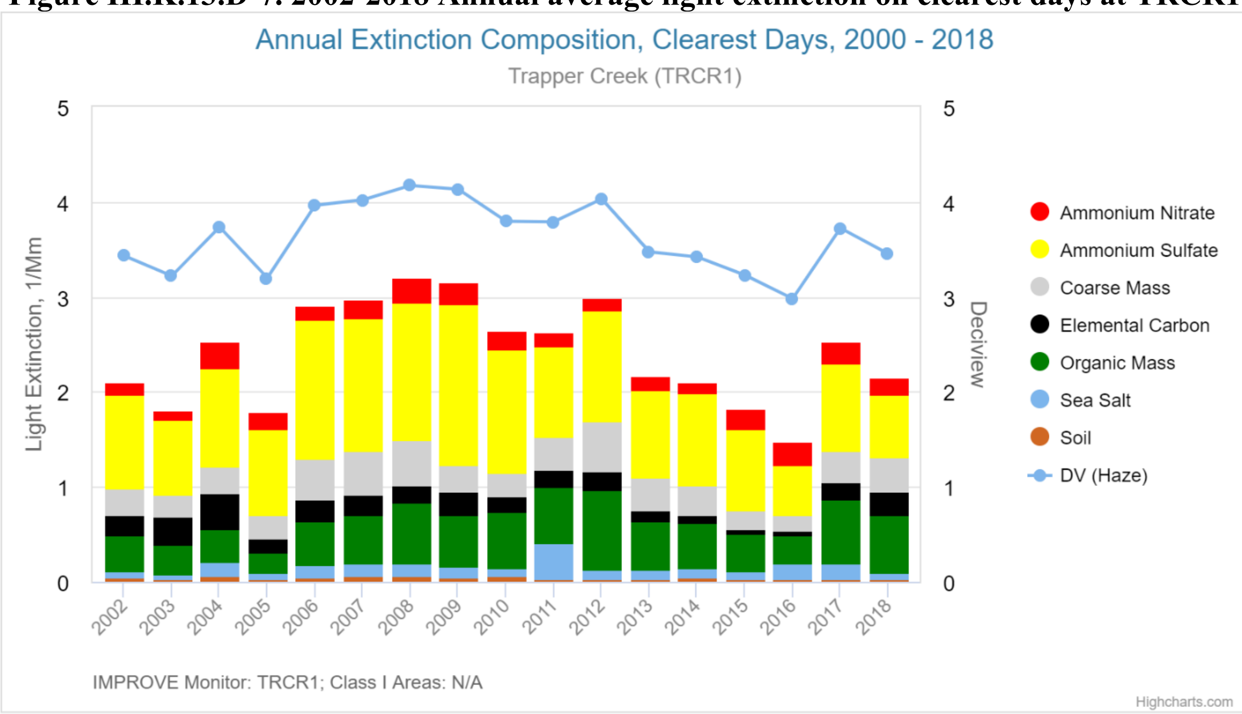


Figure III.K.13.D-7. 2002-2018 Annual average light extinction on clearest days at TRCR1



Seasonal extinction for MID at the TRCR1 monitor was recorded at its highest during summer, with a maximum average of 16.5 Mm^{-1}(Figure III.K.13.D-8). High levels of recorded OMC indicate some amount of wildfire smoke contributed to extinction on the MID that were not eliminated from MID by the MID statistical screening approach of the IMPROVE data. Higher NH_4NO_3 and $(NH_4)_2SO_4$ can potentially also be tied to the increased wildfire activity, which took place in the summer of 2015, weighting the average towards these species over the current visibility period MID.

On clearest days, the distribution of light extinction among species for site TRCR1 and DENA1 is very similar, while TRCR1 had slightly higher total light extinction (Figure III.K.13.D-9).

Figure III.K.13.D-8. 2014-2018 Seasonal light extinction composition on most impaired days at TRCR1

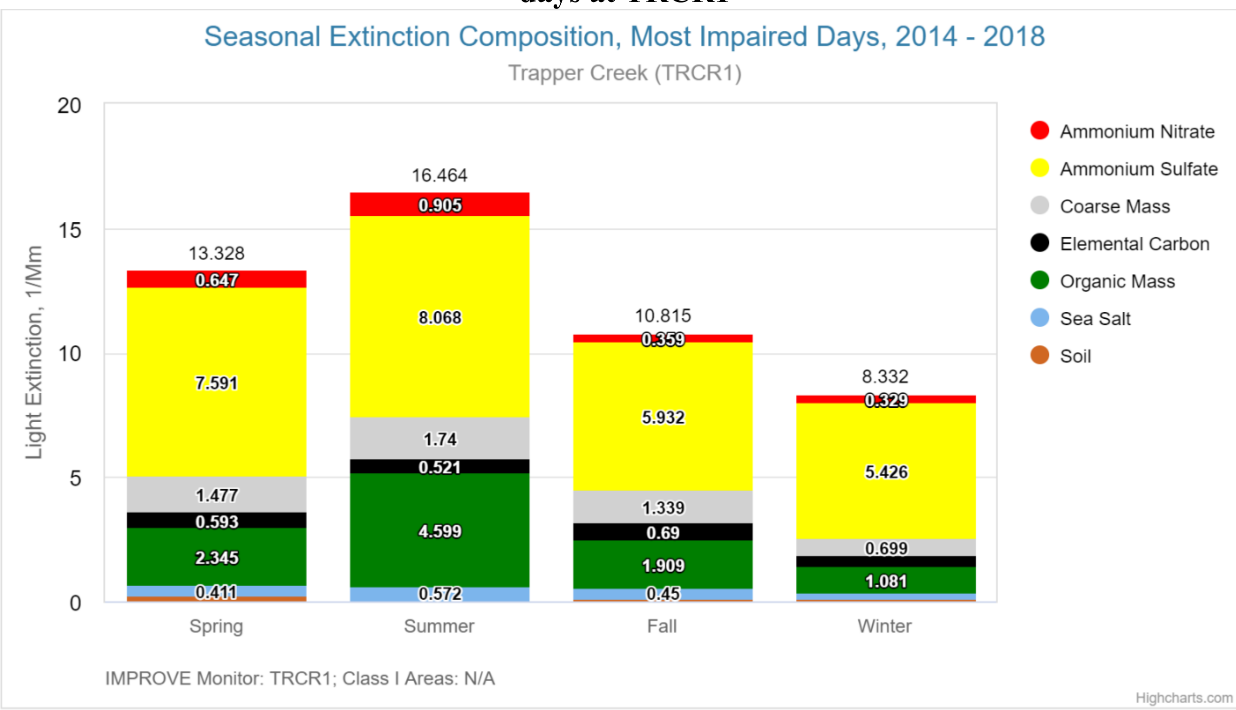
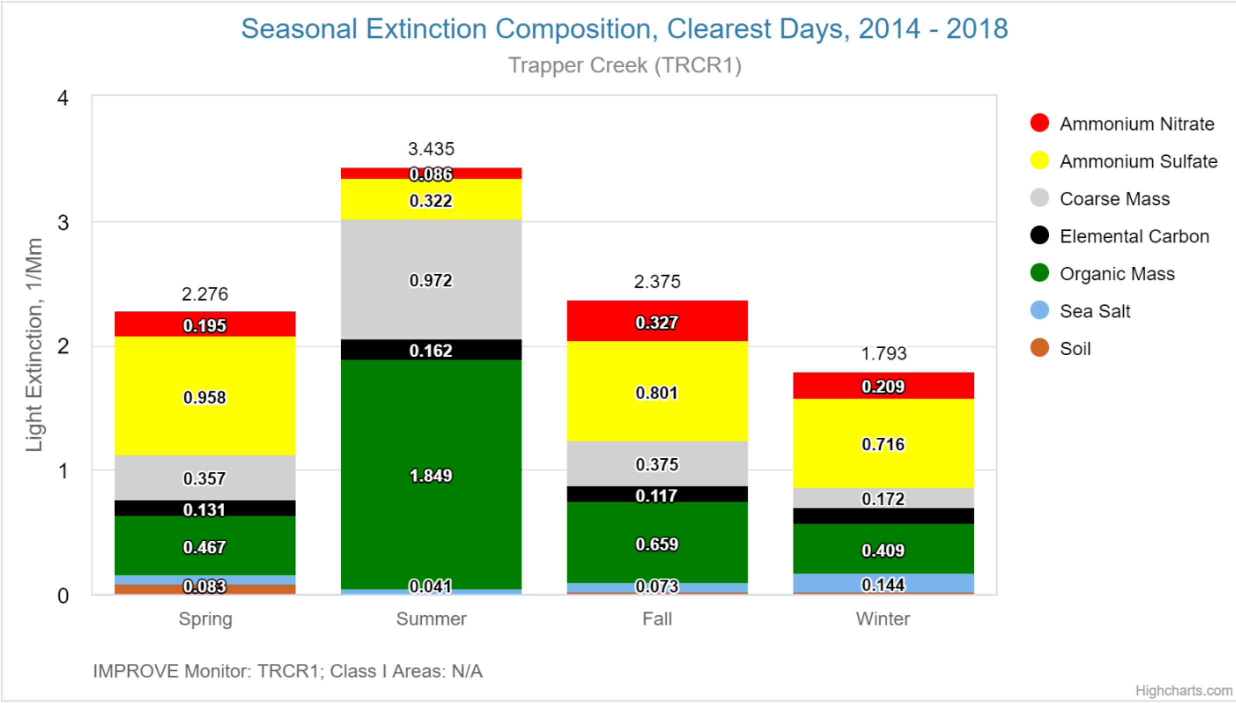


Figure III.K.13.D-9. 2014-2018 Seasonal light extinction composition on clearest days at TRCR1



C. Simeonof– SIME1

Figure III.K.13.D-10 shows that at SIME1 $(NH_4)_2SO_4$ is the dominate haze species on the MID, with sea salt, OMC, and CM contributing to a lesser extent. It cannot be determined from the monitoring observations what the source of the measured sulfate is. The Simeonof area is adjacent to both a large international maritime shipping lane as well as to several active and semi-active volcanoes which off-gas sulfur and other compounds and periodically erupt, which can potentially impact local visibility. Naturally occurring DMS emissions also occur from the ocean that can be a precursor to sulfate.

The total light extinction at SIME1 on the MID from the start of the baseline period through 2018 fluctuated around 30 Mm^{-1}, with three years 2007, 2009, and 2012 where visibility extinction increased toward 40 Mm^{-1}. Monitored OMC could be from trans-boundary from elsewhere in Alaska, or from international sources, or even biogenic VOC emissions due to the absence of large wildfires in the vicinity of the SIME monitoring station.

On the clearest days, visibility extinction was roughly split between $(NH_4)_2SO_4$ and sea salt, a naturally occurring and uncontrollable haze species from oceanic activity (Figure III.K.13.D-11). As on the MID, visibility on the clearest days remained consistent with extinction remaining around 10 Mm^{-1}. The clearest days extinction increased to just under 12 Mm^{-1} in 2011, with significant amounts of that increase originating from sea salt and CM rather than $(NH_4)_2SO_4$. The slightly elevated levels of CM as observed could indicate influence from local unpaved roads located near the monitoring station in Sand Point.

Comparing current conditions to baseline, overall, there is a slight decline in visibility for both MID and clearest days.

Figure III.K.13.D-10. 2002-2018 Annual average light extinction on most impaired days at SIME1

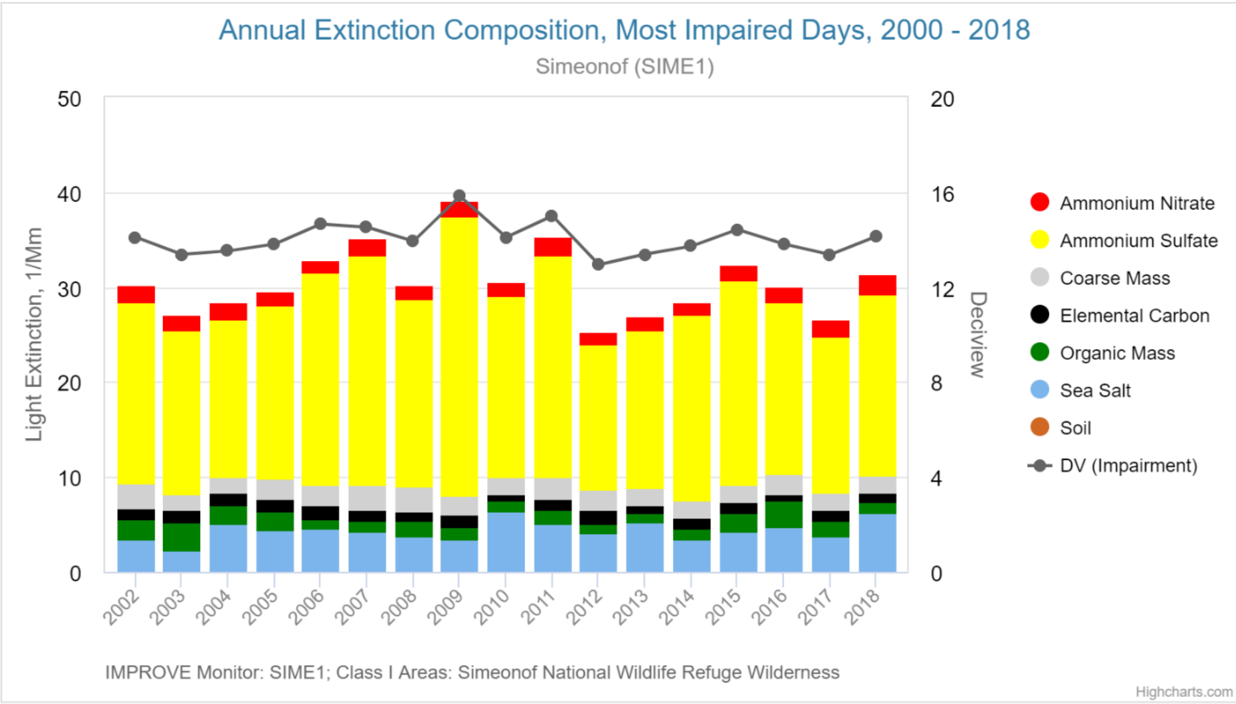
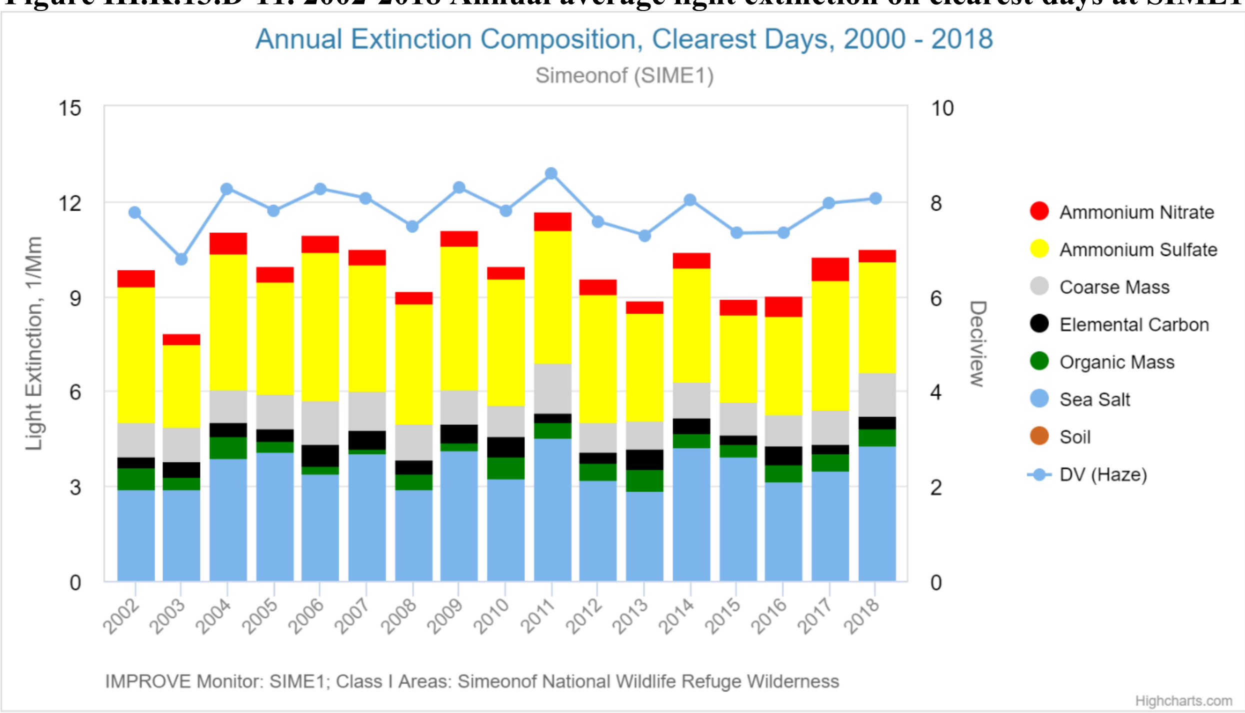


Figure III.K.13.D-11. 2002-2018 Annual average light extinction on clearest days at SIME1



As shown in Figure III.K.13.D-12 seasonal average species extinction composition on the MID, $(NH_4)_2SO_4$ level was highest during fall, when there was also the largest increase in OMC readings, indicating potentially a significant influx of wildfire smoke from outside the state. OMC levels dropped to near zero during winter, and rose again in spring, indicating the beginning of wild and prescribed fire season in the Alaska interior and the Russian Far East. The highest extinction was measured in fall, which coincides with increases in CM and $(NH_4)_2SO_4$. It is likely that this was caused by significant wildfire activity in the Russian Far East and Siberia during that period in 2016, which threw off the rest of the average for the other years in the current visibility period. Sea salt extinction has high levels recorded in spring and fall. The spring increase in sea salt could coincide with extremely late winter storms, or some early spring storms increasing ocean activity and thus sea salt contributions on the MID. The fall increase coincides with fall storm activity.

On the clearest days, during fall and winter, sea salt was the greatest contributor to extinction. Sea salt level was lowest during summer, when $(NH_4)_2SO_4$ level was highest (Figure III.K.13.D-13).

Figure III.K.13.D-12. 2014-2018 Seasonal light extinction composition on most impaired days at SIME1

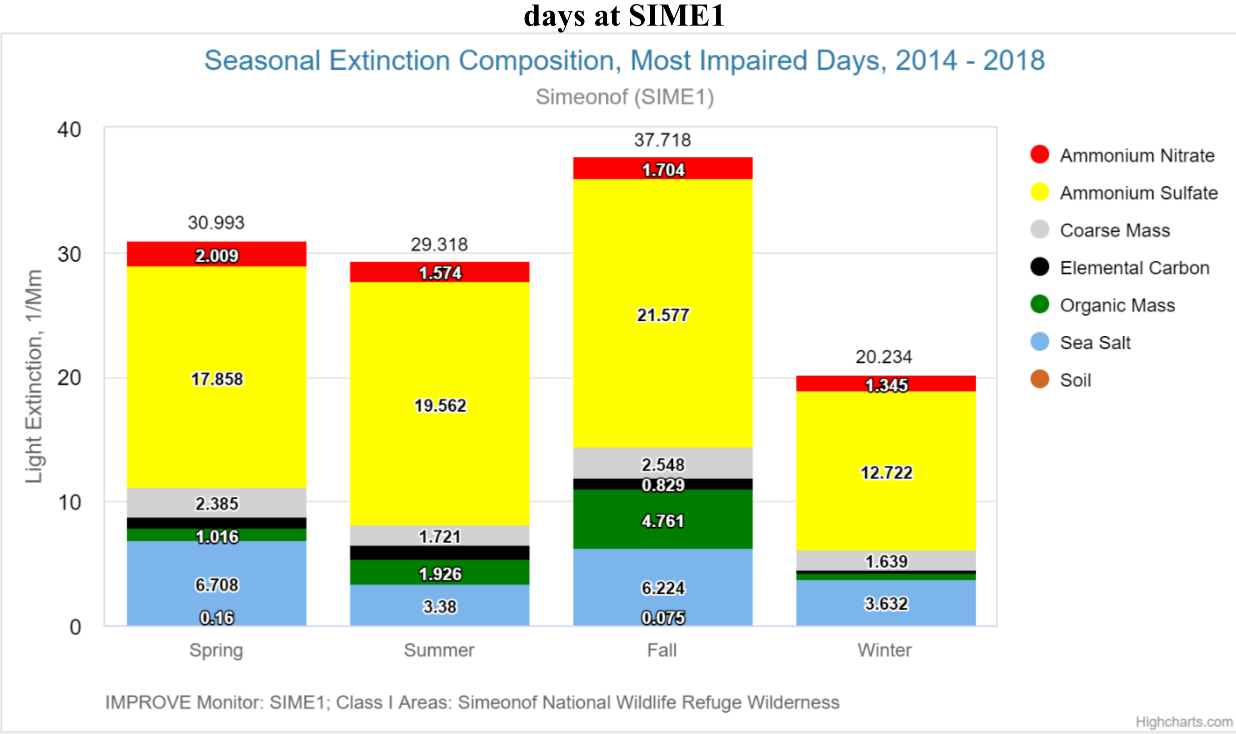
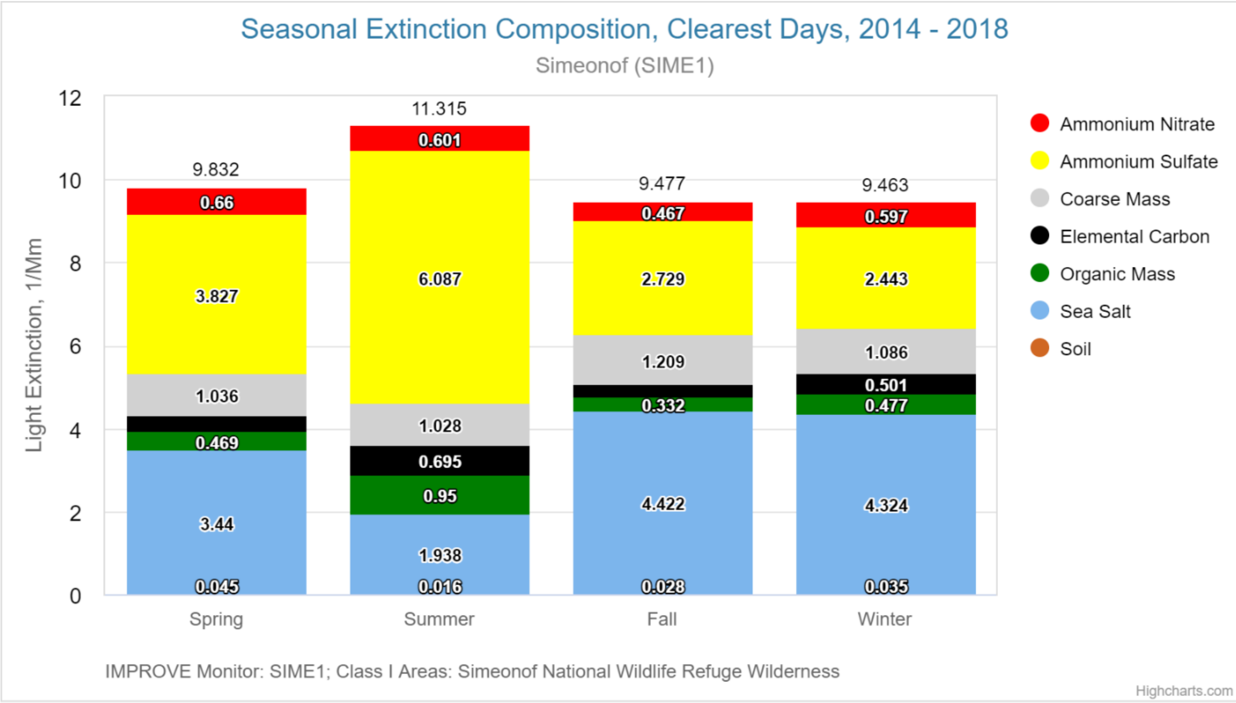


Figure III.K.13.D-13. 2014-2018 Seasonal light extinction composition on clearest days at SIME1



D. Tuxedni – TUXE1

The driving species for 2000-2018 annual extinction on the MID at TUXE1 is $(NH_4)_2SO_4$, followed by sea salt, OM, CM, and NH_4NO_3 (Figure III.K.13.D-14**)**. As with the three IMPROVE sites discussed above, visibility extinction increased at TUXE1 in 2009 which coincides with the large wildfires and active volcanic activities that year (e.g., nearby Redoubt eruption). Visibility improved in the subsequent years, indicating that this was likely a result of the episodic events, as with the other IMPROVE sites, and not tied to local anthropogenic emission increases. (Figure III.K.13.D-15)

Figure III.K.13.D-14. 2002-2014 Annual average light extinction on most impaired days at TUXE1

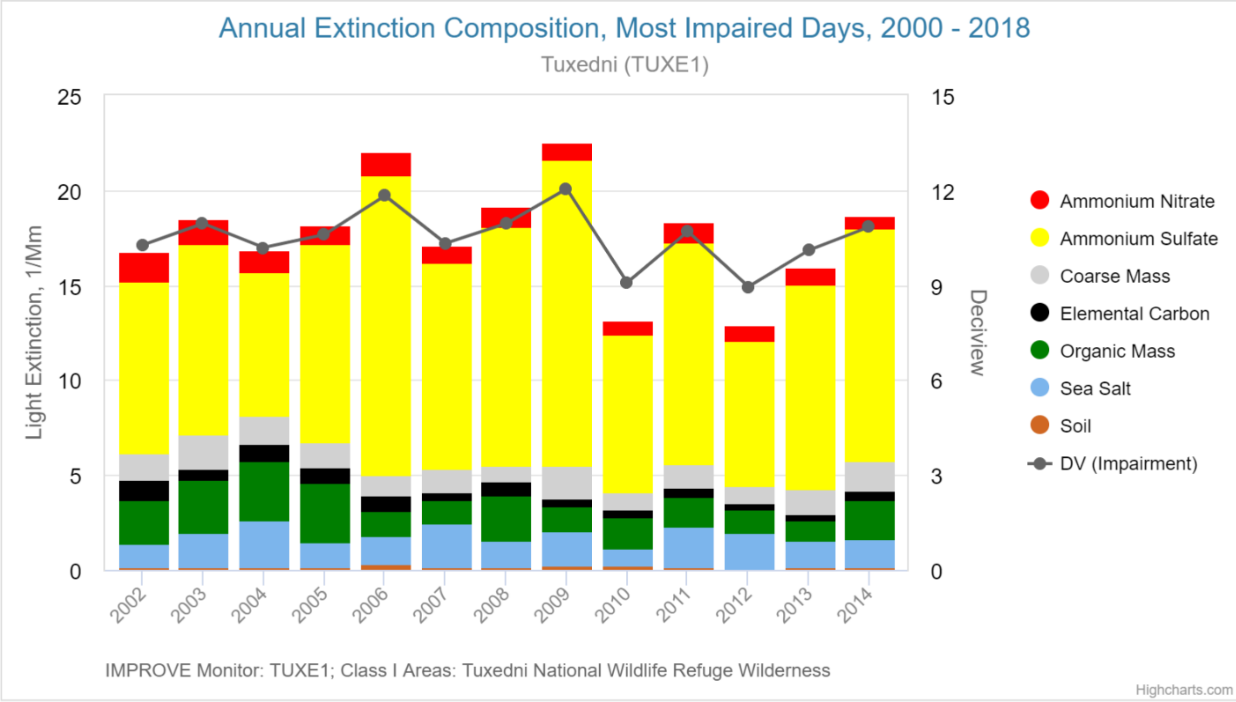
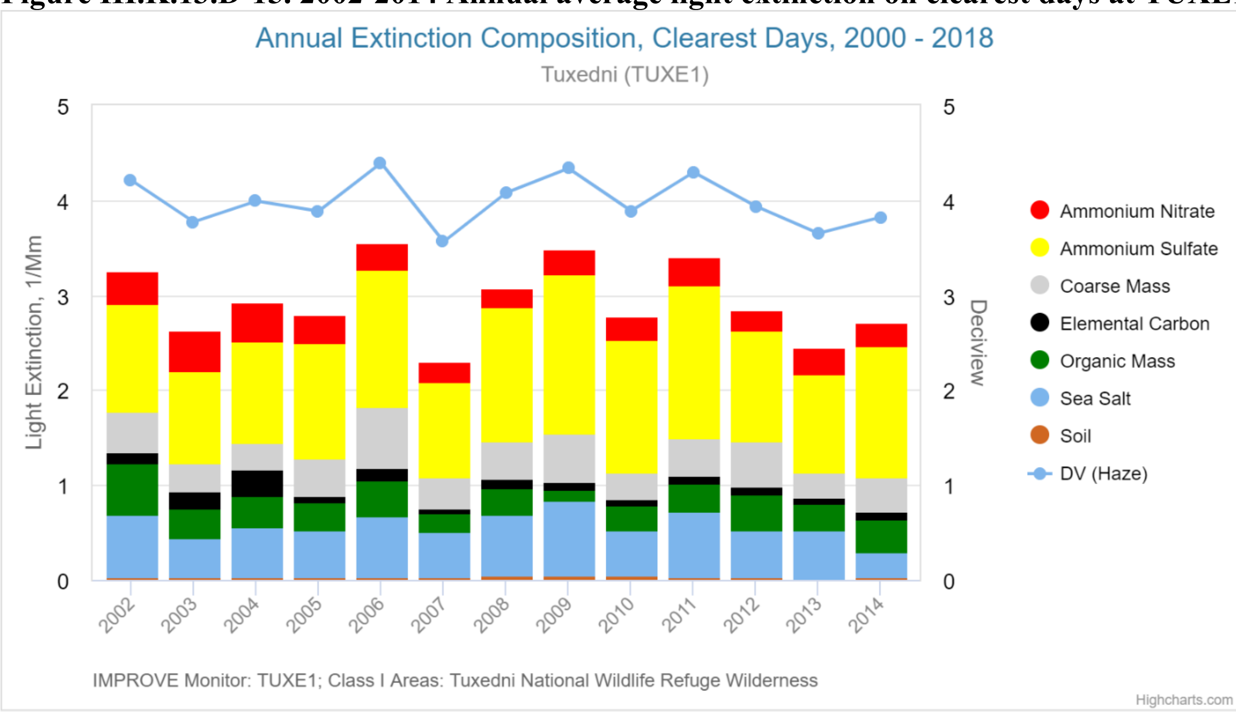


Figure III.K.13.D-15. 2002-2014 Annual average light extinction on clearest days at TUXE1



TUXE1 seasonal plots for the current years are based solely on 2014 IMPROVE data from its last year of operation. On the MID, $(NH_4)_2SO_4$ levels were high in spring and summer with a decline of 3 Mm^{-1} during fall and winter (Figure III.K.13.D-16). While on the clearest days, $(NH_4)_2SO_4$ levels were relatively consistent (Figure III.K.13.D-17). OMC and CM levels on the MID and clearest days peaked during the summer, coinciding with wildfire season. Other species, like NH_4NO_3, remained below 1 Mm^{-1}. Sea salt remained below 3 Mm^{-1} during the year and increased to its highest levels of visibility extinction during winter month, the inverse of sulfate contribution patterns across Class I Areas in Alaska.

Figure III.K.13.D-16. 2014 Seasonal light extinction composition on most impaired days at TUXE1

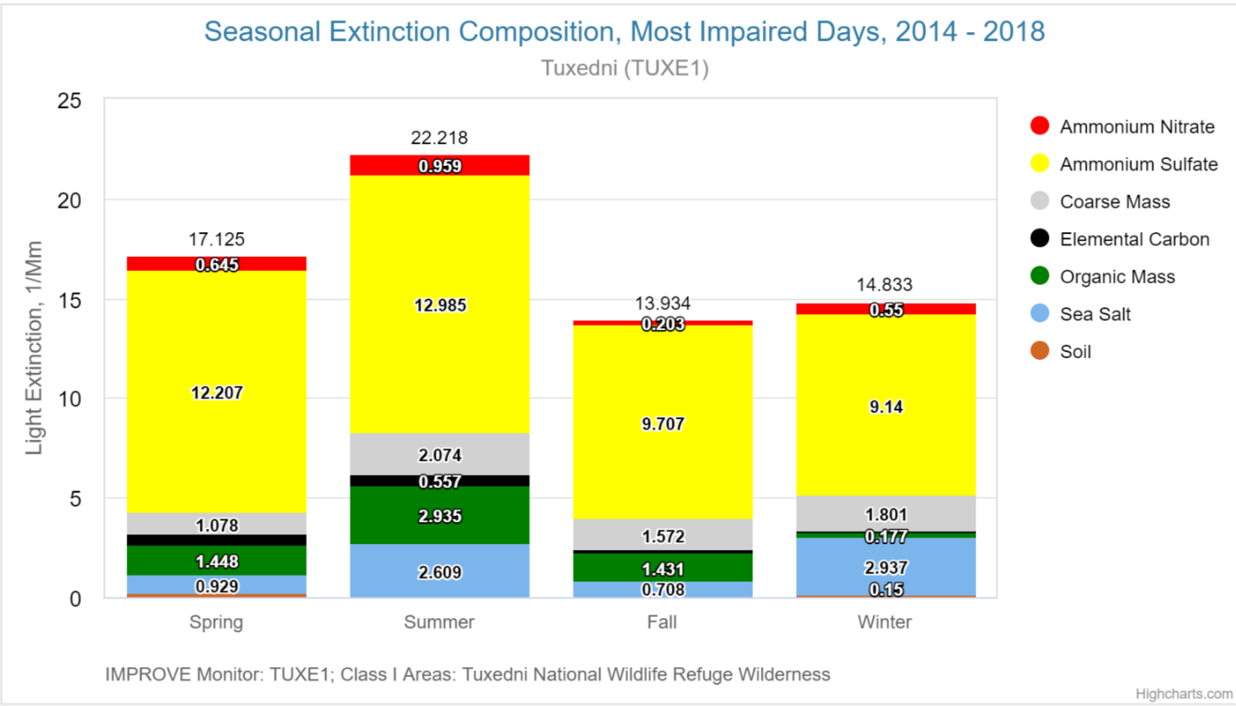
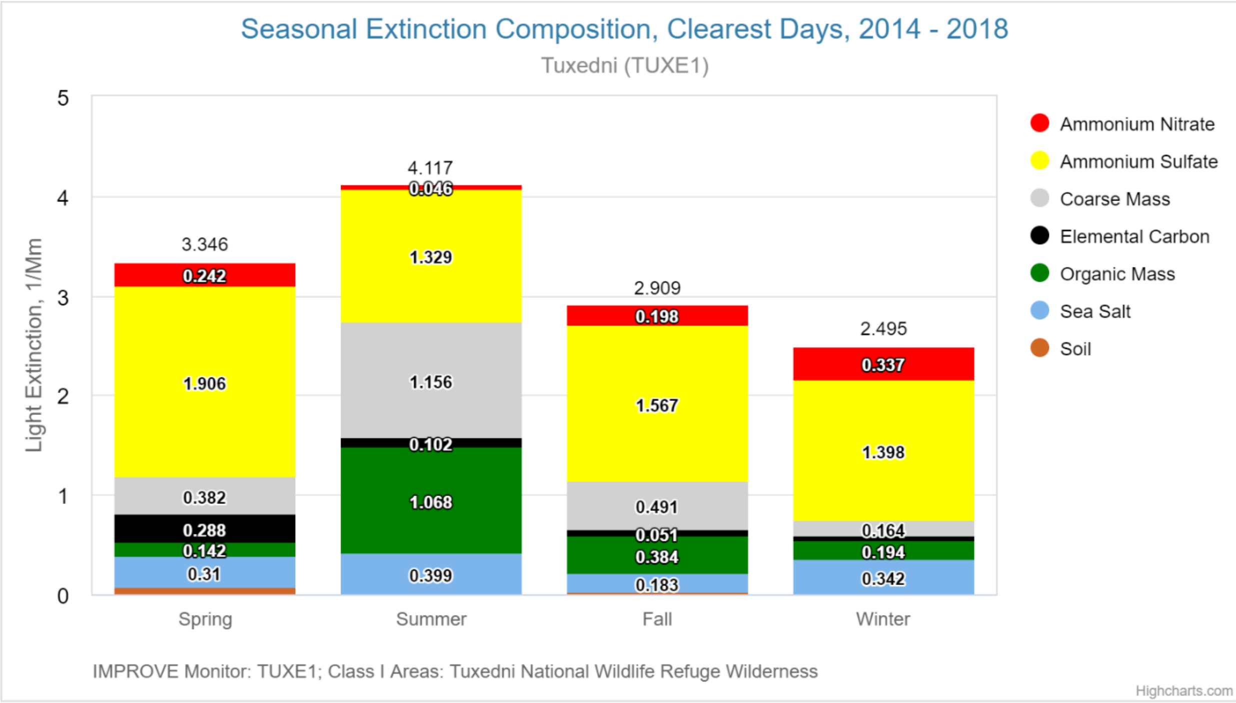


Figure III.K.13.D-17. 2014 Seasonal light extinction composition on clearest days at TUXE1



E. Kenai Peninsula Borough– KPBO1

Data for the KPBO1 monitor are available from 2016 through the end of the current visibility period in 2018. Because there is not enough data to provide the requisite data for a baseline visibility reading at the KPBO1 site, visibility conditions are not available for most impaired days, and the plots below only cover the clearest days.

Prior to the move, the TUXE1 monitor was located on the western side of Cook Inlet with a small population and little industry. The KPBO1 monitor is located on the eastern side of the inlet adjacent to several large population centers. The influence of larger stationary sources on the Kenai Peninsula and mobile sources from the Alaska state highway to KPBO1 is more apparent than at TUXE1. There are also a number of oil drilling platforms south of the KPBO1 site, as well as the Nikiski Oil Refinery, which have the potential to influence visibility and local air quality differently at the KPBO1 site compared with the location of TUXE1.

Just by comparing the annual and seasonal clearest days plots between KPBO1 and TUXE1, the difference in species and magnitudes of extinction between the two sites makes it obvious that they are sampling different air masses. The annual total light extinction at KPBO1 is roughly 3-4 Mm^{-1} higher than TUXE1, and it's more evenly distributed between $(NH_4)_2SO_4$, CM, OMC, and sea salt. Unlike TUXE1, $(NH_4)_2SO_4$ is not the dominant species on clearest days at KPBO1. (Figure III.K.13.D-18)

In spring and summer at KPBO1, CM levels rose while $(NH_4)_2SO_4$ levels went down. Sea salt peaked in spring and OMC and EC peaked during summer. Those patterns are very different from TUXE1. (Figure III.K.13.D-19)

Figure III.K.13.D-18. 2016-2018 Annual average light extinction on clearest days at KPBO1

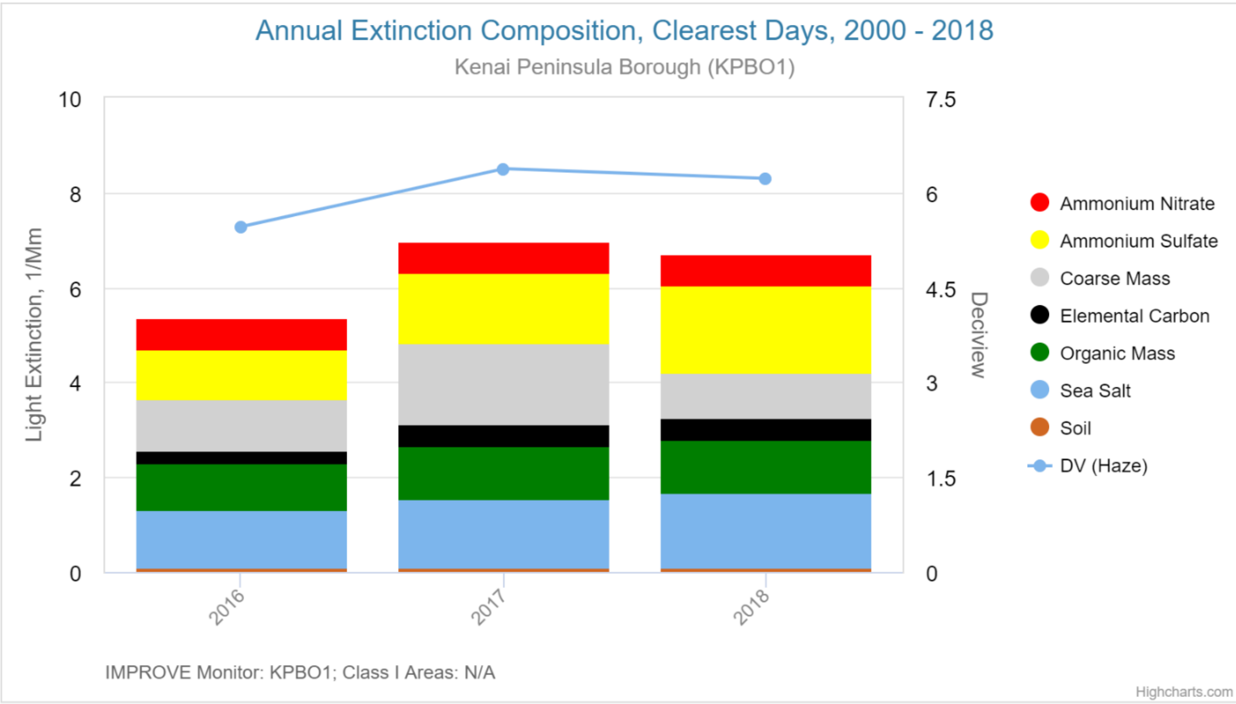
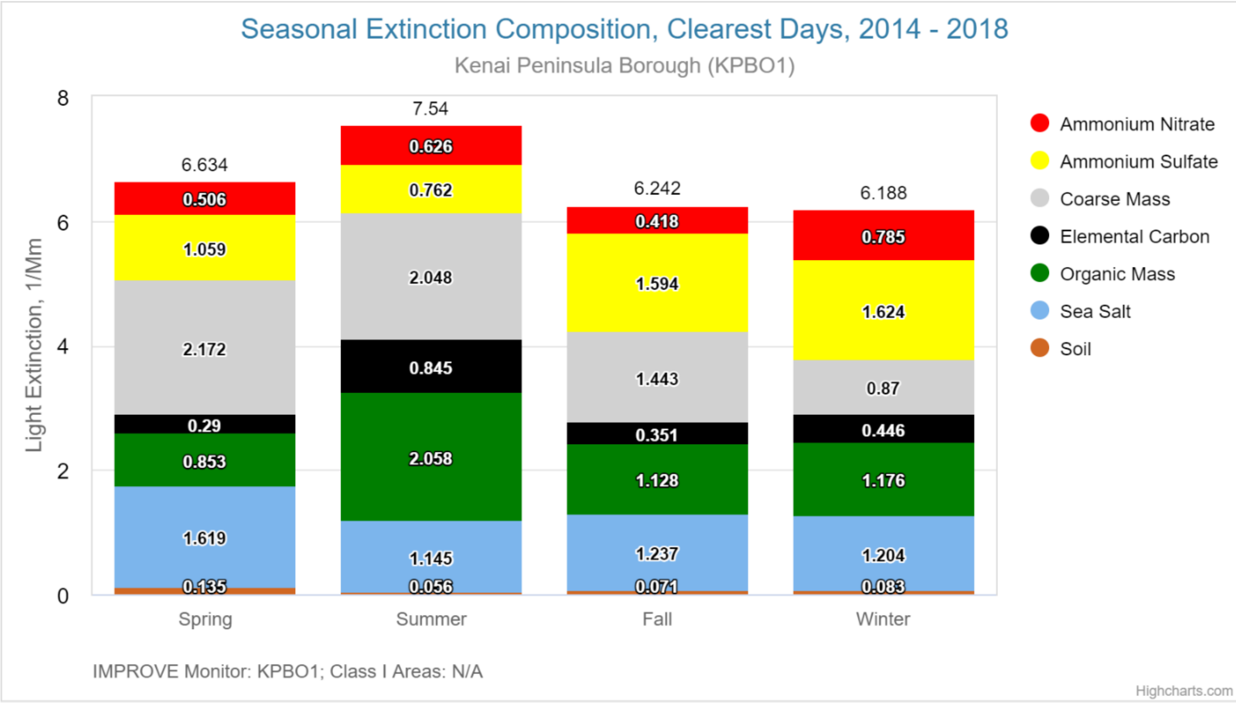


Figure III.K.13.D-19. 2016-2018 Seasonal light extinction composition on clearest days at KPBO1



III.K.13.E EMISSION INVENTORY

1. OVERVIEW

The State of Alaska, under its reporting obligations to the EPA, submits emissions data for the yearly and triennial NEI. This data provides a complete snapshot of the emissions-generating activity nationally and at the state level. By collecting this data, DEC can provide a detailed dataset to its contractors and the EPA to assist in haze modeling to isolate potential sources of visibility impairment.

For the purposes of this RH SIP, DEC will be using one current and one future forecasting inventory. The current inventory used is the 2016 inventory compiled by the EPA and MJOs in a joint EPA/MJO 2016 Inventory Collaborative Study[1] (2016 EI) that was built off the 2014 NEI. The EPA and contractors used the EPA/MJO 2016 collaborative modeling platform to model visibility impacts and facility emissions. The platform also includes a 2028 future forecasting inventory (2028 EI) which uses the most recent emissions data available to project emissions at the end of the second planning period in 2028.

Given ongoing challenges from COVID-19 and the long-term economic fallout, the available data may not be reflective of economic trends in a post-COVID setting. As this is the only dataset available to DEC or its contractors, the 2028 future forecasting inventory has been used in this planning document. DEC anticipates revisiting the issue of future emissions forecasting in the status update in 2024 and post-2020 data will be used to update the emissions forecast with post-COVID emissions data.

This section presents anthropogenic emissions from the 2016 and 2028 EI for Alaska. Given that air quality in the state is strongly affected by natural emissions as well as human activities, this section also discusses various natural sources that can contribute to visibility impairment in Alaska.

2. BASE-YEAR AND FUTURE-YEAR EMISSIONS INVENTORIES

DEC is using the 2016 EI to represent emissions for the current visibility period (2014-18), while the 2028 inventory is included to represent the end of the second planning period. The 2028 EI was put together using the 2016 EI as a base dataset and uses statistical data to predict emissions in 2028 based on economic growth, population expansion or contraction, and other factors. Both inventories allow DEC to understand potential growth areas in state emissions and model potential impacts.

Key considerations in the development of these regional haze emission inventories are outlined below.

Pollutants – Within the EPA 2016 EI are pollution inventories broken down by source categories with specific amounts for each type of visibility-impairing pollutant. These match up with criteria air pollutants (CAPs) defined by the EPA in the 1970 CAA. These pollutants are

[1] https://views.cira.colostate.edu/wiki/wiki/9169#Overview

volatile organic compounds (VOCs), carbon monoxide (CO), oxides of nitrogen (NO_x), sulfur oxides (SO_x), ammonia (NH_3), and coarse and fine particulate matter (PM_{10} and $PM_{2.5}$ respectively). Although CO is not considered a haze-generating pollutant, EPA collects emissions data on CO for its NEI datasets. As a result, CO emissions data was included in datasets used for haze analysis in this plan.

Areal Extent – The inventories represent sources within the entire state of Alaska, encompassing a total of 27 boroughs/census areas.[2] EPA used these inventories to complete preliminarily modeling for Alaska using the Community Multiscale Air Quality Modeling System (CMAQ) modeling platform for the base year 2016 and future year 2028 (See Chapter III.K.13.G for more details). Figure III.K.13.E-1 shows the extent of the rectangular modeling domains used by EPA, along with the locations of the four Class I monitoring sites in Alaska. For the Alaska modeling domain, Canada (Yukon and Northwest Territories) emissions (those that fell within the 9/27 km modeling domain) were included in the CMAQ regional model. The rest of the international emissions (Russia, East Asia, and the rest of the world) were included in the hemispheric CMAQ modeling that provided boundary conditions for the CMAQ regional model. These international emissions are not included in the emission summary below.

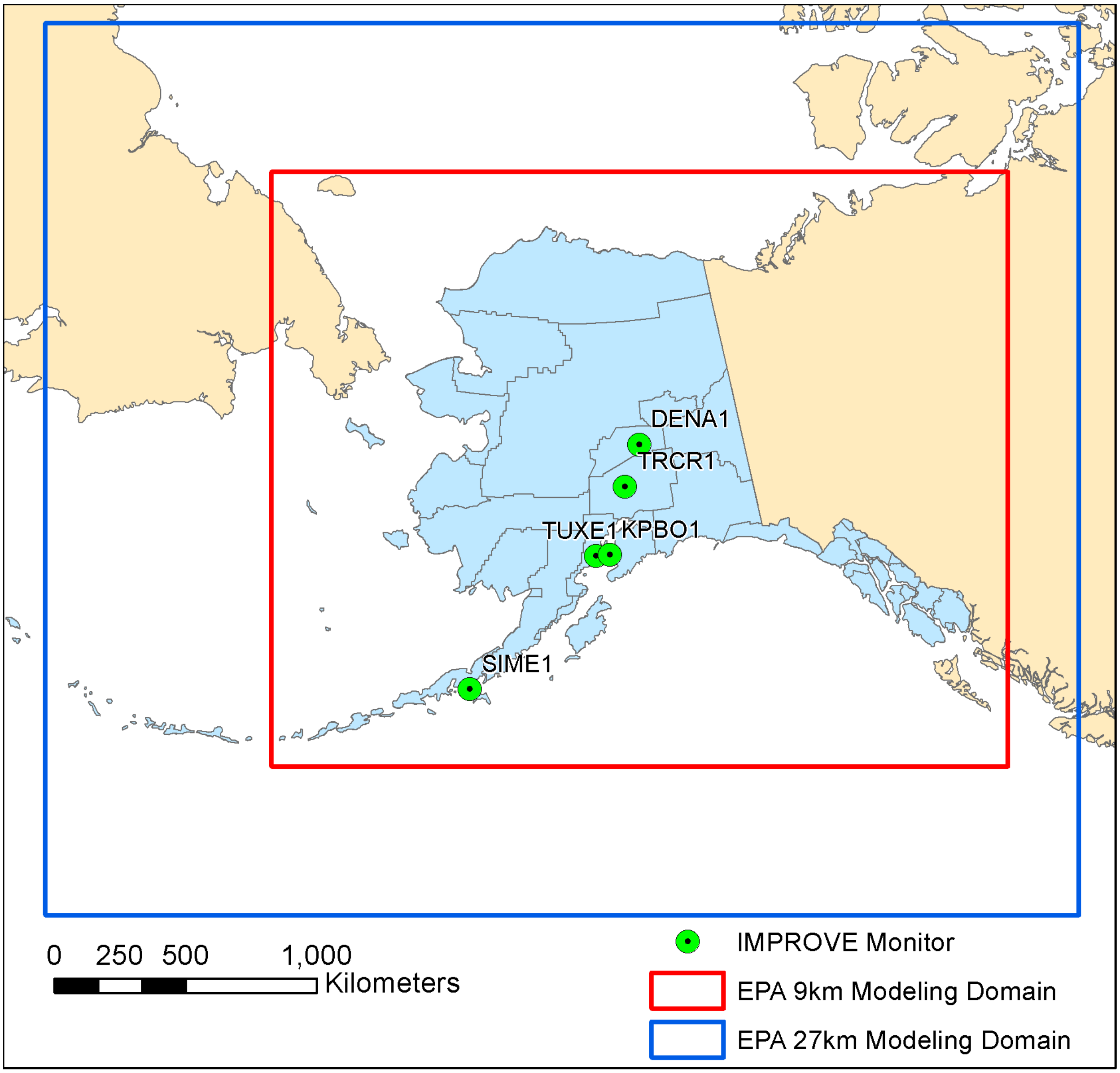
Included Sources – The 2016 and 2028 EIs include all known stationary point and area sources including fugitive dust, both anthropogenic and natural fires, and on-road and non-road mobile sources. Included sources are briefly described below:

- Electrical generating units (EGU) are stationary point sources and include both external combustion boilers and internal combustion (IC) engines (turbines and reciprocating IC engines). Fuel types included subbituminous coal, distillate oil, and natural gas.
- Non-EGU point sources are the remaining point sources including fuel combustion from external boilers and IC engines used in non-electricity generation industrial, commercial/institutional, and space heating applications. They also include major point source facility emissions from various industrial processes (e.g., chemical manufacturing, metal production, petroleum industry, oil and gas production), petroleum and solvent evaporation, and waste disposal.
- Stationary area sources (non-point) include those stationary sources not directly represented as major facility point sources, as well as other source categories for which emissions occur over areas rather than individual locations (e.g., fugitive dust).
- Non-road mobile sources include off-road vehicles and equipment (loaders, excavators, tractors/dozers, forklifts, scrapers, graders, etc.), lawn and garden, agricultural equipment, pleasure craft, snowmobiles and snowblowers, all-terrain vehicles, and off-road motorcycles. Commercial marine vessels and aviation emissions (from both aircraft and ground support equipment) were also included but were treated separately for reporting and tabulation purposes within the regional haze inventory.
- On-road mobile sources include all on-road vehicle types (e.g., passenger cars, light-duty trucks, heavy-duty trucks, buses, and motorcycles).

[2] What are referred to as “counties” in the contiguous states within the U.S. are termed “boroughs,” “municipalities” or “census areas” in Alaska. From this point forward, they are referred to interchangeably.

Biogenic sources were included in the EPA's CMAQ modeling but were not included in the emission summary. Geogenic sources and oceanic DMS emissions were not included in the 2016 EI (thus, not in the EPA's CMAQ modeling platform). These emissions were calculated separately to provide relative contributions of sulfur emissions from natural sources common to Alaska (See Section III.K.13.E.4).

Figure III.K.13.E-1 Areal Extent of Alaska Regional Haze Modeling Domain



Given this overview, specific elements of the 2016 baseline and 2028 forecasted inventories are described below.

A. 2016 Baseline Inventory

The emissions inventory used for this planning period is the 2016 EI. The State of Alaska submits emissions inventory data to the EPA on a yearly and triennial basis, with triennial being the more complete dataset. Each triennial EI is composed of both stationary and mobile source data, including major emissions categories like aviation and highway/on-road emissions from cars and trucks. Yearly emissions data, by comparison, is comprised of only the larger stationary emissions sources, such as factories or electrical generation units. The smaller emissions sources and non-point source are only updated during triennial emissions years. As a result, on-road and mobile source emissions are carried forward from the last full triennial inventory. In this inventory, then, all non-point data has been carried forward from the 2014 NEI as it was submitted to the EPA.

The NEI figures, while representing a full estimation of the emissions generated within the state, do not provide seasonal differentiation. For Alaska, this is important to note as there can be significant differences in seasonal emissions for some categories of non-point sources, like woodstoves or maritime activity. These activities are largely limited seasonally, although woodstoves have some limited use during summer. Leaving out seasonal differentiation makes it difficult for analysts to connect seasonal increases of specific categories with impairment events that show up in yearly datasets, such as local use of woodstoves during winter months.

Certain categories of emissions can be assumed to have occurred during specific seasons. Wildfires are a spring and summer occurrence in Alaska and very rarely burn before April or after October. Prescribed burning and crop burning generally occur during fall and winter to prevent wildfire ignition. This is a result of unfavorable weather and climatic conditions with snowfall and cooler weather making natural (or anthropogenic) ignition difficult. Wildfire activity can significantly vary between years due to yearly changes in rainfall and weather patterns. During the current visibility period (2014-18), 2015 had significantly higher wildfire activity with over five million acres burned that year. The following year only a half-million acres burned, a significant variance in acreage that can have large impacts on visibility measurements at Class I areas throughout the state.

B. 2028 Future-Year Inventory

Rather than using baseline inventory figures and Alaska Department of Labor population growth statistics, DEC is relying on the 2028 future year inventory developed by the EPA. This inventory uses the 2016 EI as a baseline inventory, along with state and national growth figures, to project future year emissions. DEC was heavily involved with fact-checking certain categories of emissions data provided to the state by EPA, including maritime and aviation emissions, which are significant areas of human activity within the state.

During the data review period for the 2028 future inventory, DEC analysts spent a significant amount of time reviewing the 2028 marine inventory. Like aviation, the marine industry operates throughout most of the state and provides critical transportation services to residents and private businesses. Given port sizes and infrastructure capacity in rural Alaska, it was necessary for DEC to spend more time reviewing and fact-checking emissions data provided by EPA to ensure that marine engine class results would match infrastructure and port specifications. In addition, marine sector-related impairment has been identified as a source of visibility impairment at coastal Class I areas. For future forecasting purposes, EPA modeling used 2016 emissions as the 2028 baseline while including emissions reductions predicted with the advent of global low-sulfur diesel use under IMO regulations. See Section K.13.H for the state's long-term strategy and closer analysis of this sector.

In addition to the 2028 marine inventory, DEC reviewed EPA's 2028 aviation inventory. This is due to the central role of aviation in the state's transportation infrastructure, as most off-road communities rely on small aircraft to bring residents to and from hub communities. As a result, several inconsistencies and data gaps were identified within the inventory which resulted in significant problems for its use. This included leaving out take-off and landing (LTO) emissions from major hub communities, including Anchorage, as well as smaller regional hubs like Unalaska and Nome. Without Anchorage LTO data, it is extremely difficult to apply the dataset to Class I area haze estimates at the end of the implementation period.

Along with these inventory-specific problems, the more general problem is that the rapid pace of economic changes brought about by the COVID-19 pandemic makes it difficult to project pre-2020 emissions data into the future. The economic and logistical fallout from COVID, including the suspension of cruise ships up the Inside Passage and the halting of most tourist activity, has created an environment of significant uncertainty moving into the decade. Any 2028 emissions estimates should be taken as products of pre-COVID projections. It is likely that all future estimates for stationary and mobile source emissions will need to be recalculated once the pandemic has been brought under control and economic fallout can be properly estimated. Given the scale of the economic and social impact from the pandemic, more complete economic loss figures will take time to calculate.

C. Summary of 2016 and 2028 Emission Inventories

Tables III.K.13.E-1 and III.K.13.E-2 (and Figures III.K.13.E-2 and III.K.13.E-3) show total statewide annual emissions (in tons/year) by source sector and pollutant for the calendar years 2016 and 2028 inventories, respectively. In addition to the totals across all source sectors, anthropogenic emission fractions (defined as all sectors except natural fires divided by total emissions) are also shown at the bottom of each table. Clearly, natural wildfires represent an overwhelming majority of emissions for all pollutants except NO_x and SO_2 for which they contribute 18% and 39%, respectively, of all emissions statewide. Note that uncontrollable sources including volcanoes, oceanic DMS, and international shipping (non-US SECA C3 sector in the EPA inventories) emissions that contribute the majority of SO_2 emissions in Alaska areas are not included in these tables.

Table III.K.13.E-1. 2016 Alaska Statewide Regional Haze Inventory Summary

Source Sector	Annual Emissions (tons/year)					
	VOC	CO	NO_x	$PM_{2.5}$	SO_2	NH_3
Agriculture	9	-	-	-	-	109
Airports	2,008	13,478	4,417	271	576	-
Rail	17	48	386	11	0	0
CMV - C1/C2*	216	956	6,317	160	11	3
CMV – C3*	1,998	4,310	46,238	3,123	23,736	60
Non-road	8,600	34,126	2,580	358	7	6
On-road	8,228	60,101	11,977	489	33	153
Non-point	8,224	28,956	6,307	2,500	1,510	564
RWC	820	5,073	90	712	16	34
Fugitive dust	-	-	-	1,054	-	-
Oil & Gas	26,974	13,128	42,779	540	1,702	0
EGU	307	2,445	7,793	240	1,304	2
Other Points	800	2,562	7,291	478	1,394	48
Fires	743,060	3,165,511	29,644	262,648	19,646	51,691
Total - All Sources	801,260	3,330,692	165,819	272,583	49,935	52,670
Anthropogenic Fraction	7%	5%	82%	4%	61%	2%

* This table includes marine emissions in Alaska waters and offshore to EZZ.

Table III.K.13.E-2. 2028 Alaska Statewide Regional Haze Inventory Summary

Source Sector	Annual Emissions (tons/year)					
	VOC	CO	NO_x	$PM_{2.5}$	SO_2	NH_3
Agriculture	10	-	-	-	-	119
Airports	1,945	14,915	4,371	257	598	-
Rail	18	48	391	11	0	0
CMV - C1/C2*	114	958	3,500	91	4	2
CMV – C3*	2,836	6,118	59,990	2,430	7,080	47
Non-road	5,297	30,035	1,722	201	4	7
On-road	4,142	30,961	4,789	217	23	136
Non-point	8,043	29,242	6,725	2,518	1,524	650

RWC	759	4,731	93	647	13	30
Fugitive dust	-	-	-	1,063	-	-
Oil & Gas	26,606	13,101	42,703	537	1,697	0
EGU	307	2,445	7,793	240	1,304	2
Other Points	736	2,559	7,269	483	1,404	48
Fires	743,060	3,165,511	29,644	262,648	19,646	51,691
Total - All Sources	793,874	3,300,624	168,989	271,342	33,296	52,732
Anthropogenic Fraction	6%	4%	82%	3%	41%	2%

* This table includes marine emissions in Alaska waters and offshore to EZZ.

Figure III.K.13.E-2. 2016 Alaska Statewide Regional Haze Inventory Summary. The right panel shows SO_2 and NO_x from anthropogenic sources only.

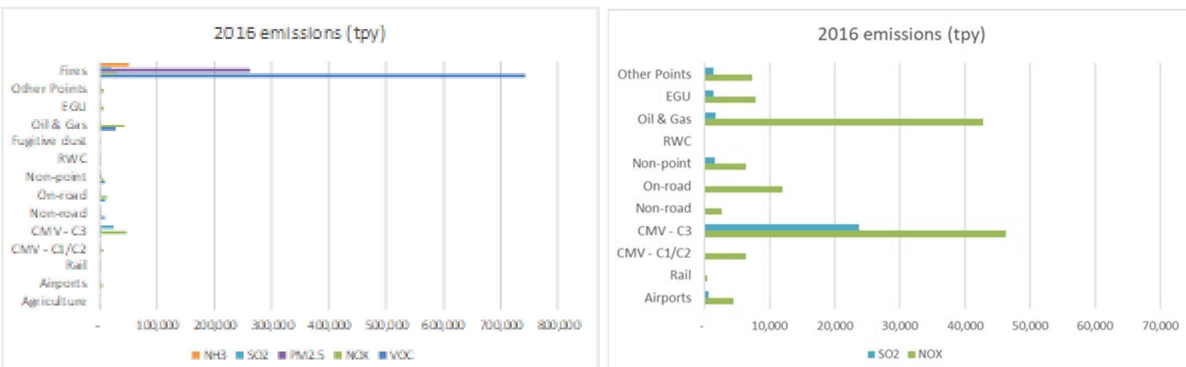


Figure III.K.13.E-3. 2028 Alaska Statewide Regional Haze Inventory Summary. The right panel shows SO_2 and NO_x from anthropogenic sources only.

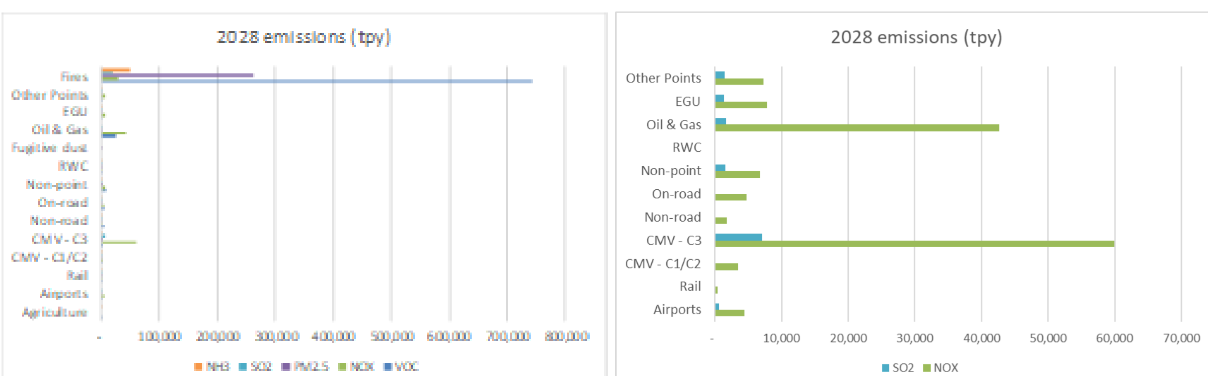
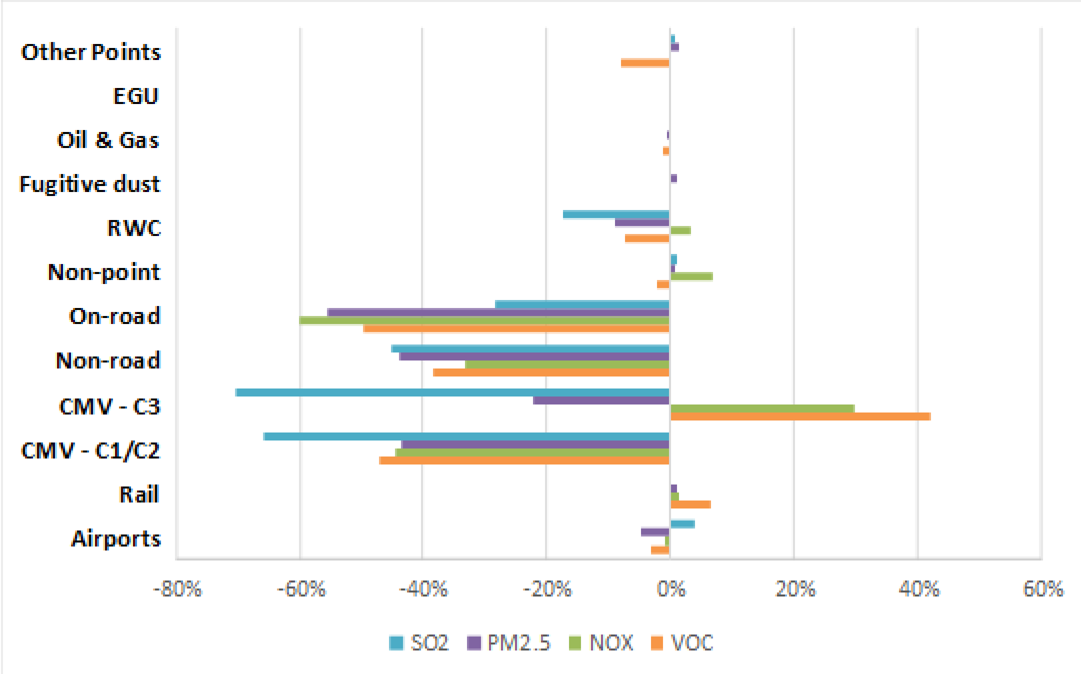


Table III.K.13.E-3 and Figure III.K.13.E-4 summarize the relative changes in statewide emissions by source sector and pollutant from 2016 to 2028. Emission increases (positive changes) are shown in red; emission decreases (negative changes) are shown in black. The relative changes in total pollutant emissions from 2016 to 2028 are very modest due to the large emissions contribution from natural fires, which were assumed to remain constant over this period. Decrease in total SO_x emissions of 33% is projected on a statewide basis, while changes to other pollutants are minimal (within 2%). Anthropogenic SO_2 emissions decrease notably from commercial marine vessels, category 3 (CMV C3) (-70%); commercial marine vessels, categories 1 and 2 (CMV C1/C2) (-66%); non-road (-45%); and on-road (-28%). Anthropogenic NO_x emissions decrease significantly from CMV C1/C2 (-45%), on-road (-60%), and non-road (-33%) decrease significantly. However, these emission decreases are offset by increases in CMV C3 (30%).

Table III.K.13.E-3. Relative Change in Alaska Regional Haze Emissions from 2016 to 2028

Source Sector	Percentage Emissions Change 2016-2028					
	VOC	CO	NO_x	$PM_{2.5}$	SO_2	NH_3
Agriculture	10%					10%
Airports	-3%	11%	-1%	-5%	4%	
Rail	7%	1%	1%	1%	0%	0%
CMV - C1/C2	-47%	0%	-45%	-43%	-66%	-43%
CMV - C3	42%	42%	30%	-22%	-70%	-22%
Non-road	-38%	-12%	-33%	-44%	-45%	5%
On-road	-50%	-48%	-60%	-56%	-28%	-11%
Non-point	-2%	1%	7%	1%	1%	15%
RWC	-7%	-7%	3%	-9%	-17%	-10%
Fugitive dust				1%		
Oil & Gas	-1%	0%	0%	-1%	0%	0%
EGU	0%	0%	0%	0%	0%	0%
Other Points	-8%	0%	0%	1%	1%	-1%
Fires						
Total - All Sources	-1%	-1%	2%	0%	-33%	0%

Figure III.K.13.E-4. Relative Change in Alaska Regional Haze Emissions from 2016 to 2028 by source category



3. CURRENT ALASKA POPULATION STATISTICS

The population of Alaska as of 2021 has dropped below 730,000 for the first time since 2010, following trends that have picked up speed over the last decade. This is in large part a result of a statewide economic recession and market forces that resulted in oil industry job losses associated with North Slope oil developments. The oil and natural gas industry has remained stable in the Cook Inlet region, though this field represents a much smaller percentage of petroleum reserves in the state than the remaining wells in the Prudhoe Bay region.[3, 4]

The oil and natural gas industry has been the major economic engine of the state since the discovery of large petroleum deposits and subsequent lease sale in the late 1960s. Along with driving economic growth, it played a large role in population migration from the contiguous United States to Alaska starting with the construction of the Trans-Alaska Pipeline System (TAPS) in the mid-1970s. Since then, the boom and bust nature of the oil and natural gas sector has been mirrored in the state's population figures.

Marked population declines occurred during periods of depressed global petroleum prices in the 1980s. More recently, national and global market forces depressed petroleum prices worldwide, which has had an impact on Alaska North Slope crude oil and gas activities. Along with the recent economic disturbances caused by the ongoing COVID-19 epidemic, the state petroleum

[3] For more information on current Cook Inlet oil production, see the following fact sheet from the Alaska Oil and Gas Commission: http://www.circac.org/wp-content/uploads/AOGA_CI_Fact_Sheet.pdf (Accessed 4/5/2021).
[4] Information on Arctic North Slope (ANS) daily production figures starting in 1981 are available from the U.S. Energy Information Administration at: https://www.eia.gov/dnav/pet/hist/LeafHandler.ashx?n=PET&s=MANFPAK2&f=M (Accessed 4/5/2021).

industry has experienced challenges that impact the size and scope of individual oil and gas development projects and production activities.

This was (until recently) the opposite in the state's burgeoning tourism industry. Tourist numbers and revenue have been growing throughout much of the last decade, with yearly increases of annual travelers. Large ocean-going cruise vessels have been increasing in size and numbers, most utilizing routes traveling up the Inside Passage, originating in Seattle and Vancouver, British Columbia, and terminating in Whittier or Seward on the Kenai Peninsula or at the Port of Anchorage.

This industry has been significantly impacted by the COVID-19 epidemic, with the 2020 cruise season all but cancelled and the 2021 season also impacted. While the tourist industry was not as significant of a population migration pull as the petroleum industry, multiple years of no or limited tourist activity could act as an accelerant on these population loss trends. DEC planners should revisit the issue of population loss trends during the progress report to update 2028 emissions modeling using post-COVID population statistics. As with most other economic or population indicators at this time, the long-term impact of the 2019-2021 COVID pandemic will likely not be apparent for several years after viral spread has been brought under control.

For emissions calculation purposes, this population trend will impact short and long-term calculations for most sectors of emissions, including power plants. These calculations are used in the EI future projections, and DEC uses current and future population figures by borough or census area when building residential emissions inventories. As discussed in the first Regional Haze plan, representative communities (RepComs) are used as stand-ins for boroughs or census areas, and population fractions are calculated to allow for population scaling. For future forecasting purposes, population growth or reduction percentages are used for calculating each population fraction applied to RepCom emissions.

Table III.K.13.E-4 lists the Alaska 2020 population by Region and Borough/Census Area (CA). The Anchorage Borough and Municipality has 40% of the Alaska population with the Fairbanks North Star Borough (FNSB) accounting for another 13%.

Table III.K.13.E-4. Current (2020) Population by Region and Borough/Census Area[5]

Region and Borough/CA	Population Size
Southcentral Alaska	
Anchorage Borough and Municipality	288,970
Matanuska-Susitna Borough	107,305
Regional Total	*399,269*
Alaska Gulf Coast	
Chugach Census Area	6,751
Copper River Census Area	2,699
Kenai Peninsula Borough	58,934

[5] Table taken from Alaska Department of Labor and Workforce Development 2020 Population Estimates, available at: https://live.laborstats.alaska.gov/pop/ (Accessed 1/12/2021).

Region and Borough/CA	Population Size
Kodiak Island Borough	12,611
Regional Total	*81,048*
Interior Alaska	
Fairbanks North Star Borough	97,159
Southeast Fairbanks Census Area	6,937
Denali Borough	1,806
Yukon-Koyukuk Census Area	5,044
Regional Total	*110,067*
Northern Alaska	
North Slope Borough	9,771
Northwest Arctic Borough	7,583
Nome Census Area	9,769
Regional Total	*27,484*
Southeastern Alaska	
Haines Borough	2,520
Hoonah-Angoon Census Area	2,074
City and Borough of Juneau	31,773
Ketchikan Gateway Borough	13,677
Petersburg Borough	3,189
Prince of Wales-Hyder Census Area	6,090
City and Borough of Sitka	8,523
Municipality of Skagway	1,147
City and Borough of Wrangell	2,379
City and Borough of Yakutat	574
Regional Total	*72,571*
Southwest Alaska	
Aleutians East Borough	2,925
Aleutians West Census Area	5,544
Bethel Census Area	17,868
Bristol Bay Borough	868
Dillingham Census Area	4,773
Kusilvak Census Area	8,088
Lake and Peninsula Borough	1,552
Regional Total	*42,295*
Alaska State Total	***728,903***

4. NATURAL EMISSIONS

Alaska's landscape is dominated by natural ecosystems rather than human dominated systems. Consequently, air quality in the state is strongly affected by natural emissions as well as human activities. Natural sources of visibility impairment emissions are those not directly attributed to human activities; they are not included in the anthropogenic point and area source inventory listed above. Natural emission impacts from within Alaska are seasonally driven with wildfire smoke in the summer, windblown dust in the spring and summer, and oceanic DMS peaking in summer. Volcano eruptions are episodic while volcano degassing can occur year-round. Natural sources outside of Alaska can also contribute to visibility impairment at Alaska Class I areas.

The EPA's CMAQ modeling includes several natural sources such as biogenic, sea-salt, and oceanic halogen sources. Lightning, wind-blown dust, volcanic, and DMS emissions were not included in EPA's CMAQ modeling. Natural source emissions were assumed to remain constant in 2028 from 2016.

A. Biogenic Emissions Sources

Forest and tundra ecosystems produce a wide variety of volatile organic hydrocarbons, with common groups being isoprenes and monoterpenes. Production of biogenic VOCs varies by latitude, plant species, diurnal cycles, temperatures, ultraviolet light, meteorology, and even browsing pressure. Some biogenic VOC species (e.g., isoprene and terpenes) can form secondary organic aerosols (SOA) that can impair visibility. Biogenic emissions of VOC and nitric oxide (NO) were included in the EPA's 2016 CMAQ modeling platform, hence were included in the visibility impact modeling. EPA used the Model of Emissions for Gases in Nature (MEGAN) version 2.06 and 2016 meteorology to estimate the 2016 biogenic emissions.

B. Wildland and Prescribed Fires

Historically, the most significant source of visibility impairment in the Alaska airshed is from wildfire activity in the Alaska and Canadian interiors. Prior to the 1990s, the state had large wildfires which would ignite once or twice per decade and cause air quality decline in urban areas and at Class I areas. In the past three decades the wildfire cycle has sped up with increasing change in the Arctic climate. As a result, the large wildfire cycle has shrunk to once every three years, with instances of higher temperatures, lower rainfall, and the regional spread of spruce-bark beetle infestation expanding areas of elevated wildfire risk. In addition, there has been an increase in tundra fires along the northern and western coasts, which further expands the total acreage at risk from wildfire activity.

The seasonal fires in the Alaska interior ignite in spring following the winter snowmelt in April and May. These wildfires burn through the end of August when warm weather gives way to late summer and early fall rains. In some instances, such as the 2016 and 2019 wildfire seasons, significant fire activity continued into September due to irregular dry spells compared to normal weather patterns.

Two sets of fire emissions are considered for regional haze planning: the EPA's fire emission inventory (see Table III.K.13.E-5) and the DEC's fire emission inventory (Table III.K.13.E-6). EPA used SmartFire2/BlueSky framework[7] to estimate day-specific wildland fire emissions.

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[6] Guenther, A., Karl, T., Harley, P., Wiedinmyer, C., Palmer, P., Geron, C., 2006. Estimates of global terrestrial isoprene emissions using MEGAN (Model of Emissions of Gases and Aerosols from Nature).
[7] Baker, K., Woody, M., Tonnesen, G., Hutzell, W., Pye, H., Beaver, M., Pouliot, G., Pierce, T., 2016. Contribution of regional-scale fire events to ozone and PM 2.5 air quality estimated by photochemical modeling approaches. Atmospheric Environment 140, 539-554.

DEC generated fire emissions are based data from the Alaska Interagency Coordination Center (AICC). The perimeters of the fires use LANDFIRE to incorporate accurate Alaska vegetation types. DEC submits wildfire emissions to EPA every three years in the triennial emissions inventory. While there are differences between the two fire emission inventories, they both indicate large inter-annual variability of wildfires in the state. The DEC fire emission inventory was not used in the visibility analysis.

Table III.K.13.E-5. EPA Fire Emissions Inventory for Alaska.

Year	$PM_{2.5}$	CO	NH_3	NO_x	SO_2	VOC
NEI 2014	173,409	2,104,317	34,331.	18,135	12,579	49,3519
2016	262,648	3,165,511	51,591.	29,644	19,646	743,060
NEI 2017	372,347	4,529,099	73,869	37,869	26,718	1,060,873

Table III.K.13.E-6. ADEC Fire Emissions Inventory for Alaska

Year	$PM_{2.5}$	CO	NH_3	NO_x	SO_2	VOC
2014	160,933	1,919,071	8,632	41,170	11,288	90,310
2015	3,147,159	37,739,788	169,764	809,643	221,999	1,775,990
2016	239,006	2,866,092	12,892	61,487	16,859	134,875
2017	112,824	1,047,849	7,051	87,438	23,975	88,849

Alaska has been recording fire emissions since the early 1980s, and this data shows the increase of both the numbers and acreage of wildfires that trends upwards (see Figure III.K.13.E-5 and Figure III.K.13.E-6).

Figure III.K.13.E-5. 1990-2017 Wildfire in Numbers

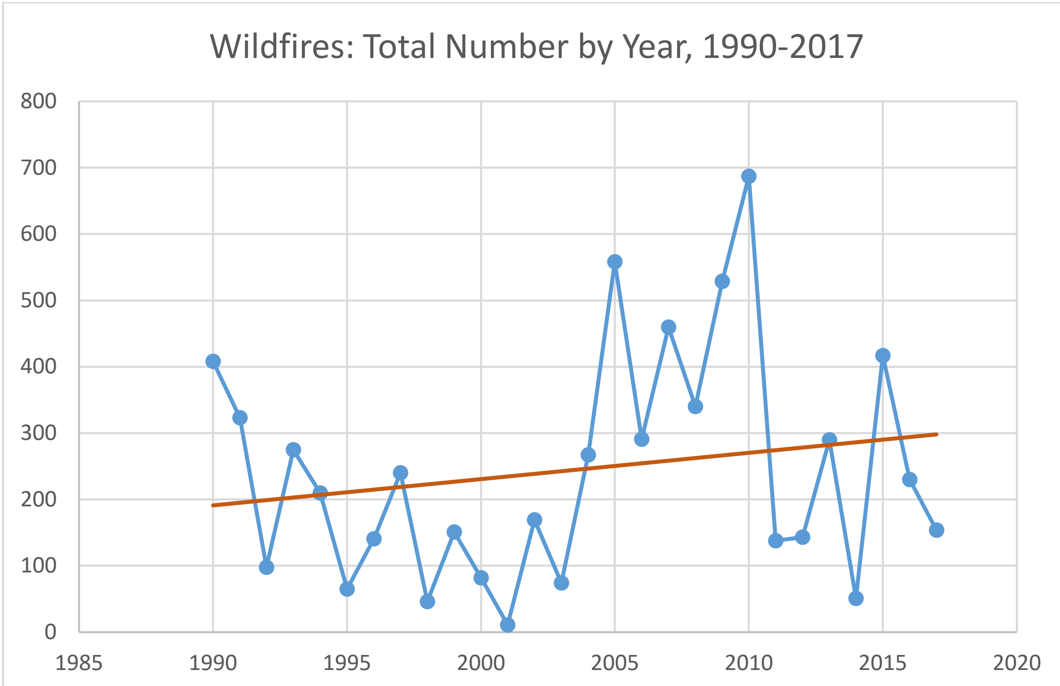
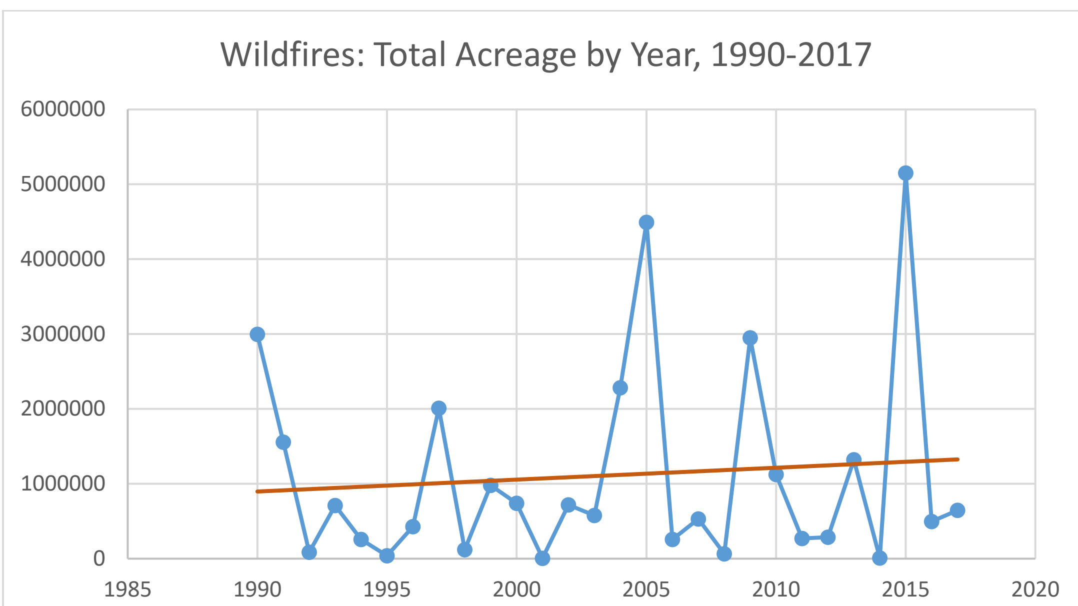


Figure III.K.13.E-6. Wildfires 1990-2017 in Acres



Similarly, Alaska maintains information on human caused and prescribed fire information which EPA data includes but is not specifically identified. Alaska data for human caused fires – both prescribed and land clearing and accidental fires is available and is used for developing goals in Section III.K.13.H (Long Term Strategy).

C. Sea Salt

Sea salt, a major component of marine aerosols, is formed by the evaporation of water ejected from wind whipped whitecaps and breaking waves. The production of sea salt aerosol and its size distribution are very sensitive to wind speed and surface conditions. Although most of the sea salt aerosol mass is in the size fraction above 1 μm diameter, a small but significant fraction of the sea salt aerosol is in the submicrometer fraction. The large particles have high settling velocities, resulting in relatively short residence times. The remaining particles are smaller, have a longer residence time, transport over longer distances, and impact visibility. Sea salt has been identified as a significant contributor to visibility impairment at all of the Class I areas in Alaska.

D. Oceanic Dimethyl Sulfide

Oceanic DMS emissions are the main natural source of global atmospheric sulfur (Simó, 2001)[8] that is precursor to sulfate aerosol. DMS [$(CH_3)_2S$] is an organosulfur compound produced by the breakdown of dimethylsulfoniopropionate (DMSP), a compound in some marine algae, through synthesis by phytoplankton. DMS emissions are estimated for Alaska using monthly climatologies of surface ocean DMS concentration and sea-to-air emission flux as a function of wind speed and temperature as described by Lana et al. (2011)[9]. The North American Mesoscale Forecast System (NAM)[10] data provides temperature and wind speed at 12 km resolution to derive DMS emissions flux (Figure III.K.13.E-7). The yield of DMS to SO_2 can vary. The yield of DMS into SO_2 as implemented in a GEOS-Chem global model is 75%[11]. Recent discovery of stable intermediate in the DMS oxidation process, hydroperoxymethyl thioformate (HPMTF) suggests that addition of the HPMTF pathway may reduce SO_2 approximately 10-30% in the Gulf of Alaska[12]. In this analysis the DMS emissions were scaled by a 0.6 factor to account for the amount of DMS that is likely ultimately oxidized to SO_2.

8 Simó, R. 2001. Production of atmospheric sulfur by oceanic plankton: biogeochemical, ecological and evolutionary links, Trends Ecol. Evol., 16(6), 287–294
9 Lana, A., Bell, T.G., Simó, R., Vallina, S.M., Ballabrera-Poy, J., Kettle, A.J., Dachs, J., Bopp, L., Saltzman, E.S., Stefels, J.J.G.B.C. and Johnson, J.E., 2011. An updated climatology of surface dimethlysulfide concentrations and emission fluxes in the global ocean. Global Biogeochemical Cycles, 25(1).
10 The North American Mesoscale Forecast System (NAM) is one of the major regional weather forecast models run by the National Centers for Environmental Prediction (NCEP) for producing weather forecasts. https://www.ready.noaa.gov/data/archives/nams/README.TXT
11 Chen, Q., T. Sherwen, M. Evans and B. Alexander. 2018. DMS oxidation and sulfur aerosol formation in the marine troposphere: a focus on reactive halogen and multiphase chemistry. Atmos. Chem. Phys., 18, 13617-13637. http://eprints.whiterose.ac.uk/136782/1/acp_18_13617_2018.pdf
12 Veres, P.R., et al., 2020. Global airborne sampling reveals a previously unobserved dimethyl sulfide oxidation mechanism in marine atmosphere. PNAS March 3, 2020 117 (9) 4505-4510. https://www.pnas.org/content/117/9/4505

Figure III.K.13.E-7. Monthly DMS flux in July, August, and September 2016 (from left to right). The domain coverage is defined by the NAM data available for Alaska

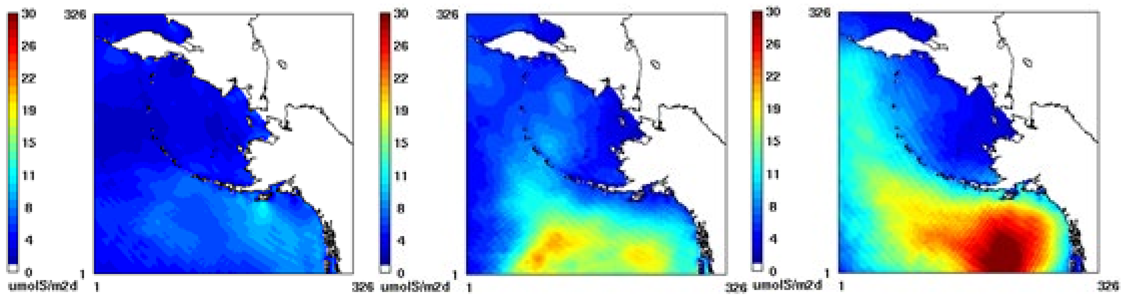
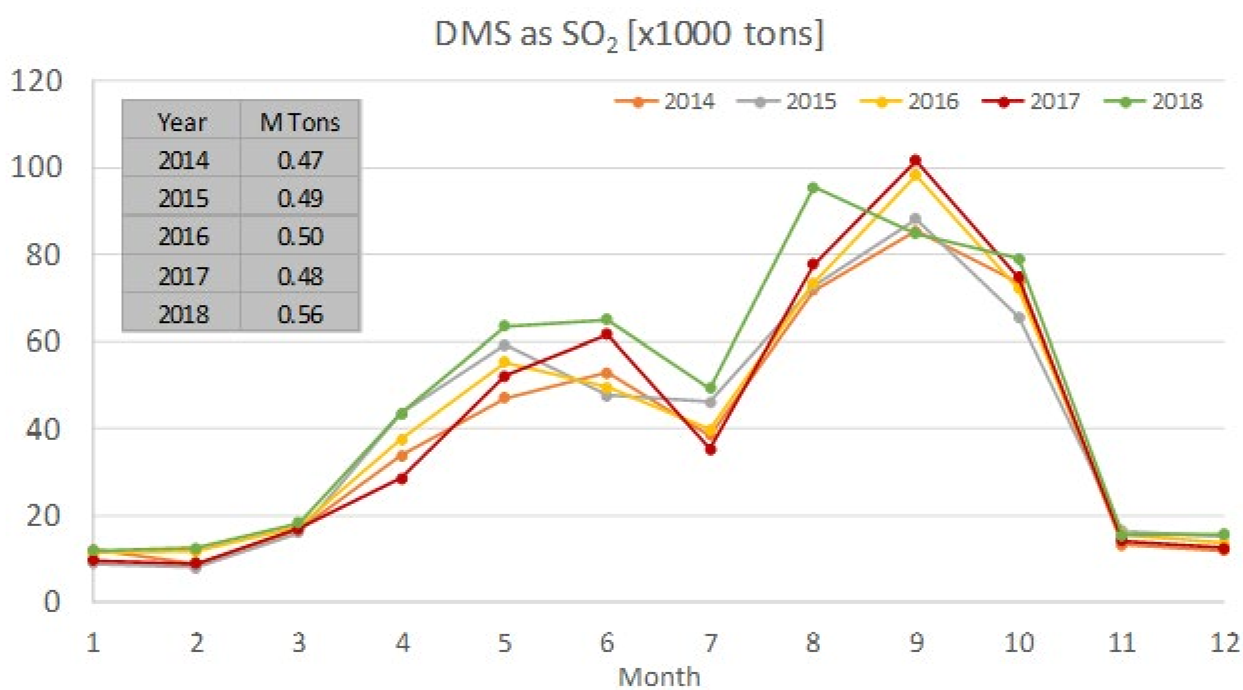


Figure III.K.13.E-8 displays monthly emissions for years 2014 to 2018 for areas approximating the EPA's CMAQ 27-km grid resolution domain (domain extent shown in Figure III.K.13.E-1). DMS emissions increase during the summer due to higher biological activity. The estimated DMS emissions exhibit limited inter-annual variability with an average annual emission of 454 thousand tons per year (SO_2 equivalent) or 37% of total SO_2 emissions in 2016 within the CMAQ 27-km domain (more detail in Section III.K.13.G). Undoubtedly, oceanic DMS is a significant natural sulfur source that can impact measured sulfate at Alaska IMPROVE sites, especially at Simenof and Tuxedni given their proximity to the ocean.

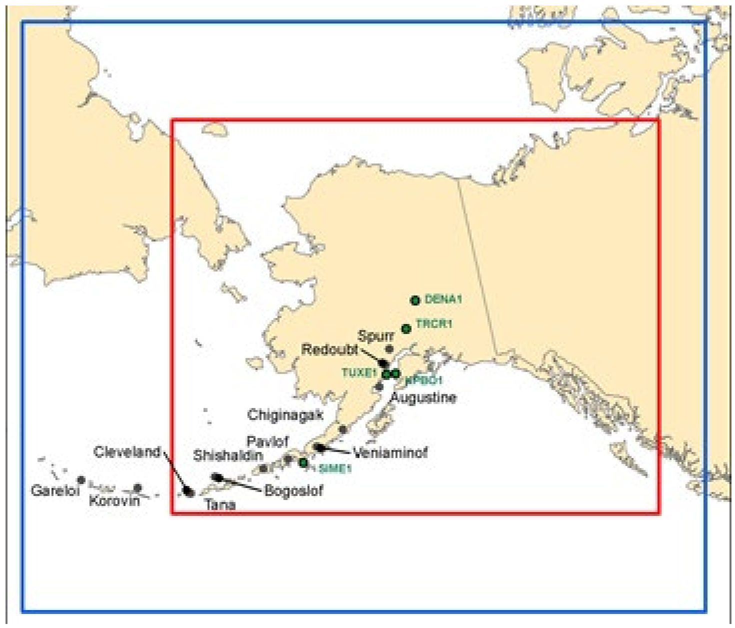
Figure III.K.13.E-8. Monthly DMS emissions during 2014-2018 for the area approximating the EPA's CMAQ 27-km grid resolution domain



E. Geogenic Sources

Alaska is home to many active and dormant volcanoes and has seen some of the largest eruptive events of the last century. The largest volcanic eruption of the twentieth century took place in 1912 at what is now Katmai National Park in an eruption known as 'Novarupta.' The U.S. Geological Survey (USGS) operates the Alaska Volcano Observatory (AVO) with the Alaska Division of Geological and Geophysical Surveys and the University of Alaska Fairbanks (UAF) Geophysical Institute. There are currently 40 active volcanoes in the state. There are several active and dormant volcanoes located near Class I areas, including Mount Pavlof located near the Simeonof Class I area. Near the Tuxedni Class I area are Mount Iliamna and Redoubt Volcano (Figure III.K.13.E-9). There have been several major and minor eruptions during the first planning period from Alaska volcanoes.

Figure III.K.13.E-9. Alaska Volcanoes and IMPROVE monitors



For Alaska air quality planning purposes, geogenic visibility is an unpredictable influence with little warning of potential eruptive events that can have significant visibility impacts. As a natural process and one which is relatively common in Alaska and in the other non-contiguous state (Hawaii), it is a reality that must be expected. In addition to Alaska volcanoes, Class I areas have received noticeable amounts of geogenic emissions from active volcanoes located on the Kamchatka Peninsula and Kurile Islands in the Russian Far East. Air quality impacts are nominal compared with eruptive events from Alaska volcanoes due to distances involved, along with atmospheric scouring over the Bering Sea and North Pacific Ocean. Generally, the impacts from Russian volcanic eruptions are mild, and the greatest impact is felt by airlines and air cargo companies rerouting to avoid volcanic plumes.

Volcanic activity can be organized under two broad categories: volcanic eruptions and volcanic degassing. Both represent different activities that can have measurable impacts on Alaska Class I areas. Active eruptions are periodic events which could disrupt visibility with the large release of volcanic gases and particles. These are generally limited in terms of their yearly impact. Degassing, by comparison, is the low-level release of volcanic gases, like SO_2, at levels not high enough to be classified as a volcanic eruption, but still large enough to potentially impact visibility. Volcanic degassing is a regular occurrence in Alaska. The AVO and USGS maintain active and passive monitoring of all Alaska's active and dormant volcanoes to ensure locals and air companies have warning if and when volcanoes move from degassing into erupting.

The most abundant gas typically released into the atmosphere from volcanic systems is water vapor, followed by carbon dioxide (CO_2) and SO_2. Volcanoes also release smaller amounts of other gases, including hydrogen sulfide (H_2S), hydrogen (H), carbon monoxide (CO), hydrogen chloride (HCl), hydrogen fluoride (HF), and helium (He). Large explosive eruptions inject a tremendous volume of sulfur aerosols into the stratosphere, which depending on wind speed and direction can significantly impact any of the Class I areas located in Alaska.

Volcanoes are important sources of sulfur dioxide (VSO_2) and are required as climate model inputs because they impact the tropospheric burden of sulfate aerosols. The non-explosive gas release can occur by advection through fractures or diffuse degassing through permeable ground and on an annual basis can be much more than eruptive emissions. Fischer et al (2019)[13] estimated that during 2005 to 2015, global VSO_2 emissions (from approximately 900 volcanoes) during eruptions were 2.6 Tg (teragram) per year compared to 23.2 Tg per year from passive degassing.

Accurate inventories of the spatial and temporal distribution of VSO_2 are difficult to obtain from ground-based measurements due to their sparse coverage spatially and temporally. Satellite-derived measurements allow for greater and more consistent coverage. Recent advances in satellite remote sensing techniques have greatly improved limitations on the eruptive and non-eruptive flux of SO_2 from volcanoes[14,15,16,17]. The NASA Goddard Earth Science Data and Information Services Center (GES DISC) produces a new global inventory of VSO_2 emissions for 2005-2019 by means of combining measurements from backscatter ultraviolet (BUV), thermal infrared (IR) and microwave (MLS) instruments on multiple satellites. Specifically, eruptive emissions are obtained from the Ozone Mapping and Profiler Suite (OMPS) nadir mapper (NM) located on the Suomi National Polar-orbiting Partnership (SNPP) satellite (Carn, 2019)[18]. Degassing emissions are obtained from Ozone Monitoring Instrument (OMI), a UV

[13] Fischer, T.P., Arellano, S., Carn, S., Aiuppa, A., Galle, B., Allard, P., Lopez, T., Shinohara, H., Kelly, P., Werner, C. and Cardellini, C., 2019. The emissions of CO2 and other volatiles from the world's subaerial volcanoes. *Scientific reports*, *9*(1), pp.1-11.
[14] Carn, S. A., Clarisse, L. & Prata, A. J., 2016. Multi-decadal satellite measurements of global volcanic degassing. *J. Volcanol. Geotherm. Res.* **311**, 99–134, http://dx.doi.org/10.1016/j.jvolgeores.2016.01.002.
[15] Carn, S.A., Fioletov, V.E., McLinden, C.A., Li, C. and Krotkov, N.A., 2017. A decade of global volcanic SO2 emissions measured from space. *Scientific reports*, *7*, p.44095.
[16] Clarisse, L. et al., 2012. Retrieval of sulphur dioxide from the infrared atmospheric sounding interferometer (IASI). *Atmos. Meas. Tech*. **5**, 581–594, http://dx.doi.org/10.5194/amt-5-581-2012.
[17] Theys, N. et al., 2013. Volcanic SO2 fluxes derived from satellite data: a survey using OMI, GOME-2, IASI and MODIS. *Atmos. Chem. Phys.*, **13**, 5945–5968, doi: 10.5194/acp-13-5945-2013.
[18] Carn, S.A., 2019. Multi-Satellite Volcanic Sulfur Dioxide L4 Long-Term Global Database V3, Greenbelt, MD, USA, Goddard Earth Science Data and Information Services Center (GES DISC), Accessed on November 2, 2020, 10.5067/MEASURES/SO2/DATA404

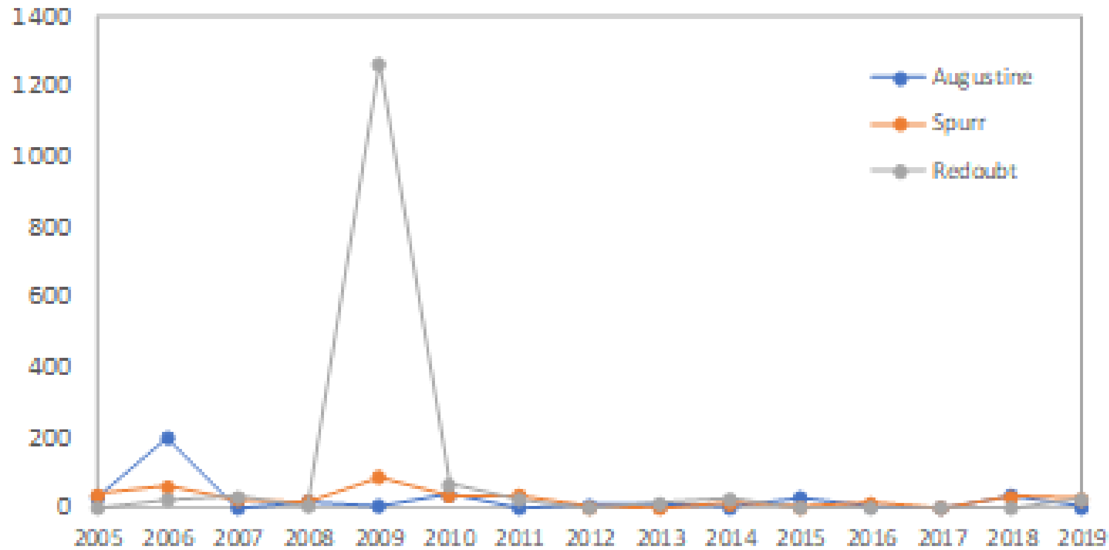
sensor located on NASA's Aura satellite (Fioletov et al., 2019)[19]. This top-down method combines all qualified daily OMI measurements (e.g., cloud free) during a particular year to provide a single cumulative rate of annual VSO_2 emissions for each volcano.

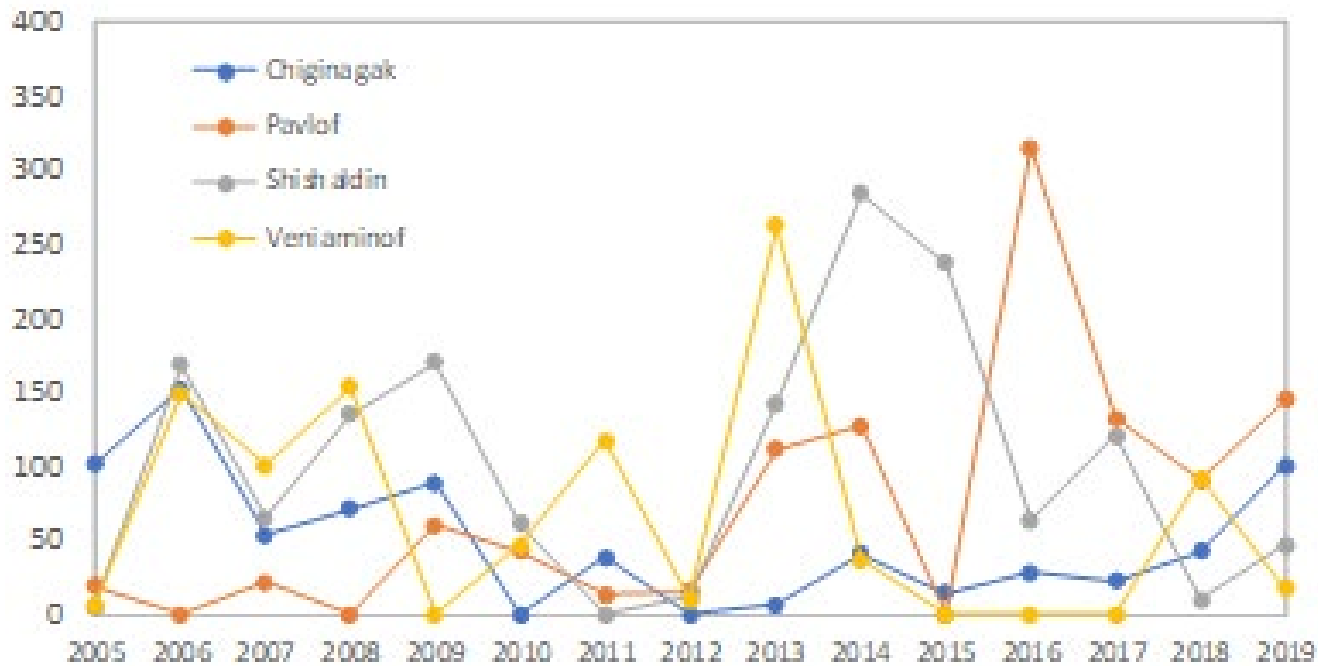
According to the NASA inventory, VSO_2 emissions in Alaska exhibit significant inter-annual variability ranging from 133 thousand tons (year 2012) to 1,957 thousand tons (year 2009) (Figure III.K.13.E-10). In 2016, VSO_2 alone is estimated to contribute 51% of total SO_2 emissions within the CMAQ 27-km grid resolution domain. Multiple volcanoes are located near the Alaska IMPROVE sites and can influence the measured $(NH_4)_2SO_4$ concentrations at these sites. Figure III.K.13.E-11 shows an example comparison of annual VSO_2 emissions and sulfate extinctions on the MID at the SIME IMPROVE site.

The higher VSO_2 emissions in 2009 include emissions from the eruption of the Redoubt volcano in southern Alaska that is located between Tuxedni and Anchorage that started March 15, 2009, and appears to be reflected in the SIME sulfate measurements on the 2009 MID. The eruptive emissions are estimated to make up less than 10% of total VSO_2 in Alaska; the rest is due to passive degassing that can last multiple days or months. For example, during 2014 to 2015, AVO classified volcano activity at Shishaldan as orange category (e.g., small-moderate eruptions, increased seismic activity) for 24 months continuously. Such variability in magnitude, frequency and temporal distribution makes it challenging to account for VSO_2 in the visibility projection and visibility glidepath. If emissions activity over the years has resulted in current year (e.g., 2014-2018) $(NH_4)_2SO_4$ levels being higher than the baseline years (2000-2004), the 2028 projections would be starting at a higher level than the baseline. When combined with small anthropogenic emission contributions, it may be impossible for the 2028 visibility projection to achieve the glidepath (see Section III.K.13.I-4).

[19] Fioletov, V., McLinden, C., Krotkov, N., Li, C., Leonard, P., Joiner, J., Carn, S.A., 2019. Multi-Satellite Air Quality Sulfur Dioxide (SO2) Database Long-Term L4 Global V1, Edited by Peter Leonard, Greenbelt, MD, USA, Goddard Earth Science Data and Information Services Center (GES DISC), Accessed on November 2, 2020, 10.5067/MEASURES/SO2/DATA403

Figure III.K.13.E-10. Satellite-derived annual VSO_2 emissions (ktons per year). 2000-2004 data is not available.




Chiginagak
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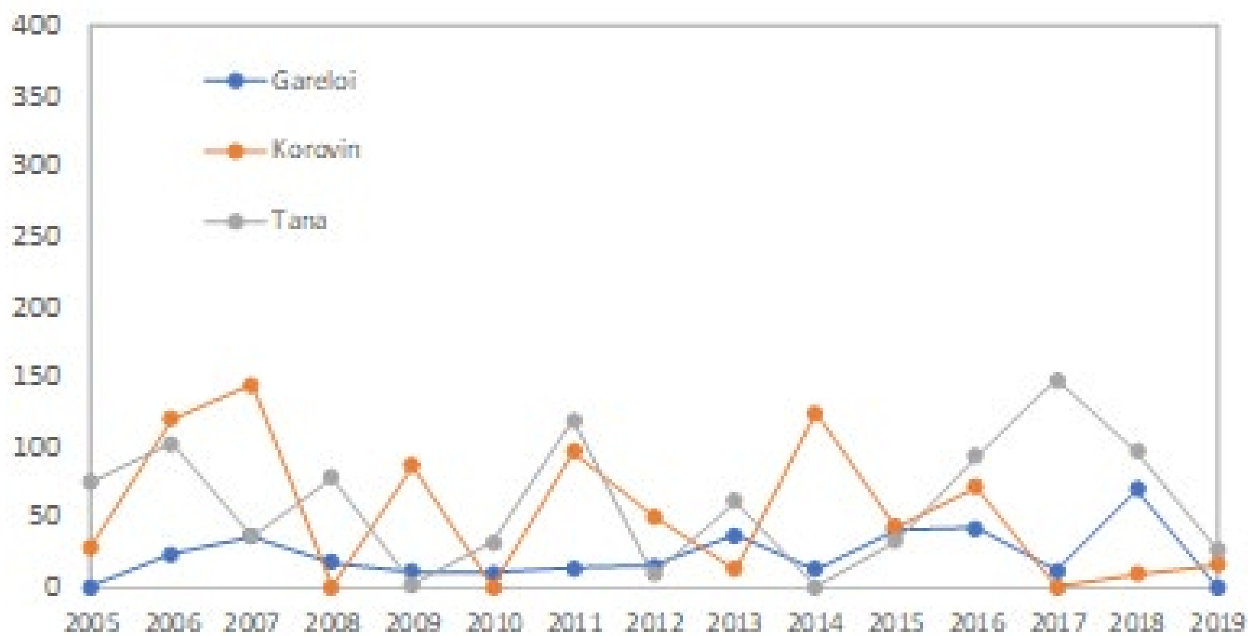
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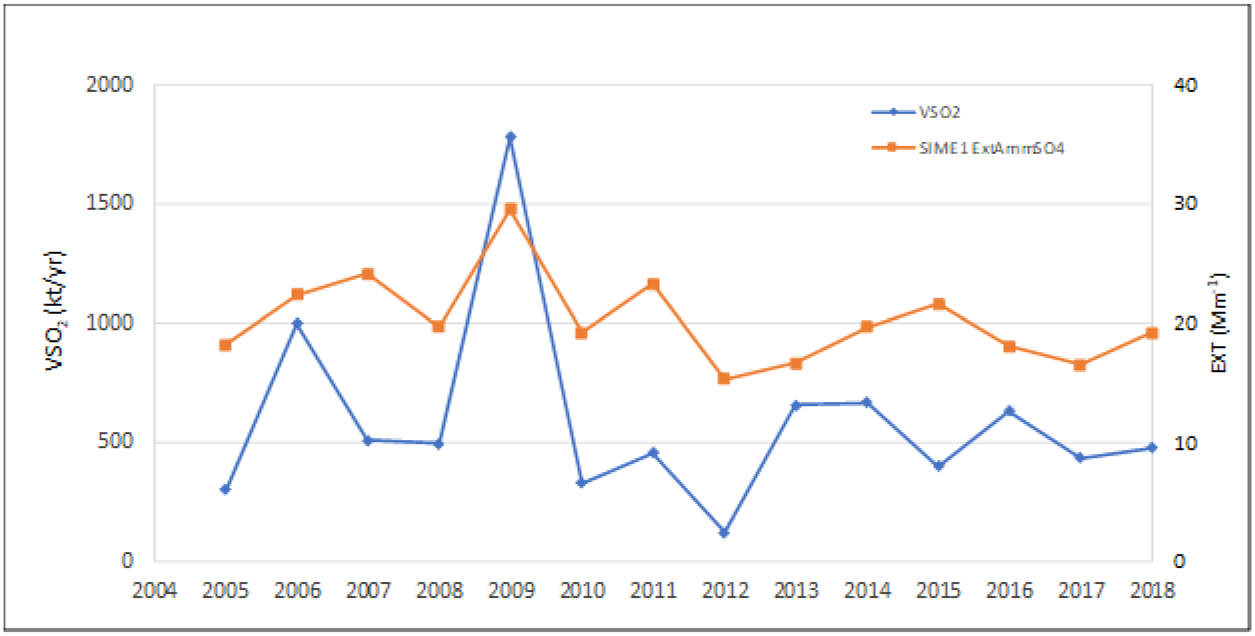
Figure III.K.13.E-11. Annual volcanic SO_2 emissions in Alaska and $(NH_4)_2SO_4$ extinction at Simeonof IMPROVE site.



5. INTERNATIONAL TRANSPORTED EMISSIONS

Several studies, such as Polisar, et al. (2001)[20], have been conducted that attributed atmospheric aerosols measured in Alaska to contributions from upwind regions as far away as portions of Asia and Russia based on back trajectory analysis and identification of unique chemical source signatures of anthropogenic sources from these regions. Dust generated by the Gobi and Taklimakan Deserts in Central Asia can also be transported to the Arctic airshed by seasonal cycles. Though this constitutes a natural source of pollution, rapid industrialization in the People's Republic of China has led to an extended period of deforestation, desertification, and heavy industrial pollution in these areas, creating conditions whereby industrially-generated heavy metals are transported to Arctic airsheds along with desert dust particles. Arctic haze and Asian dust are described in more details below.

One of the most significant sources of human-caused impairment is from maritime vessels engaged in trans-Pacific trade between East Asia and North America. Several large trade routes run south of the state, causing pollution transport to coastal and interior Class I areas. This is an uncontrollable source of pollution, as the state has no ability to regulate or control these maritime emissions outside of state waters.

The state also receives impairment from large wildfires burning in Canada, the Russian Far East, and Siberia, which have grown in size and severity over the last decade from Arctic climate

[20] Polissar, A.V., Hopke, P.K. and Harris, J.M., 2001. Source regions for atmospheric aerosol measured at Barrow, Alaska. *Environmental science & technology*, *35*(21), pp.4214-4226.

changes. These wildfire impacts have been recorded on several occasions at Class I areas as causing noticeable degradation of visibility quality and clarity at IMPROVE monitors.

A. Arctic Haze

Arctic haze is a regional air quality process whereby during winter months the Arctic atmosphere becomes saturated with anthropogenic pollution. Most of these pollutants are not created locally but instead originate in Europe, Russia, and East Asia. They are transported to the high Arctic by air currents and other atmospheric processes. Arctic atmospheric process differences due to local weather patterns in winter result in greatly reduced normal photochemical oxidation of SO_2 and other chemicals. With Arctic sunrise, photochemical oxidation is stepped up and gaseous pollutants are broken down into aerosols, causing an increase in aerosol pollution in March and April. Thus, haze periods are broken down into two periods: gaseous haze in January and February, and aerosol haze in March and April.

Haze is composed of particles no larger than 2 μm ($PM_{2.5}$), as these particles have a low settling velocity. They are capable of remaining suspended in the atmosphere for weeks at a time. This allows these particles to travel from distant emissions locations into the Arctic air shed. Because these particles are roughly the same size as the visible sunlight wavelength, the haze can more effectively scatter light and diminish visibility at ground level.

Arctic haze is often layered as a result of the small thermal lapse rate of the Arctic atmosphere in winter. This shallow lapse rate dampens vertical mixing, allowing pollution to spread horizontally rather than vertically.

During spring and summer, in the absence of haze and wildfires, Arctic visual range is quite high. Utqiagvik (formerly known as Barrow) averages around 270 kilometers of visual range in June. Average values for March, during high aerosol haze, are reduced to 143 kilometers and usually much lower. Haze instances often can drive visual range down below 30 kilometers in the high Arctic.

B. Asian Dust

Like the above Arctic haze, Asian dust is a seasonal process taking place in the spring where air masses from Asia are transported across the North Pacific to the high Arctic. Large amounts of dust are lofted from the Gobi and Taklimakan Deserts due to high winds and weather fronts which start during the end of winter. The localized impact of these dust lofting events is well recorded in neighboring Japan and Korea, where the seasonal dust events have been given their own names to describe the event. The dust fall is known as “Kosa” in Japan and as “Whangsa” on the Korean Peninsula. Along with being a period of active dust lofting from China and Mongolia, it is also a period of high activity for atmospheric transport and exchange from East Asia to the Pacific Ocean.

Geological evidence suggests global transport of Asian dust is a long-running natural process. Chemical analysis of Greenland ice cores and Hawaiian soil studies both showed the chemical and radiological fingerprints of deposited dust consistent with the composition of Asian dust sources in the Gobi and Taklimakan Deserts. It should be noted there is a similar process of dust transport from the Saharan Desert east across the Atlantic Ocean to the rainforests of the Amazon in South America. This process is believed to assist in fertilizing the rainforest and is associated with forest health.

Studies conducted in the late 1970s showed little pollution accompanying the dust during atmospheric exchange. However, more recent analyses of the dust showed an increase in anthropogenic pollution concurrent with Asian dust transport and more general Asian atmospheric exchange over the Pacific Ocean. Due to China's rapid industrialization and the associated expansion of both the Gobi and Taklimakan Deserts (related to both industrial policy and more general deforestation starting in the 1980s), it is likely dust amounts will increase in the future. This dust has been measured as containing elevated levels of heavy metals and other pollutants associated with industrial manufacturing and coal-fired power generation. This process could be reversed with recent efforts in China to begin aggressive reforestation and reseeding efforts in the western provinces, as well as parallel efforts in Mongolia. As these are relatively recent policies that have only taken effect in the last decade, it will be some time before results can be determined. Future studies inside and outside of China will demonstrate long-term results of this approach to pollution levels within the dust plumes

6. POTENTIAL SOURCE CONTRIBUTIONS AT ALASKA IMPROVE SITES

As described above, visibility impacts at Alaska IMPROVE sites are a combination of sources within and in the immediate vicinity of Alaska as well as long-range transport from other continents (e.g., Russia and China). Emission contributions from these sources can be quantified through global simulations. This section provides an initial summary of the source of sulfur emissions within and near Alaska based on a 2014 GEOS-Chem simulation. Sulfur emitting sources are focused here because sulfate is the main component contributing to visibility impairment on MID at Alaska IMPROVE sites.

GEOS-Chem includes various inventories[21] and provides sulfur (and other species) emissions rates from worldwide anthropogenic emissions, shipping emissions, biomass burning, volcanic degassing/leakage, and oceanic DMS. The Western Air Quality Study (WAQS) 2014 GEOS-Chem simulation used global anthropogenic emissions, including emissions from shipping sources, from the Community Emissions Data System (CEDS) inventory[22], biomass burning emissions from the Global Fire Emissions Database Version 4 (GFED4) inventory[23], volcanic degassing emissions of SO_2 from the AeroCom inventory, and oceanic DMS emissions from the DMS ocean exchange inventory. Table III.K.13.E-7 and Figure III.K.13.E-12 show the contributions of reactive sulfur emissions or the following regions: (1) an Alaska region; (2) the contiguous United States (CONUS); and (3) global world-wide. Figure III.K.13.E-13 shows the Alaska (dark pink) and CONUS (lighter pink) emission extraction domains on the GEOS-Chem 2 x 2.5 degree domain. The Alaska emission extraction domain was defined to roughly correspond to the EPA's 27-km grid resolution CMAQ modeling domain.

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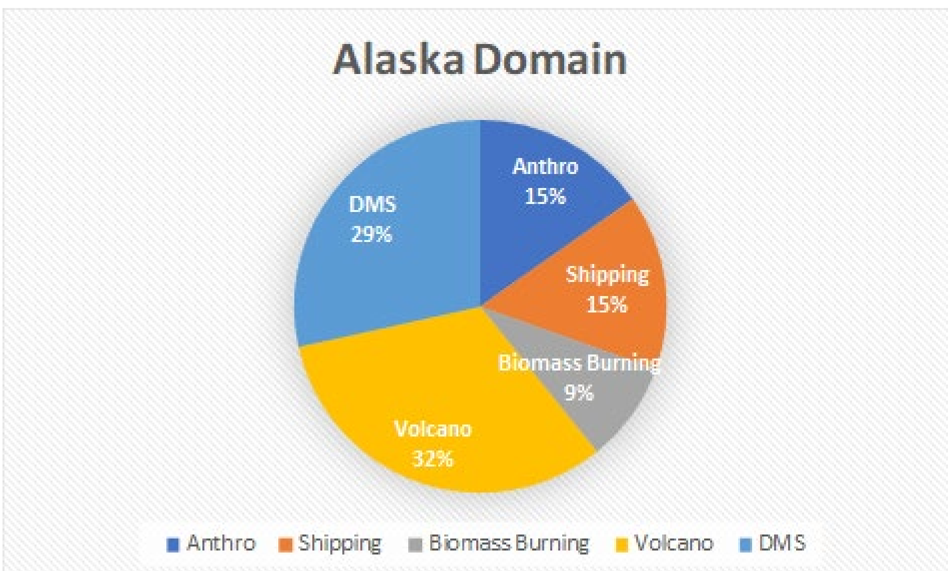
[21] wiki.seas.harvard.edu/geos-chem/index.php/HEMCO_data_directories
[22] http://wiki.seas.harvard.edu/geos-chem/index.php/CEDS_anthropogenic_emissions
[23] https://daac.ornl.gov/VEGETATION/guides/fire_emissions_v4_R1.html

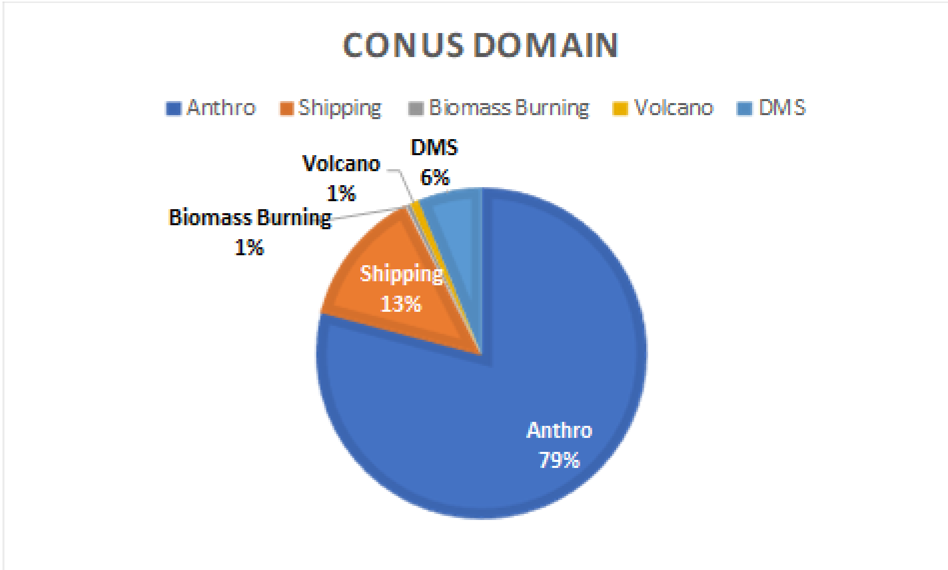
Table III.K.13.E-7. Emissions of SO_2 (Mt/year) in 2014. Data comes from the inventories in the GEOS-Chem global model

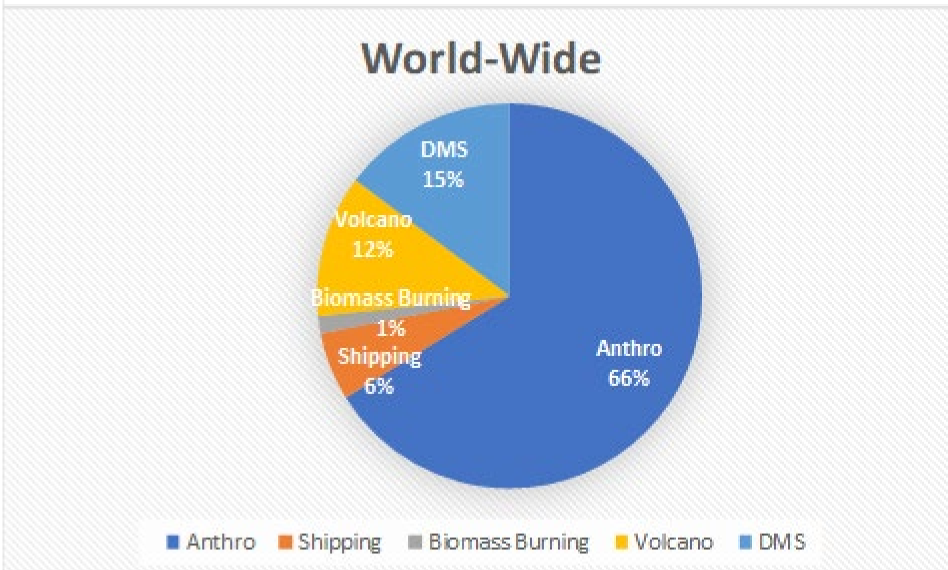
Source	Alaska Domain		CONUS Domain		World-Wide Domain	
	(M tons/yr)	(%)	(M tons/yr)	(%)	(M tons/yr)	(%)
Anthropogenic	0.39	15%	5.46	79%	102.8	66%
Shipping	0.39	15%	0.92	13%	8.90	6%
Biomass Burning	0.22	9%	0.031	0%	2.25	1%
Volcano degassing	0.82	32%	0.06	1%	18.5	12%
Oceanic DMS*	0.73	28%	0.43	6%	22.9	15%
Total	2.6		6.9		155.3	

*a DMS-to-SO_2 conversion of 0.6 applied

Figure III.K.13.E-12. Relative importance of reactive sulfur emissions from the GEOS-Chem for 2014 of three emission extraction domains: Alaska, CONUS, and World-Wide



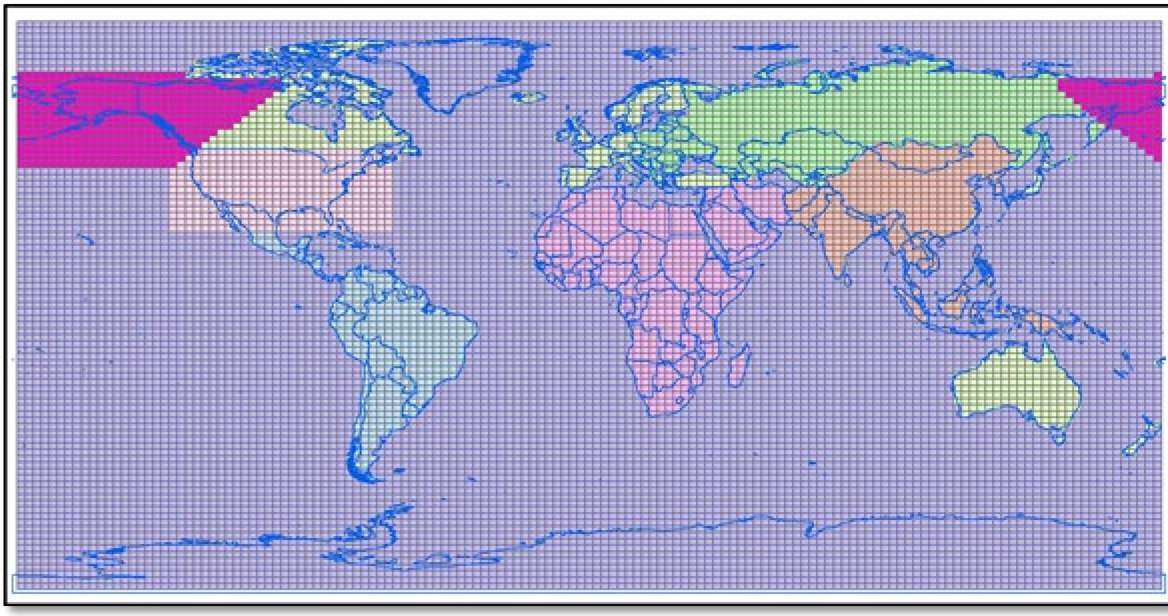




The volcano degassing SO_2 emissions account for 32% of the reactive sulfur emissions in the Alaska domain, with DMS accounting for another 28%[24]. Anthropogenic and shipping emissions account for 15% each. Biomass burning (e.g., wildfires) account for 9% of the reactive sulfur emissions, but fire emissions are very episodic and have a lot of year-to-year variability; 2014 was not a high wildfire year in Alaska. In contrast to the Alaska domain, where only 30% of the reactive sulfur emissions were from anthropogenic sources and shipping, almost 90% of the reactive emissions are anthropogenic and shipping in the CONUS domain. And world-wide, 72% of the reactive sulfur emissions are anthropogenic and shipping.

[24] In the EPA Alaska 9-km CMAQ modeling domain, volcano degassing accounts for 46% and DMS accounts for 20% of total SO_2 emissions.

Figure III.K.13.E-13. Map of the EPA Alaska 27-km CMAQ modeling domain (green) overlaid over the GEOS-Chem 2x2.5 degree grid Alaska emission extraction domain (dark pink) and CONUS emission extraction domain (lighter pink).



III.K.13.F. TECHNICAL ANALYSIS OF STATE CONTROLLABLE SOURCES

1. Overview/Purpose

40 CFR §51.308(f)(2)(i) of the RH Rule requires states to submit plans for improvement that include enforceable emissions limits, compliance schedules, and other measures necessary to make reasonable progress towards natural visibility conditions at Class I areas. To achieve these goals, states are required to develop a LTS that must "include emission limits, schedules of compliance and other measures as may be necessary to make reasonable progress'' and "identify all anthropogenic sources of visibility impairment considered by the state in developing its long-term strategy". In developing these goals, the state is to select sources and consider four factors when evaluating for potential control measures for the selected sources: 1) cost of compliance; 2) time necessary for compliance; 3) energy and non-air quality environmental impacts; and 4) remaining useful life. Consideration of visibility benefits is an optional fifth factor that states may consider per EPA's August 2019 "Guidance on Regional Haze State Implementation Plans for the Second Implementation Period."

DEC used a two-step approach to select sources for evaluation. The initial step (step one) involved an AOI and WEP analysis, which was followed by a final Q/d analysis (step two) to select sources for evaluation under the four factors. In step one, DEC initially identified twenty-six point and area sources using the WEP analysis identified in Section 2a. In step two, DEC refined the list to six point sources subject to analyses using the Q/d analysis outlined in Section 2e. Of the six point sources; one facility had a four-factor analysis conducted, two facilities were partially evaluated with on-going four-factor analyses pending if existing emissions units (EUs) aren't retired, and three facilities were not evaluated because they recently went through a Best Available Control Technology (BACT) analysis for the Fairbanks North Star Borough (FNSB) Serious $PM_{2.5}$ nonattainment area. A list of the final six sources selected for evaluation are shown in Table III.K.13.F-1.

Table III.K.13.F-1. Facility Selection for Review

Facility	Review Section
North Pole Power Plant	3a
Healy Power Plant	3b
Chena Power Plant	3c
Eielson Air Force Base	3d
Fort Wainwright	3e
Fairbanks Campus Power Plant	3f

2. Source Selection

a. Why the Focus on Sulfur Dioxide (SO_2) in the Four Factor Analysis?

EPA guidance[1] allows for the elimination of pollutants from consideration in a four-factor analysis. States can focus on the PM species that "dominate visibility impairment at the Class I areas affected by emissions from the state and then select only sources with emissions of those dominant pollutants and their precursors". Further, EPA guidance states that it may be reasonable for a state to not consider measures for control of the remaining pollutants from sources that have been selected on the basis of emissions of the dominant pollutants.

The selection of sources in Alaska to undergo a four-factor analysis was based solely on SO_2 emissions. SO_2 is a precursor pollutant of sulfate which dominates visibility impairment at Alaska Class I areas as shown in Figure III.K.13.F-2 and Section III.K.13.D. Other pollutants represent a smaller percentage of overall visibility impairment readings at the IMPROVE monitors. Sulfate domination is even more evident (> 95%) in the annual extinction composition attributable to human-caused pollution (Figure III.K.13.F-3). As in the first RH planning period, elimination of less important haze species allows for focus on the most influential species by state regulators. Given the dominance of sulfate to visibility at Alaska Class I areas, DEC elected to focus on SO_2 sources in the four-factor analysis.

Sources of SO_2 can be from natural or anthropogenic origins as described in Section III.K.13.E. Important natural SO_2 sources are volcanoes and oceanic DMS. Uncontrollable anthropogenic sources of SO_2 come from international industry operations including energy production, and marine shipping. In Alaska, anthropogenic SO_2 comes primarily from electrical generation and oil and gas development.

[1] Technical Guidance on Tracking Visibility Progress for the Second Implementation Period of the Regional Haze Program, U.S. Environmental Protection Agency, EPA-454/R-18-010, December 2018. Page 12, Step 3.a

Figure III.K.13.F-2. Average extinction on the 2014-2018 MID at DENA1 and SIME1

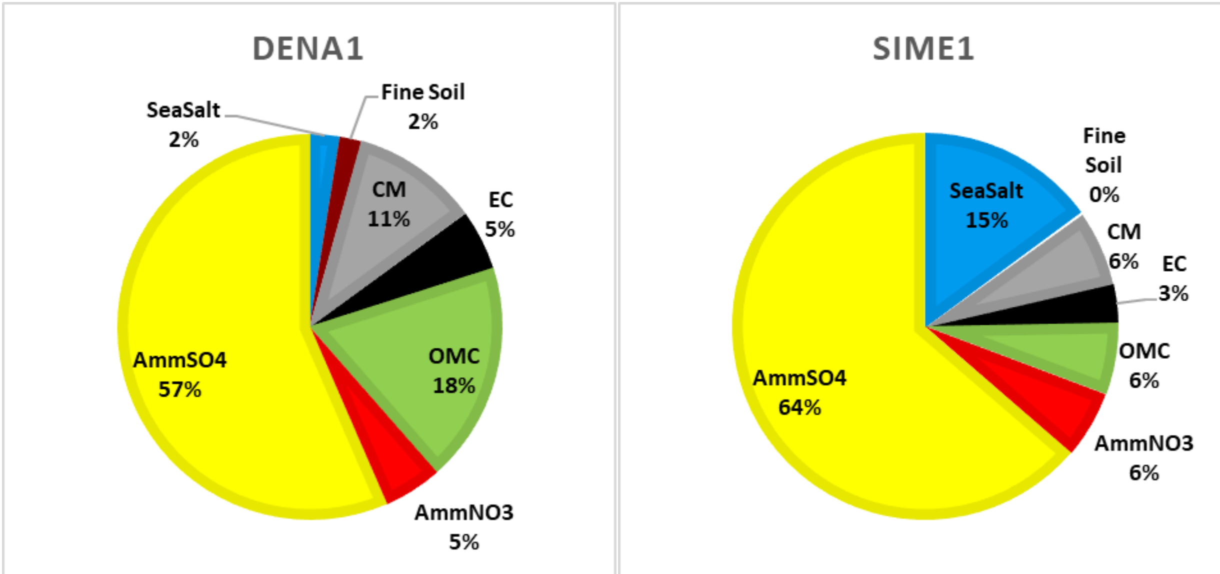
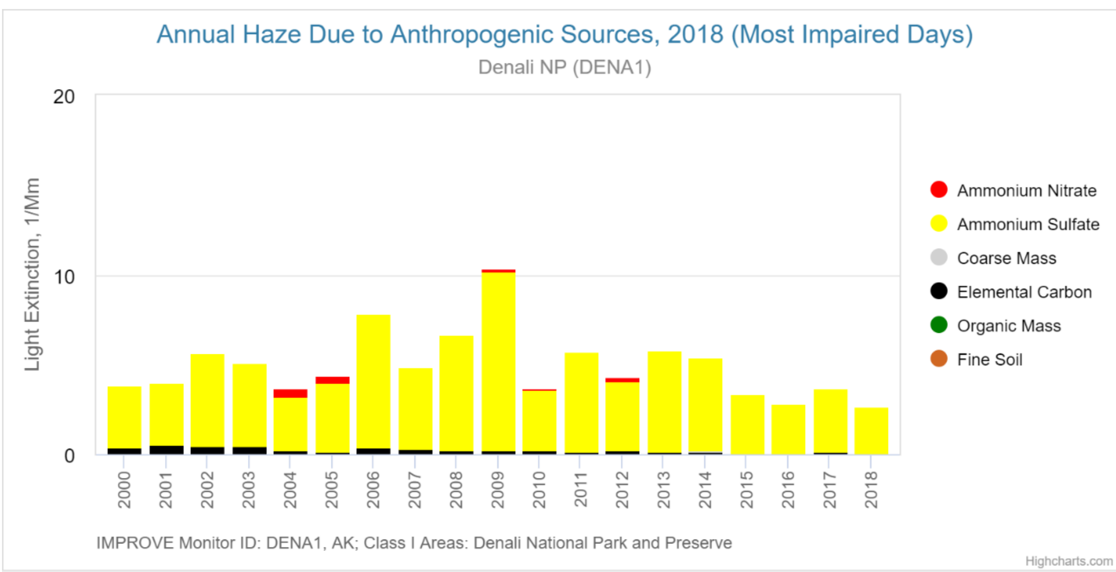
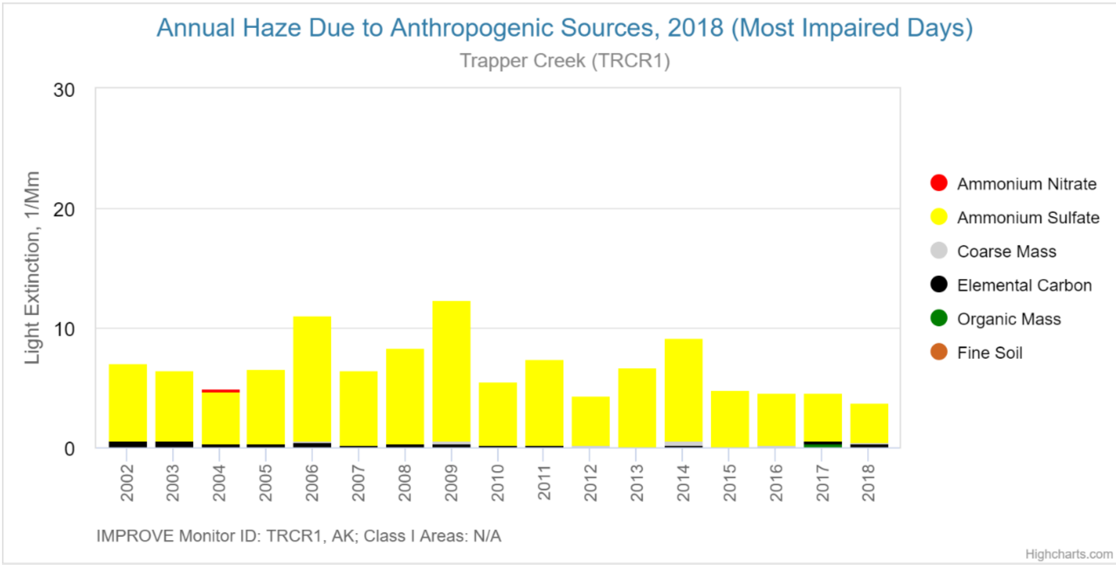


Figure III.K.13.F-3 Extinction on the 2002-2018 MID attributable to anthropogenic sources




Annual Haze Due to Anthropogenic Sources, 2018 (Most Impaired Days)
Trapper Creek (TRCR1)
Light Extinction, 1/Mm
0
10
20
30
2002
2003
2004
2005
2006
2007
2008
2009
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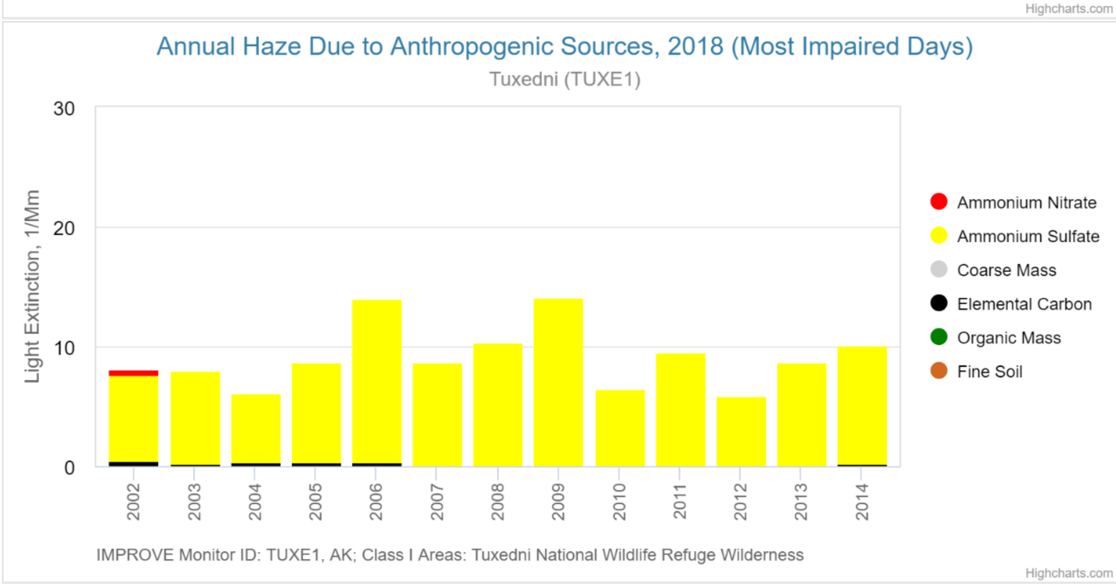
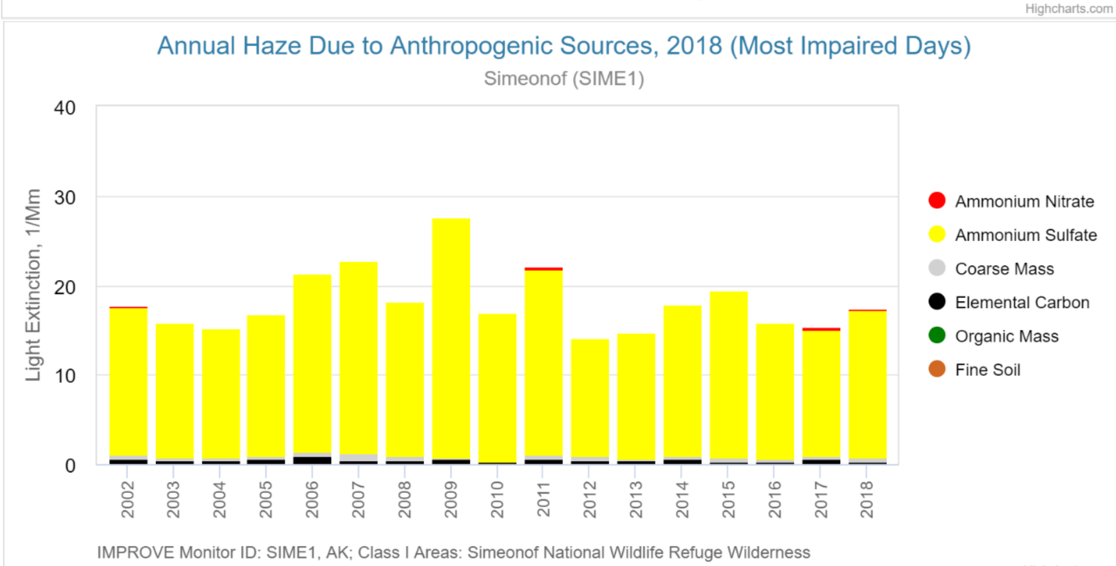
2011
2012
2013
2014
2015
2016
2017
2018
Ammonium Nitrate
Ammonium Sulfate
Coarse Mass
Elemental Carbon
Organic Mass
Fine Soil
IMPROVE Monitor ID: TRCR1, AK; Class I Areas: N/A
Highcharts.com


Annual Haze Due to Anthropogenic Sources, 2018 (Most Impaired Days)
Tuxedni (TUXE1)
Light Extinction, 1/Mm
0
10
20
30
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
Ammonium Nitrate
Ammonium Sulfate
Coarse Mass
Elemental Carbon
Organic Mass
Fine Soil
IMPROVE Monitor ID: TUXE1, AK; Class I Areas: Tuxedni National Wildlife Refuge Wilderness
Highcharts.com


Annual Haze Due to Anthropogenic Sources, 2018 (Most Impaired Days)
Simeonof (SIME1)
Light Extinction, 1/Mm
0
10
20
30
40
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
Ammonium Nitrate
Ammonium Sulfate
Coarse Mass
Elemental Carbon
Organic Mass
Fine Soil
IMPROVE Monitor ID: SIME1, AK; Class I Areas: Simeonof National Wildlife Refuge Wilderness
Highcharts.com

b. Source Selection Strategy: Step One (WEP Analysis) Overview

Many states are selecting sources for review and analysis using the Q/D method (quantity of actual emissions in tons per year divided by distance in kilometers to the IMPROVE monitor) to apply to point sources of NO_x and of SO_2. In Alaska, the Q/D source selection was based on the parameters in the WRAP tool[2]. The WRAP Q/D Tool establishes a threshold of 10 tons per year per km (tpy/km) for Q/D and 25 tpy for Q and only facilities with a distance less than 400 km were included. As noted in the EPA Guidance, the Q/D methodology does not take into consideration topography, transport direction/pathway and dispersion, and photochemical processes.

Alaska contracted with Ramboll to run HYSPLIT back trajectories to develop AOI and WEP for each Class I area. While the WEP analysis includes facility point and other anthropogenic sources (e.g., nonpoint facilities, mobile sources), only point sources are considered for a full four factor analysis. A complete analysis of the HYSPLIT modeling and WEP analysis are presented in Section III.K.13.G (Modeling). In short, the modeling used facility emissions from the National Emissions Inventory (NEI) for 2014 and 2017 and ranked facilities by their potential contributions to the WEP SO_4. The benefit of using two emission inventory years is that it provides ranges of emissions and an opportunity to identify changes in point source emissions that can be used in sector projections. Alaska used these rankings to determine the sources that are most likely contributing to visibility impairment. Alaska is already very close to natural visibility in the Class I areas; more information on current monitoring data can be found in Section III.K.13.D and for the long-term strategy in Section III.K.13.I. By focusing on sources that are likely to have the highest impact on Class I areas, any control measures implemented would theoretically result in the most reductions of impairment.

The analysis focuses on the IMPROVE MID from 2014 to 2018 at the IMPROVE sites representing Class I areas in the state, with exception of those at Tuxedni Class I area. TUXE1 site stopped operating in 2014 so the MID from 2012 to 2014 were used instead of the 2014-2018 period. The KPBO1 IMPROVE monitor started operating in 2016 and was not included in the analysis of MID as no impairment metric data is available for the site. Instead, the WEP analysis was performed for the top 20% measured visibility extinction days (Top 20%) at TUXE1 and KPBO1 for the 3 most recent years of available data (2012 to 2014 and 2016 to 2018, respectively. Table III.K.13.F-4 identifies the years of the analysis period and the analyzed metric for each IMPROVE site.

[2] Regional Haze Four-factor Analysis Screening tool developed by Ramboll. http://views.cira.colostate.edu/data/tss/ramboll/WRAP_Q_Over_D_Analyses/WRAP_Threshold_Analysis.xlsm

Table III.K.13.F-4. Alaska Class I Areas and IMPROVE monitoring sites included in the Area of Influence and Weighted Emissions Potential analysis

Class I Area	IMPROVE Site	Analysis Period	Analyzed Metric
Denali National Park and Preserve	DENA1	2014 - 2018	MID
	TRCR1	2014 - 2018	MID
Simeonof Wilderness Area	SIME1	2014 - 2018	MID
Tuxedni National Wildlife Refuge	TUXE1	2012 – 2014	MID, Top 20%
	KPBO1	2016 – 2018	Top 20%

c. Step One Methods Used for Initial Source Selection

Step 1a: Identify areas of high WEP

For each Class I area, images of the WEP generated from all analysed altitudes (i.e., 100 m, 200 m, 500 m, and 1,000 m) are examined, and the areas with SO_x WEP values of 5 percent (%) or more are identified. The highest WEP percentage does not point to a specific facility but rather an area where a variety of sources may potentially influence a Class I area. This occurs in Cook Inlet and in the FNSB. For any facility within the WEP area of 5% or greater, its location is confirmed using the corresponding DEC issued permits, and it then gets included in the selected sources.

Step 1b: Point Source Facility Selection

DEC ranked source facilities by WEP SO_4 values. Generally, there is a sharp decline in WEP values that separate major contributing sources from the rest. Table III.K.13.F-5 demonstrates this situation for the Denali Class I area where the steep decline from the WEP SO_4 rankings from approximately 4000 to less than a 1000 that could be used as a logical cutoff point for facility consideration. Only the highest emitting facilities above this cutoff are selected given that they are also located within the 5% WEP area described in Step 1a. It is possible that the WEP areas (Step 1a) do not match with any of the highest emitting facilities and in that case, additional facilities can be considered.

An additional step is used to identify facilities with extensive emission changes that may warrant further consideration related to their potential impacts. These can be seen when a facility appears in 2014 and is no longer listed in 2017. A review of permits issued by DEC is used to see if there are substantial changes at that facility. An example of this is Clear Air Force Station (Clear AFS). The point source emissions in 2014 included use of coal in their electrical generation units. By 2017, they had contracted to purchase electricity, and their emissions had been drastically reduced. In all cases, 2017 inventories are considered closer to potential future emissions.

Table III.K.13.F-5. Ranked point facilities by WEP SO_4 at DENA1

	2014 Point Source Facilities	SO_2 emissions (Q, tpy)	Q/D (tpy/km)	EWRTxQ_SO4	WEP SO_4
1	Healy Power Plant	444.94	31.69	13,644,281	971,737
2	Clear Air Force Station	213.21	3.34	3,275,622	51,286
3	Chena Power Plant	655.00	4.75	2,171,173	15,784
4	Fort Wainwright (EGU)	654.74	4.76	2,172,035	15,753
5	Eielson Air Force Base	268.05	1.93	1,002,245	7,203
6	UAF Campus Power Plant	201.99	1.48	669,816	4,896
7	GVEA North Pole Power Plant	148.37	1.09	554,759	4,063
8	TAPS PS #07	25.77	0.14	1212	175
	2017 Point Source Facilities	**SO_2 emissions (Q, tpy)**	**Q/D (tpy/km)**	**EWRTxQ_SO4**	**WEP SO_4**
1	Healy Power Plant	296.40	21.11	9,089,280	647,333
2	Chena Power Plant	627.60	4.55	2,081,175	15,094
3	Fort Wainwright UGU	460.04	3.34	1,525,532	11,090
4	Eielson Air Force Base	262.81	1.89	982,647	7,062
5	GVEA North Pole Power Plant	247.24	1.81	924,430	6,770
6	UAF Campus Power Plant	163.81	1.20	543,224	3,971
7	GVEA Zehnder Facility	29.56	0.21	98,019	706

Step 1c: Nonpoint Facility Selection

The ranked source lists include permitted facilities that were reported to EPA in the nonpoint category. If they are close to a Class I area, the contribution can still be significant. For example, the Trident Seafoods Sand Point facility emitted 0.089 tons of SO_2 in 2017 but because of its proximity to the SIME1 IMPROVE monitor, it has the highest WEP SO_4 in the ranked facility list (Table III.K.13.F-6). The second highest was the Steelhead Platform, which emitted approximately 44.7 tons of SO_2 in 2017. The Steelhead Platform's WEP SO_4 was significantly lower because of its distance from the Class I area. As such, the Sand Point Facility and Steelhead Platform are advanced to the second step of DEC's source selection criteria.

In most cases, sources can be identified in the areas with SO_x WEP of 5% or more. In some cases, no single point, nonpoint, nonroad, or mobile source can be identified. For example, east of the KPB01 IMPROVE monitor and in Western Anchorage and north of Anchorage, there are three locations identified with a WEP of 5% or greater. In this specific example, the point sources located in the WEP area that may be contributors are low on the ranking of individual source WEP (see Step 1b) so there could be multiple contributing sources.

DEC looked at the permit locations with relation to the WEP area to resolve some of these questions. In some cases, DEC determined that the emissions are from nonroad and area sources such as airstrips, railroad, and marine port facilities which will be addressed on a sector basis. For SIME1 in particular, the number of sources available for Q/d and WEP analysis are limited to sources like Trident Seafood with a small emissions profile.

Table III.K.13.F-6. SIME1 2017 Point Facilities With Highest WEP

	Facility Name	SO_2 emissions (Q, tpy)	Q/D (tpy/km)	EWRTxQ_SO4	WEP SO_4
1	Trident Seafoods; Sand Point Facility	0.089	0.073	7,350.4	6,048
2	Hilcorp - Steelhead Platform	44.7	0.055	54,302.0	67.3

Step 1d: Compiling the Source list Selection

A master list was compiled after applying Steps 1a – 1c and includes those sources that appear at more than one IMPROVE monitor. For facilities that appear at more than one IMPROVE monitor it is assumed that emission controls could result in improved visibility at more than one Class I area.

Sources that have a high WEP value in 2017 that do not appear in >5% WEP selection criteria are included. The master list of sources that are advanced to Step Two are found in Table III.K.13.F-7.

d. Step One Preliminary Source Selection Results

Table III.K.13.F-7 identifies the sources identified in the Step One WEP analysis that are advanced to the Step Two Q/d analysis for final selection. The criteria used for each source selection is also noted as well as where the location of the final review for the source is located between this chapter for sources that were selected after Step Two and the appendix of this chapter for sources that were not advanced beyond Step Two. For point sources selected because of their ranking on the WEP SO_4 (either based on 2014 or 2017 emissions or both) the criteria are shown as 'Rank point YEAR'. For source sectors selected because they are within the 5% WEP area for the MID, the criteria are listed as 'MID WEP' (or 'Top 20% WEP for KPBO1).

Table III.K.13.F-7. Preliminary Facility Selection From Step One

	Sector	Facility	Denali		Simeonof	Tuxedni		Review Section Location
			DENA1	TRCR1	SIME1	KPB01	TUXE	
1	Power Plant	GVEA North Pole Power Plant	Rank point 2014/2017					III.K.13.F 3a

2	Power Plant	Healy Power Plant*	Rank point 2014/2017	Rank point 2014/2017				III.K.13.F 3b
3	Power Plant	Chena Power Plant	Rank point 2014/2017					III.K.13.F 3c
4	Nat. Security	Eielson Air Force Base	Rank point 2014/2017					III.K.13.F 3d
5	Power Plant	Fort Wainwright EGU	Rank point 2014/2017					III.K.13.F 3e
6	Power Plant	UAF Power Plant	Rank point 2014/2017					III.K.13.F 3f
7	Nat. Security	Clear Air Force Base	Rank point 2014					III.K.13.F Appendix 2a
8	Manufact./ Seafood Process.	Trident Seafoods - Sand Point Facility			Rank point 2014/2017		Rank point 2014 (MID)	III.K.13.F Appendix 2b
9	Oil & Gas	Christy Lee/Drift River					Rank point 2014/2017 (MID)	III.K.13.F Appendix 2c
10	Power Plant	Bernice Lake Combustion Plant		Rank point 2014		Rank point 2014 (Top 20%)		III.K.13.F Appendix 2d
11	Power Plant	JBER-Electric, Gas, Drinking Water & Sanitary Services						III.K.13.F Appendix 2e
12	Power Plant	Matanuska Electric - Eklutna EGU						III.K.13.F Appendix 2f
13	Oil & Gas	Platform A		Rank point 2014		Rank point 2014 (Top 20%)		III.K.13.F Appendix 2g
14	Oil & Gas	Monopod Platform		Rank point 2014		Rank point 2014 (Top 20%)	Rank Point 2014 (MID, Top 20%)	III.K.13.F Appendix 2h

15	Oil & Gas	Grayling Platform		Rank point 2014		Rank point 2014 (Top 20%)	Rank Point 2014 (MID, Top 20%)	III.K.13.F Appendix 2i
16	Oil & Gas	Dolly Varden Platform		Rank point 2014/2017		Rank point 2014 (Top 20%)	Rank point 2014/2017(MID, Top 20%)	III.K.13.F Appendix 2j
17	Oil & Gas	King Salmon		Rank point 2014		Rank point 2014 (Top 20%)	Rank Point 2014 (MID, Top 20%)	III.K.13.F Appendix 2k
18	Oil & Gas	Steelhead		Rank point 2017			Rank Point 2017 (MID, Top 20%)	III.K.13.F Appendix 2l
19	Oil & Gas	BlueCrest Cosmopolitan				Rank point 2017 (Top 20%)		III.K.13.F Appendix 2m
20	Transport,	Ted Stevens International (ORL)		MID WEP		Top 20% WEP	Top 20% WEP	III.K.13.F Appendix 3a
	Transport	Ted Stevens International (Aviation Non-Point)		MID WEP		Top 20% WEP	Top 20% WEP	III.K.13.F Appendix 4h
21	Transport	Port of Anchorage (ORL)		MID WEP				III.K.13.F Appendix 3b
	Transport	Port of Anchorage (Marine Sector)		MID WEP				III.K.13.F Appendix 4a
22	Transport	Port McKenzie		MID WEP				III.K.13.F Appendix 4g
23	Transport	Trapper Creek Aviation		MID WEP				III.K.13.F Appendix 4i
24	Transport	Homer Aviation, Port		MID WEP		Top 20% WEP		III.K.13.F Appendix 4j, 4k, & 4l
25	Transport	Ninilchik		MID WEP		Top 20% WEP	Top 20% WEP	III.K.13.F Appendix 4m

26	Transport	Alaska Railroad		MID WEP				III.K.13.F Appendix 4c & 4n

e. Step Two Methods Used for Final Source Selection

After initial review of the 26 point and area sources identified in Step One, DEC determined that the list of point sources included numerous facilities with low actual SO_2 emissions that could not meaningfully be lowered any further. This included sources such as Trident Seafoods Sand Point Facility and Clear Air Force Base with SO_2 emissions below 0.1 tpy as well as multiple sources combusting ULSD, pipeline quality natural gas, and/or low sulfur fuel gas in the Cook Inlet area that had over-reported their actual SO_2 emissions in the 2014 NEI. Therefore, DEC included a second step (Step Two) to ensure that only the sources who are potentially contributing to haze in Class I areas and have a potential to reduce their actual SO_2 emissions would be evaluated.

For Step Two DEC used a Q/d approach as outlined in Footnote 25 and Section II.B.3.b of the August 20, 2019, Guidance on Regional Haze document (Guidance Document). The Guidance Document outlines that instead of quantifying and considering visibility impacts for the purpose of selecting sources, a state may also develop a reasonable surrogate metric for such impacts (e.g., the emissions/distance relationship). This approach involves a stationary source's actual emissions in tons per year (Q) divided by the distance to the nearest Class 1 area in kilometers (d). As was previously stated, the NEI for 2014 involved multiple sources over-reporting their actual SO_2 emissions and is more outdated than 2017 (e.g., Clear Air Force Base has since retired their coal-fired boilers). Therefore, DEC chose to use the SO_2 values reported in the 2017 NEI in the Step Two Q/d analysis as that is more representative of current and future emissions.

For Step Two, DEC chose an SO_2 Q/d threshold of 1.0 for stationary sources. As a result, all stationary sources with 2017 NEI reported SO_2 emissions values divided by distance to the nearest Class 1 area of 1.0 and above made is past this step to final evaluation. The Guidance Document states on page 13 that when using a Q/d surrogate for visibility impacts a "reasonably selected threshold for this metric" shall be used. The Guidance Document also goes on to state that, "since primary PM and PM precursors may have very different visibility impacts per ton of emissions, it may be best to evaluate Q/d metrics on an individual pollutant basis. Additionally, since the magnitude of Q/d may vary considerably when total emissions are considered versus emissions of individual primary PM and precursor pollutants, appropriate pollutant-specific Q/d thresholds for primary PM and each precursor may need to be considered as part of the analysis.

DEC has chosen an SO_2 Q/d of 1.0 and above as a reasonable surrogate threshold metric. The Guidance Document did not specify a minimum value to use for Q/d source selection and DEC notes that an SO_2 Q/d value of 1.0 should be considered conservative enough to capture all sources with SO_2 emissions that could meaningfully impact visibility in Class 1 areas. DEC notes that the Q/d threshold of 1.0 for SO_2 emissions is more conservative than the threshold of 10.0 for combined PM and precursor pollutants used in the Federal Land Managers' Air Quality Related Values Work Group (FLAG) 2010 Guidance Document for Prevention of Significant Deterioration permitting.

f. Final Source Selection

After completing the two-step source selection process for stationary sources in Alaska, DEC has identified the following list of six sources that warrant evaluation as can be seen below in Table III.K.13.F-8.

Table III.K.13.F-8. Final Facility Selection for Review

Facility	Nearest Monitor	Distance to Monitor – d (km)	Quantity of SO_2 Emissions – Q (tpy)	Q/d SO_2	Section Number
North Pole Power Plant	Denali N.P.	122	247.2	2.0	3a
Healy Power Plant	Denali N.P.	6	296.4	49.4	3b
Chena Power Plant	Denali N.P.	119	627.6	5.3	3c
Eielson Air Force Base	Denali N.P.	133	262.8	2.0	3d
Fort Wainwright	Denali N.P.	119	460.0	3.9	3e
Fairbanks Campus Power Plant	Denali N.P.	117	163.8	1.4	3f

DEC notes that the second step in the source selection process resulted in only selecting stationary sources that have impacts on Denali National Park. This was a result of the largest emitting stationary source near the Tuxedni National Wildlife Refuge (Hilcorp's Steelhead Platform) only having SO_2 emissions of 44.7 tons in 2017. Additionally, the largest emitting source near the Simeonof Wilderness Area (Trident Seafoods Akutan Seafood Processing Facility) only emitted 2.8 tons of SO_2 in 2017. DEC will continue to monitor emissions from stationary sources in Alaska which may result in additional sources nearer to Tuxedni National Wildlife Refuge or Simeonof Wilderness Area warranting full four-factor analyses in future rounds of RH. See Section III.K.13.H Long-Term Strategy for the approach identified for monitoring new sources or major changes in existing sources for addressing possible future impacts.

3. Four-Factor Analysis

a. Golden Valley Electric Association, North Pole Power Plant

i. Introduction

The NPPP is an electric generating facility owned and operated by GVEA that currently operates under Title V Operating Permit AQ0110TVP04 Rev. 1. The standard industrial classification (SIC) code for this stationary source is 4911 - Electric Services. The power plant contains two fuel oil-fired simple cycle gas combustion turbines, two fuel oil-fired combined cycle gas combustion turbines, one fuel oil-fired emergency generator, and two propane fired boilers. These EUs are listed below in Table III.K.13.F-9. The stationary source also owns insignificant EUs that include several gas-fired heaters.

Table III.K.13.F-9. Golden Valley Electric Association, North Pole Power Plant Emissions Units

EU ID	Emissions Unit Name	Emissions Unit Description	Fuel	Rating/Size	Installation or Construction Date
1	GT#1	GE Frame 7, Series 7001 Regenerative Gas Turbine	Fuel Oil	672 MMBtu/hr (60.5 MW)	1976
2	GT#2	GE Frame 7, Series 7001 Regenerative Gas Turbine	Fuel Oil	672 MMBtu/hr (60.5 MW)	1977
5	GT#3	GE LM6000PC Gas Turbine (water injection for NO_x control) (oxidation catalyst for CO control)	Naphtha/LSR Jet A	455 MMBtu/hr (43 MW, nominal)	2005
6	GT#4	GE LM6000PC Gas Turbine (water injection for NO_x control) (oxidation catalyst for CO control)	Naphtha/LSR Jet A	455 MMBtu/hr (43 MW, nominal)	Not Installed[1]
7	Emergency Generator	Mitsubishi Engine #0A8829 (Generac Gen Set #5231150100)	Fuel Oil	565 hp	2005
11	Building Boiler	Bryan Steam RV500 Boiler	Propane	5.0 MMBtu/hr	2005
12	Building Boiler	Bryan Steam RV500 Boiler	Propane	5.0 MMBtu/hr	2005

Table Notes: [1] Estimated installation is 2024.

The NPPP recently went through an emissions control analysis as a part of the planning requirements triggered when the FNSB nonattainment area was designated as "Serious" with respect to nonattainment of the 2006 24-hour $PM_{2.5}$ National Ambient Air Quality Standards (NAAQS), which was published in Federal Register Vol. 82, No. 89, May 10, 2017, pages 21703-21706. CAA section 189(b)(1)(B) and 40 C.F.R. § 51.1010 describe the Serious area attainment plan requirements for best available control measures (BACM). Large stationary sources are a subgroup of emissions sources that are given special attention in the required BACM analysis (large stationary sources are subject to best available control technologies or

BACT analyses). Per federal requirement, DEC evaluated all point sources with emissions greater than 70 TPY of $PM_{2.5}$ or for any individual $PM_{2.5}$ precursor (NO_x, SO_2, NH_3, VOCs).

This evaluation resulted in the following emissions controls contained in Table III.K.13.F-10, which are those required in Table 7.7-15 of the Amendments to: State Air Quality Control Plan Vol II: III.D.7.7 Control Strategies document; adopted November 19, 2019.[3]

Table III.K.13.F-10. Summary of BACT

Pollutant	BACT Emission Limit	BACT Control Device or Operational Limitation	Effective Dates of Control/Limit
EUs 1 and 2 Fuel Oil-Fired Simple Cycle Gas Turbines - 672 MMBtu/hr (each)			
NO_x	Precursor Demonstration*	No additional control	N/A
PM2.5	0.012 lb/MMBtu (3-hr avg.)	Low Ash Fuel, Limited Operation, and Good Combustion Practices	Existing
SO2	1,000 ppmw sulfur deliveries fuel on curtailment days	Certified Statement or Approved Analysis of Sulfur Content	Title I Permit App. by June 9, 2020 Effective no later than October 1, 2020
	15 ppmw sulfur in fuel October 1 – March 31 (natural gas optional)	Certified Statement or Approved Analysis of Sulfur Content	Title I Permit App. by June 9, 2022 Effective no later than October 1, 2023
EUs 5 and 6 - Combined Cycle Gas Turbines - 455 MMBtu/hr (each)			
NO_x	Precursor Demonstration*	No additional control	N/A
PM2.5	0.012 lb/MMBtu (3-hr avg.)	Low Ash Fuel, Limited Operation, and Good Combustion Practices	Existing
SO2	50 ppmw sulfur in fuel (except during startup) (natural gas optional)	Certified Statement of Sulfur Content	Title I Permit App. by June 9, 2020 Effective no later than June 9, 2021
EU 7 - Diesel-Fired Emergency Generator - 400 kW			
NO_x	Precursor Demonstration*	No additional control	N/A
PM2.5	0.32 g/hp-hr (3-hr avg.)	Good Combustion Practices, Positive Crankcase Ventilation, and Limited Operation	Existing

[3] Background and detailed information regarding Fairbanks $PM_{2.5}$ State Implementation Plan (SIP) can be found at http://dec.alaska.gov/air/anpms/communities/fbks-pm2-5-serious-sip/.

Pollutant	BACT Emission Limit	BACT Control Device or Operational Limitation	Effective Dates of Control/Limit
SO2	0.05 weight percent sulfur in fuel	Certified Statement of Sulfur Content	Title I Permit App. by June 9, 2020 Effective no later than June 9, 2021
EUs 11 and 12 - Propane-Fired Boilers 5.0 MMBtu/hr (each)			
NO_x	Precursor Demonstration*	No additional control	N/A
PM2.5	0.008 lb/MMBtu (3-hr avg.)	Good Combustion Practices and Propane as Fuel	Existing
SO2	120 ppmv sulfur in fuel	Certified Statement of Sulfur Content	Existing

The previously mentioned analysis for the NPPP resulted in multiple SO_2 emissions limits. The requirement to combust fuel with a maximum sulfur content of 1,000 ppmw in EUs 1 and 2 on curtailment days has already gone into effect. Meanwhile, additional sulfur limiting requirements will go into effect on June 9, 2021, and October 1, 2023, such as requiring ULSD be combusted in EUs 1 and 2 from October 1 through March 31.

DEC compiled a list of SO_2 emissions at the stationary source using the EI submissions for years 2014-2019 which can be seen in Table III.K.13.F-11. As can be seen in Table III.K.13.F.11, EUs 1, 2, and 5 are the only EUs with sizeable SO_2 emissions over the past 6 years. Additionally, as can be seen in Table III.K.13.F-10 above, emergency diesel generator EU 7 has a new requirement to burn fuel with a maximum of 0.05 weight percent sulfur, and boiler EUs 11 and 12 are already required to burn propane, which is an inherently low sulfur fuel. Taking all of this into account, DEC has chosen to perform a four-factor analysis of the NPPP on EUs 1, 2, and 5. DEC has chosen to use the value from the highest actual emissions year, for each EU, for all cost analyses performed.

Table III.K.13.F-11. North Pole Power Plant SO_2 Emissions

Calendar Year	EU ID	SO_2 Emitted (tons) Emissions Inventory	SO_2 Emitted (tons) Emissions Inventory
2019	1	17.04	268.4
	2	251.03	
	5	0.32	
	7	0.00	
	11	0.00	
	12	0.00	
	1	19.8	
	2	189.84	

2018	5	5.58	215.2
	7	0.00	
	11	0.00	
	12	0.00	
2017	1	31.68	269.5
	2	228.87	
	5	8.89	
	7	0.00	
	11	0.00	
	12	0.00	
2016	1	37.87	239.8
	2	190.76	
	5	11.20	
	7	0.00	
	11	0.00	
	12	0.00	
2015	1	8.47	149.1
	2	131.74	
	5	8.84	
	7	0.00	
	11	0.00	
	12	0.00	
2014	1	5.64	148.4
	2	138.15	
	5	4.58	
	7	0.00	
	11	0.00	
	12	0.00	

ii. SO2 Four-Factor Analysis

Section 169A(g)(1) of the CAA lists four factors that must be taken into consideration in determining reasonable progress and states are required to consider those four factors (i.e., cost of compliance, time necessary for compliance, energy and non-air environmental impacts, and remaining useful life of the source) in the control analysis step.

1. Cost of Compliance for the Fuel Oil-Fired Simple Cycle Gas Turbines (EUs 1 and 2)

The cost of compliance estimates the values of capital costs, annual operating and maintenance costs, annualized costs, and cost per ton of emission reductions that have been prepared according to EPA's Air Pollution Control Cost Manual. Costs are expressed in terms of cost effectiveness in the standardized unit of dollars per ton of actual SO_2 emissions reduced. DEC used information from the BACT analyses completed for the Fairbanks Serious SIP for SO_2 to complete the cost of compliance analyses. This information included previous BACT determinations found in the RACT, BACT, & LAER Clearinghouse (RBLC) database; internet research; and BACT analyses submitted to DEC by GVEA for the NPPP and Zehnder Facility.

The RBLC was searched for all determinations in the last 10 years under the process code 15.190 for simple cycle gas turbines (rated at 25 MW or more) The search results for simple cycle gas turbines are summarized in Table III.K.13.F-12.

Table III.K.13.F-12. RBLC Summary of SO_2 Controls for Fuel Oil-Fired Simple Cycle Gas Turbines

Control Technology	Number of Determinations	Emission Limits	
Ultra-Low Sulfur Diesel	7	0.0015	% S by wt.
Fuel Oil (0.1 % S by wt. or less)	2	0.0026 – 0.055	lb/MMBtu
Good Combustion Practices	3	0.6	lb/hr

a. RBLC Review

A review of similar units in the RBLC indicates that limiting the sulfur content of fuel and good combustion practices are the principle SO_2 control technologies determined as BACT for fuel oil-fired simple cycle gas turbines. The lowest SO_2 emission rate listed in the RBLC is combustion of ULSD at 0.0015 percent sulfur by weight (% S by wt.).

i. Identification of SO2 Control Technology for the Simple Cycle Gas Turbines

From research, DEC identified the following technologies as available for control of SO_2 emissions from fuel oil-fired simple cycle gas turbines rated at 25 MW or greater:

1. Ultra Low Sulfur Diesel (ULSD)

ULSD has a fuel sulfur content of 0.0015 % S by wt. or less. Using ULSD would reduce SO_2 emissions because the fuel oil-fired simple cycle gas turbines are mostly combusting No. 2 fuel oil that has a sulfur content averaging around 0.35 % S by wt. for half of the year (April 1 through September 31). Switching to ULSD for the other half of the year would result in around a 99.5 percent decrease in SO_2 emissions from the fuel oil-fired simple cycle gas turbines. DEC considers ULSD a technically feasible control technology for the fuel oil-fired simple cycle gas turbines.

2. No. 1 Fuel Oil (maximum sulfur content of 0.1 % S by wt.)

No. 1 fuel oil has a sulfur content of 0.1 % S by wt. (1,000 ppmw) or less. Using fuel with a sulfur content of 0.1 % S by wt. would reduce SO_2 emissions because the fuel oil-fired simple cycle gas turbines are mostly combusting No. 2 fuel oil that has a sulfur content of around 0.35 % S by wt. for half of the year (April 1 through September 31). Switching to No. 1 fuel oil would result in an approximate 67.5 percent decrease in SO_2 emissions from the fuel oil-fired simple cycle gas turbines. DEC considers low sulfur diesel a technically feasible control technology for the fuel oil-fired simple cycle gas turbines.

b. Eliminate Technically Infeasible SO_2 Technologies for the Simple Cycle Gas Turbines

All control technologies identified are technically feasible for the fuel oil-fired simple cycle gas turbines.

c. Rank point the Remaining SO_2 Control Technologies for the Simple Cycle Gas Turbines

The following control technologies have been identified and ranked for control of SO_2 from the fuel oil-fired simple cycle gas turbines (Table III.K.13.F-13):

Table III.K.13.F-13. Control Technologies

Control Technology	Control Level
Ultra Low Sulfur Diesel	99.5% Control
No. 1 Fuel Oil	67.5% Control

Table Note: Control technologies already required at the stationary source, including burning ULSD for half the year and practicing good combustion practices, or those included in the design of the EU are considered 0% control for the purposes of this four-factor analysis.

d. Evaluate the Most Effective Controls

GVEA provided an economic analysis for the Serious SIP BACT exercise for switching the fuel combusted in the simple cycle gas turbines to ULSD. DEC used this cost analysis and an update provided by GVEA for the cost per gallon of ULSD, No. 1, and No. 2 fuel oils delivered to the NPPP between January 2019 and October 2020 to perform our cost analyses.

i. Department Evaluation of BACT for SO_2 Emissions from the Simple Cycle Gas Turbines

DEC's cost analyses calculated a cost per ton of SO_2 emissions removed resulting from a switch to ULSD. There is no capital cost involved with this fuel switch for EUs 1 and 2. Therefore, the only value driving cost for the evaluation was the yearly cost difference in fuel prices between No. 2 fuel oil compared to ULSD and No. 1 fuel oil. From January 2019 through October 2020, the average price per gallon of ULSD delivered to the NPPP was \$1.918. This is \$0.250 more per gallon than the cost of No. 2 fuel oil at 1.668. Note that during this same time period, the average price per gallon for No. 1 fuel oil was \$1.618, which is \$0.05 cheaper than No. 2 fuel oil. EUs 1 and 2 are already required to switch to ULSD (SO_2 BACT) for half of the year (October through

March). Therefore, the RH cost calculations used half of the total fuel used during the highest SO_2 emitting year as well as half of the total SO_2 emissions for that year.

A summary of these analyses is shown in Table III.K.13.F-14 and Table III.K.13.F-15.

Table III.K.13.F-14. Department Economic Analysis for Technically Feasible SO_2 Controls for EU 1

Control Alternative	2016 SO_2 Emissions (tons)	Emission Reduction (tpy)	Total Capital Investment ($)	Total Annualized Costs ($/year)	Cost Effectiveness ($/ton)
ULSD	18.94	18.85	N/A	$206,296	$10,946
No. 1 Fuel Oil	18.94	12.90	N/A	N/A	N/A
Capital Recovery Factor = 0.0 (There is no capital investment involved with this cost calculation)					

Table III.K.13.F-15. Department Economic Analysis for Technically Feasible SO_2 Controls for EU 2

Control Alternative	2019 SO_2 Emissions (tons)	Emission Reduction (tpy)	Total Capital Investment ($)	Total Annualized Costs ($/year)	Cost Effectiveness ($/ton)
ULSD	125.34	124.72	N/A	$1,420,905	11,393
No. 1 Fuel Oil	125.34	83.78	N/A	N/A	N/A
Capital Recovery Factor = 0.0 (There is no capital investment involved with this cost calculation)					

DEC's cost of compliance economic analysis indicates the level of SO_2 reduction does not justify the use of ULSD for the fuel oil-fired simple cycle gas turbines at the NPPP ($11,393/ton). No. 1 fuel oil (maximum sulfur content of 0.1 percent by weight) costs approximately $0.05 per gallon less to purchase than No. 2 fuel oil from Petro Star, Inc.'s North Pole Refinery, and would result in approximately 13 less tons of SO_2 emissions from EU 1 in 2016 and 84 less tons of SO_2 emissions from EU 2 in 2019; for the highest emitting years reviewed for the respective turbines. No. 1 fuel oil contains a slightly lower fuel heat content of 133.4 MMBtu/kgal compared to No. 2 fuel oil at 138.3 MMBtu/kgal as reported by GVEA in the 2019 NEI.[4] However, the 3.5% reduction in fuel heat content in No. 1 fuel oil compared to No. 2 fuel oil is offset by the 3.1% reduction in price.

Therefore, DEC finds it cost effective for the NPPP to switch to combusting No. 1 fuel oil in EUs 1 and 2. This finding is predicated on the assumption that GVEA will be able to purchase No. 1 fuel oil from the Petro Star North Pole Refinery. If the North Pole Refinery is not able to

[4] National Emissions Inventory (NEI) | Air Emissions Inventories | US EPA

supply GVEA with No. 1 fuel oil due to shortages in supply, the NPPP may continue to burn No. 2 fuel oil in EUs 1 and 2 until such time as No. 1 fuel oil is again available.

e. Selection of SO_2 Controls for the Simple Cycle Gas Turbines

DEC's finding is that the control selected for this RH evaluation for SO_2 emissions from the fuel oil-fired simple cycle gas turbines is as follows:

SO_2 emissions from EUs 1 and 2 shall be controlled by limiting the sulfur content of fuel combusted in the turbines to no more than 0.1 percent by weight (1,000 ppmw, No. 1 fuel oil).[5]

Compliance with the proposed fuel sulfur content limit will be demonstrated with fuel shipment receipts and/or fuel test results for sulfur content.

2. Cost of Compliance for the Fuel Oil-Fired Combined Cycle Gas Turbine (EU 5)

The cost of compliance estimates the values of capital costs, annual operating and maintenance costs, annualized costs, and cost per ton of emission reductions that have been prepared according to EPA's Air Pollution Control Cost Manual. Costs are expressed in terms of cost effectiveness in the standardized unit of dollars per ton of actual SO_2 emissions reduced. DEC used information from the BACT analyses completed for the Fairbanks Serious SIP for SO_2 to complete the cost of compliance analyses. This information included previous BACT determinations found in the RBLC database, internet research, and BACT analyses submitted to DEC by GVEA for the NPPP and Zehnder Facility.

The RBLC was searched for all determinations in the last 10 years under the process code 15.290 for combined cycle gas turbines (rated at 25 MW or more) The search results for combined cycle gas turbines are summarized in Table III.K.13.F-16.

Table III.K.13.F-16. RBLC Summary of SO_2 Controls for Fuel Oil-Fired Combined Cycle Gas Turbines

Control Technology	Number of Determinations	Emission Limits	
Ultra-Low Sulfur Diesel	1	0.0015	% S by wt.

a. RBLC Review

A review of similar units in the RBLC indicates that limiting the sulfur content of fuel is the principle SO_2 control technologies determined as BACT for fuel oil-fired combined cycle gas turbines. The lone SO_2 limit listed in the RBLC is for combustion of ULSD.

[5] In the event that the North Pole Refinery is not able to supply GVEA with No. 1 fuel oil due to shortages in supply, the North Pole Power Plant may continue to burn No. 2 fuel oil in EUs 1 and 2 until such time as No. 1 fuel oil is again available.

i. Identification of SO_2 Control Technology for the Fuel Oil-fired Combined Cycle Gas Turbines

From research, DEC identified the following technologies as available for control of SO_2 emissions from fuel oil-fired combined cycle gas turbines rated at 25 MW or greater:

1. Ultra Low Sulfur Diesel (ULSD)

The methods by which combusting ULSD reduces sulfur emissions was discussed in detail in Section 1.a.ii.1.a.ii - Identification of SO_2 Control Technology for the fuel oil-fired simple cycle turbines, and will not be repeated here. DEC considers ULSD a technically feasible control technology for the fuel oil-fired combined cycle gas turbines

2. Light Straight Run Turbine Fuel (LSR)

EU 5 typically combusts LSR when not in startup. The sulfur content of the LSR is limited to no more than 50 ppmv as required by Condition 5.1 of Minor Permit AQ0110MSS01. DEC considers operating LSR a technically feasible control technology for the fuel oil-fired combined cycle gas turbines.

b. Eliminate Technically Infeasible SO_2 Technologies for the Combined Cycle Gas Turbines

All control technologies identified are technically feasible for the fuel oil-fired combined cycle gas turbines.

c. Rank point the Remaining SO_2 Control Technologies for the Combined Cycle Gas Turbines

The following control technology has been identified and ranked for control of SO_2 from the fuel oil-fired combined cycle gas turbines (Table III.K.13.F-17):

Table III.K.13.F-17. Control Technology

Control Technology	Control Level
Ultra Low Sulfur Diesel	77.2% Control

Table Note: Control technologies already required at the stationary source, including burning LSR except during startup and practicing good combustion practices, or those included in the design of the EU are considered 0% control for the purposes of this four-factor analysis.

d. Evaluate the Most Effective Controls

GVEA provided an economic analysis for the Serious SIP BACT exercise for switching the fuel combusted in the combined cycle gas turbine to ULSD. DEC used this cost analysis and an update provided by GVEA for the cost per gallon of No. 1 fuel oil, ULSD and LSR delivered to the NPPP between January 2019 and October 2020 to perform our cost analysis.

i. Department Evaluation of BACT for SO_2 Emissions from the Combined Cycle Gas Turbines

DECs cost analysis calculated a cost per ton of SO_2 emissions removed resulting from a switch to ULSD. There is no capital cost involved with this fuel switch for EU 5. Therefore, the only value driving cost for the evaluation was the yearly cost difference in fuel prices between LSR and No. 1 (used during start-up) compared to ULSD.

A summary of these analyses is shown in Table III.K.13.F-18.

Table III.K.13.F-18. Department Economic Analysis for Technically Feasible SO_2 Controls for EU 5

Control Alternative	2016 SO_2 Emissions (tons)	Emission Reduction (tpy)	Total Capital Investment ($)	Total Annualized Costs ($/year)	Cost Effectiveness ($/ton)
ULSD	10.75	8.30	N/A	$12,802,923	$1,542,463
Capital Recovery Factor = 0.0 (There is no capital investment involved with this cost calculation)					

DEC's cost of compliance economic analysis indicates the level of SO_2 reduction does not justify the use of ULSD for the fuel oil-fired combined cycle gas turbine at the NPPP ($1,542,463/ton). Therefore, there is no emission limit or control selected for EU 5 as a part of the RH economic analysis. DEC notes that this analysis was based on actual emissions and therefore only EU 5 was evaluated. However, the Permittee is authorized to install an identical fuel oil-fired combined cycle gas turbine (EU 6) under prior air quality permitting. Therefore, this evaluation for EU 5 is also considered an evaluation for EU 6 upon installation.

3. Time Necessary for Compliance

DEC chose to require GVEA to make a switch to fuel oil with a maximum sulfur content of 0.1 percent by weight (1,000 ppmw, No. 1 fuel oil) for EUs 1 and 2. GVEA shall submit a permit application by January 1, 2024, to make this fuel switch enforceable and the requirement to combust No. 1 fuel oil will be effective January 1, 2025.

4. Energy and Non-Air Quality Environmental Impacts

No. 1 fuel oil contains slightly less fuel heat content at 133.4 MMBtu/kgal compared to No. 2 fuel oil at 138.3 MMBtu/kgal as reported by GVEA in the 2019 NEIs. This results in approximately a 3.5% reduction in fuel heat content compared to No. 2 fuel oil. Therefore, the stationary source will have to combust slightly more fuel to make the same power output. However, this slight increase in fuel consumption will be offset by the approximately 68% reduction in SO_2 emissions resulting from combusting the lower sulfur fuel oil.

5. Remaining Useful Life of the Source

At this time, DEC anticipates the NPPP will be operating indefinitely. DEC continues to track changes at point sources through its Title I and Title V permitting programs and is considering whether to include requirements to maintain operating and maintenance schedules on site, that could be included in operating permit renewals. This would include maintaining an anticipated equipment replacement schedule and potentially dates for expected source retirement.

DEC Regional Haze Findings for GVEA's North Pole Power Plant
Finding: DEC finds that it is cost effective and feasible for GVEA to switch EUs 1 and 2 to fuel oil with a maximum sulfur content of 0.1 percent by weight (1,000 ppmw, No. 1 fuel oil). This finding is predicated on the assumption that GVEA will be able to purchase No. 1 fuel oil from the Petro Star North Pole Refinery. If the North Pole Refinery is not able to supply GVEA with No. 1 fuel oil due to shortages in supply, the NPPP may continue to burn No. 2 fuel oil in EUs 1 and 2 until such time as No. 1 fuel oil is again available.

On or before January 1, 2024, GVEA shall submit a Title I permit application to DEC that includes a RH requirement to limit the sulfur content of fuel combusted in EUs 1 and 2 to fuel oil with a maximum sulfur content of 0.1 percent by weight (1,000 ppmw, No. 1 fuel oil) to be effective no later than January 1, 2025. A summary of DEC's findings is as follows:

Table III.K.13.F-19. Final Determination for GVEA – North Pole Power Plant

Pollutant	Regional Haze Controls	Regional Haze Determination	Effective Dates of Control/Limit
EUs 1 and 2 – Fuel Oil-Fired Simple Cycle Gas Turbines - 672 MMBtu/hr (each)			
SO_2	Clean Fuel Switch to No. 1 fuel oil	Switch to fuel oil with a maximum sulfur content of 0.1 percent by weight (1,000 ppmw, No. 1 Fuel Oil)*	Submit permit application by January 1, 2024 Expect permit issuance by January 1, 2025
EUs 5 and 6 – Combined Cycle Gas Turbines - 455 MMBtu/hr (each)			
SO_2	Already Effectively Controlled (50 ppmw sulfur limit in fuel except during startup)	No Additional Control	N/A

* This finding is predicated on the assumption that GVEA will be able to purchase No. 1 fuel oil from the Petro Star North Pole Refinery. If the North Pole Refinery is not able to supply GVEA with No. 1 fuel oil due to shortages in supply, the NPPP may continue to burn No. 2 fuel oil in EUs 1 and 2 until such time as No. 1 fuel oil is again available.

b. Golden Valley Electric Association: Healy Power Plant

The Healy Power Plant is an electric generating facility owned and operated by GVEA, and GVEA is the Permittee for the stationary source's Title V Operating Permit AQ0173TVP03. The SIC code for this stationary source is 4911 – Electrical Power Generation. The primary power generating units include two coal-fired steam generators: the 25-MW Foster-Wheeler Unit No. 1 (EU 1) and the 54-MW TRW Integrated Entrained Combustion System (EU 2) formerly known as the Healy Clean Coal Project (HCCP). The stationary source also operates two Cleaver

Brooks standby building boilers (EUs 3 and 4), one standby diesel generator (EU 5), and a firewater pump engine (EU 13). These emissions units (EUs) are listed below in Table III.K.13.F-20.

Table III.K.13.F-20. Healy Power Plant Emission Unit Inventory

EU ID	Emissions Unit Name	Emissions Unit Description	Rating/Size	Construction Date
1	Unit No. 1	Foster-Wheeler Boiler, pulverized coal fired steam generator with a 12 module ICA baghouse, SN 78-266	327 MMBtu/hr	November 1967
2	Unit No. 2	TRW Integrated Entrained Combustion System, pulverized coal-fired steam generator with Joy activated recycle spray dryer absorber and Joy pulse jet fabric filter, SN 1	658 MMBtu/hr	1996
3	Auxiliary Boiler No. 1	Cleaver Brooks CB 189-300, Standby process and building boiler, SN L-39759, Diesel-fired	12.554 MMBtu/hr	1967
4	Auxiliary Boiler No. 2	Cleaver Brooks CB 100-800-15, Standby process and building boiler, SN OLO94777, Diesel-fired	23.0 MMBtu/hr	1996
5	Diesel Generator No. 1	Electro-Motive Diesel, EMD 20-645-E4, SN 67-B1-1152 (engine) Standby diesel generator, SN A-20-D (generator)	2.75 MW	1967
6	Crusher System	Crusher System2 SN 885247 (Secondary Crusher No. 1) SN 844034 (Secondary Crusher No. 2)	12,000 cfm	1996
73	Limestone Storage Silo	Limestone Storage Silo with baghouse	800 cfm	1996
8	Flyash Storage Silo	Flyash Storage Silo with baghouse	5,000 cfm	1996
9	Sodium Bicarbonate Handling System	Sodium bicarbonate handling system4	440 cfm	1998
10	Coal Handling System (dust collector #2)	Coal Handling System5	20,000 cfm	1996

EU ID	Emissions Unit Name	Emissions Unit Description	Rating/Size	Construction Date
13	Firewater Pump Engine	Caterpillar Diesel Model 3406B, Diesel-fired firewater pump engine; SN 6TB14931	264 hp	1997
Fugitive Emission Sources				
11	Haul Road	Haul Road (located on GVEA property) from Usibelli Coal Mine property line to coal pile	0.25 miles	1967
12	Coal Storage Pile	Open Coal Storage Piles	Up to 15-day coal supply, with both EU IDs 1 and 2 in operation	1967

For the second implementation period RH SIP update, DEC performed a limited review in place of a full four-factor analysis because the stationary source already has dry sorbent injection (DSI) emissions controls installed on EU 1 and has spray dry absorber (SDA) emissions controls installed on EU 2. Additionally, GVEA is under a Consent Decree (CD) with the EPA which requires GVEA to decide on or before December 31, 2022, to either install SCR (or an alternative NO_x control technology approved by EPA) on EU 1 or retire the boiler. The deadline to have SCR installed on EU 1 or have the EU retired is no later than December 31, 2024. DEC looked back over the previous six-year period (2014-2019) for which data is currently available to determine the source's SO_2 emissions. Table III.K.13.F-21 shows SO_2 emissions reported to DEC through the NEI for 2014 and 2016 through 2019 (the years that NEI information was available for the source) and used the emissions fee estimate for 2015.

Table III.K.13.F-21. Healy Power Plant SO_2 Emissions

Calendar Year	Coal-Fired Boilers SO_2 Emitted (tons)	Other EUs SO_2 Emitted (tons)	Total SO_2 Emitted (tons)
2019	318.09	0.00	318.09
2018	376.02	0.00	376.02
2017	296.40	0.00	296.40
2016	427.20	0.00	427.20
2015	689.00	0.00	689.00
2014	444.94	0.00	444.94

As can be seen from Table III.K.13.F-21, the SO_2 emissions emitted at the Healy Power Plant are from the two coal-fired boilers EUs 1 and 2, which DEC focused on. Condition 44 of Operating Permit AQ0173TVP03 limits EU 2 to a SO_2 emissions rate of not more than 0.10 lb/MMBtu, and Condition 44.1 requires EU 2 to use SDA when in operation. Condition 45 of Operating Permit AQ0173TVP03 limits EU 1 to a SO_2 emissions rate of not more than 0.30 lb/MMBtu, and Condition 45.1 requires EU 1 to use DSI when in operation. Section II.B.3.f. of the Guidance

Document discusses selecting sources that already have effective emission control technology in place. The Guidance Document states the following:

> "It may be reasonable for a state not to select an effectively controlled source. A source may already have effective controls in place as a result of a previous RH SIP or to meet another CAA requirement. In general, if post-combustion controls were selected and installed recently (see illustrative examples below) to meet a CAA requirement, there will be only a low likelihood of a significant technological advancement that could provide further reasonable emission reductions having been made in the intervening period. If a source owner has recently made a significant expenditure that has resulted in significant reductions of visibility impairing pollutants at an emissions unit, it may be reasonable for the state to assume that additional controls for that unit are unlikely to be reasonable for the upcoming implementation period. A state that does not select a source or sources for the following or any similar reasons should explain why the decision is consistent with the requirement to make reasonable progress, i.e., why it is reasonable to assume for the purposes of efficiency and prioritization that a full four-factor analysis would likely result in the conclusion that no further controls are necessary."

In addition, Section II.B.3.f. of the Guidance Document also goes on to state:

> "BART-eligible units that installed and began operating controls to meet BART emission limits for the first implementation period, on a pollutant-specific basis. Although the Regional Haze Rule anticipates the re-assessment of BART-eligible sources under the reasonable progress Rule provisions, if a source installed and is currently operating controls to meet BART emission limits, it may be unlikely that there will be further available reasonable controls for such sources. However, states may not categorically exclude all BART-eligible sources, or all sources that installed BART controls, as candidates for selection for analysis of control measures."

Section II.B.3.d. of the Guidance Document discusses the option to consider the four statutory factors when selecting sources and states the following:

> "EPA expects that, typically, states are more likely to select sources based on visibility impacts and not consider the four reasonable progress factors (i.e., cost of compliance, remaining useful life, time necessary for compliance, and energy and non-air quality environmental impacts) until after a source is selected. However, in some cases, a state may already have information on one or more of the four reasonable progress factors at the time of source selection. If so, the state may consider that information at the source-selection stage. In particular circumstances, that information may indicate that it is reasonable to exclude the source for evaluation of emission control measures because it is clear at this step that no additional control measures would be adopted for the source. The source-selection step is intended to add flexibility and discretion to the state planning process – ultimately, the state decides which sources to consider for reasonable progress."

DEC has chosen not to perform a full four-factor analysis on the Healy Power Plant because the two coal-fired boilers already have SO_2 emissions controls. Additionally, EU 1 may be retired in the near future and already went through a BART analysis during the first implementation period RH SIP that found additional SO_2 controls on the EU to be cost ineffective. In the case of EU 2, the coal-fired boiler has an emissions limit of 0.10 lb/MMBtu with SDA, which is half the emissions limit given in the Guidance Document's example of a coal-fired boiler electrical generating unit that is equipped with flue gas desulfurization (which includes DSI and SDA) that meets a 0.2 lb/MMBtu emission rate. Although EU 1 has a less stringent emissions limit of 0.30 lb/MMBtu, the boiler is equipped with DSI using sodium bicarbonate, which the EPA Air Pollution Control Cost Manual estimates can achieve control efficiencies of 50 to 70%.[6] The emissions data reported via the NEI from the continuous emissions monitoring system for EU 1 over the previous three-year period for which data is available (2017-2019) showed an average SO_2 emissions rate of 0.26 lb/MMBtu. Additionally, the CD requires GVEA to decide on or before December 31, 2022, to either install SCR (or an alternative control technology approved by EPA) on EU 1 or retire the boiler. As of September 30, 2021, GVEA has yet to decide on adding additional controls or retiring the EU.

The 2010 Regional Haze BART determination[7] for Healy EU 1 found that the incremental cost effectiveness for the addition of a spray dry absorber system was $29,813 per ton of SO_2 removed and for a wet scrubber system was $12,033 per ton of SO_2 removed. In line with the Guidance Document, DEC believes that there has been no significant cost reductions in the previous decade that would warrant re-evaluating the addition of these two types of controls for EU 1 as they would still be considered cost ineffective. However, the previous BART determination found that optimizing the already installed DSI system on EU 1 would cost $4,218 per ton of SO_2 removed. It is possible that a re-evaluation of DSI optimization for EU 1 could result in a cost effectiveness finding by DEC. Therefore, in the event that GVEA chooses not to retire EU 1, DEC will require that GVEA complete a full four-factor analysis for DSI optimization and submit the final four factor analysis to DEC by July 1, 2023. Alternatively, GVEA may establish an enforceable emission limit for SO_2 of 0.20 lb/MMBtu by submitting an application for a permit amendment by January 1, 2024. It would be expected that a permit would be issued by January 1, 2025, which would result in EU 1 being considered an effectively controlled EU per the Guidance Document.

Final Determination for GVEA Healy Power Plant

The conclusion of DEC's limited review for GVEA's Healy Power Plant is that EU 2 is effectively controlled, and the stationary source is in the process of deciding to retire the older coal-fired boiler EU 1 or add on SCR controls. EU 1 has the highest SO_2 emissions per MMBtu of energy consumed in all GVEA's emissions unit inventory, and the Healy Power Plant is their closest stationary source to a Class I area (Denali). Therefore, if GVEA decides to retire EU 1 this would result in a shift of electricity generation to other EUs owned by GVEA's fleet of emissions units, which would result in a net reduction of SO_2 emissions. If GVEA elects not to retire EU 1, there will be a reduction in NO_x emissions as SCR would be installed which should have a positive impact on visibility. Additionally, DEC will require GVEA to complete a full four-factor analysis for DSI optimization and submit the final four factor analysis to DEC by

[6] EPA Air Pollution Control Cost Manual Section 5 SO_2 and Acid Gas Controls Chapter 1.2.1.3: https://www.regulations.gov/document?D=EPA-HQ-OAR-2015-0341-0082.

[7] See the Appendix III.K.6 Best Available Retrofit Technology (BART) Documentation PDF on DEC's website: https://dec.alaska.gov/air/anpms/regional-haze/sip/.

July 1, 2023, or establish an enforceable emission limit for SO_2 of 0.20 lb/MMBtu by submitting an application for a permit amendment by January 1, 2024. It would be expected that a permit would be issued by January 1, 2025, which would result in EU 1 being considered effectively controlled EU per the Guidance Document. DEC will continue to monitor the status of GVEA's decision with respects to their CD with the EPA. A summary of DEC's RH findings are as follows:

Table III.K.13.F-22. Final Determination for GVEA – Healy Power Plant

Pollutant	Regional Haze Controls	Regional Haze Determination	Effective Dates of Control/Limit
EU 1 – Coal-Fired Boiler with DSI - 327 MMBtu/hr			
SO_2	Option 1 – Consent Decree	Retire EU 1 by December 31, 2024	Decision by December 31, 2022 Retirement effective no later than December 31, 2024
	Option 2 – Four Factor Analysis	Submit a four-factor analysis for DSI optimization to DEC	Submit Four-Factor Analysis by July 1, 2023
	Option 3 – Enforceable Limit	Establish enforceable emission limit of 0.20 lb/MMBtu	Submit permit application by January 1, 2024 Expect permit issuance by January 1, 2025
EU 2 – Coal-Fired Boiler with SDA - 658 MMBtu/hr			
SO_2	Already Effectively Controlled (0.10 lb/MMBtu emission rate with Spray Dry Absorber)	No Additional Controls	N/A

c. Aurora Energy, LLC: Chena Power Plant

The Chena Power Plant is an electric generating facility owned and operated by Aurora Energy, LLC (Aurora), and Aurora is the permittee for the stationary source's Title V Operating Permit AQ0315TVP04 Revision 1. The SIC code for this stationary source is 4911 - Electric Services. The Chena Power Plant is a co-generation power plant that is designed to supply the local power grid with up to 27.5 megawatts of electrical power and provide steam and hot water heat to commercial and residential customers in the city of Fairbanks. The power producing units consist of four coal-fired boilers. These EUs are listed below in Table III.K.13.F-23 and Table III.K.13.F-24.

Table III.K.13.F-23. Chena Power Plant Emission Unit Inventory

EU ID	Emissions Unit Name	Emissions Unit Description	Rating/Size	Installation or Construction Date
1	Coal Preparation Plant	Exhaust and Fugitive Emissions	75 tons/hour	1950[1]
2	Coal Stockpile	Fugitive Emissions	0.59 acre	1950[2]
3	Ash Vacuum Pump Exhaust	Ash System Baghouse Exhaust	24,187 tons/yr (of ash)	1997
4	Chena 1 Coal-Fired Boiler	Full Stream Baghouse Exhaust	76.8 MMBtu/hr	1952
5	Chena 2 Coal-Fired Boiler	Full Stream Baghouse Exhaust	76.8 MMBtu/hr	1952
6	Chena 3 Coal-Fired Boiler	Full Stream Baghouse Exhaust	76.8 MMBtu/hr	1954
7	Chena 5 Coal-Fired Boiler	Full Stream Baghouse Exhaust	254.7 MMBtu/hr	1970

Table Notes: [1] EU ID 1 was modified in 1990.
[2] EU ID 2 was modified in 2013.

Table III.K.13.F-24. Chena Power Plant Fugitive Emission Unit Inventory

EU ID	Emissions Unit Name	Emissions Unit Description	Rating/Size	Installation or Construction Date
8	Truck Bay Ash Loadout	Bottom of silo – Fugitive Emissions	N/A	1952
9	Paved Roadways	Fugitive Emissions	N/A	1950

The Chena Power Plant recently went through an emissions control analysis as a part of the designation of the FNSB nonattainment area as "Serious" with regard to nonattainment of the 2006 24-hour $PM_{2.5}$ NAAQS which was published in Federal Register Vol. 82, No. 89, May 10, 2017, pages 21703-21706. CAA section 189(b)(1)(B) and 40 C.F.R. § 51.1010 describe the Serious area attainment plan requirements for BACM/BACT. Large stationary sources are a subgroup of emissions sources that are given special attention in the required BACM/BACT analysis. Per federal requirement, DEC evaluated all point sources with emissions greater than 70 TPY of $PM_{2.5}$ or for any individual $PM_{2.5}$ precursor (NO_x, SO_2, NH_3, VOCs). This evaluation resulted in the following emissions controls contained in Table III.K.13.F-25, which are those required in Table 7.7-10 of the Amendments to: State Air Quality Control Plan Vol II: III.D.7.7 Control Strategies document; adopted November 19, 2019.[3]

Table III.K.13.F-25. BACT and SIP Findings Summary Table for Chena Power Plant

Pollutant	BACT Emission Limit	BACT Control Device or Operational Limitation	Effective Dates of Control/Limit
EUs 4 through 7 - Coal-Fired Boilers - 497 MMBtu/hr (combined)			
NO_x	Precursor Demonstration*	No additional control	N/A
SO_2	0.25% sulfur by weight	Certified Statement of Sulfur Content	Title I Permit App. by June 9, 2020 Effective no later than June 9, 2021
	0.301 lb/MMBtu (3-hr avg.)	No Additional Controls (periodic source testing)	Title I Permit App. by June 9, 2020 Effective no later than June 9, 2021

Section II.B.3.f. of the Guidance Document discusses selecting sources that have recently undergone emission control technology review. The Guidance Document states the following:

> "New, reconstructed, or modified emission units that went through Best Available Control Technology (BACT) review under the Prevention of Significant Deterioration (PSD) program or Lowest Achievable Emission Rate (LAER) review under the nonattainment new source review program for major sources and received a construction permit on or after July 31, 2013,46 on a pollutant-specific basis. The statutory considerations for selection of BACT and LAER are also similar to, if not more stringent than, the four statutory factors for reasonable progress."

DEC Regional Haze Findings for Chena Power Plant

DEC's recent analysis of the Chena Power Plant for the Serious nonattainment area resulted in a limit on the sulfur content of the coal received at the stationary source as well as an SO_2 limit on the coal-fired boilers themselves. Taking into consideration the BACT analysis recently performed for the nonattainment area and the sulfur limits already imposed by this effort, DEC will not further evaluate the Chena Power Plant for the second implementation period of RH planning. A summary of DEC's RH findings are as follows:

Table III.K.13.F-26. Final Determination for Chena Power Plant

Pollutant	Regional Haze Controls	Regional Haze Determination	Effective Dates of Control/Limit
EUs 4 through 7 - Coal-Fired Boilers - 497 MMBtu/hr (combined)			
SO_2	Already Effectively Controlled (0.301 lb/MMBtu; 0.25% sulfur be weight in coal)*	No Additional Controls	N/A

* Background and detailed information regarding Fairbanks $PM_{2.5}$ State Implementation Plan (SIP) can be found at http://dec.alaska.gov/air/anpms/communities/fbks-pm2-5-serious-sip/.

d. US Air Force: Eielson Air Force Base

The Eielson Air Force Base (Eielson AFB) is owned and operated by the United States Air Force (USAF), and the USAF is the permittee for the stationary source's Title V Operating Permit AQ0264TVP02 Revision 5. The SIC code for this stationary source is 9711 – National Security. Eielson AFB consists of an operational airfield, residential housing, office buildings, gas stations, utilities, military police and fire departments, public schools, chapels, hospital facilities, retail stores, recreational facilities, and more. The stationary source's EUs are listed below in Table III.K.13.F-27.

Table III.K.13.F-27. Eielson Air Force Base Emission Unit Inventory

EU ID	Emission Unit Name	Emission Unit Description	Rating/Size	Install Date
Coal Fired Boilers1				
1	CH&PP Main Boiler #1	Springfield Boiler	120,000 lb/hr	1952
2	CH&PP Main Boiler #2	Springfield Boiler	120,000 lb/hr	1952
3	CH&PP Main Boiler #3	Springfield Boiler	120,000 lb/hr	1952
4	CH&PP Main Boiler #4	Springfield Boiler	120,000 lb/hr	1952
5A	CH&PP Main Replacement Boiler #5	Coal-Fired Boiler	120,000 lb/hr	2016
6A	CH&PP Main Replacement Boiler #6	Coal-Fired Boiler	120,000 lb/hr	2014
Liquid Fuel Fired Boilers				
7	Auxiliary Heating Plant Boiler #1	Cleaver Brooks Boiler	58.7 MMBtu/hr	2002
8	Auxiliary Heating Plant Boiler #2	Cleaver Brooks Boiler	58.7 MMBtu/hr	2002
9	Missile Storage Boiler #1	Cleaver Brooks Boiler	3.3 MMBtu/hr	1991
10	Missile Storage Boiler #2	Cleaver Brooks Boiler	2.9 MMBtu/hr	1993
11	Alert Hangar Boiler #1	Cleaver Brooks Boiler	6.0 MMBtu/hr	2008
12	Alert Hangar Boiler #2	Cleaver Brooks Boiler	6.0 MMBtu/hr	2008
13	Waste Water Treatment Boiler #12	Cleaver Brooks Boiler	6.7 MMBtu/hr	2012
14	Waste Water Treatment Boiler #2	Cleaver Brooks Boiler	6.7 MMBtu/hr	2012
15	Auxiliary Heating Plant II Boiler #1	--TBD; Not Installed--	98 MMBtu/hr	TBD

EU ID	Emission Unit Name	Emission Unit Description	Rating/Size	Install Date
16	Auxiliary Heating Plant II Boiler #2	--TBD; Not Installed--	98 MMBtu/hr	TBD
Propane Fired Heaters				
17	Corrosion Control Heater #1	Midco Burner	17.0 MMBtu/hr	1987
18	Corrosion Control Heater #2	Midco Burner	17.0 MMBtu/hr	1987
Diesel and Gasoline Fired Internal Combustion Engines				
19	CH&PP Main Auxiliary Generator	EMD Diesel Engine	2,500 kW	1987
20	CH&PP Auxiliary Power Generator #1	Onan Diesel Engine	1,125 kW	1998
21	CH&PP Auxiliary Power Generator #2	Onan Diesel Engine	1,125 kW	1998
22	CH&PP Auxiliary Power Generator #3	Onan Diesel Engine	1,125 kW	1998
23	CH&PP Auxiliary Power Generator #4	Onan Diesel Engine	1,125 kW	1998
24	Waste Water Treatment Generator	Caterpillar Diesel Engine	500 kW	1994
25	Central Avenue (Clinic) Generator	Cummins Diesel Engine	300 kW	2006
26	Refueling Station Generator-Oscar Row	Onan Diesel Engine	750 kW	1994
27	Engineer Hill Generator	Onan Diesel Engine	150 kW	1987
28	Alert Hangar Generator	Komatsu Diesel Engine	100 kW	1985
29	Power Plant Fire Pump	Caterpillar Diesel Engine	196 hp	1987
30	Missile Maintenance Generator	Onan-Cummins Diesel Engine	125 kW	2011
31	Control Tower Generator	Onan Diesel Engine	125 kW	2005
32	Telephone Exchange Generator	Cummins Diesel Engine	125 kW	2003
33	Command Post Generator	Cummins Diesel Engine	80 kW	2009
34	Airfield Lighting Generator	Onan Diesel Engine	300 kW	2003
35	Fire Pump P8 (Thunder Dome #1)	Cummins Diesel Engine	340 hp	1989
36	Fire Pump P9 (Thunder Dome #2)	Cummins Diesel Engine	340 hp	1989
37	Fire Pump P10 (Thunder Dome #3)	Cummins Diesel Engine	340 hp	1989
38	Fire Pump P11 (F-16 Hangar Pump #1)	Cummins Diesel Engine	340 hp	1986
39	Fire Pump P12 (F-16 Hangar Pump #2)	Cummins Diesel Engine	340 hp	1986

EU ID	Emission Unit Name	Emission Unit Description	Rating/Size	Install Date
40	Fire Pump P13 (F-16 Hangar Pump #3)	Cummins Diesel Engine	340 hp	1986
41	Fire Pump P19 (Hog Pen A-10s)	Detroit Diesel Engine	235 hp	1994
42	Fire Pump P20 (Hog Pen A-10s)	Detroit Diesel Engine	235 hp	1994
43	Fire Pump P6 – Fire Support	Caterpillar Diesel Engine	121 hp	1989
44	Fire Pump P5 – Fire Support	Caterpillar Diesel Engine	121 hp	1990
45	Fire Pump P1 – Fire Support	Caterpillar Diesel Engine	121 hp	1989
46	Taxi Way #3 Fire Pump	Caterpillar Diesel Engine	121 hp	1989
47	Pumphouse #3 Fire Pump	Caterpillar Diesel Engine	121 hp	1989
48	Fire Pump P2	Caterpillar Diesel Engine	120 hp	1989
49	Communications Squadron Emergency Generator	Onan Diesel Engine	100 kW	2003
50	Water Treatment Plant Generator	Cummins Diesel Engine	300 kW	2012
51	Utilidor (Auxiliary Heat Plant) Emergency Generator	Onan Diesel Engine	500 kW	2002
52	E-2 Complex Fuel Tank Emergency Generator	Kohler Power Diesel Engine	475 kW	2002
53	Fuel Hydrant System Emergency Generator	Caterpillar Diesel Engine	556 kW	2002
54	Joint Mobility Complex (JMC) Emergency Generator	Cummins Diesel Engine	800 kW	2002
55	North ILS Generator	Onan Diesel Engine	60 kW	1993
56	DET 460 Generator	Cummins Diesel Engine	60 kW	2010
57	Conventional Munitions Fire Pump #1	Detroit Diesel Engine	120 hp	1999
58	Conventional Munitions Fire Pump #2	Detroit Diesel Engine	120 hp	1999
59	New Security Forces Facility Generator (CSC)	Cummins Diesel Engine	350 kW	2005
60	Fire Stationary No. 1 Generator	Cummins Diesel Engine	80 kW	2003
61	Base Supply Fire Pump	Cummins Diesel Engine	208 hp	1993
62	354 Wing MOC Generator	Cummins Diesel Engine	100 kW	2004
63	F-Well pump	Cummins Diesel Engine	230 hp	2010
65	Aircraft Arrestor Engine NW3	Waukesha Gas Engine	65 hp	1970
66	Aircraft Arrestor Engine NE	Waukesha Gas Engine	65 hp	1970
67	Aircraft Arrestor Engine ¾ W	Waukesha Gas Engine	65 hp	1970
68	Aircraft Arrestor Engine ¾ E	Waukesha Gas Engine	65 hp	1970
69	Aircraft Arrestor Engine SE	Waukesha Gas Engine	65 hp	1970
70	Aircraft Arrestor Engine SW	Waukesha Gas Engine	65 hp	1970

EU ID	Emission Unit Name	Emission Unit Description	Rating/Size	Install Date
71	Loop Refueling (Type III Hydrant) Generator	Cummins Diesel Engine Emergency Generator	450 kW	2006
73	4 Bay Loop Hangar	Cummins Diesel Engine	100 kW	2010
74	8 Bay Loop Hangar	Cummins Diesel Engine	200 kW	2010
75	Missile Maintenance Well Pump Generator	Cummins Diesel Engine	60 kW	2006
76	E-2 Farm Fire Pump Emergency Generator	Deere Diesel Engine	120 hp	2005
77	Dining Facility Emergency Generator	Cummins Diesel Engine	230 kW	2010
78	Red Flag Emergency Generator	Cummins Diesel Engine	50 kW	2009
80	Cooling Pond Generator	Cummins Diesel Engine	350 kW	2010
Hush House (Jet Engine Test Facility)				
81	Hush House	N/A	N/A	1989
Portable Asphalt/Rock Crusher Diesel Fired Internal Combustion Engines				
82	Recycle Plant Engine	John Deere Diesel Engine	450 hp	2007
83	Jaw Crusher Engine	John Deere Diesel Engine	450 hp	2008
84	Hydrascreen Engine	Deutz Diesel Engine	96 hp	2007
Fire Training				
85	Fire Training	Fire Training Burn	N/A	N/A
Portable Asphalt/Rock Crusher Fugitives				
86	Crusher #1	Cobra 1000 Recycling Plant	150 TPH	2007
87	Conveyor Transfer Point #1	Transfer Point (Recycling Plant to Superior Stackable Conveyor)	150 TPH	2007
88	Conveyor Transfer Point #2	Transfer Point (Superior Stackable conveyor to 683 Hydrascreen	150 TPH	2007
89	Screening	Findlay 683 Hydrascreen	150 TPH	2007
90	Conveyor Transfer Point #3	Transfer Point (683 Hydrascreen to Oversize Return Conveyor Belt)	50 TPH	2007
91	Conveyor Transfer Point #4	Transfer Point (Oversize Conveyor Belt Return to Cobra 1000 Recycle Plant)	50 TPH	2007
92	Conveyor Transfer Point #5	Transfer Point (683 Hydrascreen to Second Deck Oversize Return Conveyor Belt)	50 TPH	2007
93	Fines Screening	683 Hydrascreen Fines Screen	100 TPH	2007
94	Conveyor Transfer Point #6	Transfer Point (Fines Screen to Fines Belt)	100 TPH	2007

EU ID	Emission Unit Name	Emission Unit Description	Rating/Size	Install Date
95	Conveyor Transfer Point #7	Transfer Point (Fines Belt to Superior Radial Stacking Conveyor)	100 TPH	2007
96	Conveyor Transfer Point #8	Transfer Point (Conveyor Discharge onto Asphalt Pile)	100 TPH	2007
97	Jaw Crusher Feed	Jaw Crusher Dump Point	150 TPH	2008
98	Conveyer Transfer Point #9	Transfer Point (Jaw Crusher Screen to Superior Conveyer # 1)	100 TPH	2008
99	Conveyer Transfer Point #10	Transfer Point (Superior Conveyer # 1 to Superior Conveyer # 2)	100 TPH	2008
100	Conveyer Transfer Point #11	Transfer Point (Superior Conveyer # 2 discharge on to Asphalt Stockpile)	100 TPH	2008
101	Crusher #2	Jaw Crusher	150 TPH	2008
102	Conveyer Transfer Point #12	Transfer Point (Jaw Crusher Conveyer to Recycling Plant Feed Conveyor)	150 TPH	2008
103	Conveyer Transfer Point #13	Transfer Point (Jaw Crusher Conveyer to Cobra 1000 Recycling Plant)	150 TPH	2008
Jet Kerosene (JP-8) Storage Tanks				
104	South Ramp Loop Tank #6167	AST – Internal Floating Roof Tank	420,000 gal	2006
105	South Ramp Loop Tank #6268	AST – Internal Floating Roof Tank	420,000 gal	2006
106	Tanker Row Tank #3241-5	AST – Internal Floating Roof Tank	420,000 gal	2000
107	Tanker Row Tank #3244-6	AST – Internal Floating Roof Tank	420,000 gal	2000
Other Regulated Sources				
109	Aircraft Corrosion Control Facility	Regulated Surface Coating	N/A	1987
110	Sandwich Belt Conveyer	Regulated Coal Processing System	N/A	1994
111	Coal Tripper System	Coal Tripper system with 6 identical 2,500 cfm Pulse Jet Collector Bin Vent Filters	150 TPH	2010
Insignificant CI RICE Subject to NESHAP Subpart ZZZZ				
64A	A Water Well Pump Generator5	Cummins Diesel Engine	60 kW	2012
64B	B Water Well Pump Generator	Cummins Diesel Engine	60 kW	2012
112	North Glideslope Generator	Cummins Diesel Engine	23 kW	2001

EU ID	Emission Unit Name	Emission Unit Description	Rating/Size	Install Date
113	ASOS/GPS Generator	Onan Diesel Engine	30 kW	2005
114	Base Radio MARS Generator	Onan Diesel Engine	35 kW	2003
115	TACAN South Glideslope Generator	Onan Diesel Engine	35 kW	2005
116	Lift Station Generator	Cummins Diesel Engine	30 kW	1991
117	South ILS Generator	Onan Diesel Engine	35 kW	2005
118	Quarry Hill Generator	Deere Diesel Engine	26 kW	2004
119	POL Control Generator	Kubota Diesel Engine	20 kW	2010
120	Consolidated Munitions Generator	Onan Diesel Engine	16 kW	1999
121	CE Control Generator	Onan Diesel Engine	6 kW	1985
122	Fire Station #2 Generator	John Deere Diesel Engine	55 kW	1997
123	Emergency Wastewater Pump Engine	John Deere 4039D Diesel Engine	60 kW	1991
124	Emergency Wastewater Pump Engine	John Deere 4045D Diesel Engine	63 kW	2008
125	Emergency Wastewater Pump Engine	John Deere 4045D Diesel Engine	63kW	2008
129	North Slope Relay Generator	Cummins Diesel Engine	60 kW	2011
Insignificant Gasoline Storage Tanks Subject to NESHAP Subpart CCCCCC				
126	Horizontal Gasoline Fuel Tank	N/A	25,948 gallons	1987
127	Horizontal Gasoline Fuel Tank	N/A	25,948 gallons	1987
128	Horizontal Gasoline Fuel Tank	N/A	25,948 gallons	1987

Table Notes: Minor Permit AQ0264MSS05 was issued on August 9, 2010, and authorizes the stationary source to replace the existing coal-fired boilers EUs 1 through 6 with new coal-fired boilers EUs 1A, 2A, and 4A through 6A.

For the second implementation period RH SIP update, DEC performed a limited review in place of a full four-factor analysis because the stationary source is already in the process of installing DSI using sodium bicarbonate on the replacement coal-fired boilers EUs 1A, 2A, and 4A through 6A as the older coal-fired boilers EUs 1 through 6 are being phased out. Currently EUs 5A, and 6A have already been installed at the stationary source with sodium bicarbonate DSI controls. DEC looked back over the previous six-year period (2014-2019) for which data is currently available to determine the sources SO_2 emissions. Table III.K.13.F-28 shows SO_2 emissions reported to DEC in emission fee estimates from 2014 through 2019. Additionally, the SO_2 emissions reported in the NEI for 2014 and 2017 (the only year that NEI information was available for the source) are contained in Table III.K.13.F-28 as a footnote.

Table III.K.13.F-28. Eielson Air Force Base SO_2 Emissions

Calendar Year	Coal-Fired Boilers SO_2 Emitted (tons)	Other EUs SO_2 Emitted (tons)	Total SO_2 Emitted (tons)
2019	237.98	3.66	241.64
2018	211.77	3.20	214.97
2017	238.90	1.70	240.60[1]
2016	261.18	1.54	262.72
2015	263.10	2.30	265.40
2014	267.3	1.70	269.00[1]

Table Notes: [1] USAF reported 262.81 tons of SO_2 emissions in the 2017 NEI and 268.05 tons of SO_2 emissions in the 2014 NEI.

As can be seen from Table III.K.13.F-28, the sizeable SO_2 emissions emitted at the Eielson AFB are from the coal-fired boilers. DEC created Table III.K.13.F-29 below to differentiate the SO_2 emissions from the older coal-fired boilers EUs 1 – 4, as well as the newly installed coal-fired boilers with DSI, EUs 5A and 6A. Note that Table III.K.13.F-29 starts in 2017 as this is the first full year of operating both boiler EUs 5A and 6A.

Table III.K.13.F-29. Eielson Air Force Base SO_2 Emissions

Year	EU ID	Coal Usage (tpy)	Coal Usage Percent of Total	SO_2 E.F. (lb/ton)	SO_2 E.F. % reduction From EUs 1-4	SO_2 Emissions (tons)
2019	1 through 4	149,281	85%	3.14	0%	234.37
	5	11,832	7%	0.27	91%	1.6
	6	13,537	8%	0.31	90%	2.1
	5 & 6	25,369	15%	0.29	91%	3.7
Total		174,650				238.07
2018	1 through 4	120,945	72%	3.14	0%	189.88
	5	18,206	11%	0.59	81%	5.36
	6	27,670	17%	1.20	62%	16.6
	5 & 6	45,876	28%	0.96	70%	21.96
Total		166,821				211.84
2017	1 through 4	144,712	84%	3.22	0%	232.99
	5	23,066	13%	0.49	85%	5.70
	6	3,545	2%	0.12	96%	0.21
	5 & 6	26,611	16%	0.44	86%	5.91
Total		171,323				238.90

2017 - 2019 Totals	1 through 4	414,938	81%	3.17	0%	657.24
	5	53,104	10%	0.48	85%	12.66
	6	44,752	9%	0.85	73%	18.91
	5 & 6	97,856	19%	0.65	80%	31.57
Total		512,794				688.81

As can be seen from Table III.K.13.F-29 above, the newer coal fired boilers EUs 5A and 6A equipped with DSI controls emit approximately 80% fewer SO_2 emissions per ton of coal combusted, compared to EUs 1 through 4.

The USAF received authorization to do a phased replacement of the coal boilers with the issuance of Minor Permit AQ0264MSS05 on August 9, 2010. The permit application for this project anticipated that Eielson AFB would have the final boiler (EU 1A) installed in October 2019 and EU 3 demolished in 2020. However, the timeline for the replacement of the boilers has stalled with EU 6A starting up on October 28, 2014, and EU 5A starting up on October 10, 2016, and no significant progress towards boiler replacement has taken place since that date. Therefore, DEC will require the USAF to either submit an application for a permit amendment to establish an enforceable retirement date for the remaining coal-fired boilers EUs 1 through 4 or submit a full four-factor analysis for add on SO_2 pollution control technologies to include wet scrubbers, DSI, and SDA by July 1, 2023.

DEC Regional Haze Findings for Eielson Air Force Base

The conclusion of DEC's limited review for USAF's Eielson AFB is that the stationary source is still intending to replace the older coal-fired boilers without SO_2 emissions controls with newer coal-fired boilers with sodium bicarbonate DSI and SCR. The two boilers already replaced are averaging about 80% less SO_2 emissions per ton of coal consumed compared to the older boilers. In the years to come, as the older boilers are replaced, there will be a substantial decline in emissions from the stationary source which will result in a positive impact on visibility. DEC will require the USAF to either submit an application for a permit amendment to establish an enforceable retirement date for the remaining coal-fired boilers EUs 1 through 4 or submit a full four-factor analysis for add on SO_2 pollution control technologies to include wet scrubbers, DSI, and SDA by July 1, 2023. A summary of DEC's Regional Haze findings are as follows:

Table III.K.13.F-30. Final Determination for Eielson Air Force Base

Pollutant	Regional Haze Controls	Regional Haze Determination	Effective Dates of Control/Limit
EUs 1 – 4 Coal-Fired Boilers - 120,000 lb/hr			
SO_2	Option 1 – Retire Existing EUs 1 – 4	Submit permit application with enforceable retirement dates	Submit application by July 1, 2023 Retirement effective no later than December 31, 2024
	Option 2 – Four Factor Analysis	Submit a four-factor analysis for DSI, wet scrubber, and SDA	Submit Four-Factor Analysis by July 1, 2023
EUs 5A – 6A Coal-Fired Boiler with DSI - 120,000 lb/hr			

Pollutant	Regional Haze Controls	Regional Haze Determination	Effective Dates of Control/Limit
SO_2	Already Effectively Controlled (0.20 lb/MMBtu emission rate with DSI)	No Additional Controls	N/A

e. U.S. Army, Doyon Utilities: Fort Wainwright

Fort Wainwright is a military installation located within and adjacent to the city of Fairbanks, Alaska, in the Tanana River Valley. The EUs located within the military installation at Fort Wainwright are either owned and operated by a private utility company, Doyon Utilities, LLC. (DU) under Title V Operating Permit AQ1121TVP02 Revision 2, or by U.S. Army Garrison Fort Wainwright (Fort Wainwright or FWA) under Title V Operating Permit AQ0236TVP04. The two entities, DU and FWA, comprise a single stationary source operating under two permits. The stationary source includes coal-fired boilers for a combined heat and power plant, as well as emergency generator engines, fire pump engines, backup diesel fired boilers, and waste oil-fired boilers. These EUs are listed below in Table III.K.13.F-31 and Table III.K.13.F-32.

Table III.K.13.F-31. DU Fort Wainwright Emission Unit Inventory

EU ID1	Description of EU	Rating/Size		Location
1	Coal-Fired Boiler 3	230	MMBtu/hr	Central Heating and Power Plant (CHPP)
2	Coal-Fired Boiler 4	230	MMBtu/hr	CHPP
3	Coal-Fired Boiler 5	230	MMBtu/hr	CHPP
4	Coal-Fired Boiler 6	230	MMBtu/hr	CHPP
5	Coal-Fired Boiler 7	230	MMBtu/hr	CHPP
6	Coal-Fired Boiler 8	230	MMBtu/hr	CHPP
7a	South Coal Handling Dust Collector DC-01	13,150	acfm	CHPP
7b	South Underbunker Dust Collector DC-02	884	acfm	CHPP
7c	North Coal Handling Dust Collector NDC-1	9,250	acfm	CHPP
8	Backup Generator Engine	2,937	hp	CHPP
9	Emergency Generator Engine	353	hp	Building 1032
14	Emergency Generator Engine	320	hp	Building 1563
22	Emergency Generator Engine	35	hp	Building 3565
23	Emergency Generator Engine	155	hp	Building 3587
29	Emergency Pump Engine	75	hp	Building 1056
30	Emergency Pump Engine	75	hp	Building 3403
31	Emergency Pump Engine	75	hp	Building 3724
32	Emergency Pump Engine	75	hp	Building 4162
33	Emergency Pump Engine	75	hp	Building 1002
34	Emergency Pump Engine	220	hp	Building 3405

EU ID1	Description of EU	Rating/Size		Location
35	Emergency Pump Engine	55	hp	Building 4023
36	Emergency Pump Engine	220	hp	Building 3563
51a	DC-1 Fly Ash Dust Collector	3,620	acfm	CHPP
51b	DC-2 Bottom Ash Dust Collector	3,620	acfm	CHPP
52	Coal Storage Pile	N/A		CHPP

Table III.K.13.F-32. U.S. Army Garrison Fort Wainwright Emission Unit Inventory

EU ID	Description of EU	Rating/Size		Location
8	Backup Diesel-Fired Boiler 1	19	MMBtu/hr	Basset Hospital
9	Backup Diesel-Fired Boiler 2	19	MMBtu/hr	Basset Hospital
10	Backup Diesel-Fired Boiler 3	19	MMBtu/hr	Basset Hospital
11	Backup Diesel-Electric Generator 1	900	kW	Basset Hospital
12	Backup Diesel-Electric Generator 2	900	kW	Basset Hospital
13	Backup Diesel-Electric Generator 3	900	kW	Basset Hospital
22	VOC Extraction and Combustion	N/A		
23	Fort Wainwright Landfill	1.97	million cubic meters	
24	Aerospace Activities	N/A		
26	Emergency Generator	324	hp	Building 2132
27	Emergency Generator	67	hp	Building 1580
28	Emergency Generator	398	hp	Building 3406
29	Emergency Generator	47	hp	Building 3567
30	Fire Pump	275	hp	Building 2089
31	Fire Pump #1	235	hp	Building 1572
32	Fire Pump #2	235	hp	Building 1572
33	Fire Pump #3	235	hp	Building 1572
34	Fire Pump #4	235	hp	Building 1572
35	Fire Pump #1	240	hp	Building 2080
36	Fire Pump #2	240	hp	Building 2080
37	Fire Pump	105	kW	Building 3498
38	Fire Pump #1	120	hp	Building 5009
39	Fire Pump #2	120	hp	Building 5009
40	Waste Oil-Fired Boiler	2.6	MMBtu/hr	Building 5007
50	Emergency Generator Engine	762	hp	Building 1060
51	Emergency Generator Engine	762	hp	Building 1060
52	Emergency Generator Engine	82	hp	Building 1193
53	Emergency Generator Engine	587	hp	Building 1555
54	Emergency Generator Engine	1,059	hp	Building 2117
55	Emergency Generator Engine	212	hp	Building 2117
56	Emergency Generator Engine	176	hp	Building 2088
57	Emergency Generator Engine	212	hp	Building 2296
58	Emergency Generator Engine	71	hp	Building 3004
59	Emergency Generator Engine	35	hp	Building 3028
60	Emergency Generator Engine	95	hp	Building 3407

EU ID	Description of EU	Rating/Size	Location
61	Emergency Generator Engine	50 hp	Building 3703
62	Emergency Generator Engine	18 hp	Building 5108
63	Emergency Generator	68 hp	Building 1620
64	Emergency Generator	274 hp	Building 1054
65	Emergency Generator	274 hp	Building 4390
???	Distillate Fired Boilers (23)	Varies	Varies
???	Waste Oil-Fired Boiler	2.5 gal/hr	Building 3476
???	Waste Oil-Fired Boiler	2.5 gal/hr	Building 3476

Fort Wainwright recently went through an emissions control analysis as a part of the planning requirements triggered when the FNSB nonattainment area was designated as "Serious" with respect to nonattainment of the 2006 24-hour $PM_{2.5}$ NAAQS, which was published in Federal Register Vol. 82, No. 89, May 10, 2017, pages 21703-21706. CAA section 189(b)(1)(B) and 40 C.F.R. § 51.1010 describe the Serious area attainment plan requirements for BACM/BACT. Large stationary sources are a subgroup of emissions sources that are given special attention in the required BACM/BACT analysis. Per federal requirement, DEC evaluated all point sources with emissions greater than 70 TPY of $PM_{2.5}$ or for any individual $PM_{2.5}$ precursor (NO_x, SO_2, NH_3, VOCs).

This evaluation resulted in the following emissions controls contained in Table III.K.13.F-33, which are those required in Table 7.7-11 of the Amendments to: State Air Quality Control Plan Vol II: III.D.7.7 Control Strategies document; adopted November 19, 2019.[3]

Table III.K.13.F-33. BACT and SIP Findings Summary Table for Fort Wainwright

Pollutant	BACT Emission Limit	BACT Control Device or Operational Limitation	Effective Dates of Control/Limit
EUs 1 through 6 - Coal Fired Boilers - 230 MMBtu/hr (each)			
NO_x	Precursor Demonstration*	No additional control	N/A
$PM_{2.5}$	0.045 lb/MMBtu (3-hr avg.)	Full Stream Baghouse	Existing
SO_2	0.25% sulfur by weight	Certified Statement of Sulfur Content	Title I Permit App. by June 9, 2020 Effective no later than June 9, 2021
	0.12 lb/MMBtu (3-hr avg.)	Dry Sorbent Injection (DSI)	Title I Permit App. by June 9, 2020 Effective no later than October 1, 2023
Emergency Engines, Generators, and Fire Pumps			
NO_x	Precursor Demonstration*	No additional control	N/A
$PM_{2.5}$	0.015 - 1.0 g/hp-hr (3-hr avg.)	Good Combustion Practices and Limited Operation	Existing

Pollutant	BACT Emission Limit	BACT Control Device or Operational Limitation	Effective Dates of Control/Limit
SO_2	15 ppmw sulfur in fuel	Certified Statement of Sulfur Content	Title I Permit App. by June 9, 2020 Effective no later than June 9, 2021
Fuel Oil Boilers			
NO_x	Precursor Demonstration*	No additional control	N/A
$PM_{2.5}$	0.012 lb/MMBtu (3-hr avg.)	Good Combustion Practices and Limited Operation	Existing
SO_2	15 ppmw sulfur in fuel	Certified Statement of Sulfur Content	Title I Permit App. by June 9, 2020 Effective no later than June 9, 2021
Material Handling Sources (Coal Prep and Ash Handling)			
$PM_{2.5}$	0.0025 - 0.02 gr/dscf	Enclosed Emission Points and Good Operating Practices	Title I Permit App. by June 9, 2020 Effective no later than June 9, 2021

Section II.B.3.f. of the Guidance Document discusses selecting sources that have recently undergone emission control technology review. The Guidance Document states the following:

> "New, reconstructed, or modified emission units that went through Best Available Control Technology (BACT) review under the Prevention of Significant Deterioration (PSD) program or Lowest Achievable Emission Rate (LAER) review under the nonattainment new source review program for major sources and received a construction permit on or after July 31, 2013,46 on a pollutant-specific basis. The statutory considerations for selection of BACT and LAER are also similar to, if not more stringent than, the four statutory factors for reasonable progress."

DEC Regional Haze Findings for Fort Wainwright CHPP
DEC's recent analysis of Fort Wainwright for the Serious nonattainment area resulted in a limit on the sulfur content of the coal received at the stationary source as well as the requirement to install dry sorbent injection to control SO_2 on the coal-fired boilers. Additionally, the diesel-fired engines and boilers were also required to combust ULSD. Taking into consideration the BACT analysis recently performed for the nonattainment area and the sulfur limits already imposed by this effort, DEC will not further evaluate Fort Wainwright for the second implementation period of RH planning. In addition to the previously performed BACT analysis requiring DSI, DU subsequently provided additional cost analyses for dry sorbent injection, spray dry absorbers, and wet scrubbers, which are included in the appendix to this chapter, Appendix III.K.13.F. A summary of DEC's RH findings are as follows:

Table III.K.13.F-34. Final Determination for Fort Wainwright CHPP

Pollutant	Regional Haze Controls	Regional Haze Determination	Effective Dates of Control/Limit
EUs 1 through 6 - Coal-Fired Boilers - 230 MMBtu/hr (each)			
SO_2	Already Effectively Controlled (0.12 lb/MMBtu with DSI; 0.25% sulfur by weight in coal)*	No Additional Controls	N/A

* Background and detailed information regarding Fairbanks $PM_{2.5}$ State Implementation Plan (SIP) can be found at http://dec.alaska.gov/air/anpms/communities/fbks-pm2-5-serious-sip/.

f. University of Alaska: Fairbanks Campus Power Plant

The Fairbanks Campus Power Plant is owned and operated by the University of Alaska Fairbanks (UAF), and UAF is the Permittee for the stationary source's Title V Operating Permit AQ0316TVP02 Revision 1. The SIC code for the stationary source is 8211 – Colleges, Universities, and Professional Schools.

The Fairbanks Campus Power Plant is a co-generation power plant that is designed to supply electrical power and heat to the campus. The fuel consuming EUs consists of a 295.6 MMBtu/hr coal/woody biomass-fired boiler, two dual fuel-fired 180.9 MMBtu/hr boilers, a medical/pathological waste incinerator, and diesel-fired generators and boilers. These EUs are listed below in Table III.K.13.F-35.

Table III.K.13.F-35. Fairbanks Campus Power Plant Emission Unit Inventory

EU ID	Description of EU	Rating / Size		Fuel Type	Installation or Construction Date
3	Dual-Fired Boiler	180.9	MMBtu/hr	Dual Fuel	1970
4	Dual-Fired Boiler	180.9	MMBtu/hr	Dual Fuel	1987
8	Peaking/Backup Diesel Generator	13,266	hp	Diesel	1999
9A	Medical/Pathological Waste Incinerator	83	lb/hr	Medical / Infectious Waste	2006
19	Diesel Boiler	6.13	MMBtu/hr	Diesel	2004
20	Diesel Boiler	6.13	MMBtu/hr	Diesel	2004
21	Diesel Boiler	6.13	MMBtu/hr	Diesel	2004
23	Diesel Generator Engine	235	kW	Diesel	2003
24	Diesel Generator Engine	51	kW	Diesel	2001

EU ID	Description of EU	Rating / Size		Fuel Type	Installation or Construction Date
26	Diesel Generator Engine	45	kW	Diesel	1987
27	Diesel Generator Engine	500	hp	Diesel	TBD
28	Diesel Generator Engine	120	hp	Diesel	1998
29	Diesel Generator Engine	314	hp	Diesel	2013
105	Limestone Handling System	1,200	acfm	N/A	2019
107	Sand Handling System	1,600	acfm	N/A	2019
109	Ash Handling System	1,000	acfm	N/A	2019
110	Ash Handling System Vacuum	2,000	acfm	N/A	2019
111	Ash Loadout to Truck	N/A		N/A	2019
113	Dual Fuel-Fired Circulating Fluidized Bed (CFB) Boiler	295.6	MMBtu/hr	Coal/Woody Biomass	2019
114	Dry Sorbent Handling Vent Filter Exhaust	5	acfm	N/A	2019
128	Coal Silo No. 1 with Bin Vent	1,650	acfm	N/A	2019
129	Coal Silo No. 2 with Bin Vent	1,650	acfm	N/A	2019
130	Coal Silo No. 3 with Bin Vent	1,650	acfm	N/A	2019

The Fairbanks Campus Power Plant recently went through an emissions control analysis as a part of the planning requirements triggered when the FNSB nonattainment area was designated as “Serious” with respect to nonattainment of the 2006 24-hour $PM_{2.5}$ NAAQS, which was published in Federal Register Vol. 82, No. 89, May 10, 2017, pages 21703-21706. CAA section 189(b)(1)(B) and 40 C.F.R. § 51.1010 describe the Serious area attainment plan requirements for BACM/BACT. Large stationary sources are a subgroup of emissions sources that are given special attention in the required BACM/BACT analysis. Per federal requirement, DEC evaluated all point sources with emissions greater than 70 TPY of $PM_{2.5}$ or for any individual $PM_{2.5}$ precursor (NO_x, SO_2, NH_3, VOCs).

This evaluation resulted in the following emissions controls contained in Table III.K.13.F-36, which are those required in Table 7.7-16 of the Amendments to: State Air Quality Control Plan Vol II: III.D.7.7 Control Strategies document; adopted November 19, 2019.[3]

Table III.K.13.F-36. BACT and SIP Findings Summary Table for Fairbanks Campus Power Plant

Pollutant	BACT Emission Limit	BACT Control Device or Operational Limitation	Effective Dates of Control/Limit
Dual Fuel-Fired Boiler – 295.6 MMBtu/hr			
NO_x	Precursor Demonstration*	No additional control	N/A
$PM_{2.5}$	0.012 lb/MMBtu	Fabric Filters (Baghouse)	Existing
SO_2	0.25% sulfur by weight	Certified Statement of Sulfur Content	Title I Permit App. by June 9, 2020

Pollutant	BACT Emission Limit	BACT Control Device or Operational Limitation	Effective Dates of Control/Limit
			Effective no later than June 9, 2021
	0.2 lb/MMBtu (30-day avg.)	No additional control	Existing
Diesel-Fired Engines			
NO_x	Precursor Demonstration*	No additional control	N/A
$PM_{2.5}$	0.015 - 1.0 g/hp-hr (3-hr avg.)	Positive Crankcase Ventilation, Good Combustion Practices, and Limited Operation	Existing
SO_2	15 ppmw sulfur in fuel	Certified Statement or Approved Analysis of Sulfur Content	Title I Permit App. by June 9, 2020 Effective no later than June 9, 2021
EUs 3, 4, and 19 through 21 - Fuel Oil-Fired Boilers			
NO_x	Precursor Demonstration*	No additional control	N/A
$PM_{2.5}$	0.012 lb/MMBtu (Diesel 3-hr avg.) 0.0075 lb/MMBtu (N.G. 3-hr avg.)	Good Combustion Practices and Limited Operation	Existing
SO_2	1,000 ppmw sulfur in fuel (Diesel) 0.60 lb/MMscf (Natural Gas) October 1 – March 31	Certified Statement or Approved Analysis of Sulfur Content	Title I Permit App. by June 9, 2020 Effective no later than October 1, 2020
	15 ppmw sulfur in fuel (Diesel) 0.60 lb/MMscf (Natural Gas) October 1 – March 31	Certified Statement or Approved Analysis of Sulfur Content	Title I Permit App. by June 9, 2021 Effective no later than October 1, 2023
EU 9a – Pathogenic Waste Incinerator (83 lb/hr)			
NO_x	Precursor Demonstration*	No additional control	N/A
$PM_{2.5}$	4.67 lb/ton	Limited Operation and Multiple Chamber Design	Title I Permit App. by June 9, 2020 Effective no later than June 9, 2021
SO_2	15 ppmw sulfur in liquid fuel	Certified Statement of Sulfur Content	Title I Permit App. by June 9, 2020

Pollutant	BACT Emission Limit	BACT Control Device or Operational Limitation	Effective Dates of Control/Limit
			Effective no later than June 9, 2021
Material Handling Sources (Coal Prep and Ash Handling)			
$PM_{2.5}$	0.003 - 0.050 gr/dscf	Enclosed Emission Points, fabric filters, and vents	Title I Permit App. by June 9, 2020 Effective no later than June 9, 2021
	5.50E-05 lb/ton	Enclosure Emission Points	

DEC's recent analysis of the Fairbanks Campus Power Plant for the Serious nonattainment area resulted in a limit on the sulfur content of the coal received at the stationary source. Additionally, the diesel-fired engines and pathogenic waste incinerator were also required to combust ULSD year-round, while the diesel-fired boilers were required to combust ULSD for half of the year from October through March. The Fairbanks Campus Power Plant also recently replaced two coal-fired boilers installed in 1962 with a new coal/woody biomass-fired circulating fluidized bed boiler that has considerably lower SO_2 emissions. Calendar year 2020 was the first year of new boiler operations after the retirement of the existing boilers and stationary source wide SO_2 emissions dropped from an average of 190.0 tons per year between 2014 through 2019 to 20.8 tons, an 89% decrease in emissions.

Section II.B.3.f. of the Guidance Document discusses selecting sources that have recently undergone emission control technology review. The Guidance Document states the following:

> "New, reconstructed, or modified emission units that went through Best Available Control Technology (BACT) review under the Prevention of Significant Deterioration (PSD) program or Lowest Achievable Emission Rate (LAER) review under the nonattainment new source review program for major sources and received a construction permit on or after July 31, 2013,46 on a pollutant-specific basis. The statutory considerations for selection of BACT and LAER are also similar to, if not more stringent than, the four statutory factors for reasonable progress."

DEC Regional Haze Findings for Fairbanks Campus Power Plant

Taking into consideration the BACT analysis recently performed for the nonattainment area and the sulfur limits already imposed by this effort, as well as the significant drop in SO_2 emissions as a result of replacing the existing coal-fired boilers, DEC will not further evaluate the Fairbanks Campus Power Plant for the second implementation period of RH planning. A summary of DEC's RH findings are as follows:

Table III.K.13.F-37. Final Determination for Fairbanks Campus Power Plant

Pollutant	Regional Haze Controls	Regional Haze Determination	Effective Dates of Control/Limit
EU 113 – Dual Fuel-Fired Boiler – 295.6 MMBtu/hr			
SO_2	Already Effectively Controlled (0.20 lb/MMBtu; 0.25% sulfur by weight in coal)*	No Additional Controls	N/A

* Background and detailed information regarding Fairbanks $PM_{2.5}$ State Implementation Plan (SIP) can be found at http://dec.alaska.gov/air/anpms/communities/fbks-pm2-5-serious-sip/.

III.K.13.G AIR QUALITY MODELING

1. OVERVIEW

Modeling is a critical technical step in many of the planning requirements of the RH Rule. Models are needed for source apportionment, control strategy development and optimization, quantification of incremental impacts of individual source categories, and analysis of cumulative impacts. Air quality and visibility modeling in support of regional haze planning in the WRAP region was the responsibility of the WRAP Regional Haze Planning Work Group (RHPWG[1]) under the direction of the Regional Technical Operations Work Group (RTOWG[2]). The RHPWG/RTOWG used the air pollution emissions data provided by member states to simulate historic air quality conditions (i.e., base year of 2014) and estimate the benefit of emissions reductions programs in the future (i.e., future year of 2028). The WRAP 2014 modeling platform includes all WRAP states except Alaska and Hawaii.

Alaska does not have WRF meteorology available or a photochemical grid modeling platform to perform similar modeling to evaluate impacts to visibility. Due to the funding constraints, it was not possible for Alaska to perform photochemical grid modeling as part of their RH SIP. The development of the URP glidepath for Alaska Class I areas uses two modeling studies performed by others. First, the EPA conducted preliminary modeling for Alaska using a CMAQ photochemical grid model regional modeling platform for the base year 2016 and future year 2028. There are caveats to this work that will be described below in the base year modeling section. Second, UAF ran the GEOS-Chem global chemistry model for the year 2016 that was used to provide estimates of the contributions of international anthropogenic emissions to visibility. The GEOS-Chem modeling is described in Appendix III.K.13.I. In addition to the photochemical grid modeling, AOI, WEP, and Potential Source Contributions (PSC) analyses were performed for the IMPROVE sites in Alaska that represent Class I areas to estimate the sources of emissions within, or near, the state that had the potential to contribute the most to visibility impairment at the IMPROVE sites on most impaired days and other periods.

2. EPA 2016 BASE YEAR CMAQ MODELING

EPA conducted CMAQ photochemical modeling of Alaska and surrounding areas using a 2016 modeling database and 27-km and 9-km grid resolution domains. The base year simulation together with its paired future year simulation are used to calculate relative response factors (RRFs) for each component of $PM_{2.5}$ and CM that are used in making future year visibility projections. The geographic extent of the modeling domains was shown in Figure III.K.13.E-1. Modeling inputs and setup are described in the EPA's Technical Supporting Document[3].

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[1] https://www.wrapair2.org/RHPWG.aspx

[2] https://www.wrapair2.org/rtowg.aspx

[3] U.S. Environmental Protection Agency, 2020. Technical Support Document for EPA's Updated 2028 Regional Haze Modeling for Hawaii, Virgin Islands, and Alaska. Office of Air Quality Planning and Standards. July. https://vice.cira.colostate.edu/files/iwdw/platforms/WRAP_2014/WEP_AOI/WEP_AOI_AK_R20201223/DOCS/TSD_HI_VI_AK_2028_Regional_Haze_Modeling_6.pdf

The lateral boundary and initial species concentrations are based on a CMAQ hemispheric simulation at 108-km grid resolution that completely and continuously covers the Northern Hemisphere. The international emission inventories are synthesized from the Hemispheric Transport of Air Pollution Version 2 inventory (EDGAR-HTAPv2) for the year 2010 and projected to 2014 using the Community Emissions Data System (CEDS) inventory. The China emission inventory was developed at Tsinghua University and was representative of 2016. Details of emission development for the CMAQ hemispheric simulation is described in the EPA's Hemispheric Modeling Platform Technical Support Document (TSD).[4]

Model performance evaluation (MPE) of the base year is important to establish confidence in the future year contribution analyses and calculations. EPA evaluated CMAQ performance for PM species component at IMPROVE and other PM monitoring networks. Model performance on the 20% MID and 20% clearest days at individual IMPROVE sites are presented in Figure III.K.13.G-1 that is reproduced from the EPA Alaska CMAQ modeling TSD. The model tends to underestimate sulfate (SO_4) which dominates visibility impairment at Alaska sites on the 2016 MID. The Normalized Mean Bias (NMB) and Normalized Mean Error (NME) for SO_4 (see Table III.K.13.G-1) was compared to numerical "goals" and less stringent "criteria" benchmarks recommended by Emery et al. (2016)[5]. The purpose of MPE benchmarks is not to give a passing or failing grade to a simulation, but rather to put results into the proper context of previous model applications that establish what level of performance can be realistically expected. These benchmarks were developed by analyzing the model performance for regional-scale photochemical grid models mostly in the lower 48 states, and we do not expect photochemical models to perform as well as for Alaska where the concentrations are highly dependent on estimates of international and natural emissions that are not as well-known as U.S. anthropogenic emissions.

Annual NME at DENA1, TRCR1, and SIME1 are 70%, 71%, and 59%, respectively, exceeding the SO_4 error goal and criteria for error (≤35% and ≤50%). The MID NME is higher at DENA1 (73%) and SIME1 (69%). The MID NMB fails the SO_4 bias goal and criteria for bias (≤±10% and ≤±30%) at all three sites. The underestimation of SO_4 could pose an issue for using EPA's CMAQ modeling results for Alaska regional haze modeling. The EPA's CMAQ modeling did not include reactive sulfur emissions from volcanos or oceanic DMS. An analysis of 2014 emissions for a region (based on the WRAP 2014 GEOS-Chem simulation) essentially equivalent to EPA's CMAQ Alaska 27-km domain found that 60% of the reactive sulfur emissions were from volcano degassing and DMS (see Table III.K.13.E-7).

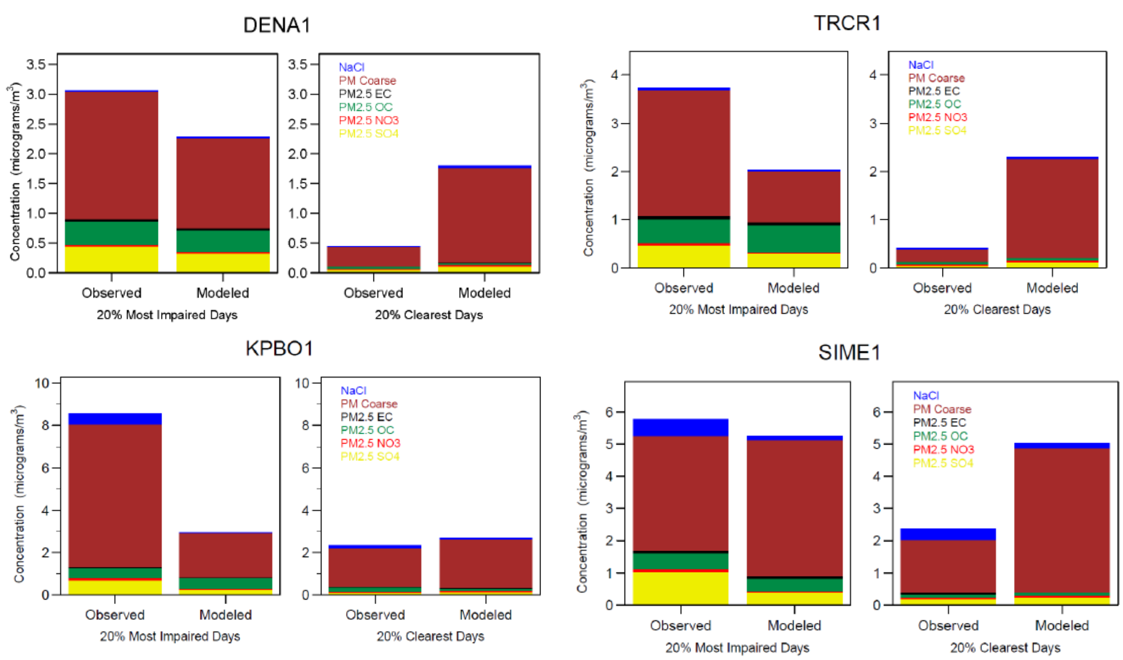
[4] U.S. Environmental Protection Agency, 2019. 2016 Hemispheric Modeling Platform Version 1: Implementation, Evaluation, and Attribution. Research Triangle Park, NC. U.S. Environmental Protection Agency. U.S. EPA

[5] Emery, C., Liu, Z., Russell, A.G., Odman, M.T., Yarwood, G. and Kumar, N., 2017. Recommendations on statistics and benchmarks to assess photochemical model performance. Journal of the Air & Waste Management Association, 67(5), pp.582-598.

Table III.K.13.G-1. 2016 CMAQ model performance of sulfate concentrations across all days and most impaired days.

Site/Days	Mean Obs ($\mu g/m^3$)	Mean Model ($\mu g/m^3$)	NMB (%)	NME (%)	MB ($\mu g/m^3$)	ME ($\mu g/m^3$)
DENA1						
All days	0.18	0.18	0.9%	70%	0	0.13
MID	0.44	0.29	-34%	73%	-0.15	0.32
TRCR1						
All days	0.18	0.19	0.3%	71%	0	0.13
MID	0.47	0.22	-48%	68%	-0.23	0.32
SIME1						
All days	0.5	0.25	-51%	59%	-0.25	0.29
MID	1.04	0.34	-67%	69%	-0.69	0.72

Figure III.K.13.G-1. Stacked bar charts detailing the average composition of speciated particulate matter in 2016 on the 20% most impaired days (right) and 20% clearest days (right) at Alaska IMPROVE sites. [Source: EPA's Alaska CMAQ TSD Appendix A]



3. EPA 2028 PROJECTED YEAR CMAQ MODELING

EPA conducted CMAQ modeling for a 2028 emissions scenario to make 2028 visibility projections along with a separate 2028 zero-out U.S. anthropogenic emissions modeling scenario. The zero-out U.S. anthropogenic emission simulations exclude any anthropogenic emission sources located in the U.S. or territories to provide visibility conditions caused by international anthropogenic emissions and natural sources that are beyond the control of states preparing the RH SIP. This included Class 1 and 2 commercial marine vessels but not Class 3 vessels. CMAQ model setup and all other inputs (i.e., meteorological fields, initial concentrations, and boundary concentrations) are unchanged from the 2016 base year simulation.

Table III.K.13.G-2 shows the base and future year deciview values on the 20% clearest days at each Class I area for the base model period (2014-2017) and future year (2028) based on the EPA's CMAQ simulations. For all sites in Alaska, visibility on the 20% clearest days is projected to be below the baseline (2000-2004) visibility condition (see Section III.K.13.D) satisfying the RH Rule requirement of no degradation in visibility for the clearest days since the baseline period.

Table III.K.13.G-2. Observed IMPROVE 2014-2017 base year and projected 2028 future year visibility (deciview) on the 20% clearest days at each IMPROVE site representing Class I areas in Alaska. [Source: EPA's Alaska CMAQ TSD].

Class I Area	IMPROVE site	Base Year (2014-2017) 20% Clearest Days (dv)	Future Year (2028) 20% Clearest Days (dv)
Denali NP	TRCR1	3.34	3.32
Denali NP	DENA1	2.19	2.16
Tuxedni National Wildlife Refuge	KPBO1/TUXE1	4.62	4.23
Simeonof Wilderness Area	SIME1	7.68	7.42

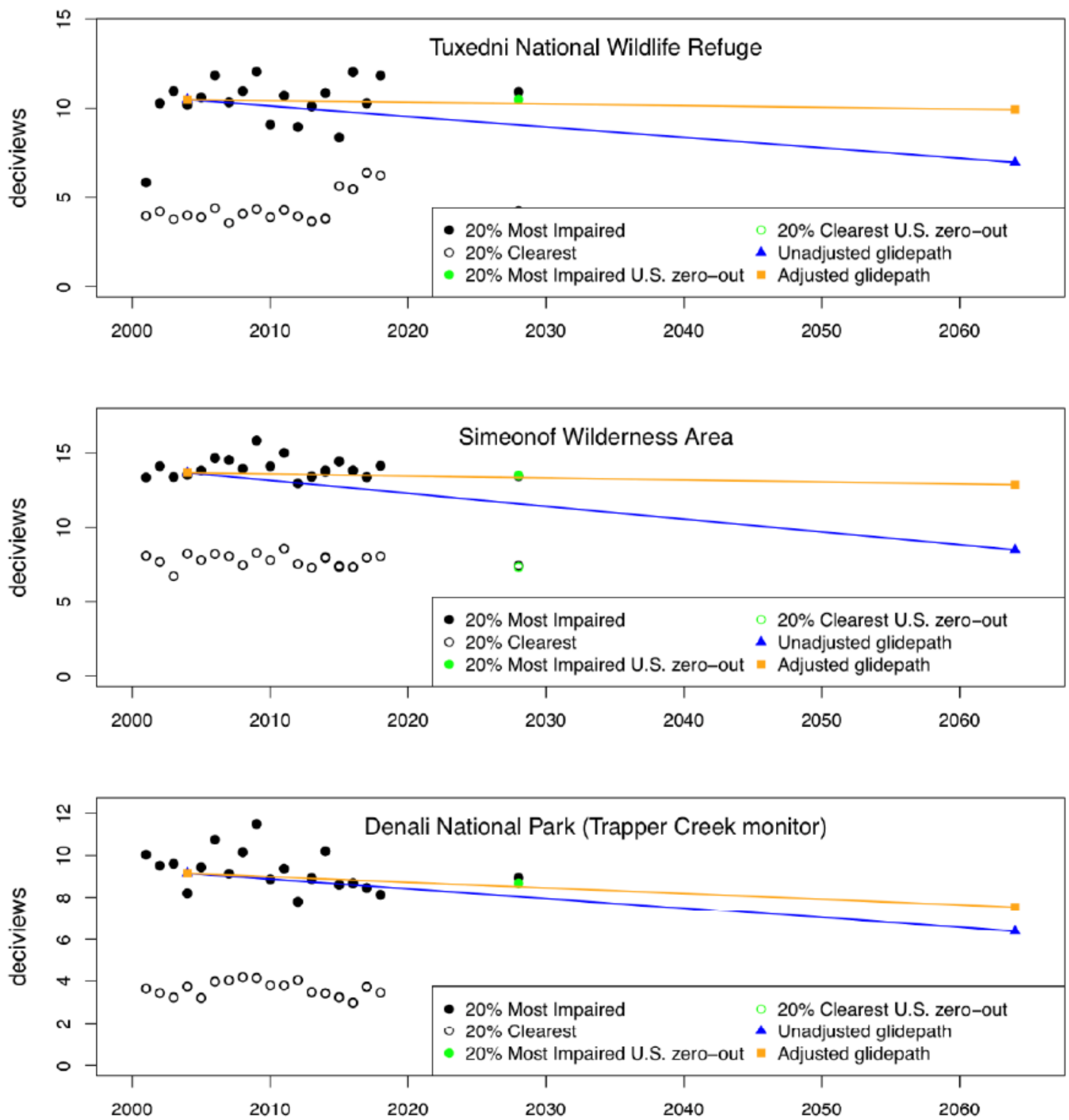
Table III.K.13.G-3 shows the 2028 visibility projections on the 20% MID that are below the 2000-2004 Baseline condition (see Section III.K.13.D). However, they are above the unadjusted and alternative, or "adjusted" (i.e., accounting for international anthropogenic emission contributions) 2028 glidepath. EPA estimated the international anthropogenic contributions to visibility using the hemispheric scale CMAQ zero-out model simulations. Only sulfate was added to the 2064 goal at each of these Class I areas to provide an adjusted glideslope. The estimate of international anthropogenic contribution is based on 2016 emissions and is not considering the contribution of international emissions to nitrate or primary $PM_{2.5}$ components.

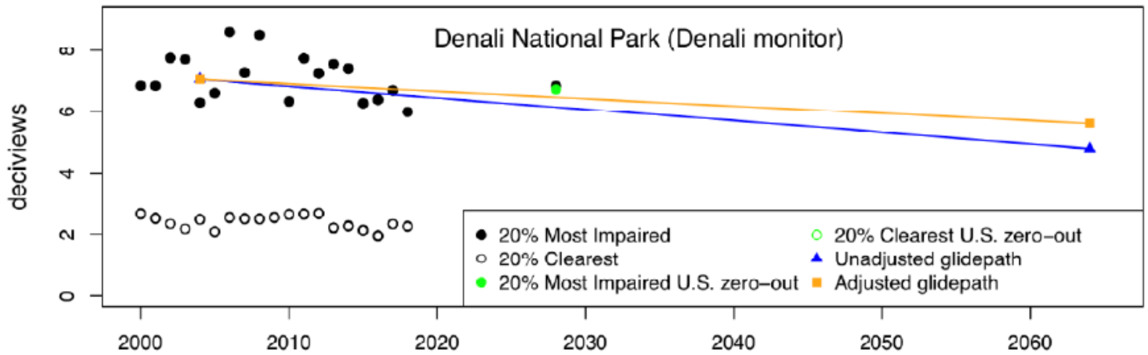
Table III.K.13.G-3. Observed IMPROVE 2014-2017 base year and projected 2028 future year visibility (deciview) on the 20% most impaired days at each IMPROVE site representing Class I areas in Alaska. [Source: EPA's Alaska CMAQ TSD]

Class I Area	IMPROVE site	Base Year (2014-2017) 20% Most Impaired Days (dv)	Future Year (2028) 20% Most Impaired Days (dv)	2028 Unadjusted Glidepath 20% Most Impaired Days (dv)	2028 Adjusted Glidepath 20% Most Impaired Days (dv)
Denali NP	TRCR1	8.99	8.95	8.05	8.52
Denali NP	DENA1	6.86	6.84	6.15	6.47
Tuxedni NWR	KPBO1/TUXE1	11.43	10.9	9.07	10.25
Simeonof WA	SIME1	13.86	13.43	11.6	13.35

Figure III.K.13.G-2 displays the URP Glidepath (blue line) for each Class I area in Alaska and shows that the projected 2028 MID (black solid circle; 2014-2017 base period) lies above the unadjusted and even the adjusted URP Glidepath (orange line). In fact, even when all U.S. anthropogenic emissions are eliminated (green solid circle), the 2028 projected MID is still above the adjusted URP glidepath. These results imply that the concept of glidepath may not be appropriate for Alaska given significant natural sulfur emissions in the area that are highly variable from year to year (see Section III.K.13.E-4) so that it is impossible to achieve the glidepath with controls of U.S. anthropogenic emissions.

Figure III.K.13.G-2. Default and Adjusted URP Glidepath at each Class I area in Alaska and 2028 visibility projections for the MID and clearest days from EPA's Alaska CMAQ modeling TSD. [Source: EPA's Alaska CMAQ TSD]





EPA's URP Glidepath approach was developed for use with Class I areas in the lower 48 states and has several issues when applied to Alaska. EPA's CMAQ modeling also has issues for use in Alaska regional haze modeling. The prevalent issues are as follows:

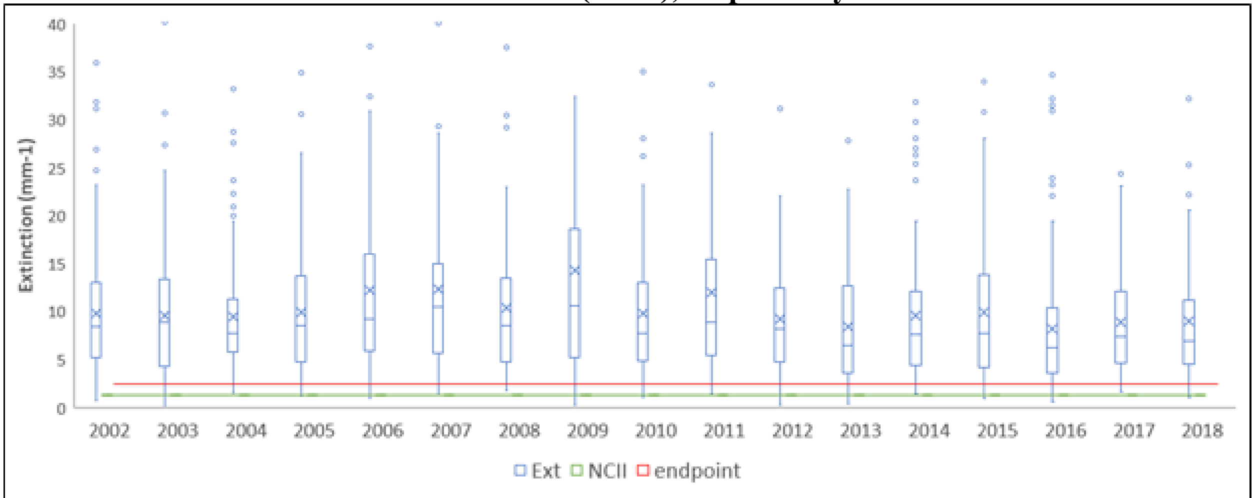
- EPA's CMAQ modeling did not include reactive sulfur emissions from volcanos or oceanic DMS or emissions from Russia. An analysis of the 2014 GEOS-Chem emissions inventory found that ~60% of the reactive sulfur emissions within the EPA's CMAQ Alaska 27-km domain were from volcano degassing and DMS (see Table III.K.13.E-7).

- The IMPROVE MID approach is a flawed visibility impairment metric for Alaska since potentially there can be a large component of natural sulfate from volcanos and DMS. The IMPROVE MID implicit assumption that, with the exception of background natural (NC II) conditions, visibility extinction due to $(NH_4)_2SO_4$ and NH_4NO_3 are mainly anthropogenic in origin is not true in Alaska. The potential influence of volcano emissions to $(NH_4)_2SO_4$ on the MID is shown in Figure III.K.13.E-11.

- The volcanic SO_2 emissions can exhibit significant inter-annual variability. If 2014-2018 are years with more active volcano SO_2 emissions compared to the baseline 2000-2004 at an Alaska Class I area, it will be impossible for the 2028 projection even without U.S. anthropogenic emissions to achieve the glidepaths since the 2014-2018 IMPROVE MID is used as the starting point for the 2028 projections (e.g., 2028 no U.S. emissions point in Figure III.K.13.G-2). The adjusted glidepaths are almost flat for TUXE1 and SIME1 so would not signify any efforts and success in reducing local emissions.

- Both NCII and 2064 endpoint for SO_4 are largely lower than the 25-percentile sulfate extinction at SIME1 (Figure III.K.13.G-3). Whether natural SO_4 is properly accounted for in the 2064 endpoint is difficult to determine without doing air quality modeling with these emissions.

Figure III.K.13.G-3. Whisker plot of sulfate extinction at SIME1. The bottom of each bar is the lower quartile. The red and green line displays the 2064 endpoint and natural conditions II (NCII), respectively.



- Given the issues described above, an alternative MID was developed by screening out IMPROVE days with high observed $(NH_4)_2SO_4$ to account for volcano emission impacts in a similar way to how fire and dust contributions are screened out using carbon and crustal measurements as proxies. New URP glidepaths were developed using the alternative MID with sulfur screening (see Appendix III.K.13.I).

4. ALASKA AREA OF INFLUENCE (AOI) AND WEIGHTED EMISSIONS POTENTIAL (WEP) ANALYSIS

Back-trajectory receptor models are useful tools for identifying source locations that have the potential to contribute to visibility impairment and have been used to facilitate regional haze planning. This section describes an AOI and WEP analysis that uses a back-trajectory model together with air quality measurement data and emission inventories to identify the geographic areas and emission sources with a high probability of contributing to anthropogenically impaired visibility at Class I areas within Alaska. The analysis focuses on the IMPROVE MID from 2014 to 2018 at the IMPROVE sites representing Class I areas in the state. The IMPROVE sites in this analysis are DENA1, TRCR1, SIME1, and TUXE1 that represent three Alaska Class I areas as shown in Table III.K.13.G-4. The TUXE1 site stopped operating in 2014 so the MID from 2012 to 2014 were used instead of the 2014-2018 period as used for the other Alaska IMPROVE sites. The Kenai Peninsula Borough (KPBO1) site was added to replace TUXE1 with 2016 being its first full year, but KPBO1 could not be included in the WEP/AOI analysis as no MID metric data is available for the site. Instead, an AOI and WEP analysis was performed for the 20% highest measured visibility extinction days for $(NH_4)_2SO_4$, NH_4NO_3, and CM at TUXE1 and KPBO1 for the 3 most recent years of available data (2012 to 2014 and 2016 to 2018, respectively).[6]

Table III.K.13.G-4. Alaska Class I Areas and IMPROVE monitoring sites included in the Area of Influence and Weighted Emissions Potential analysis.

Class I Area	IMPROVE Site	Analysis Period
Denali National Park and Preserve	Denali Headquarters Site (DENA1)	2014 - 2018
	Trapper Creek Site (TRCR1)	2014 - 2018
Simeonof Wilderness Area	Simeonof (SIME1)	2014 - 2018
Tuxedni National Wildlife Refuge	Tuxedni (TUXE1)	2012 - 2014
	Kenai Peninsula Borough (KPBO1)	2016 – 2018*

* The KPBO1 IMPROVE site first full year of operation was 2016 so was not included in the analysis of MID as no MID impairment metric data is available for the site as the 95th percentile carbon and crustal thresholds were based on analyzing IMPROVE data from 2000-2014.

A PSC analysis was also performed to characterize the relative potential contributions of natural (e.g., volcano) and anthropogenic (e.g., on-road mobile sources) emission sources groups to the $(NH_4)_2SO_4$ extinction on the MID. The input data, methods, and resulting data products for the WEP/AOI and PSC analyses are described separately in the following sections. Although the procedures used to conduct the Alaska WEP/AOI analysis of anthropogenic emissions and PSC analysis of natural and anthropogenic SO_x emissions are similar, they are very different analysis and need to be viewed separately. Details and more products from the Alaska WEP/AOI and PSC analysis are available on the WRAP TSS website.[7]

A. Area of Influence Analysis Metrics

There are three metrics used to characterize areas and emission sources that have the potential to contribute to visibility degradation at Class I areas.

i. Residence Time Analysis

The residence time (RT) is the cumulative time that trajectories reside in a specific geographical area (the EPA's 9-km domain aggregated to 27-km resolution in this study) and are normalized to display percentage of total trajectory time:

$$\tau_{ij} = \frac{1}{NT}\sum_{k=1}^{N} \tau_{ijk}$$

[6] The 20% highest ammonium sulfate, ammonium nitrate, and CM days at TUXE1 and KPBO1 were identified using the IMPROVE Daily Budgets dataset [http://vista.cira.colostate.edu/DataWarehouse/IMPROVE/Data/SummaryData/RHR_2018/Updated/SIA_daily_budgets_4_20_2.csv]

[7] http://views.cira.colostate.edu/tssv2/WEP-AOI-AK/

where τ_{ij} is the residence time of the k^{th} trajectory at the grid cell (i, j), N is the total number of trajectories, and T is the duration of each trajectory. The Hybrid Single-Particle Lagrangian Integrated Trajectory (HYSPLIT) model[8,9] was used to calculate 72-hour (3-day) back trajectories arriving at the IMPROVE site location on each of the MID at four times per day (6:00, 12:00, 18:00, 24:00 local standard time) and at four heights above the ground (100 meter (m), 200 m, 500 m and 1,000 m). The 2012 to 2018 meteorological data used in the HYSPLIT model is the NAM hybrid sigma-pressure gridded (NAMS) for Alaska at 12 km resolution.

ii. Extinction Weighted Residence Time

The extinction weighted residence time (EWRT) defines geographical areas with a high probability of influencing visibility (i.e. the area of influence) at each of the IMPROVE sites that has impairment due to $(NH_4)_2SO_4$, NH_4NO_3, OMC and EC:

$$EWRT_{ij} = \sum_{k=1}^{N} b_{ext_k} \tau_{ijk}$$

where b_{ext} is the extinction coefficient attributed to the pollutant (i.e., $(NH_4)2SO_4$, NH_4NO_3, or CM) measured upon arrival of the k^{th} trajectory at the IMPROVE site.

iii. Weighted Emissions Potentials

The WEP determines the potential impacts from sources by combing the EWRT values with anthropogenic emissions (Q) from sources. To incorporate the dilution effects of dispersion, deposition, and chemical transformation along the path of the trajectories, emissions were inversely weighted by the distance (d) between the centers of the grid cell emitting the emissions and the grid cell containing the IMPROVE site. Each grid cell has a horizontal resolution of 27 km x 27 km.

$$\frac{Q_{ij}}{d_{ij}} EWRT_{ij}$$

[8] Stein, A.F., Draxler, R.R, Rolph, G.D., Stunder, B.J.B., Cohen, M.D., and Ngan, F., (2015). NOAA's HYSPLIT atmospheric transport and dispersion modeling system, Bull. Amer. Meteor. Soc., 96, 2059-2077, http://dx.doi.org/10.1175/BAMS-D-14-00110.1

[9] Rolph, G., Stein, A., and Stunder, B., (2017). Real-time Environmental Applications and Display sYstem: READY. Environmental Modelling & Software, 95, 210-228, https://doi.org/10.1016/j.envsoft.2017.06.025

B. Emission Input Data

The WEP analysis was performed using both gridded emissions from the EPA 2016 Alaska CMAQ modeling platform and 2014 and 2017 facility-level NEI data. The EPA 2016 gridded emissions of NO_x, SO_x, primary organic aerosol (POA), and EC were used for the analysis of $(NH_4)_2SO_4$, NH_4NO_3, OMC, and EC, respectively, and were aggregated into the following source sectors for the WEP analysis:

- TOTAL_ANTHRO – All anthropogenic emissions
- PT_EGU – Electric generating unit emissions
- PT_NON-EGU – Point source emissions from industrial activities
- OG_AREA_POINT – Oil and Gas area and point sources (Upstream and Midstream)
- NON-POINT – Low-level area source emissions including non-point, agricultural, residential wood combustion, and fugitive dust emissions
- ON-ROAD – On-road mobile source emissions
- NON-ROAD – Off highway mobile source emissions including non-road, airport, commercial marine (C1, C2, and C3), and rail sources

C. AOI and WEP Results

For each Class I area, images of the RT, EWRT, and WEP were generated for the 100 m and 1000 m heights and for a combined analysis in which data from all trajectory heights are aggregated (All). The interpretation of these results can be made qualitatively and quantitatively. The RH Rule has no specific guidance on threshold values for residence time. As an aid to analysis, contour boundaries were added to identify regions with scaled residence time values greater than 0.05%, 0.1%, 0.2%, 0.5%, and 1%. Figures III.K.13.G-4 through III.K.13.G-19 present examples of plot products generated for each Class I area. All plots in this analysis can be found on the Alaska WEP-PSC webpage[10] on the WRAP TSS website.

i. Denali – DENA1

The RT pattern for the MID in 2014-2018 at DENA1 shows a relatively dense, almost bull's-eye pattern with nearby locations having the maximum RT, which diminishes with distance (Figure III.K.13.G-4). The pattern is stretched, however, from the southwest to the northeast, suggesting that sources in Anchorage, Mat-Su, and Fairbanks are principal contributors. The similarity of the unweighted RT (Figure III.K.13.G-4) and the SO_4 EWRT (Figure III.K.13.G-5) plots imply that the MID are largely driven by high SO_4 concentrations, although NO_3 also contributes (Figure III.K.13.G-5). The potential impact from NO_x emission sources can be determined using the WEP plots in Figure III.K.13.G-6 which also shows contour boundaries (in green) to help define the NO_x AOI as those areas with EWRT greater than 0.1% or 0.5%. Non-EGU point NO_x emissions near the DENA1 site are shown to have WEP values exceeding 5%. On-road and non-road mobile sources contribute more than 0.1% of WEP values. The SO_2 WEP plots in Figure

10 https://views.cira.colostate.edu/tssv2/WEP-AOI-AK/

III.K.13.G-7 indicate that EGU and Non-EGU point SO_2 sources have WEP values exceeding 3%.

Figure III.K.13.G-4. Residence Time (RT) analysis for DENA1 monitoring site and back trajectories that arrive at the site on the Most Impaired Days for each year 2014-2018 at 100 m (left), 1000 m (middle) and all (right) heights above ground.

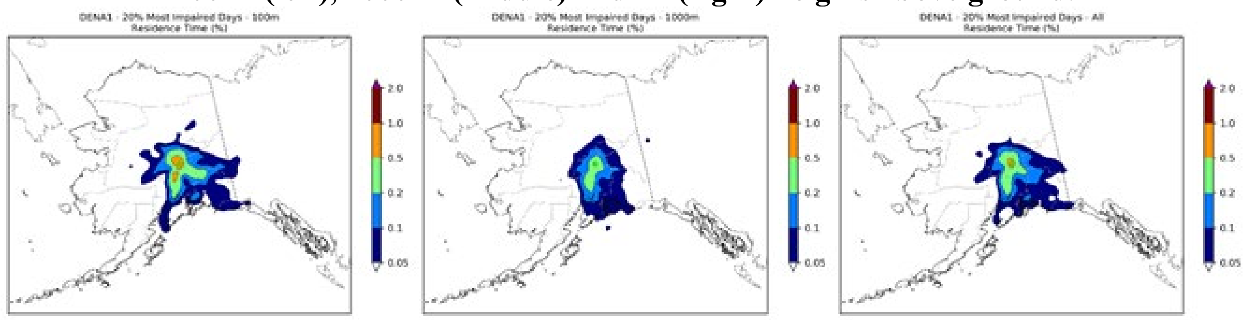


Figure III.K.13.G-5. Extinction Weighted Residence Time (EWRT) analysis for ammonium nitrate (left) and ammonium sulfate (right) at the DENA1 monitor for the Most Impaired Days during 2014-2018 aggregated across all trajectory heights.

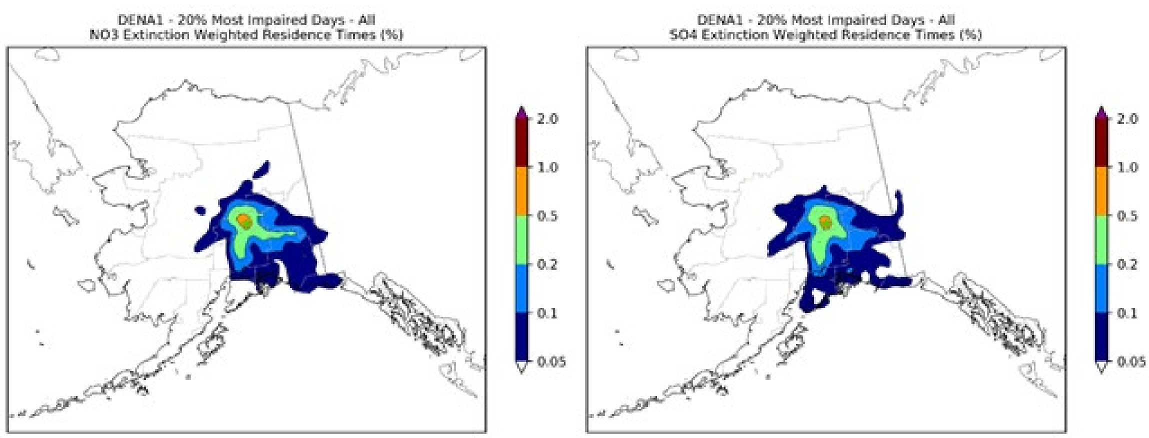


Figure III.K.13.G-6. Weighted Emissions Potential (WEP) analysis for ammonium nitrate extinction at the DENA1 monitor on the Most Impaired Days during each year of 2014-2018 for NO_x emissions from four Source Sectors: (1) total anthropogenic (top left), (2) Oil and Gas (top right), (3) On-road mobile (middle left), (4) Non-road mobile (middle right), (5) EGU point (bottom left) and (6) Non-EGU point sources (bottom right). Results are aggregated across all trajectories' heights.

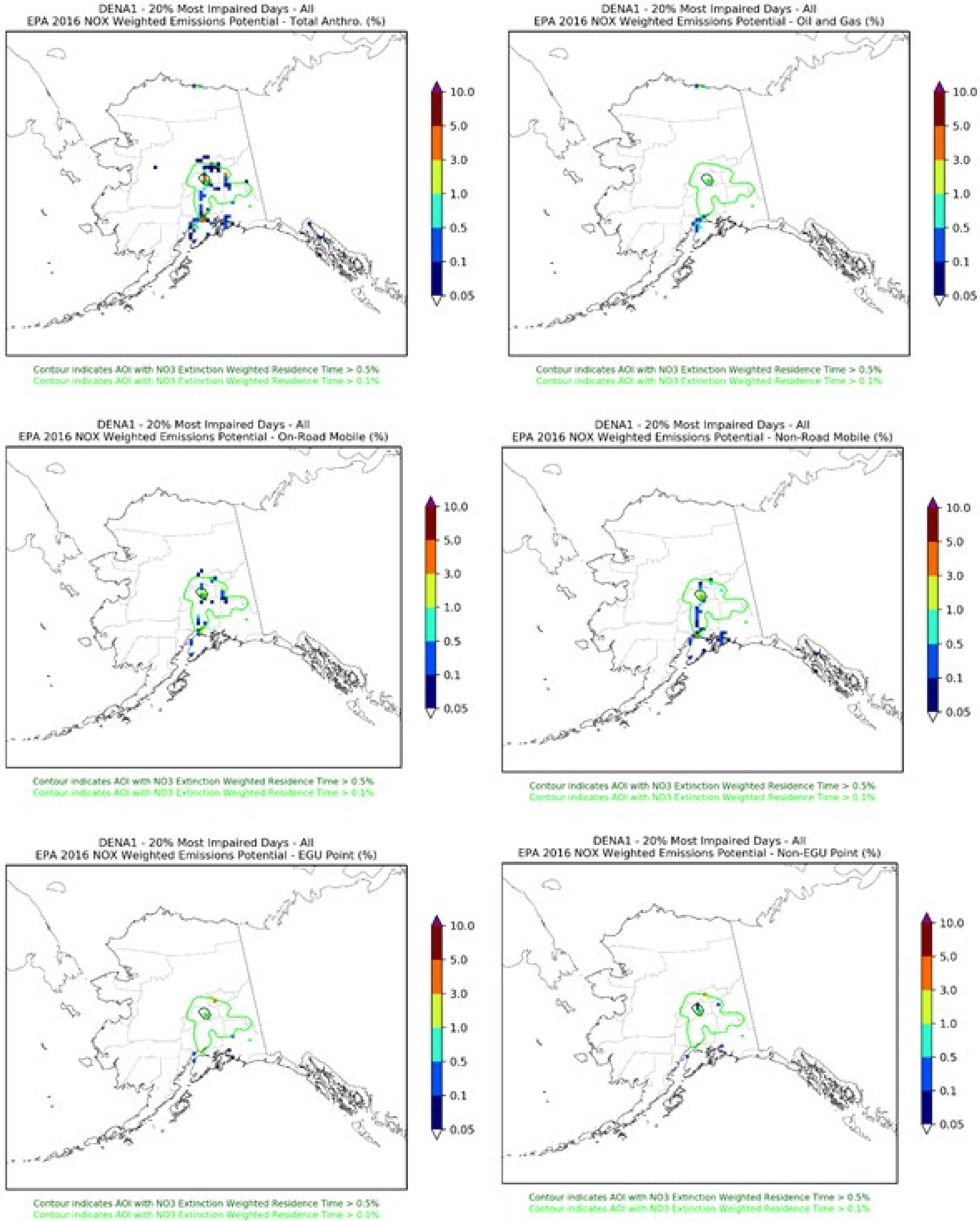
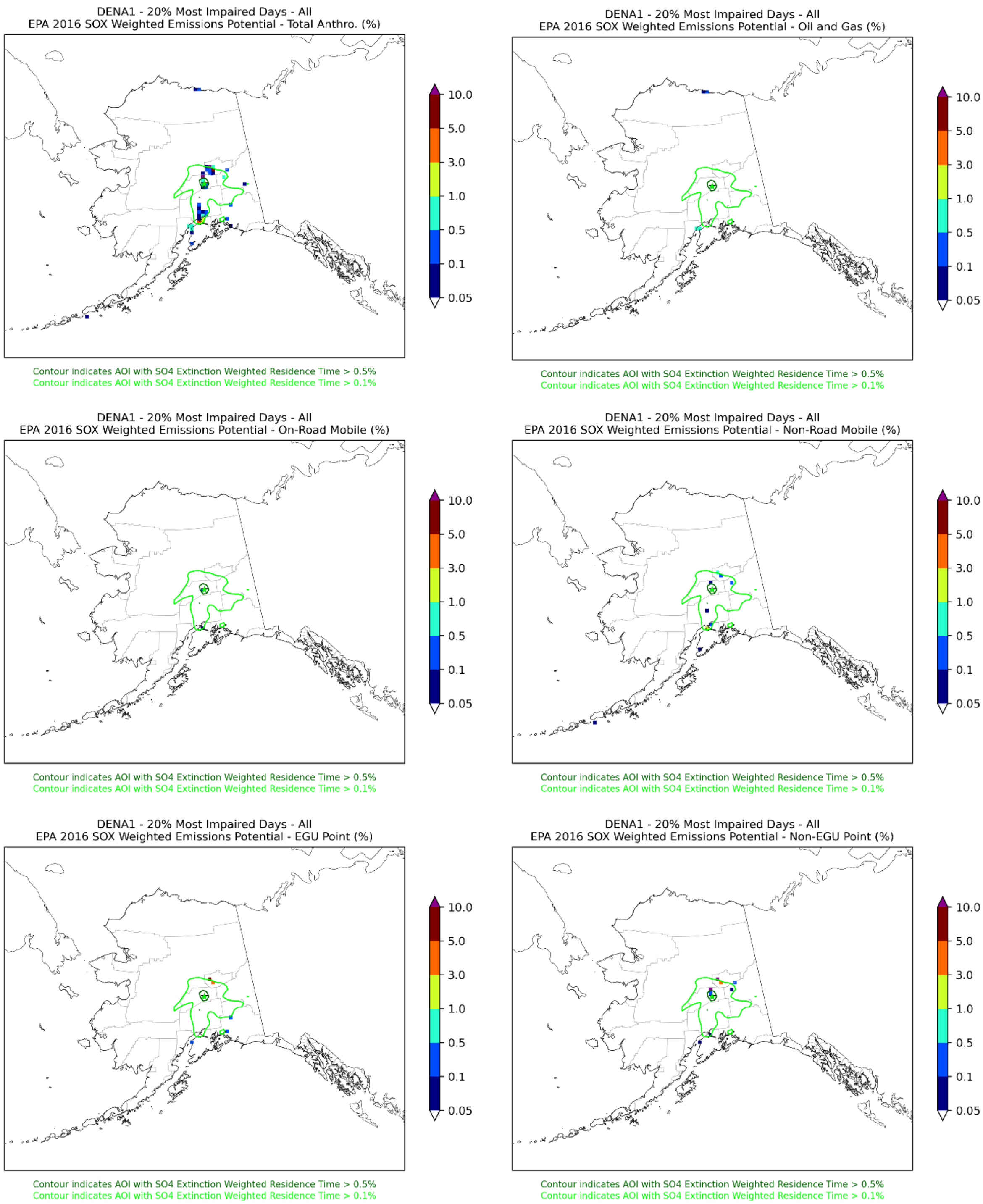


Figure III.K.13.G-7. Weighted Emissions Potential (WEP) analysis for ammonium sulfate extinction at the DENA1 monitor on the Most Impaired Days during each year of 2014-2018 for SO_x emissions from five Source Sectors.



ii. Trapper Creek – TRCR1

A similar, but a less symmetrical, pattern of RT and EWRT is seen in Figures III.K.13.G-8 and III.K.13.G-9 for the MID at Trapper Creek IMPROVE site. The WEP plots show a complex mixture of source contributions. On-road and non-road mobile sources contribute more than 5% of NO_x WEP values while oil & gas and EGU point sources are shown to have WEP values exceeding 3% (Figure III.K.13.G-10). The SO_2 WEP plots (Figure III.K.13.G-11) show non-road mobile and oil & gas SO_2 sources to have WEP values exceeding 5%.

Figure III.K.13.G-8. Residence Time (RT) analysis for TRCR1 IMPROVE monitoring site and back trajectories that arrive at the site on the Most Impaired Days for each year 2014-2018 at 100 m (left), 1000 m (middle) and All (right) heights above ground.

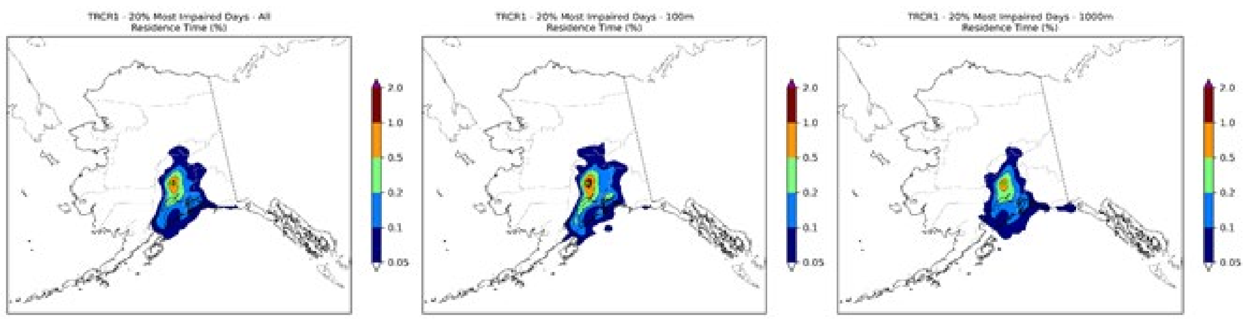


Figure III.K.13.G-9. Extinction Weighted Residence Time (EWRT) analysis for ammonium nitrate (left) and ammonium sulfate (right) at the TRCR1 monitor for the Most Impaired Days during 2014-2018 aggregated across all trajectory heights.

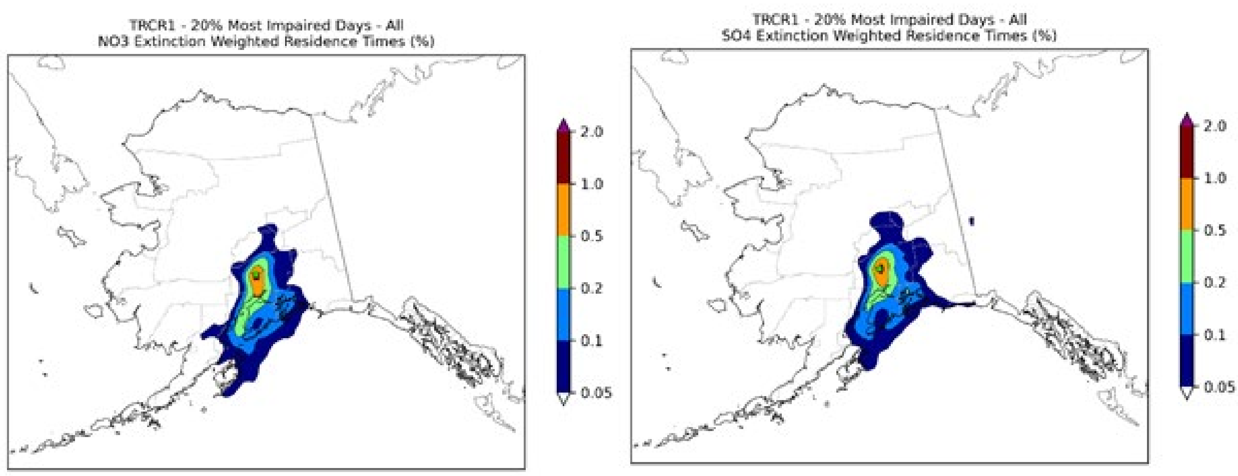


Figure III.K.13.G-10. Weighted Emissions Potential (WEP) analysis for ammonium nitrate extinction at the TRCR1 monitor on the Most Impaired Days during each year of 2014-2018 for NO_x emissions from four Source Sectors.

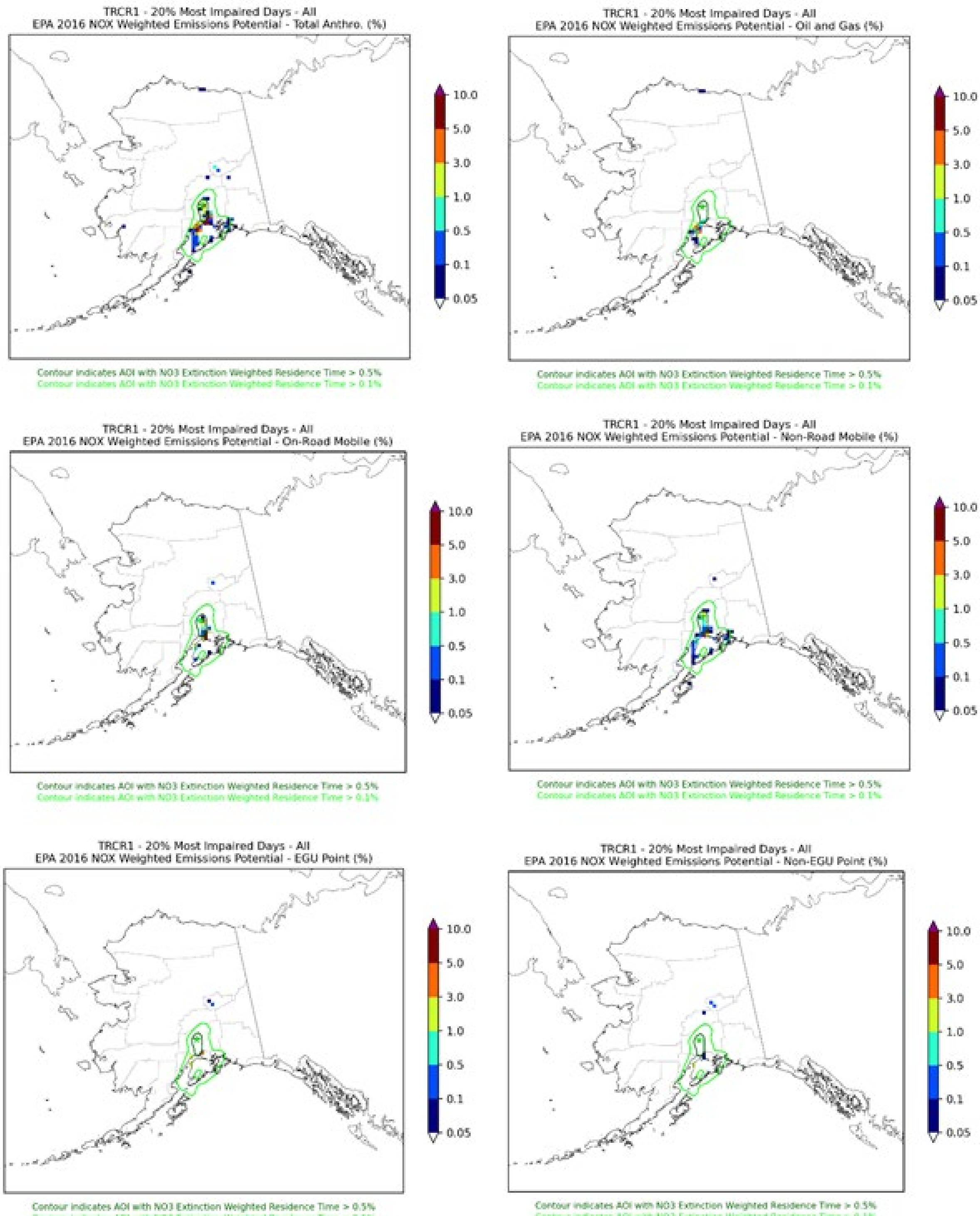
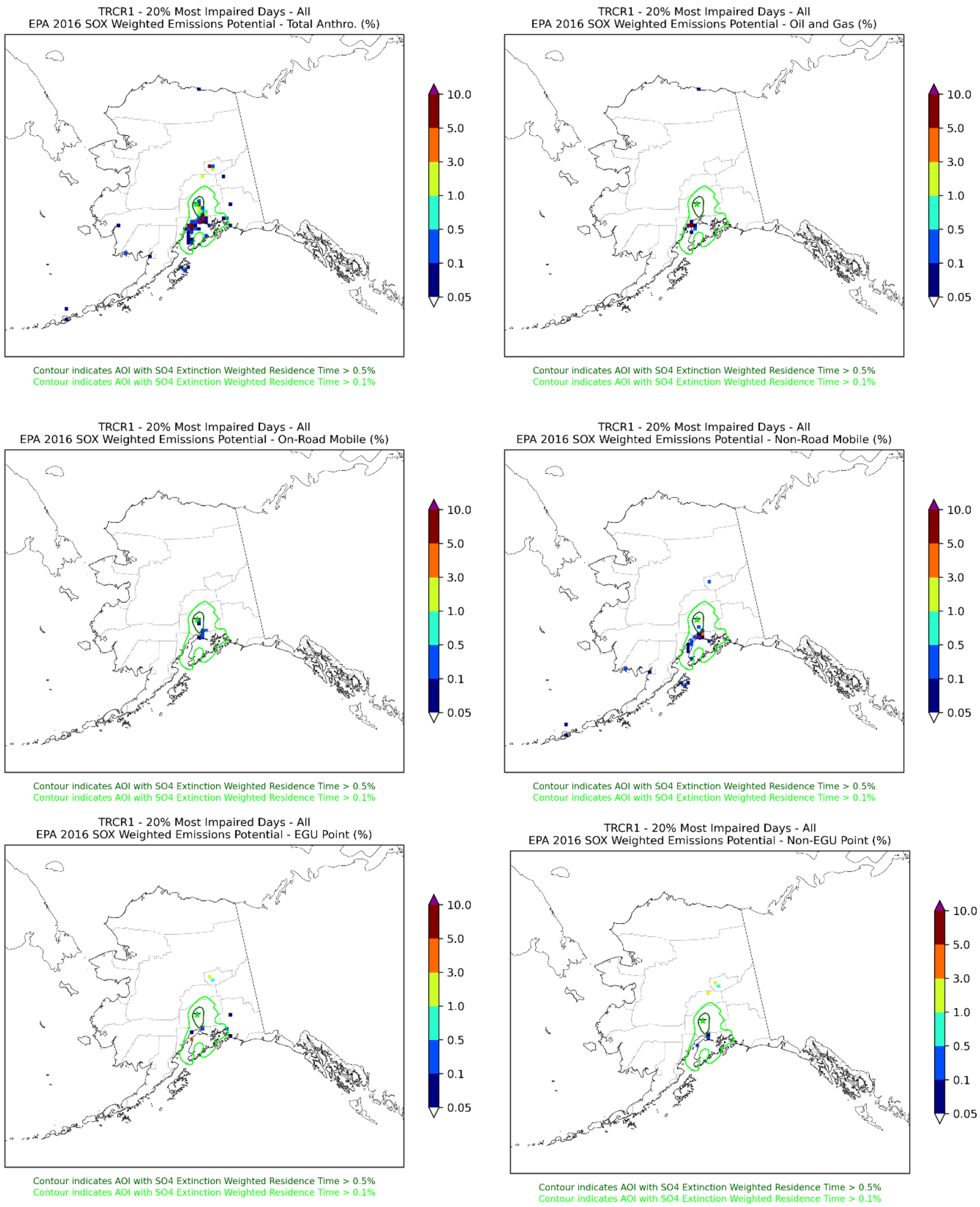


Figure III.K.13.G-11. Weighted Emissions Potential (WEP) analysis for ammonium sulfate extinction at the TRCR1 monitor on the Most Impaired Days during each year of 2014-2018 for SO_x emissions from five Source Sectors.



iii. Simeonof – SIME1

The area of maximum impact on the MID at SIME1 stretches toward the southwest following the Aleutian Island chain, which is primarily open water (Figures III.K.13.G-12 and III.K.13.G-13). The RT of locations in the central part of the state is shown to be much less. However, since the density of anthropogenic emissions within the Aleutian Islands is significantly lower than from the areas within the mainland, it will be important to account for the effect of RT, distance, and emissions density when determining which sources have the potential to have the highest impact at Simeonof (and each of the other sites). Figure III.K.13.G-14 and Figure III.K.13.G-15 show that shipping (non-road) is the dominant anthropogenic source of NO_x and SO_2 impacting the site.

Figure III.K.13.G-12. Residence Time (RT) analysis for SIME1 monitoring site and back trajectories that arrive at the site on the Most Impaired Days for each year 2014-2018 at 100 m (left), 1000 m (middle) and All (right) heights above ground.

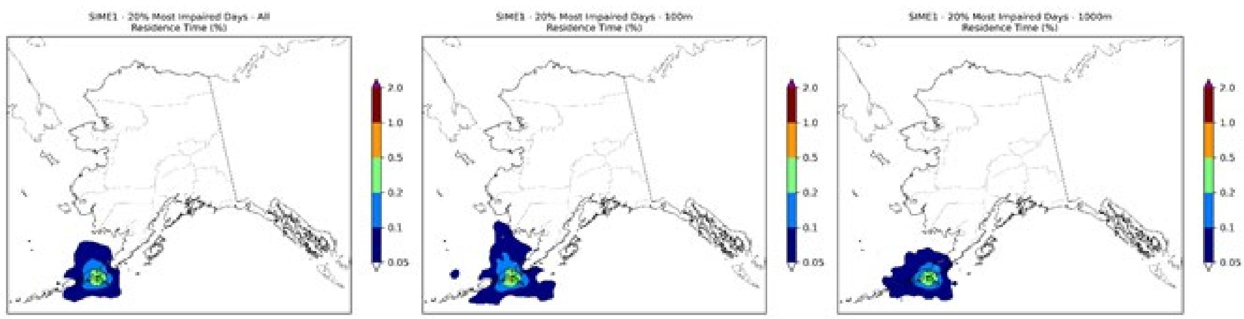


Figure III.K.13.G-13. Extinction Weighted Residence Time (EWRT) analysis for ammonium nitrate (left) and ammonium sulfate (right) at the SIME1 monitor for the Most Impaired Days during 2014-2018 aggregated across all trajectory heights.

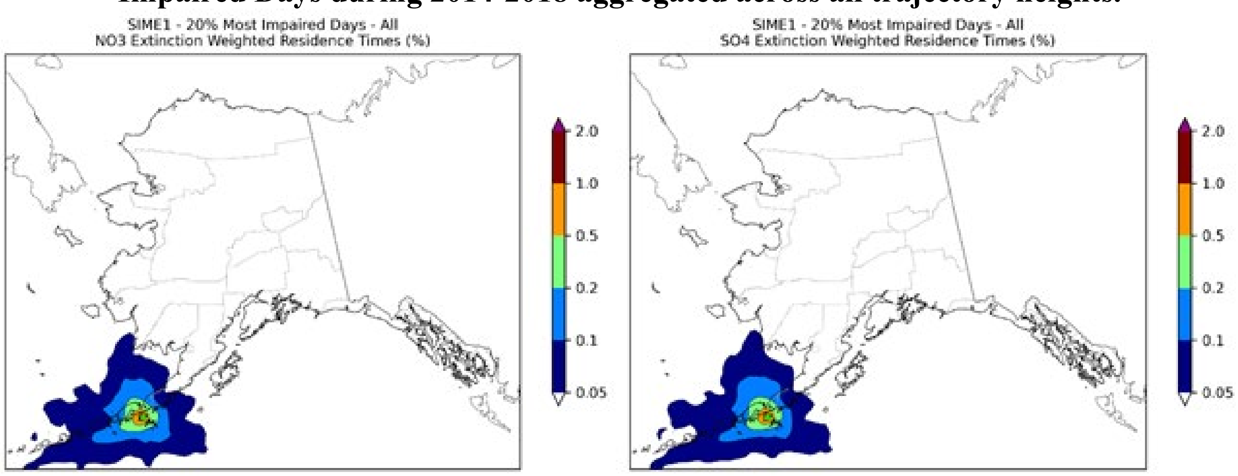


Figure III.K.13.G-14. Weighted Emissions Potential (WEP) analysis for ammonium nitrate extinction at the SIME1 monitor on the Most Impaired Days during each year of 2014-2018 for NOx emissions from four Source Sectors.

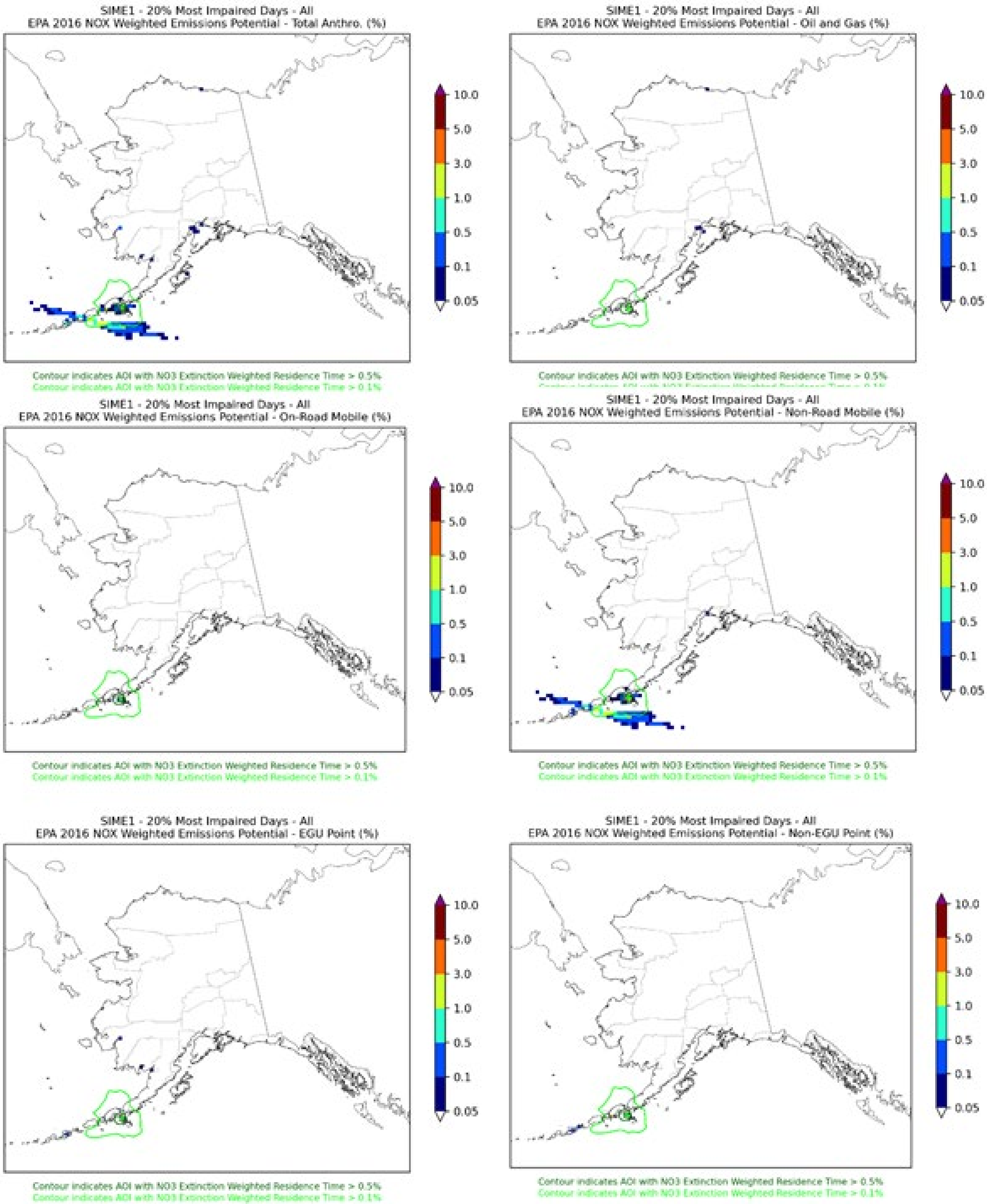
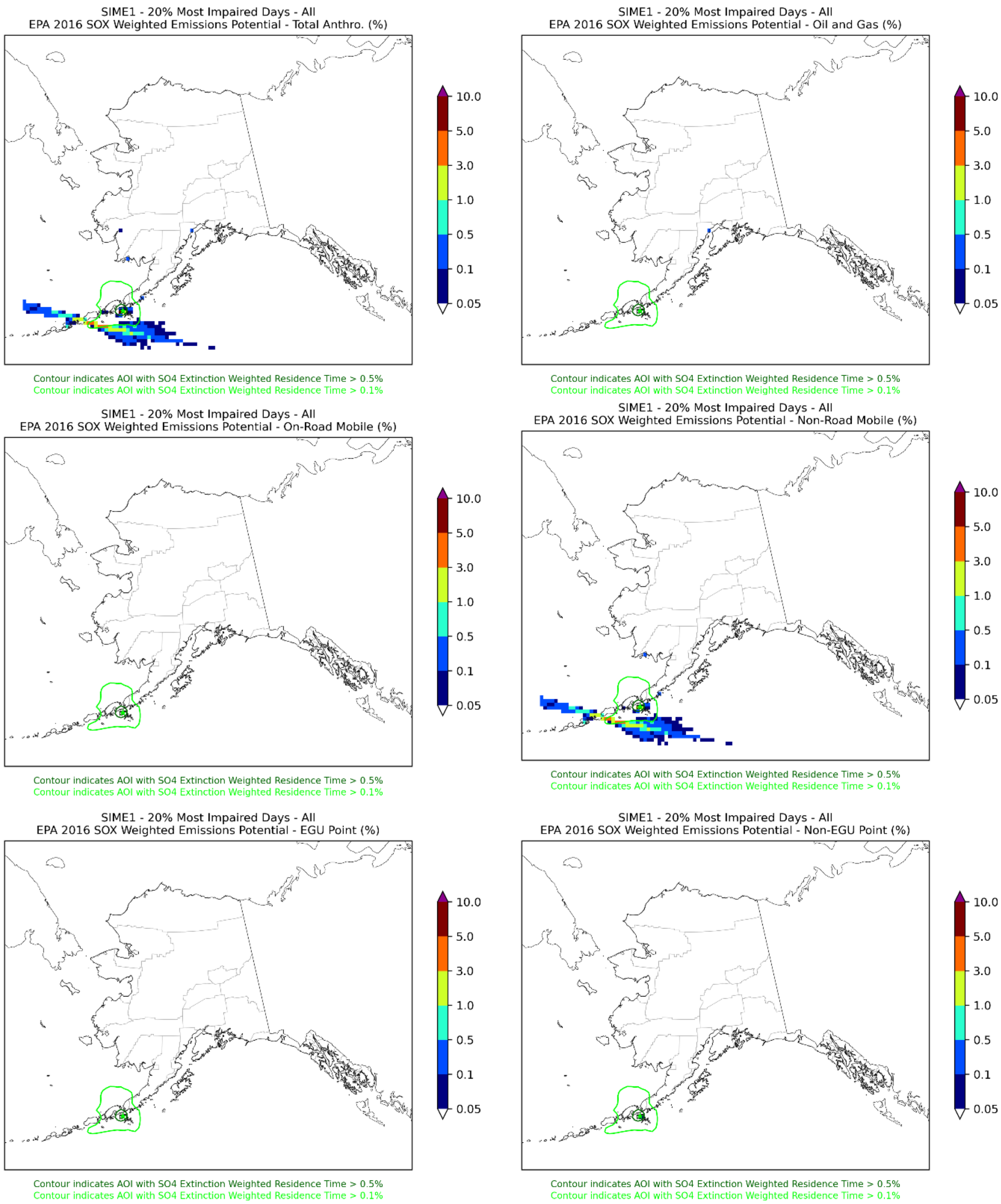


Figure III.K.13.G-15. Weighted Emissions Potential (WEP) analysis for ammonium sulfate extinction at the SIME1 monitor on the Most Impaired Days during each year of 2014-2018 for SO_x emissions from five Source Sectors.



iv. Tuxedni – TUXE1

Figures III.K.13.G-16 and III.K.13.G-17 show that the pattern on the MID for Tuxedni is less symmetrical for the areas with the greatest RT, and areas to the east have greater influence than those to the west. Sources located in the Kenai, Anchorage, and Mat-Su are likely to have a significant impact on this site. Oil and gas sources near Anchorage are shown to be the largest source of NO_x and SO_2 emissions contributing more than 3-5% of WEP values (Figure III.K.13.G-18 and Figure III.K.13.G-19).

Figure III.K.13.G-16. Residence Time (RT) analysis for TUXE1 monitoring site and back trajectories that arrive at the site on the Most Impaired Days for each year 2014-2018 at 100 m (left), 1000 m (middle) and All (right) heights above ground.

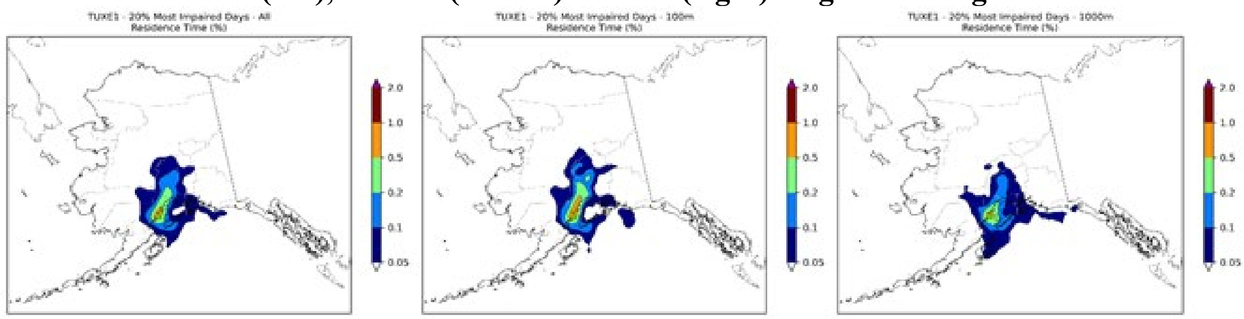


Figure III.K.13.G-17. Extinction Weighted Residence Time (EWRT) analysis for ammonium nitrate (left) and ammonium sulfate (right) at the TUXE1 monitor for the Most Impaired Days during 2014-2018 aggregated across all trajectory heights.

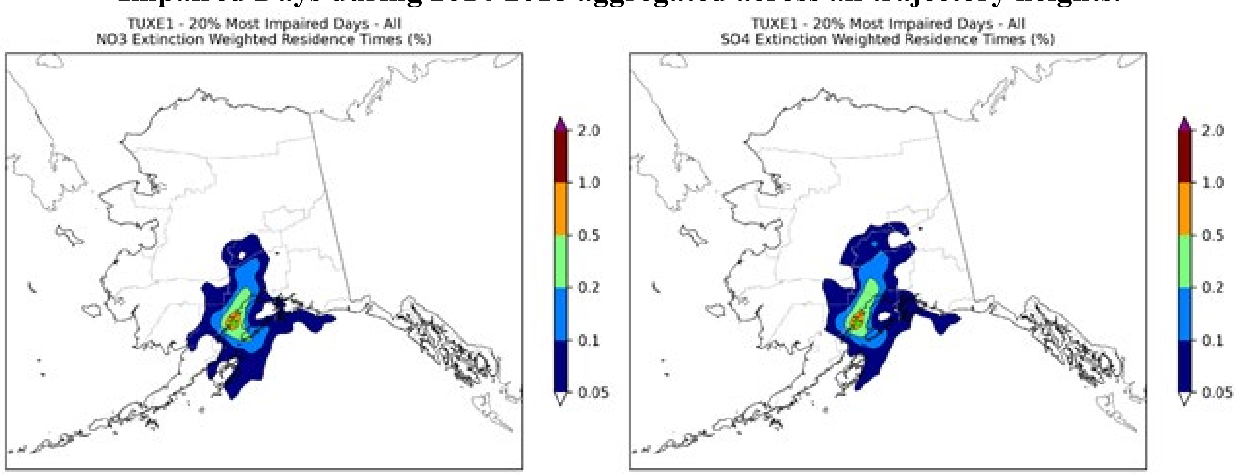


Figure III.K.13.G-18. Weighted Emissions Potential (WEP) analysis for ammonium nitrate extinction at the TUXE1 monitor on the Most Impaired Days during each year of 2014-2018 for NO_x emissions from four Source Sectors.

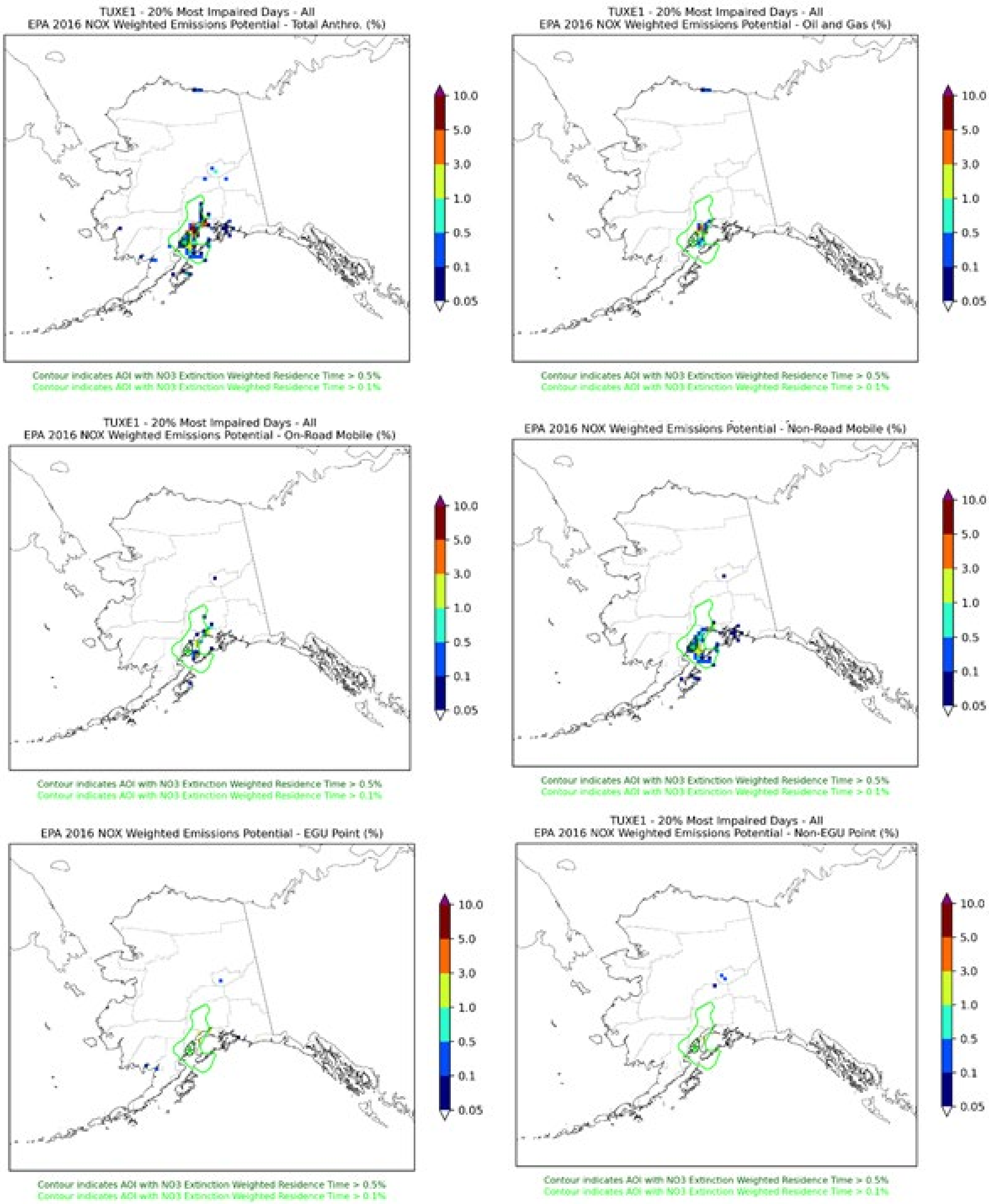
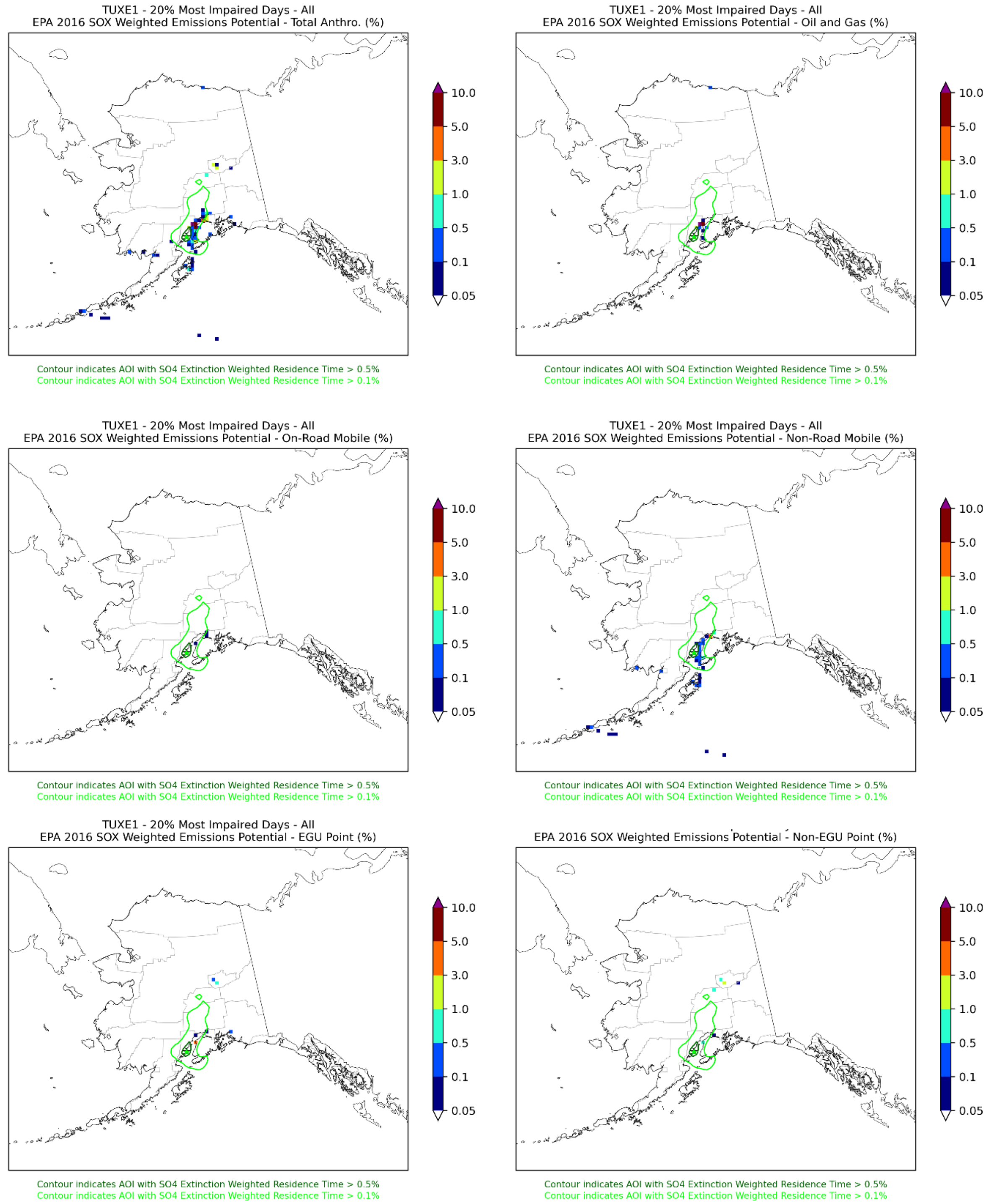


Figure III.K.13.G-19. Weighted Emissions Potential (WEP) analysis for ammonium sulfate extinction at the TUXE1 monitor on the Most Impaired Days during each year of 2014-2018 for SO_x emissions from five Source Sectors.



D. Ranking of Potential Contributions by Facility

SO_2 and NO_x are the main anthropogenic pollutants that affect visibility at Class I areas in Alaska. On an individual basis, point sources are the largest contributors to anthropogenic SO_2 and NO_x emissions; therefore, the state of Alaska elected to focus on point sources in this planning period. The facility-level WEP and Q/d analysis is used to select the sources to be included in four-factor analysis. The top 10 facilities at each Class I area based on the WEP analysis are present in Table III.K.13.G-5 through Table III.K.13.G-12. Both 2014 and 2017 emissions were considered; only the 2017 results are presented below.

Table III.K.13.G-5. Top 10 facilities whose 2017 NO_x emissions have the potential to contribute to visibility impairment due to ammonium nitrate at DENA1 on the Most Impaired Days for each year in 2014-2018.

Facility ID	Facility Name	County	d (m)	Q (tpy)	EWRT NO_3	Q/d	WEP NO_3
229000002	Golden Valley Electric Association; Healy Power Plant	Denali Borough (068)	14,041	231	3289	16.4	54079
209000011	Golden Valley Electric Association; North Pole Power Plant	Fairbanks North Star Borough (090)	136,548	843	327	6.2	2017
209000081	Doyon Utilities, LLC; Fort Wainwright (Privatized Emission Units)	Fairbanks North Star Borough (090)	137,560	603	334	4.4	1461
209000002	Aurora Energy LLC; Chena Power Plant	Fairbanks North Star Borough (090)	137,883	592	334	4.3	1432
209000007	University of Alaska; Fairbanks Campus Power Plant	Fairbanks North Star Borough (090)	136,810	316	334	2.3	771
209000001	US Air Force (Eielson); Eielson Air Force Base	Fairbanks North Star Borough (090)	139,142	307	327	2.2	720
212200046	Hilcorp Alaska, LLC; Swanson River Field	Kenai Peninsula Borough (122)	346,110	2121	92	6.1	563
218500022	BP Exploration (Alaska) Inc.; Central Gas Facility (CGF)	North Slope Borough (185)	731,770	5833	43	8.0	346
218500075	BP Exploration (Alaska) Inc.;	North Slope	731,744	8274	29	11.3	327

Facility ID	Facility Name	County	d (m)	Q (tpy)	EWRT NO_3	Q/d	WEP NO_3
	Central Compressor Plant (CCP)	Borough (185)					
202000001	Anchorage Municipal Light & Power; George Sullivan Plant Two	Anchorage Borough (020)	279,166	277	232	1.0	231

Table III.K.13.G-6. Top 10 facilities whose 2017 SO_x emissions have the potential to contribute to visibility impairment due to ammonium sulfate at DENA1 on the Most Impaired Days for each year in 2014-2018.

Facility ID	Facility Name	County	d (m)	Q (tpy)	EWRT SO_4	Q/d	WEP SO_4
229000002	Golden Valley Electric Association; Healy Power Plant	Denali Borough (068)	14041	296	30665	21.1	647333
209000002	Aurora Energy LLC; Chena Power Plant	Fairbanks North Star Borough (090)	137883	628	3316	4.6	15094
209000081	Doyon Utilities, LLC; Fort Wainwright (Privatized Emission Units)	Fairbanks North Star Borough (090)	137560	460	3316	3.3	11090
209000001	US Air Force (Eielson); Eielson Air Force Base	Fairbanks North Star Borough (090)	139142	263	3739	1.9	7062
209000011	Golden Valley Electric Association; North Pole Power Plant	Fairbanks North Star Borough (090)	136548	247	3739	1.8	6770
209000007	University of Alaska; Fairbanks Campus Power Plant	Fairbanks North Star Borough (090)	136810	164	3316	1.2	3971
209000003	Golden Valley Electric Association; Zehnder Facility	Fairbanks North Star Borough (090)	138781	30	3316	0.2	706
226100031	Copper Valley Electric Association; Glennallen Diesel Plant	Valdez-Cordova Census Area (261)	248383	40	4055	0.2	653

Facility ID	Facility Name	County	d (m)	Q (tpy)	EWRT SO_4	Q/d	WEP SO_4
202000002	Doyon Utilities, LLC; DU-JBER-Electric, Gas, Drinking Water and Sanitary Services	Anchorage Borough (020)	276122	52	3475	0.2	650
229000070	Mystery Creek Resources, Inc.; Nixon Fork Mine, McGrath	Yukon-Koyukuk Census Area (290)	290670	55	957	0.2	180

Table III.K.13.G-7. Top 10 facilities whose 2017 NO_x emissions have the potential to contribute to visibility impairment due to ammonium nitrate at TRCR1 on the Most Impaired Days for each year in 2014-2018.

Facility ID	Facility Name	County	d (m)	Q (tpy)	EWRT NO_3	Q/d	WEP NO_3
212200046	Hilcorp Alaska, LLC; Swanson River Field	Kenai Peninsula Borough (122)	178,330	2121	981	11.9	11671
212200031	Chugach Electric Association; Beluga River Power Plant	Kenai Peninsula Borough (122)	130,956	370	2059	2.8	5813
212200104	Alaska Electric and Energy Cooperative; Nikiski Combined Cycle Plant	Kenai Peninsula Borough (122)	190,436	467	1762	2.5	4323
202000001	Anchorage Municipal Light & Power; George Sullivan Plant Two	Anchorage Borough (020)	124,470	277	1714	2.2	3815
212200066	Tesoro Alaska Company, LLC; Kenai Refinery	Kenai Peninsula Borough (122)	189,301	374	1762	2.0	3479
217000005	Titan Alaska LNG, LLC (formerly Fairbanks Natural Gas, LLC); LNG Plant #1	Matanuska-Susitna Borough (170)	99,209	104	3256	1.0	3411

Facility ID	Facility Name	County	d (m)	Q (tpy)	EWRT NO_3	Q/d	WEP NO_3
212200061	Hilcorp Alaska, LLC; Platform A	Kenai Peninsula Borough (122)	179,771	231	2200	1.3	2822
212200009	Hilcorp Alaska, LLC; Tyonek Platform	Kenai Peninsula Borough (122)	141,390	145	2256	1.0	2316
212200041	Hilcorp Alaska, LLC; Bruce Platform	Kenai Peninsula Borough (122)	173,455	148	2200	0.9	1875
212200062	Hilcorp Alaska, LLC; Platform C, Middle Ground Shoal, Cook Inlet	Kenai Peninsula Borough (122)	183,227	148	2200	0.8	1778

Table III.K.13.G-8. Top 10 facilities whose 2017 SO_x emissions have the potential to contribute to visibility impairment due to ammonium sulfate at TRCR1 on the Most Impaired Days for each year in 2014-2018.

Facility ID	Facility Name	County	d (m)	Q (tpy)	EWRT SO_4	Q/d	WEP SO_4
202000002	Doyon Utilities, LLC; DU-JBER-Electric, Gas, Drinking Water and Sanitary Services	Anchorage Borough (020)	121591	52	17713	0.4	7523
229000002	Golden Valley Electric Association; Healy Power Plant	Denali Borough (068)	183170	296	3887	1.6	6290
209000002	Aurora Energy LLC; Chena Power Plant	Fairbanks North Star Borough (090)	308004	628	2029	2.0	4135
209000081	Doyon Utilities, LLC; Fort Wainwright (Privatized Emission Units)	Fairbanks North Star Borough (090)	307600	460	2029	1.5	3035
212200007	Hilcorp Alaska, LLC ; Steelhead Platform	Kenai Peninsula Borough (122)	178162	45	8827	0.3	2217
209000001	US Air Force (Eielson);	Fairbanks North Star	306412	263	2294	0.9	1968

Facility ID	Facility Name	County	d (m)	Q (tpy)	EWRT SO_4	Q/d	WEP SO_4
	Eielson Air Force Base	Borough (090)					
209000011	Golden Valley Electric Association; North Pole Power Plant	Fairbanks North Star Borough (090)	305506	247	2294	0.8	1856
212200043	Hilcorp Alaska, LLC; Dolly Varden Platform	Kenai Peninsula Borough (122)	180962	28	8827	0.2	1359
202000095	Matanuska Electric Association, Inc; Eklutna Generation Station	Anchorage Borough (020)	107635	12	10646	0.1	1221
209000007	University of Alaska; Fairbanks Campus Power Plant	Fairbanks North Star Borough (090)	306928	164	2029	0.5	1083

Table III.K.13.G-9. Top 10 facilities whose 2017 NO_x emissions have the potential to contribute to visibility impairment due to ammonium nitrate at SIME1 on the Most Impaired Days for each year in 2014-2018.

Facility ID	Facility Name	County	d (m)	Q (tpy)	EWRT NO_3	Q/d	WEP NO_3
201000025	Trident Seafoods; Sand Point Facility	Aleutians East Borough (013)	1215	154	7068	127	896134
201300011	Maruha Nichiro Corporation (Peter Pan Seafoods); King Cove Facility	Aleutians East Borough (013)	119760	237	1370	2.0	2709
201600008	City of Unalaska; Dutch Harbor Power Plant (DHPP)	Aleutians West Census Area (016)	424566	639	223	1.5	336
206000003	Alaska Village Electric Cooperative; Bethel Power Plant	Bethel Census Area (050)	614387	679	193	1.1	213
201300005	Trident Seafoods; Akutan	Aleutians East	367911	160	489	0.4	213

Facility ID	Facility Name	County	d (m)	Q (tpy)	EWRT NO_3	Q/d	WEP NO_3
	Seafood Processing Facility	Borough (013)					
201600003	UniSea, Inc.; Dutch Harbor Seafood Processing Plant	Aleutians West Census Area (016)	425899	394	223	0.9	207
207000001	Nushagak Electric Cooperative, Inc; Dillingham Power Plant	Dillingham Census Area (070)	433325	321	264	0.7	195
212200031	Chugach Electric Association; Beluga River Power Plant	Kenai Peninsula Borough (122)	856164	1862	72	2.2	157
206000004	Naknek Electric Association, Inc.; Naknek Power Plant	Bristol Bay Borough (060)	436012	364	171	0.8	143
212200046	Hilcorp Alaska, LLC; Swanson River Field	Kenai Peninsula Borough (122)	828011	1705	50	2.1	102

Table III.K.13.G-10. Top 10 facilities whose 2017 SO_x emissions have the potential to contribute to visibility impairment due to ammonium sulfate at SIME1 on the Most Impaired Days for each year in 2014-2018.

Facility ID	Facility Name	County	d (m)	Q (tpy)	EWRT SO_4	Q/d	WEP SO_4
201000025	Trident Seafoods; Sand Point Facility	Aleutians East Borough (013)	1215	0	82404	0.1	5424
212200069	Hilcorp Alaska, LLC; Monopod Platform	Kenai Peninsula Borough (122)	812887	170	1214	0.2	254
212200043	Hilcorp Alaska, LLC; Dolly Varden Platform	Kenai Peninsula Borough (122)	804131	141	1214	0.2	213
212200034	Alaska Electric and Energy Cooperative; Bernice Lake Combustion	Kenai Peninsula Borough (122)	804741	107	1268	0.1	168

Facility ID	Facility Name	County	d (m)	Q (tpy)	EWRT SO_4	Q/d	WEP SO_4
	Turbine (BCT) Plant						
212200061	Hilcorp Alaska, LLC; Platform A	Kenai Peninsula Borough (122)	808097	99	1349	0.1	165
206000003	Alaska Village Electric Cooperative; Bethel Power Plant	Bethel Census Area (050)	614387	37	2579	0.1	155
212200008	Hilcorp Alaska, LLC; King Salmon Platform	Kenai Peninsula Borough (122)	809361	69	1214	0.1	103
212290002	Hilcorp Alaska, LLC; Grayling Platform	Kenai Peninsula Borough (122)	807064	27	1214	0.0	40
229000002	Golden Valley Electric Association; Healy Power Plant	Denali Borough (068)	1146828	445	78	0.4	30
218530001	Hilcorp Alaska, LLC; Endicott Production Facility (END)	North Slope Borough (185)	1778854	258	159	0.1	23

Table III.K.13.G-11. Top 10 facilities whose 2017 NO_x emissions have the potential to contribute to visibility impairment due to ammonium nitrate at TUXE1 on the Most Impaired Days for each year in 2014-2018.

Facility ID	Facility Name	County	d (m)	Q (tpy)	EWRT NO_3	Q/d	WEP NO_3
212200046	Hilcorp Alaska, LLC; Swanson River Field	Kenai Peninsula Borough (122)	128,612	2121	280	16	4621
212200007	Hilcorp Alaska, LLC; Steelhead Platform	Kenai Peninsula Borough (122)	109,953	297	1516	2.7	4092
212200060	Cook Inlet Pipe Line Company; Drift River Terminal / Christy Lee Platform	Kenai Peninsula Borough (122)	71,417	73	2275	1.0	2339

Facility ID	Facility Name	County	d (m)	Q (tpy)	EWRT NO_3	Q/d	WEP NO_3
	Aggregated Source						
212200031	Chugach Electric Association; Beluga River Power Plant	Kenai Peninsula Borough (122)	159,537	370	958	2.3	2220
212290002	Hilcorp Alaska, LLC; Grayling Platform	Kenai Peninsula Borough (122)	110,428	144	1516	1.3	1982
212200069	Hilcorp Alaska, LLC; Monopod Platform	Kenai Peninsula Borough (122)	116,804	152	1516	1.3	1972
212200104	Alaska Electric and Energy Cooperative; Nikiski Combined Cycle Plant	Kenai Peninsula Borough (122)	103,788	467	419	4.5	1885
212200043	Hilcorp Alaska, LLC; Dolly Varden Platform	Kenai Peninsula Borough (122)	107,140	133	1516	1.2	1875
212200008	Hilcorp Alaska, LLC; King Salmon Platform	Kenai Peninsula Borough (122)	113,045	129	1516	1.1	1735
212200066	Tesoro Alaska Company, LLC; Kenai Refinery	Kenai Peninsula Borough (122)	104,889	374	419	3.6	1492

Table III.K.13.G-12. Top 10 facilities whose 2017 SO_x emissions have the potential to contribute to visibility impairment due to ammonium sulfate at TUXE1 on the Most Impaired Days for each year in 2014-2018.

Facility ID	Facility Name	County	d (m)	Q (tpy)	EWRT SO_4	Q/d	WEP SO_4
212200007	Hilcorp Alaska, LLC; Steelhead Platform	Kenai Peninsula Borough (122)	109953	45	22641	0.4	9212

Facility ID	Facility Name	County	d (m)	Q (tpy)	EWRT SO_4	Q/d	WEP SO_4
212200043	Hilcorp Alaska, LLC; Dolly Varden Platform	Kenai Peninsula Borough (122)	107140	28	22641	0.3	5887
212290002	Hilcorp Alaska, LLC; Grayling Platform	Kenai Peninsula Borough (122)	110428	16	22641	0.1	3221
212200008	Hilcorp Alaska, LLC; King Salmon Platform	Kenai Peninsula Borough (122)	113045	15	22641	0.1	2981
212200060	Cook Inlet Pipe Line Company; Drift River Terminal / Christy Lee Platform Aggregated Source	Kenai Peninsula Borough (122)	71417	5	31684	0.1	2075
212200114	BlueCrest Alaska Operating LLC; Cosmopolitan Project	Kenai Peninsula Borough (122)	49844	15	6884	0.3	2055
212200069	Hilcorp Alaska, LLC; Monopod Platform	Kenai Peninsula Borough (122)	116804	9	22641	0.1	1796
229000002	Golden Valley Electric Association; Healy Power Plant	Denali Borough (068)	469484	296	2584	0.6	1631
209000001	US Air Force (Eielson); Eielson Air Force Base	Fairbanks North Star Borough (090)	593139	263	3083	0.4	1366
209000011	Golden Valley Electric Association; North Pole Power Plant	Fairbanks North Star Borough (090)	592412	247	3083	0.4	1287

E. Potential Source Contributions (PSC) Analysis

A PSC analysis was performed to assess the relative potential contributions of anthropogenic and natural emission source groups within the EPA 27-km Alaska modeling domain to $(NH_4)_2SO_4$ extinction on the MID. This is a larger domain and different than the WEP/AOI anthropogenic emissions analysis discussed above that used the extent of the EPA 9-km domain at 27-km resolution. PSC was calculated by integrating (i.e., summing) the WEP across the modeling domain for each source group. In reviewing the results of the gridded WEP/AOI analysis DEC noticed that the EPA modeling platform did not include emissions from the Healy Power Plant.

The PSC analysis includes SO_2 emissions for Healy in 2016 (427.2 tons per year) in the EGU sector.

Unlike the WEP analysis, which only considered anthropogenic emission sources, the PSC analysis also included volcanic emissions of SO_2 and oceanic emissions of DMS. Volcano eruption emissions were not considered in this analysis so just volcano degassing emissions were used. An analysis of 2014 GEOS-Chem emissions for a region essentially equivalent to EPA's CMAQ Alaska 27-km domain found that ~60% of the reactive sulfur emissions were from volcano degassing and DMS (see Section III.K.13.E Emission Inventory and Appendix III.K.13.I). Including these sources in the PSC allows for characterization of potential natural contributions to visibility impairment on the MID and provides context for the potential anthropogenic source contributions.

Table III.K.13.G-13 summarizes the total SO_2 or SO_2 equivalent (i.e., DMS) emissions within the 27-km domain for the various source sectors. The DMS emissions were scaled by a 0.6 factor to account for the fact that it is estimated that only approximately 60% of the DMS emissions are ultimately converted to SO_2. The anthropogenic emissions are from EPA's 2016 CMAQ modeling. DMS was calculated using 2016 meteorology and volcanic emissions were based on satellite inventories for 2014-2018. The volcanic and DMS natural emissions contribute 83% of the SO_2 emissions within the 27-km CMAQ domain. This is higher percentage of natural SO_2 emissions than the 67% contribution estimated analyzing 2014 GEOS-Chem inventories for a similar size domain as described in Section III.K.13.E. These differences are due in part to the CMAQ 2016 modeling not including emissions from Russia as a large portion of Russia is included in the 27-km domain, although uncertainties in calculating volcanic and DMS emissions may also have contributed to the differences.

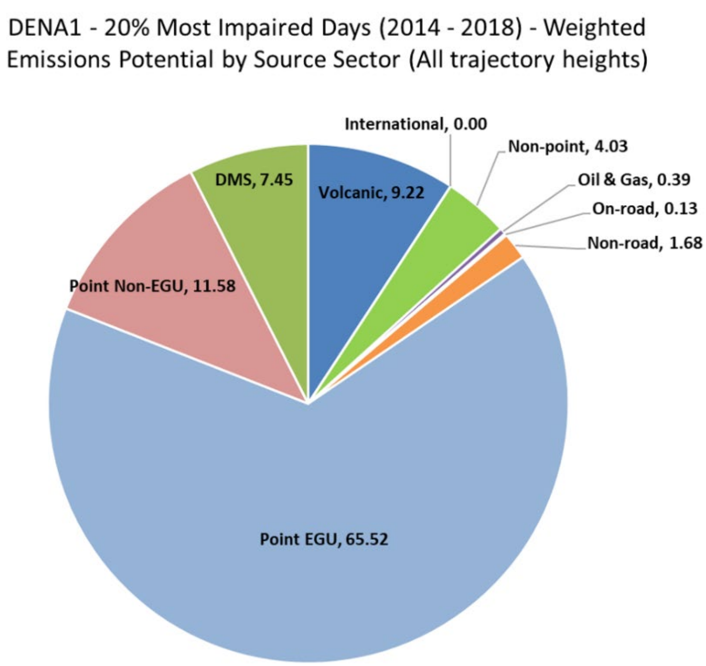
Table III.K.13.G-13. Total 2016 SO_2 emissions (tons per year, TPY) within the 27-km domain by source sector.

Source Sector	SO_2 Emissions	
	(TPY)	(%)
US EGU Point	1,747	0.14%
US Non-EGU Point	1,435	0.12%
US On-Road Mobile	40	0.0%
US Oil & Gas	1,739	0.14%
US+CMV Non-Road Mobile	187,801	15.2%
US Non-Point	1,598	0.13%
International	15,707	1.3%
DMS (2014-2018 average)	454,064	36.7%
Biogenic	0.0	0.0%
Volcanic (2014-2018 average)	573,775	46.3%
Total	1,540,617	100%

The pie charts of PSC for each SO_2 source group as a percentage of the total potential contributions to $(NH_4)_2SO_4$ extinction at the DENA1, TRCR1, TUXE1 and SIME1 on the MID are shown in Figures III.K.13.G-20 through III.K.13.G-23. A significant fraction of the PSC for DENA1 and TRCR1 were from anthropogenic emission sources (approximately 83% and 27%, respectively), while the PSC for TUXE1 and SIME1 were dominated by DMS and volcanic emissions (approximately 3% and 2% from the anthropogenic emission sources, respectively). DMS constitutes a significant fraction (8-23%) of the PSC at all four IMPROVE sites. Volcanic emissions also constitute a significant fraction at all sites but were the dominant source at TUXE1 and SIME1 and half of the PSC at TRCR1. The volcanic contribution increased with proximity to the Alaska Peninsula and Aleutian Islands. Plots of the gridded RT, EWRT, and WEP for each Class I area similar to those done for the AOI/WEP analysis and are available on the WRAP TSS website[11].

While back trajectory analyses such as WEP and PSC can help identify potential sources impacting visibility at Alaska Class I areas, they do not replace and do not represent source apportionment modeling because they do not account for chemical transformation, dispersion, and deposition of pollutants and transport of pollutants from outside of the domain analyzed. Source apportionment needs to account for all sources and global sources from outside of the domain are missing in the PSC. But the PSC does provide a qualitative assessment of the possible relative contributions of SO_2 sources within the analysis domain.

Figure III.K.13.G-20. Potential Source Contribution by Source Sector for SO_x emission contributions to ammonium sulfate extinction at DENA1 on the 20% Most Impaired Days (2014-2018).



[11] https://views.cira.colostate.edu/tssv2/WEP-AOI-AK/

Figure III.K.13.G-21. Potential Source Contribution by Source Sector for SO_x emission contributions to ammonium sulfate extinction at TRCR1 on the 20% Most Impaired Days (2014-2018).

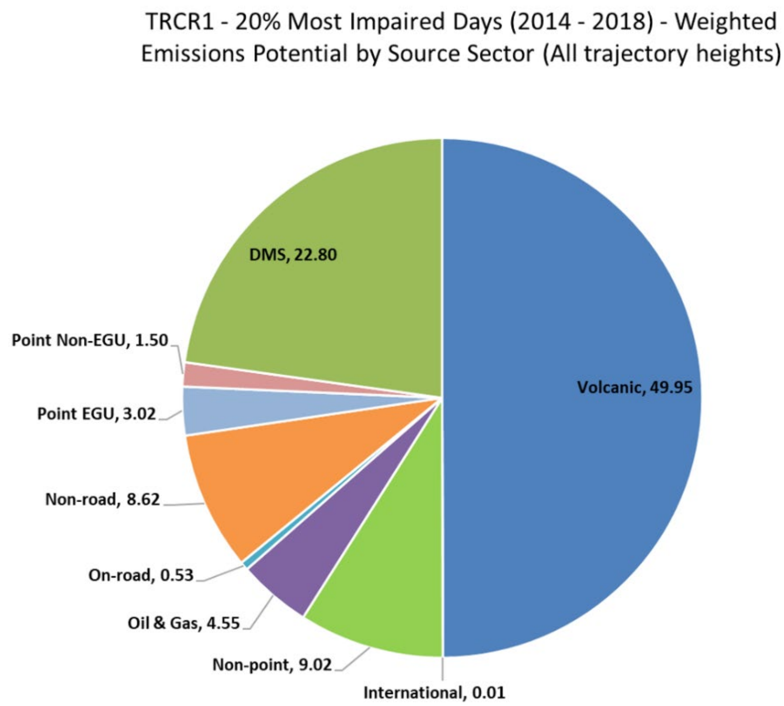


Figure III.K.13.G-22. Potential Source Contribution by Source Sector for SO_x emission contributions to ammonium sulfate extinction at TUXE1 on the 20% Most Impaired Days (2012-2014).

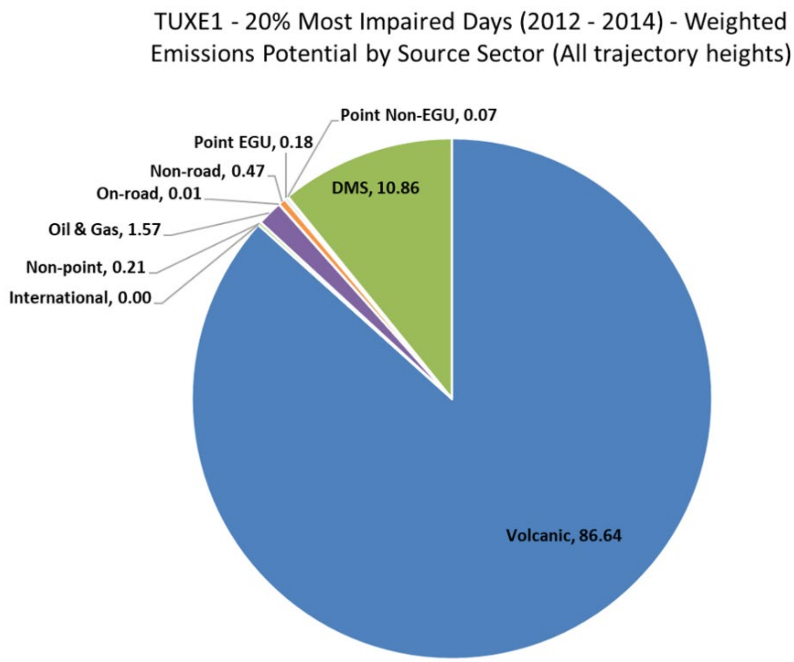
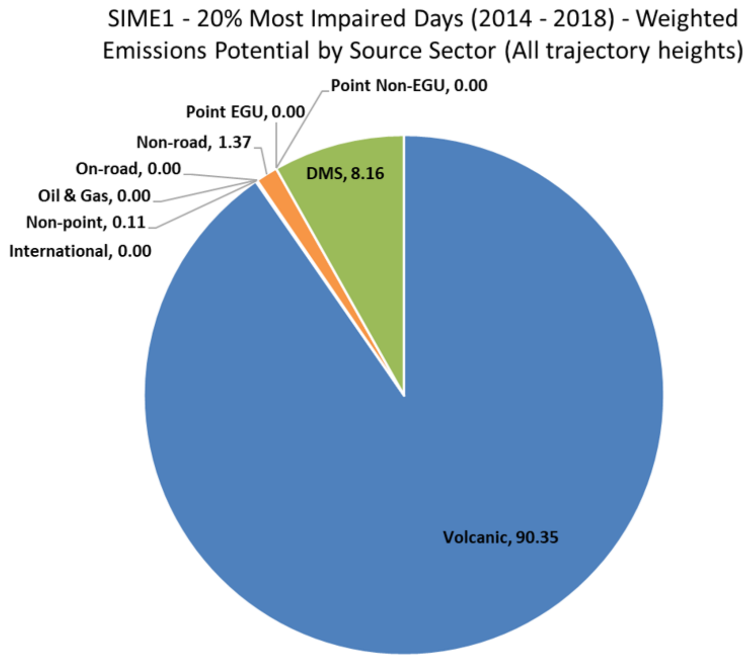


Figure III.K.13.G-23. Sulfate Potential Source Contribution by Source Sector for SO_x emission contributions to ammonium sulfate extinction at SIME1 on the 20% Most Impaired Days (2014-2018).



III.K.13.H LONG-TERM STRATEGY FOR REGIONAL HAZE

1. INTRODUCTION

The RH Rule requires Alaska to submit a 10-15 year long-term strategy (LTS) to address regional haze visibility impairment in each Class I area in Alaska and for each Class I area outside Alaska that may be affected by emissions originating from within the Alaska. Due to the long distances from Alaska to the Lower 48 states, Alaska has not identified any Class I areas outside of Alaska that are impacted by Alaskan emissions, and no states have notified Alaska through the regional planning process of Alaska source impacts on their Class I areas. As a result, Alaska's strategy focuses solely on addressing visibility impairment in Alaska's Class I areas.

Alaska has found that international emissions transported into Alaska have an impact on visibility in the Class I areas. These international emissions cannot be controlled by local or state control measures and are factored into the reasonable progress goals discussed in Section III.K.13.I. The LTS must identify all manmade sources of visibility-impacting pollution that Alaska considered in developing the strategy as well as the measures needed to achieve Alaska's reasonable progress goals. The LTS presented in this section covers the second regional haze planning period, from 2019 through 2028.

A. Overview of the Long-Term Strategy Development Process

Alaska is a participant in WRAP, which is a major source of technical and policy assistance for the western states in developing regional haze reduction strategies. The WRAP's Technical Support System (TSS: http://views.cira.colostate.edu/tssv2/) provides a single, one-stop shop for access, visualization, analysis, and retrieval of the technical data and regional analytical results prepared by WRAP Forums and Workgroups in support of regional haze planning in the West. The TSS specifically summarizes results and consolidates information about air quality monitoring, meteorological and receptor modeling analyses, and emission inventories and models. In addition to the WRAP products, DEC undertook additional analyses in the development of this plan.

- Emissions Data – Section III.K.13.E describes the emission inventory information for Alaska that was used in developing this plan.

- Modeling Techniques – Section III.K.13.G describes the source attribution analysis developed by Alaska, including the use of back trajectory modeling and a WEP tool to identify the potential contributions of anthropogenic sources of sulfate, nitrate, organic carbon, and elemental carbon to visibility impairment at Alaska Class I areas.

- Monitoring Data – Section III.K.13.C describes the IMPROVE monitoring network in Alaska. Section III.K.13.D provides a summary of monitoring data, trends, and breakdown by pollutant for each of the site locations in Alaska.

The RH Rule Section 51.308(f)(2) requires the state to identify all anthropogenic (i.e., manmade) sources of visibility impairment considered in developing the LTS for the Second Planning Period. Table III.K.13.H.1 lists the pollutants inventoried, the related aerosol species, some of the key sources for each pollutant, and some notes regarding implications of these pollutants. The largest contributors to visibility extinction at Alaska Class I areas are sulfate and OMC, both of which can come from controllable or uncontrollable origins. Uncontrollable emissions sources contribute to the atmospheric mix of visibility-impairing pollutants produced by anthropogenic sources in Alaska, all detected but not differentiated by the IMPROVE monitors. The fact that uncontrollable natural and anthropogenic sources outside of the United States affect visibility is not neglected in the analysis presented in this RH SIP. Nonetheless, Alaska's emissions control strategy focuses on those anthropogenic sources within the state.

Table III.K.13.H-1 Pollutants, aerosol species, and major sources.

Emitted Pollutant	Related Aerosol	Key Sources	Notes
Sulfur Dioxide (SO_2)	Ammonium Sulfate	Stationary sources, commercial marine vessels Volcanoes, oceanic DMS	Natural SO_2/DMS emissions can potentially have large contributions to visibility degradation at Alaska Class I areas. Anthropogenic sources include coal-burning power plants, other industrial sources such as refineries and cement plants, both on- and off-road diesel engines, and marine vessels.
Oxides of Nitrogen (NO_X)	Ammonium Nitrate	On- and off-road mobile sources, stationary sources, area sources. Fires and lightning NOx.	NO_X emissions are generally associated with anthropogenic sources. Common sources include virtually all combustion activities, especially those involving cars, trucks, power plants, and other industrial processes. Although natural wildfires and, to a lesser extent, lightning can contribute as well.
Ammonia (NH_3)	Ammonium Sulfate and Ammonium Nitrate	Area sources (e.g., livestock and agricultural), on-road mobile sources	Ammonium is not directly measured by the IMPROVE program but affects formation potential of ammonium sulfate and ammonium nitrate. All measured nitrate and sulfate are assumed to be associated with ammonium for IMPROVE reporting purposes.
Volatile Organic Compounds (VOCs)	Organic Mass Carbon (OMC)	Biogenic, on- and off-road mobile sources, area sources	VOCs are gaseous emissions of carbon compounds, some of which can be converted to particulate OMC through chemical reactions in the atmosphere.
Primary Organic	OMC	Wildfires, area sources	POA represents organic aerosols that are emitted directly as particles, as opposed to gases. Wildfires and other biomass burning

Emitted Pollutant	Related Aerosol	Key Sources	Notes
Aerosol (POA)			(e.g., home heating) contribute to POA. Wildfire events are generally sporadic and highly variable from year-to-year.
Elemental Carbon (EC)	EC	Wildfires, on- and off-road mobile sources	Large EC events are often associated with large OMC events during wildfires. Other sources include both on- and off-road diesel engines.
Fine soil	Soil	Windblown dust, fugitive dust, road dust, area sources	Fine soil is reported here as the crustal or soil components of $PM_{2.5}$.
Coarse Mass (CM)	Coarse Mass	Windblown dust, fugitive dust	Coarse mass is reported by the IMPROVE network as the difference between PM_{10} and $PM_{2.5}$ mass measurements. Windblown dust is often the largest contributor to CM.

2. FACTORS FOR LONG TERM STRATEGY CONSIDERATION

The RH Rule Section 51.308(f)(2)(iv) lists the following minimum factors that must be considered in development of the LTS:

(a) Emission reductions due to ongoing air pollution control programs, including measures to address reasonably attributable visibility impairment;
(b) Measures to mitigate the impacts of construction activities;
(c) Source retirement and replacement schedules;
(d) Smoke management practices for agricultural and forestry burning;
(e) Anticipated net effect on visibility over the period of the LTS.

Consideration of each of these factors and future considerations are discussed below.
DEC is also incorporating discussions on future considerations, where appropriate, in developing the LTS.

B. Regional Haze Visibility Protection Area

To assist the state's efforts in meeting 40 C.F.R. 51.308(f)(2) in establishing a LTS and to track and control current and potential new sources that may affect visibility in the Class I areas, DEC is establishing a Regional Haze Visibility Protection Area (RH-VPA). State regulation, *18 AAC 50.025 Visibility and other special protection areas,* is expanded to add an additional area. The RH-VPA was developed using a process that followed four main steps:

1. Defined the subset of stationary point sources that affect visibility for the Class I area;

2. Selected a jurisdictional boundary over which the RH-VPA was to be defined that includes those sources;
3. Determined the appropriate directionality and extent of the RH-VPA for each Class I area. This was accomplished by analysis of the back-trajectory residence times (RT) analysis and WEP NO_x and SO_x analysis for the MID. NO_x and SO_x are the two main PM precursors from anthropogenic sources that contribute to visibility impairment at these locations.
4. Verified the defined RH-VPA with respect to the current WEP for NO_x and SO_x to ensure that the RH-VPA comprises the vast majority (e.g., more than 80 %) of current anthropogenic emissions that may contribute to SO_4 and NO_3 impairment on the MID.

The detailed methodology used to develop the VPA is documented in Appendix III.K.13.H.

The RH-VPA boundary is illustrated in Figure III.K.13.H.1 and described in Table III.K.13.H.2.

Figure III.K.13 H-1. Regional Haze Visibility Protection Area

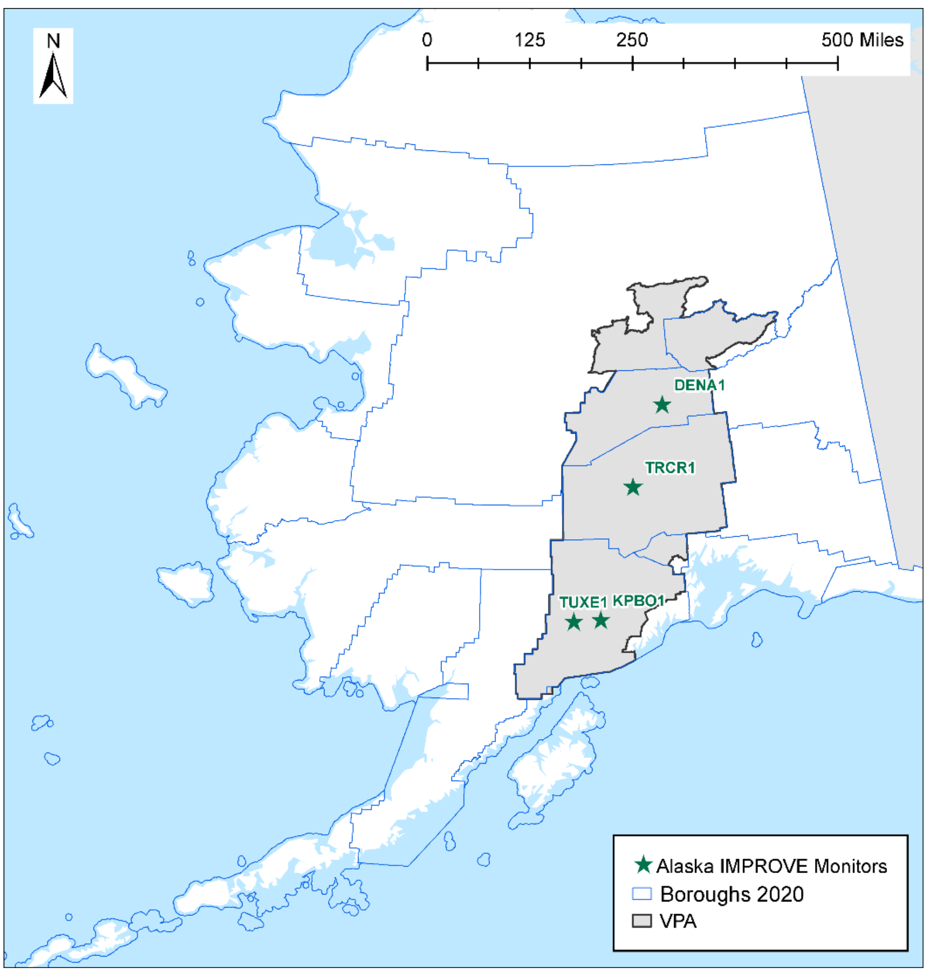


Table III.K.13.H-1 Regional Haze Visibility Protection Area Description

The physical description of the boundary is:

Perimeter Block Groups for the VPAs					
BOROUGH Number	Borough Name	TRACT	BLKGRP	FIPS	NAME
20	Anchorage Municipality	101	2	20200001012	Block Group 2
20	Anchorage Municipality	204	2	20200002042	Block Group 2
20	Anchorage Municipality	2900	1	20200029001	Block Group 1
20	Anchorage Municipality	2900	2	20200029002	Block Group 2
68	Denali Borough	100	1	20680001001	Block Group 1
68	Denali Borough	100	2	20680001002	Block Group 2
90	Fairbanks North Star Borough	1100	1	20900011001	Block Group 1
90	Fairbanks North Star Borough	1700	1	20900017001	Block Group 1
90	Fairbanks North Star Borough	1800	1	20900018001	Block Group 1
90	Fairbanks North Star Borough	1900	1	20900019001	Block Group 1
90	Fairbanks North Star Borough	1900	3	20900019003	Block Group 3
122	Kenai Peninsula Borough	100	1	21220001001	Block Group 1
122	Kenai Peninsula Borough	300	1	21220003001	Block Group 1
122	Kenai Peninsula Borough	400	3	21220004003	Block Group 3
122	Kenai Peninsula Borough	1200	1	21220012001	Block Group 1
170	Matanuska-Susitna Borough	101	1	21700001011	Block Group 1
170	Matanuska-Susitna Borough	200	2	21700002002	Block Group 2
290	Yukon-Koyukuk Census Area	200	2	22900002002	Block Group 2

The RH-VPA will be used to identify new development and sources for more detailed haze-related data reporting/tracking and to require additional control measures should they become necessary in the future.

C. Emission Reductions Due to Ongoing Air Pollution Programs

Under 40 CFR §51.308(f)(2)(iv)(A), states are required to consider emission reductions due to ongoing air pollution control programs as part of the LTS, including measures to address Reasonably Attributable Visibility Impairment (RAVI). Alaska has previously addressed RAVI requirements in the Alaska Air Quality Control Plan.

Alaska has several ongoing programs and regulations that directly protect visibility or provide for improved visibility by generally reducing emissions. DEC regulations at 18 AAC 50 and the overall Alaska Air Quality Control Plan serve to control air pollutants that can impair visibility and impact Class I areas in Alaska. Efforts that reduce emissions also include adherence to federal regulations and the benefits of fuel sulfur limitations for marine vessels under EPA and the US Coast Guard regulations that adopt the International Marine Organization (IMO) requirements. The state has also enacted SIP control programs for the FNSB, due to the declaration of nonattainment for $PM_{2.5}$ NAAQS, which assist in controlling a number of visibility impairing pollutants from that region of the state. Relevant aspects of state and federal control programs are described below as they relate to the LTS for this RH Plan.

This summary does not attempt to estimate the actual improvements in visibility at each Class I area that will occur between 2021and 2028, because existing technical tools are inadequate to accurately do so. The visibility benefits from these programs are secondary to the primary health-based air pollution objectives of these programs and rules.

(a) Best Available Retrofit Technology (BART) Program

One of the primary strategy approaches taken in the first RH Plan was the BART Program, which required visibility analyses for facilities constructed between 1962 and the passage of the 1977 CAA Amendment and prescribed control technologies for those with measurable impacts on Class I Areas. This was a central part of Alaska's visibility review program in the first RH SIP period. In Alaska, BART applied to a narrow group of sources, mostly power generation and petrochemical refineries located in Southcentral and Interior Alaska.

Under the terms of the 1999 RH Rule, BART analyses and determinations were completed for the first RH Plan and were implemented within the first implementation period. The BART program is not required for any newer facilities built after 1962. As all facilities built within the BART Rule timeframe have been analyzed and no extension of the timeframe has been proposed or established, the BART program will remain at its current status moving forward. All facilities within the state which have BART requirements will continue to have these requirements in place until final emissions unit (EU) retirement has been registered with the state. As a result, BART remains a functional part of the state's LTS as it applies to specific stationary sources.

DEC originally identified seven industrial facilities with units determined to be eligible for BART in the first RH SIP:

- Anchorage Municipal Light and Power, George Sullivan Plant 2
- Golden Valley Electric Association, Healy Power Plant (GVEA)
- Agrium, Chemical-Urea Plant
- Alyeska Pipeline Service Company, Valdez Marine Terminal
- ConocoPhillips Alaska Inc., Kenai LNG Plant (CPAI)
- Tesoro, Kenai Refinery
- Chugach Electric, Beluga River Power Plant

Of these facilities, all but two were eliminated from further BART application. The remaining two facilities were the GVEA Healy Power Plant and the Agrium Urea Chemical plant. Of these two, GVEA Healy has been in operation through much of the last decade, and the Agrium Urea plant has been in stand-by mode for the same period. The Agrium facility has undergone a recent New Source Review (NSR) permit update to allow it to operate should its owners choose to reactivate it. The current permit that has been approved by DEC required a BACT analysis and determination that resulted in the requirement for the most stringent available emissions controls should the facility be reactivated.

The other facility for which BART applies is the GVEA Healy Power Plant near the Denali Class I area. This is a coal-fired electric generating unit which has been operational for the last half-century and provides electrical power to the Interior and FNSB; the facility also maintains a fleet of local diesel and coal-fired generators. With the declaration of the Fairbanks $PM_{2.5}$ nonattainment area, GVEA has discussed the potential of shifting more power generation reliance over to Healy to avoid issues with air pollution within the nonattainment area. As a result, there is the potential for increased emissions from the Healy facility which is approximately 7 miles from the Denali Class I area. Further discussions on the GVEA Healy Power Plant and analyses of its current emissions footprint can be found in Section III.K.13.F, which is the four-factor facility analysis section.

All other BART-eligible facilities have either had retrofits which abrogated the BART requirement, were determined to be too small or too distant from a Class I area to have a significant impact on visibility, or have not been actively operated in the last decade. The George Sullivan Plant 2 has undergone complete replacement of the BART eligible EUs and has been reopened with updated mechanical emissions controls and operational practices.

D. Prevention of Significant Deterioration (PSD)/New Source Review Regulations (NSR)

The State's PSD/NSR rules will also protect visibility in Class I areas from degradation due to emissions from new industrial sources and major changes to existing sources. Alaska's regulations (18 AAC 50 Article 3) and SIP (see Alaska SIP Volume II, Section II and associated Appendices) require visibility impact assessment and mitigation associated with emissions from new and modified major stationary sources through protection of air quality related values (AQRVs). AQRVs are scenic and environmentally related resources that may be adversely affected by a change in air quality, including visibility, odor, noise, vegetation, and soils.

Alaska's continued implementation of PSD and NSR requirements with FLM involvement for Class I area impact review will assure that no Class I area experiences degradation in visibility resulting from expansion or growth of stationary sources in the state.

E. Operating Permit Program and Minor Source Permit Program On-Going and Future Considerations

DEC implements a Title V operating permit program as well as a minor source permit program for stationary sources of air pollution. The Title V permits are consistent with the requirements of 40 CFR Part 70, and requirements are found in 18 AAC 50 Article 3, Major Stationary Source Permits. The requirements for minor source permits are found in 18 AAC 50 Article 5, Minor Permits (see Alaska SIP Volume II, Section II and associated Appendices). Sources that may be required to obtain minor permits include asphalt plants, thermal soil remediation units, rock crushers, incinerators, coal preparation plants, or a Port of Anchorage stationary source. Minor permits are required for new or existing sources with a potential to emit above specific thresholds before construction, before relocating a portable oil and gas operation, or before beginning a physical change or change in the method of operation. Details are included in the state regulations.

These permit programs, coupled with PSD/NSR requirements, serve to ensure that stationary industrial sources in Alaska are controlled, monitored, and tracked to prevent deleterious effects of air pollution. Given the level of visibility impairment at Alaska's Class I areas and the uncertainty of the technical information and analyses, the sources that have been found to be potential significant contributors to impairment have been reviewed and are discussed in Section III.K.13.F, which is the four-factor facility analysis section. DEC believes that at this time the existing stationary source controls, coupled with RH BART controls (described above), will be adequate for the purposes of reducing visibility impairment on the worst visibility days and maintaining visibility on the best visibility days in Alaska Class I areas. DEC will continue to assess and evaluate the impacts of stationary sources on Class I area visibility in future SIP revisions and will consider whether additional controls are warranted for stationary sources to insure reasonable progress in the long term.

DEC's Air Quality Permit program is expanding its record keeping, reporting, and application requirements to include additional information for those sources that may be located in the proposed RH-VPA to assist in meeting 40 C.F.R. 51.308(f)(2)(iv). DEC would use the additional information attained to assist with the required 5-year progress reports, the Plans for future implementation periods, and meeting requirements under 40 CFR 51.308(f)(3).

Potential Future Considerations

In the event that visibility impairment exceeds the glidepath visibility goals in future planning periods, the following measures have been identified that could be considered and implemented for all (major, minor, or area), or a subset of, point sources located within a RH-VPA:

- Require asphalt plants to operate on highline power.
- Require all permitted major or minor sources combusting liquid fuel to switch to ultra-low sulfur diesel (ULSD).
- Require all Title V sources receiving fuel gas for combustion use fuel gas meeting the following requirements:
    - 20.0 grains or less of total sulfur per 100 standard cubic feet. Equivalents of this in other units are as follows: 0.068 weight percent total sulfur, 680 parts per million by weight (ppmw) total sulfur, and 338 parts per million by volume (ppmv) at 20 degrees Celsius total sulfur;
    - must either be composed of at least 70 percent methane by volume or have a gross calorific value between 950 and 1100 British thermal units (Btu) per standard cubic foot.
- Require all Title V sources combusting on-site fuel gas to limit H_2S concentration in the gas to no more than 1,000 ppmv.
- Require all newly constructed Title V stationary sources to evaluate potential NO_x, SO_2, and PM emission control technologies using EPA's top down Best Available Control Technology (BACT) approach.
- Require all existing coal fired boilers to meet a SO_2 emissions limit of 0.2 lb/MMBtu.

F. Local, State and Federal Mobile Source Control Programs

Mobile source emissions are primarily controlled by federal regulations. During the writing of the first RH SIP, Alaska was exempted from imposition of federal on-road ULSD requirements. However, Alaska is now fully compliant with the federal ULSD requirements for on-road and non-road uses. In addition to the ULSD requirements, lower-sulfur content diesel use has been mandated for ships operating within the North American Emissions Control Area (ECA), which includes Southeast Alaska and the Gulf of Alaska west to the northern end of Kodiak Island.

The Federal Motor Vehicle Control Program (FMVCP) is the federal certification program that requires all new cars sold in 49 states to meet specific emission standards. (California is excluded because it has its own state-mandated certification program.) As part of the FMVCP, all new cars must meet their applicable emission standards on a standard test cycle called the Federal Test Procedure (FTP). These standards vary according to vehicle age, with the newer vehicles required to be considerably cleaner than older models. The result of this decline over time in allowable emissions from newly manufactured vehicles has been a drop in overall emissions from the vehicle fleet, as older, dirtier vehicles are replaced with newer, cleaner vehicles.

EPA's Tier 2 and 3 emission standards for passenger cars, light trucks, and larger passenger vehicles are focused on reducing emissions most responsible for ozone, CO, and PM (i.e., NOx, SO_2, and hydrocarbon (HC) emissions). The fuels and control equipment introduced to meet these standards will result in reductions in visibility impairing pollutants. Mandated reductions in the sulfur content of gasoline will further enhance the performance of this equipment. This will also reduce emissions from the existing fleet of gasoline-powered vehicles by reducing the deterioration of catalytic converters.

In addition to these federal programs, the two CO maintenance areas in Fairbanks and Anchorage have local programs to address mobile source emissions that will also continue to reduce visibility impairing pollutants. Both communities have transit programs that assist in reducing vehicle emissions in their respective areas. In Anchorage, specific local programs included in the SIP are a vanpool/ridesharing program, which reduces overall vehicle miles travelled; and efforts to encourage the use of block heaters in the winter to reduce cold start emissions from motor vehicles. In Fairbanks, there continues to be outreach on local plug-ins for engine block heater use, and electrification of parking lots also assists with reducing mobile source emissions from cold starts. Fairbanks is also working to convert its transit fleet to compressed natural gas (CNG). It should be noted that Fairbanks and Anchorage had local inspection and maintenance (I/M) programs during the first RH SIP which have since been discontinued. Both I/M programs were suspended after it was demonstrated through SIP amendments that they were no longer necessary for the areas to demonstrate attainment with the CO standard. Only after the CO Maintenance areas submitted SIP amendments that were approved by EPA were the programs discontinued.

G. Implementation of Programs to Meet PM NAAQS

(a) Eagle River and the Mendenhall Valley PM_{10} Nonattainment Area

The community of Eagle River and the Mendenhall Valley in Juneau are former nonattainment areas with respect to the NAAQS for PM_{10}. These areas exceeded the PM_{10} standards primarily due to wood burning and road dust sources. Both areas have been redesignated by EPA as maintenance areas, meaning that both have attained NAAQS for PM_{10}. The Municipality of Anchorage (MOA) voluntarily controls road dust in the spring by applying magnesium chloride in Eagle River and Anchorage to minimize the impact of re-entrained road dust during break up that causes visibility issues. Sweepers are also deployed early in the communities to gather the material used for traction during the winter which also contributes to visibility issues. The City and Borough of Juneau also performs dust control activities in the spring and maintains a wood smoke control program during the winter months. While not a requirement of the maintenance plan, Juneau is also working to electrify its transit fleet to further reduce emissions.

Other communities in Alaska face similar problems, particularly with regards to road dust. Both wood burning and road dust sources can contribute to visibility impairment. While most of Alaska's communities are not in close proximity to Class I areas, improvements made through PM control programs—such as wood smoke control, road paving, or dust suppression—may assist in mitigating visibility impacts, depending on the proximity to Class I areas. DEC is an active participant in the state's rural dust working group along with the EPA, the Alaska Native Tribal Health Consortium (ANTHC), and UAF. This group is focused on cooperative efforts aimed at reducing road dust impacts in communities throughout the state.

(b) Fairbanks $PM_{2.5}$ Nonattainment Area

In the years following the promulgation of the first RH Plan, the Fairbanks $PM_{2.5}$ Nonattainment Area has undergone several rounds of SIP revisions. The Fairbanks $PM_{2.5}$ Serious SIP was adopted in November 2019 as a result of the area's failure to attain the NAAQS for $PM_{2.5}$ per the CAA deadline for Moderate nonattainment areas. In 2020, DEC submitted an amendment package for the Serious SIP to further address local air quality in the FNSB as the area failed to meet the attainment deadline for Serious nonattainment areas.

DEC has been operating a series of local air quality monitors within the Fairbanks area to provide real-time data during weather inversions and instances when local air quality can deteriorate significantly. This air quality problem is in large part a result of local home heating options, which rely on wood and coal, along with limited alternative energy options for the Interior, where oil and coal are the primary available fuels for power and heating. Significant efforts have been made to expand natural gas availability in the area, which is now starting to provide cleaner burning options for primary space heating.

DEC has built up a series of control measures aimed at reducing local $PM_{2.5}$ levels in the ambient air. Over the last decade, DEC and its partners at the FNSB have built a changeout program using financial and enforcement incentives to encourage local residents to replace older and more polluting wood-burning appliances with EPA certified catalytic appliances or fuel oil or natural gas heating appliances. The state also conducted BACT analyses on local major stationary sources, including several power plants.

Currently, EPA is in the process of reviewing DEC's proposed control and mitigation measures for the Fairbanks area. The agency's final decision regarding state proposals for air quality controls will be discussed in the progress report, including any findings or changes regarding control measures or BACT determinations. Any potential impact on visibility results at the Denali Class I area will be discussed along with policy proposals to ensure continued visibility progress at the Class I area.

For more information regarding the Fairbanks $PM_{2.5}$ Serious SIP and supporting documents, see the following link: https://dec.alaska.gov/air/anpms/communities/fbks-pm2-5-nonattainment-air-quality-plan/

(c) Other areas with elevated $PM_{2.5}$

The Butte area of the Matanuska-Susitna Borough has experienced elevated levels of PM_{10} and $PM_{2.5}$. Some of the elevated levels are due to dust coupled with high winds but in the Butte area, the use of wood heating devices and open burning are likely contributors to elevated $PM_{2.5}$. In 2017, air quality monitoring data indicated that the area could exceed the $PM_{2.5}$ NAAQS of 35 micrograms/cubic meter. As a result, DEC worked with the Matanuska-Susitna Borough to embark on an education program to minimize emissions and avoid the possibility of violations of the standard. Efforts continue in this area to assess, track, and mitigate $PM_{2.5}$ and PM_{10} impacts from natural and local sources in the Butte area.

H. International Emissions Control Programs

There are a small number of internationally enforced emissions control programs which the United States has signed onto via treaty and adoption of requirements into federal regulations. For RH planning purposes in Alaska, the primary control program considered as part of the state's Long-Term Strategy is the IMO's low-sulfur diesel program established in 2010. Because of the significance of marine generated sulfur for Alaska regional haze planning, this control program should be considered a large element of the state's visibility improvement approach during the second planning period.

As of January 1, 2020, all IMO signatory states' marine vessels travelling in international waters are required to burn low-sulfur marine fuel. Prior to the low-sulfur marine fuel rule, high-sulfur fuel oil (HSFO), bunker oil, and other less refined fuels were sold and burned by vessels in many developing countries.

Vessels transiting shipping routes located in the vicinity of Alaska will be burning 0.5% sulfur fuel. Vessels transiting in designated Emission Control Areas (ECA) are limited to a maximum fuel oil sulfur limit of 0.10 %. The Alaska ECAs cover include the Inside Passage, a major shipping route through Southeast Alaska utilized by passenger and cargo traffic, as well as much of the Gulf of Alaska.

Under the terms of the ECA, vessels are only allowed to burn marine fuel with 0.1% sulfur content. These provisions are similar to other sulfur control areas in Western Europe and the Baltic Sea, where marine sulfur has been linked to air quality and public health problems for several decades. The declaration of the North American ECA and its subsequent enforcement has already been linked to improved air quality and visibility increases at coastal Class I areas in the western United States. In 2020 the rule further limited the sulfur in the fuel oil used on board ships operating outside designated emission control areas to 0.50% m/m (mass by mass) - a significant reduction from the previous limit of 3.5%.

ECAs are not established in Western or Northern Alaska nor the Aleutian Islands. This coverage gap leaves two of the state's four Class I areas (Simeonof and Bering Sea Wilderness Areas) outside of the North American ECA. The reduction in marine fuel sulfur content in 2020 should reduce visibility impairing pollutants as measured at the IMPROVE monitoring stations and will be assessed in the 2025 progress report; it is not yet known how much improvement will be observed at IMPROVE monitoring sites.

3. LONG-TERM STRATEGY BY SOURCE SECTOR

This section covers current and potential future trends for Alaska's Class I areas, with a focus on stationary source projects which are in the environmental review and permit review stages. Additional discussions of non-stationary sector trends, such as the marine and aviation sectors, will also be summarized. Mobile source emissions are more difficult to analyze under a four-factor approach that is more applicable and useful for stationary sources. As such, trend analysis is best used to understand the trajectory of mobile source emissions over the planning period.

The following subsections provide the LTS grouped by source sectors which are of particular significance to Alaska's Class I areas.

A. Mining Sector Sources

Donlin Gold Mine

The Donlin Gold Mine along the Kuskokwim River is currently in its construction phase and is planned to open before the end of the second implementation period. The mine is located within 250 miles of the Tuxedni Wilderness Area and Denali National Park; distance to the Simeonof Wilderness Area is approximately 500 miles. <u>The distances to Class I Areas and amounts of pollution generated by the mine are such that DEC does not consider this to be a potential major source of visibility-impairing pollutants at this time.</u>

Pebble Mine

The Pebble Mine is a proposed copper and rare earth minerals mine that would be located at Lake Iliamna in the Lake and Peninsula Borough. The mine would be roughly equidistant from both the Tuxedni and Simeonof Wilderness Areas, 250 miles from both areas. Its proposed air emissions footprint would make it a major stationary source in the state. As of January 2021, the

U.S. Army Corps of Engineers (Corps of Engineers) had denied the mine's applications for permits under the Clean Water Act; the Corps of Engineers' decision was appealed and is not fully resolved. Given the Corps of Engineers' decision and other challenges associated with this mine development project, DEC cannot say with certainty that the project will proceed during the second planning period. If the mine project does move forward, state and federal air quality permitting requirements would need to be addressed prior to construction.

Ambler Mining District

The Ambler Mining District is a series of copper and rare earth mines located south of the Brooks Range along the Kobuk River. Currently the only access to the district is via air or river barge during ice free periods in spring and summer. A proposed access road linking the district with the Dalton Highway has completed the National Environmental Policy Act (NEPA) review process as of July 2021. Once the access road is completed, it is possible that the number of exploratory development and operational mines may increase, which could add to the number of facilities needing analysis in the progress report long-term strategy. However, the timing of development and construction of new stationary source facilities is not yet known with any certainty.

B. Oil and Gas Sector Sources

The Alaska oil and gas sector long-term strategy are described in two sub-sections covering North Slope and Cook Inlet current facilities and future development, including leasing activity. This allows for an understanding of these proposed projects and potential impacts on visibility at Class I areas nearby.

Proposed oil and gas developments and lease sales have garnered considerable statewide and national political attention. Other projects, such as the Alaska liquefied natural gas (LNG) Project have changed in scope and size after the initial proposal. Many of these oil and gas projects are on both federal and state lands. Projections included in this RH Plan are based on the information currently available.

Field Developments and Projects - Arctic North Slope Lease Sales

In recent years, production of oil and natural gas has declined in the state, most apparent in the Arctic Coastal Plains Area. Modelled forecast scenarios generated by Ramboll for the WRAP Oil and Gas Work Group showed a 13% decrease in oil and gas production through 2022 compared with base year 2014 for the medium scenario. The low modelled scenario showed a potential 45% decrease in oil production from 2014[1]. Without any new development, production will decline l through the end of the planning period. The Alaska Division of Oil Gas[2] and the Energy

[1] Final Report: 2028 Future Year Oil and Gas Emission Inventory for WESTAR-WRAP States - Scenario #1: Continuation of Historical Trends, by John Grant, Rajashi Parikh, Amnon Bar-Ilan, Ramboll US Corporation. October 2019

[2] Fall 2018 Production Forecast to the *House Finance Committee,* Maduabuchi Pascal Umekwe, Ph.D., Alaska Department of Natural Resources, Division of Oil and Gas, February 27, 2019.

Information Administration[3] mirror these projections. There is potential for growth from the Pikka and Point Thomson development projects in the Alaska North Slope fields during the second planning period but impacts on state Class I areas will likely be minimal due to the distance from any North Slope fields to the nearest protected area. Denali National Park is 475 miles south of Prudhoe Bay. Impacts on the Tuxedni Class I Area are examined in greater detail in Section III.K.13.F, where Cook Inlet platforms are discussed.

Arctic National Wildlife Refuge 1002 Lease Sales

ANWR oil lease sales have been a topic of significant public attention for decades. The federal government initiated a process culminating in a lease sale in 2020. In January 2021, a new Executive Order barred any new lease sales in ANWR and suspended the offerings to allow the Secretary of the Interior to conduct a thorough review of environmental impacts without a time limit.[4] Uncertainties about whether the federal government will proceed with oil and gas leasing makes it speculative to predict the timing of any future development in this area.

Should leasing occur and future developments proceed, state and federal air quality permitting requirements would need to be addressed prior to construction. The potential impact on visibility at Denali National Park, the nearest Class I area, would be addressed under RH Rule stipulations at that time.

Field Developments and Projects – Cook Inlet Lease Sales

Prior to 2020, Cook Inlet lease sales had been scheduled by BOEM as part of its Outer Continental Shelf (OCS) oil and gas program. In some cases, there were no bids or interest expressed (Lease Sales 211,219,199, and 191). Lease sale 244 was completed in 2017, and the Lease Sale 258 is targeted for 2022. These lease offerings are in the vicinity of Ninilchik and Homer and close to Tuxedni Class I Area. Exploration and Development related activities could impact visibility.

DEC will review the draft environmental impact statements for any future lease offerings and will review exploration and construction permits applications. As a part of the permit review process, a more thorough analysis of potential construction and operations emissions can be conducted. The proposed Visibility Protection Area will provide an opportunity for a more comprehensive State review and ability to examine emission controls.

Single Projects and Facility Developments

In addition to the potential development prospects in the planning period, the state has several individual facilities that may move into construction or operations phases during the planning

[3] Annual Energy Outlook 2019 with projections to 2050, U.S. Energy Information Administration Office of Energy Analysis, U.S. Department of Energy, January 2019

[4] "Executive Order on Protecting Public Health and the Environment and Restoring Science to Tackle the Climate Crisis," January 20, 2021, Section 4: "The Arctic," available at: https://www.whitehouse.gov/briefing-room/presidential-actions/2021/01/20/executive-order-protecting-public-health-and-environment-and-restoring-science-to-tackle-climate-crisis/ (Accessed 2/2/2021).

period. Summaries and potential impact on neighboring Class I areas as presented in the EIS for these projects were included in the analysis.

Alaska LNG Project

The Alaska LNG (AK LNG) Project is a proposed project by the Alaska Gasline Development Corporation (AGDC) for a liquid natural gas pipeline including processing stations which would connect available natural gas reserves on the North Slope with state markets in Interior and Southcentral Alaska as well as international markets. It would be composed of three stationary sources: a Gas Treatment Plant on the North Slope, a pipeline running south from the North Slope to the Kenai Peninsula with compressor and heater stations, and a Liquefaction Plant on the Kenai Peninsula to prepare the gas for transport as LNG to markets in the Contiguous United States and East Asia. Analysis is split into three sub-sections to cover each of the stationary source facilities for their impact on the state's long-term strategy.

Gas Treatment Plant: North Slope

The first of the three stationary sources attached to this project is a planned Gas Treatment Plant on the North Slope. This facility would take raw natural gas pumped from the gas wells on the North Slope, process it to remove impurities, and transfer it to the gas pipeline for transport to markets in Interior and Southcentral Alaska, as well as the final Liquefaction Plant on the Kenai. Along with the gas compressor and processing facilities, this installation would have its own dedicated natural gas-fired electrical generators and support facilities for on-site employees. If completed, it would be one of the largest stationary sources in the North Slope Borough with potential emissions under maximum flaring conditions of 3,322 TPY for NOx, 903 TPY for particulate matter, and 1,076 TPY for SO_2, as allowed under Construction Permit AQ1524CPT01.[5]

At present, the Gas Treatment Plant has completed the construction permitting process with DEC.[6] By the timeline established in the EIS, construction is estimated to take at least 90 months (seven years, six months) to complete. Given publicly cited construction times and accompanying logistics involved, it appears unlikely that the project would reach operational status before the end of the second planning period. This should then be reviewed as a possible source of visibility impairment at the Denali Class I area during the third planning period, as construction could potentially be completed at the end of 2028 as per current planning documents and timelines.

[5] For more information about species-specific pollutant amounts, see the following: "Alaska LNG Environmental Impact Statement," *Federal Energy Regulatory Commission*, Vol. 3, p. 4-937, available at: https://www.ferc.gov/sites/default/files/2020-05/03%2520Alaska%2520LNG%2520FEIS%2520Volume%25203.pdf (Accessed 2/16/2021).
[6] Alaska Department of Environmental Conservation, Air Quality Division, Permitting Department, Air Quality Control Construction Permit Number is AQ1524CPT01, issued 8/13/2020 to the AK Gasline Development Corporation

Gas Pipeline and Compressor Stations: North Slope, Interior AK, Southcentral AK

The second stage of the proposed AK LNG Project is an 800-mile pipeline running south from the Gas Treatment Plant on the North Slope to the Liquefaction Plant at Nikiski on the Kenai Peninsula. In addition to the pipeline, a total of nine compressor stations are planned to be built along the length of the pipeline as well. Pipeline compressor stations were reported in the draft EIS as small sources of pollution below 100 TPY of any individual criteria pollutant. With these figures, the compressor stations are minor stationary sources and are not likely to significantly impact visibility at either the Denali or Tuxedni Class I areas. At present, there have been no permit applications to DEC for either the planned gas pipeline or any of the planned nine compressor stations.

Currently, the facility is in the planning stages with a final EIS issued by the Federal Energy Regulatory Commission (FERC) as of March 2020. There have been no air permit applications from project planners to DEC, and thus the only available emissions are those included in the EIS. By the timeline established in the EIS, construction is estimated to take at least 90 months (seven years, six months) to complete. It appears unlikely that the project would reach full operational status before the end of the second planning period. This should then be reviewed as a possible source of visibility impairment at the Denali Class I area during construction activities or operations in the third planning period. At present, the project is not funded for construction.

Liquefaction Plant: Nikiski

The third and final stage of the proposed AK LNG Project is AGDC's Liquefaction Plant, which is planned to be built on the Kenai Peninsula near the Agrium Kenai Nitrogen Operations Facility in Nikiski, adjacent to the Tesoro Kenai LNG Plant which is no longer operating. This facility would compress and subcool feed gas stream to liquid natural gas for both the internal Alaska market, as well as for markets in East Asia via marine LNG carriers. Under state regulations, DEC has jurisdiction over the liquefaction facility as a potential permitted stationary source. DEC will not have jurisdiction over the nonpoint mobile sources, such as marine LNG carriers, which would export the liquid natural gas processed and finished at the liquefaction facility. Based on the EIS, the gas liquefaction facility would be a significant source of NOx and VOC emissions within the airshed of the Tuxedni Class I area.[7]

AGDC submitted an application for the Liquefaction Plant construction permit with DEC on May 1, 2018. The construction permit underwent a 90-day public comment period from September 11 through December 10, 2020. On March 25, 2021, AGDC requested that DEC stop work on responding to the comments received on the preliminary permit. As of November 2021, permit work for the construction permit is still on hold. By the timeline established in the EIS, construction is estimated to take at least 90 months (seven years, six months) to complete. Given publicly cited construction times and accompanying logistics involved, it appears unlikely that the project would reach operational status before the end of the second planning period. This

[7] For more information see the following: "Alaska LNG EIS," *FERC*, Vol. 3, p. 4-961, available at: https://www.ferc.gov/sites/default/files/2020-05/03%2520Alaska%2520LNG%2520FEIS%2520Volume%25203.pdf (Accessed 2/16/2021).

should then be reviewed as a possible source of visibility impairment at the Tuxedni Class I area during the third planning period.

Agrium Kenai Nitrogen Operations Facility

The Kenai Nitrogen Operations Facility, also referred to as the Agrium Urea Facility, is a chemical fertilizer manufacturing plant located in Nikiski adjacent to the Kenai Refinery. The facility is located within the area of influence for the Tuxedni Class I area. During the first RH Plan, this facility, along with the Kenai Refinery, underwent BART analysis due to its age and permit status. In addition to BART analysis, the facility's current permit underwent a PSD permit process and has BACT limits on NO_x, CO, VOCs, PM, and CO_2 equivalents. The facility has Selective Catalytic Reduction (SCR) and SoLoNO_x technology installed on its turbines as well as SCR installed on the package boilers and primary reformer to reduce NO_x emissions. The facility did not go through a BACT analysis for SO_2 emissions because their potential to emit for that pollutant is only 10.2 tons per year, which is below the PSD thresholds.

The facility was most recently issued Construction Permit AQ0083CPT07 on March 26, 2021, which would allow it to operate during the current planning period. However, the facility has not operated during the last ten years while it has maintained an active permit with DEC during that span. Therefore, DEC has no reason to believe that the restart of the facility is imminent. Even if the facility was brought online and made operational, with potential SO_2 emissions of 10.2 tons per year it likely would not trigger an evaluation based on the Q/d approach used by DEC in step-two of our source selection method, which is specified in Section III.K.13.F. However, if the facility resumes operations, DEC will revisit the facility during the progress report and perform the two-step source selection process to analyze if the facility is having visibility impacts on the Tuxedni Class I area. If the two-step source selection process shows visibility impacts, the source will undergo a four-factor analysis.

Tesoro Kenai Refinery

The Tesoro Alaska Company, LLC (Marathon) Kenai Refinery is a crude oil refinery located in Nikiski adjacent to the Agrium Kenai Nitrogen Operations Facility and the planned location of the Alaska Gasline Development Corporation Liquefaction Plant. It has been in operation since the late 1960s and during the first RH Plan underwent initial review and was exempted from BART analysis due to its low emissions profile. The facility maintains and operates low NOx burners on several heaters and boilers. Additionally, the refinery has several permit limits regarding SO_2 including: 0.0225 weight percent sulfur (wt% S) for liquid fuel on the two turbines, 0.35 wt% S for liquid fuel on several generators and fire-pump engines, and facility wide limits of 162 ppmv H_2S for refinery gas and 100 ppmv H_2S for natural gas and liquefied petroleum gas.

The Kenai Refinery currently operates under Title V Permit Operating Permit AQ0035TVP02 Rev. 9 and has submitted an application for a renewal of their operating permit. According to emission fee estimates submitted by Tesoro for emissions from 2014 through 2019, the facility had SO_2 emissions ranging from a low of 11.8 tons of SO_2 in 2014 to a high of 14.8 tons of SO_2 emissions in 2016. The low SO_2 emissions during this review period combined with the 88 kilometer distance to the nearest Class I area (Tuxedni National Wildlife Area) resulted in DEC not evaluating the refinery, as it would not have been selected according to the Q/d approach used by DEC in step-two of our source selection method.

Tesoro Kenai Liquefied Natural Gas (LNG) Plant

The Tesoro Alaska Company, LLC Kenai LNG Plant, also known as the Boil-Off Gas Facility, is an LNG manufacturing and distribution plant located adjacent to the Kenai Refinery, the Agrium Kenai Nitrogen Operations Facility, and the proposed AGDC Liquefaction Plant. The facility has maintained a Title V operating permit throughout the last decade. Although the facility has an operating permit, it has not been operational the last several years and has been in a warm shutdown mode with SO_2 emissions less than 0.1 TPY in 2017 through 2019. The current Title V Operating Permit AQ0090TVP03 Rev. 1 was issued for the Kenai LNG plant on March 6, 2020, and contains SO_2 PTE of 5.0 TPY. Therefore, even if the facility was operating at full capacity, the SO_2 emissions would be below the thresholds that would warrant analysis for RH based on the Q/d approach used by DEC in step-two of our source selection method. Although there is a current development project to introduce cool-down gas back to the facility to allow it to import LNG as a potential supplier to Agrium and the Kenai Refinery, the only reported current emissions submitted to DEC have been from facility maintenance operations to maintain the warm shutdown. The facility reported less than 5 tons of NOx, 3.3 tons of CO, and under 0.1 tons of SO_2 for 2020.

Boil-Off Gas Facility (Kenai LNG Retrofit)

The Kenai LNG facility underwent FERC EIS review in late 2020 as part of Trans-Foreland planning to transition into an LNG import facility. Plans are to upgrade the export terminal to import liquid natural gas and process the feedstock material through a boil-off gas process to refine it to use for fuel for local facilities. FERC approved the current plans in the Trans-Foreland application at the end of 2020 after addressing comments filed by DEC.

Absent a continuation of the current maintenance status at the Kenai LNG Facility, it is likely that any change in activities at the facility would generate some increased emissions. As proposed, the Kenai LNG Boil-Off Gas facility would have fewer emissions than potential operational emissions at the old Kenai LNG facility. However, as of November 5, 2021, no Air Quality permit application has been received for review. If the proposed project results in an increase in emissions above the PSD significant thresholds in 40 C.F.R. 52.21, then the facility will undergo a BACT evaluation.

BlueCrest Alaska Operating LLC Cosmopolitan Project

The Cosmopolitan Project is a project owned and operated by BlueCrest on the southern end of the Kenai Peninsula. The facility is currently operating under Minor Permit AQ1385MSS04 which was issued April 27, 2020. As of November 5, 2021, the facility has not become fully operational and has yet to trigger Title V permitting thresholds. The project is divided between off-shore jack-up drill rigs and on-shore equipment which includes a small crude oil processing facility and storage tanks for the products. Reported actual (assessable) emissions for FY2021 were 115 tons for all criteria pollutants, of which only 0.1 tons was from SO_2.[8]

Construction and facility development will likely occur during the second planning period. Minor Permit AQ1385MSS04 allows for potential emissions of SO_2 of 61.3 TPY. However, this assumes the permit limit maximum sulfur content in natural gas of 320 ppmv. This facility currently has extremely low H_2S samples averaging under 6 ppmv to date. Beginning in 2019, the source installed a new mechanical refrigeration unit to better meet pipeline quality gas standards which lowered H_2S concentrations in the gas even further. Therefore, DEC has no reason to believe that the Cosmopolitan Project will trigger analysis anytime in the near to mid future even as the project ramps up production. However, the field is within the area of influence for the Tuxedni Class I area, so DEC will examine operational emissions in the progress report to ensure the field is not causing significant visibility impacts at the Class I area.

C. Electrical Generation Sector

The electrical generation and transmission grid in Alaska is divided into several regions and categories: rural interior, road and Railbelt, North Slope, and Southeastern Alaska. Generally, rural Alaska uses diesel for generation with some exceptions (renewables are now often coupled with diesel); Anchorage, Palmer, and Wasilla primarily use natural gas; and Fairbanks primarily uses coal for generation. Electrical generation in Southeast Alaska relies mostly on hydroelectric power generation with diesel generators as backup. Generation fuel source is dependent on fuel availability; natural gas is the primary fuel used by electrical companies in Southcentral Alaska.

Southcentral Alaska

Energy production in Southcentral Alaska is mainly from natural gas with several of the production plants having been reconfigured to use natural gas in the last two decades. Therefore, visibility impacts are limited. For more information, see the below overviews of stationary sources in Southcentral Alaska:

George Sullivan Plant Two

The George Sullivan Plant, located in the Municipality of Anchorage (MOA), uses natural gas and has recently been retrofitted within the last five years with emissions control technology. Technologies installed on Turbines 6 and 7 during the refit process include Selective Catalytic Reduction (SCR) and Catalytic Oxidation. The facility reported less than 0.1 tons of SO_2 emissions in 2019. Similar emissions were reported over the last five years as a result of the facility combusting pipeline quality natural gas in their EUs. It is unlikely that this facility will shut down or limit operations during the second planning period as it provides much of the power for the MOA. As natural gas is readily available from fields located on the Kenai Peninsula and in Cook Inlet, it is unlikely that the facility's power production capacity would be limited due to fuel availability. Power production will likely remain stable as will facility

[8] Bluecrest Cosmopolitan, AQ1385MSS04, 2020 Assessable Emissions Report for FY2022, March 29, 2021.

emissions; potential slight declines could occur should population trends in the MOA continue to decrease into the second planning period.

International Station Power Plant

The International Station Power Plant is a smaller natural gas-fired power plant located in the MOA. It provides additional generation capacity for the energy grid of Southcentral Alaska and Anchorage. It was purchased by Chugach Electric at the same time as the George Sullivan Plant. The facility reported less than 0.1 tons of SO_2 emissions in 2019. Similar emissions were reported over the last five years as a result of the facility combusting pipeline quality natural gas in their EUs. Barring emergency repairs to the George Sullivan Plant or other unexpected circumstances, it is unlikely that International Station will have increased usage during the second planning period.

Hank Nikkels Plant One

The Hank Nikkels Power Plant is a small power station in the MOA owned and operated by Chugach Electric which provides additional power generation capacity in Southcentral Alaska. It has a generation capacity of sixty megawatts and can generate electricity using both natural gas and diesel in the older of the two available generators. The facility reported less than 0.2 tons of SO_2 emissions in 2019. Similar emissions were reported over the last five years as the facility is a back-up power plant. As this facility is a back-up power plant and is not used for full generation, it is unlikely that emissions will change into the next decade. Like the International Station Power Plant, barring an unforeseen shutdown at the George Sullivan or Eklutna Generating Station, this facility will likely not have increased usage.

Eklutna Generating Station

The Eklutna Generating Station is a 170-Megawatt power plant owned and operated by the Matanuska Electric Association (MEA), running on natural gas and built in the last ten years. Reported SO_2 emissions at the generating station were 12.3 tons in 2019, with similar SO_2 emissions reported for the last several years. DEC notes that these SO_2 emissions were calculated with the maximum sulfur limits allowed in the permit and are therefore conservative estimations. Looking forward into the next decade, it is possible that this facility may have an increase in emissions if the Matanuska-Susitna Borough population increases. This would not cause significant increases in visibility degradation at either the Tuxedni or Denali monitoring stations, as the facility already utilizes pipeline quality natural gas and has relatively new generators fitted with SCR to control NOx emissions.

Interior Alaska

As discussed previously in the overview section, the primary fuel sources available for use for power producers in interior Alaska are locally mined coal from the Healy Coal Mine and distillate products refined in North Pole or imported into the area. Compared with available fuel for power generation in Southcentral Alaska, the emissions profile of fuels available in this area are of a higher impairment potential. In addition to the higher impairment potential, the FNSB is located north of the Denali Class I area and has also been the subject of ongoing $PM_{2.5}$ control efforts to address nonattainment concerns.

The FNSB $PM_{2.5}$ nonattainment area has been in place for much of the first planning period and has resulted in a series of SIPs. The area currently is operating under a Serious SIP, and state planners have projected that the area will attain the federal $PM_{2.5}$ NAAQS during the second planning period.

Healy Power Plant

The Healy Power Plant is a coal-fired electrical plant located in Healy, Alaska, owned and operated by the GVEA, and provides electricity to the FNSB and Interior. The Healy Power Plant was the subject of significant examination prior to and during the first RH implementation period and was one of the facilities in the state to have BART emissions limitations applied under permit regulations.

SO_2 controls at the Healy Power Plant include dry sorbent injection (DSI) on EU 1 and spray dry absorbers (SDA) on EU 2. The Healy Power Plant has been under a federally enforced Consent Decree since 2012. Under the stipulations of the Consent Decree, the Healy facility installed \$100 Million in NO_x controls on both Units 1 and 2 of the plant, in addition to SNCR equipment on Unit 2 in 2015. As per the agreement, GVEA must either install an additional \$50-70 Million in SCR control equipment on Unit 1 or decide to shut down the unit by December 31, 2022. After this decision is made, GVEA will have until December 31, 2024, to follow through with its agreement.

Fairbanks Campus Power Plant

The UAF Campus Power Plant is a coal-fired electrical power plant located in the FNSB and has a permit issued by DEC- Air Quality that was finalized in 2015. As a facility located within the FNSB $PM_{2.5}$ nonattainment area, it was subject to analysis under the nonattainment SIP development process. The power plant is categorized as a major source under the DEC permit program and operates under Title V Operating Permit AQ0316TVP03 issued on October 29, 2021. The facility currently has a potential to emit of 1,436 TPY of all pollutants which drops to 1,427 TPY on October 1, 2023, as a result of ULSD requirements from the SIP taking effect. This includes potential emissions of 40 TPY of $PM_{2.5}$ and 519 TPY of SO_2.

The new coal-fired boiler was designed to meet federal emissions standards at the time of construction, including the 0.2 lb/MMBtu SO_2 limit in NSPS Subpart Db. However, the new boiler does not contain flue gas desulfurization emissions controls such as DSI or SDA. As this facility provides heat and power to UAF and has new emission units constructed within the last ten years, it is likely that this power plant will continue to operate through the current planning period, and beyond.

Chena Power Plant

The Chena Power Plant is a coal-fired electrical power plant located in the Fairbanks Municipality that is owned and operated by Aurora Energy, LLC. The plant provides electricity to the local grid and district steam heat to much of downtown Fairbanks, servicing local space heating needs. The power plant has been operating since the early 1950s and currently operates under Title V Operating Permit AQ0315TVP04 Rev. 1 issued on March 4, 2020. The Chena Power Plant does not include any control equipment to limit SO_2 emissions and has a baghouse exhaust system installed on the common exhaust stack to reduce particulate matter. Although the facility is approaching seventy years old, Aurora has not indicated that it will close the power plant prior to the end of the second planning period.

GVEA North Pole Power Plant

The North Pole Power Plant (North Pole) is an electrical generating facility that combusts distillate fuel in combustion turbines to provide power. The power plant is authorized to operate two fuel oil-fired simple-cycle gas combustion turbines, two fuel oil-fired combined cycle gas turbines (only one of which has been installed as of November 5, 2021), one fuel oil-fired emergency generator, and two propane-fired boilers.

North Pole Power Plant was analyzed during the nonattainment SIP development process due to its location within the FNSB $PM_{2.5}$ nonattainment area. GVEA did not commit to a plant closure during the second planning period for North Pole. The company will be reducing the sulfur content of its fuel oil as a result of the FNSB $PM_{2.5}$ nonattainment area SIP. Beginning October 1, 2023, GVEA is required to burn ULSD in EUs 1 and 2 from October 1 – March 31. The SIP requirements from the SIP also included EUs 5 and 6 (6 is not yet installed) combusting fuel with a maximum sulfur content of 50 ppmw (except during startup). Additionally, as a result of the four-factor analysis performed on EUs 1 and 2 for RH, the source will be switching to fuel oil with a maximum sulfur content of 1,000 ppmw during the remainder of the year (April 1 – September 30). See section III.K.13.F of the RH SIP for further information on the four-factor analysis. The combination of these measures will result in a significant drop in SO_2 emissions at North Pole Power Plant. DEC calculations show that these restrictions on the sulfur content of fuel combined with historical fuel usage would result in actual SO_2 emissions of less than 60 TPY from 2014 through 2019.

GVEA Zehnder Power Plant

The Zehnder Facility is an electrical generating facility that combusts distillate fuel in combustion turbines to provide power. The power plant contains two fuel oil-fired simple-cycle gas combustion turbines and two diesel-fired generators used for emergency power and to serve as black start engines for the GVEA generation system.

Zehnder was analyzed during the nonattainment SIP development process due to its location within the FNSB nonattainment area. GVEA did not commit to a plant closure during the second planning period for Zehnder. The Zehnder Facility agreed to a SO_2 emissions limit as a result of the FNSB SIP. DEC issued Title V Operating Permit AQ0109TVP04 on May 11, 2021, which limits the power plant to 67.4 TPY of SO_2 emissions beginning September 1, 2022. DEC also notes that Zehnder has historically had SO_2 emissions below the new limit of 67.4 TPY, which resulted in the facility not being selected for analysis during this 2nd implementation period for RH.

Fort Wainwright (Doyon Utilities)

The Fort Wainwright Combined Heat and Power Plant (CHPP) is a privatized utility which provides electrical and heating services to Fort Wainwright in the Fairbanks area. The facility has been operational since 1955. It is a coal-fired facility with six boilers, all installed in 1953 when the fort and utilities were constructed. Due to NAAQS violations for CO emissions all six boilers have been operating at 20 percent reduced capacity since 2017.

In October 2020, the U.S. Army Corps of Engineers (USACE) issued a draft environmental impact statement (EIS) outlining the options for plant replacement given its age, operating limits, and an understanding of future power and heating demands at the military installation.[9] Under the EIS, the USACE has committed to begin to implement their decision by the year 2026. The no-action alternative in the EIS of continued operation of the existing coal-fired boilers with additional sulfur control retrofits identified in the nonattainment SIP, was included in the EIS along with three other alternatives. These alternatives were the construction of a replacement coal-fired CHPP, dual-fuel CHPP using natural gas and ULSD, and a system of distributed natural gas boilers.

Of these, the coal-fired CHPP was the highest cost and would have the greatest risk of system failure. The distributed natural gas boilers were ranked as having the lowest implementation costs with an energy usage reduction of up to 46 percent and would take full advantage of currently installed emergency generators.[10]

This facility will be revisited in the progress report at which time it is believed a decision will have been made and progress made either on retrofitting the existing units with sulfur controls or constructing a replacement for the current CHPP.

D. Mobile Sources

Mobile source emission control strategies may be difficult to achieve and some, such as marine, aviation, and on-road vehicles are among those that are under limited control by the State. Off-road sources, such as asphalt plants and mobile drilling rigs, have limited options for controls that would make a significant difference in addressing visibility impacts. This section addresses those mobile sources that appear in the RH Significant Impact (SI) high value WEP areas.

[9] The EIS can be viewed at https://home.army.mil/alaska/index.php/fort-wainwright/NEPA/HEU-EIS
[10] U.S. Army Garrison Alaska, U.S. Army. Draft Environmental Impact Statement: Addressing Heat and Electrical Upgrades at Fort Wainwright, Alaska. Fort Wainwright, AK: U.S. Army Garrison AK, U.S. Army, June 2020, p. viii-iv.

(a) Marine Sources

Marine Sulfur Control Areas: IMO Low-Sulfur Diesel Rules, North American ECA

As described previously in the International Emissions Control Program section, oceangoing vessels have fuel requirements specified by the IMO and federal agencies. A new fuel sulfur limit was made compulsory following an amendment to Annex VI of the International Convention for the Prevention of Pollution from Ships (MARPOL). From January 2020, the United Nations shipping agency, IMO, will ban ships from using fuels with a sulfur content above 0.5%, compared with 3.5% before January 2020. Within specific designated emission control areas the limits were already stricter (0.10%). In Alaska the zone of influence for the ECA extends from Southeast Alaska west to the northern end of Kodiak Island, leaving the remainder of the western part of the state outside of this zone of sulfur regulation. It is expected that this change will result in lower emissions.

Cruise and Passenger Vessel Traffic

Alaska generally has a strong tourism industry which includes the seasonal transport of passengers to Alaska via cruise ships, particularly in Southeast Alaska. The cruise ship industry in Alaska set records for passenger traffic in each of the three years leading up to the COVID-19 Pandemic in the spring of 2020. With the pandemic, all cruise traffic was suspended for the 2020 summer season due to disease concerns, and the 2021 season was greatly diminished in the number of vessels and a truncated sailing season. As such, it will be difficult to calculate potential long-term passenger or cruise vessel traffic until after the pandemic has been brought under control. Emission changes and visibility impacts should be revisited during the progress report in 2024 using available traffic data.

Trans-Arctic Shipping and Cruise Traffic

Although it is unlikely that large amounts of marine traffic will traverse trans-Arctic shipping routes during the next decade, long-term climate change trends indicate thinning ice packs. Increasing numbers of reinforced cargo vessels have begun using the available shipping routes during summer months that are closer to both the Canadian and Russian coasts, although ice breakers are still required at this time for any trans-Arctic trade to be conducted.[11, 12]

The Chinese Foreign Ministry has expressed interest in what is being called a "Polar Silk Road" where trans-Arctic routes and over-the-top shipping lanes are to be used to shorten trade routes

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[11] "Polar Shipping Routes," *The Geography of Transport Systems: Fifth Edition*, Routledge Press, 2020, available at: https://transportgeography.org/contents/chapter1/transportation-and-space/polar-shipping-routes/ (Accessed 1/26/2021).

[12] For more information on potential long-term ice thaw and trans-Polar shipping, see the following article: "As Arctic Ice Vanishes, New Shipping Routes Open," Jugal Patel, Henry Fountain, *New York Times*, May 3, 2017, available at: https://www.nytimes.com/interactive/2017/05/03/science/earth/arctic-shipping.html (Accessed 1/26/2021).

to Europe. This is a long-term trend that will likely take beyond the ten-year time frame of current planning documents to move towards fruition.[13]

This trend has also been reflected in growing numbers of Arctic cruise ships which are visiting ports further north than in previous years. Prior to the 2020 COVID-19 pandemic, there were increasing numbers of vessels visiting remote Alaska ports along the coast. Cities like Nome on the Seward Peninsula and Unalaska in the Aleutians have had an increasing amount of annual cruise traffic, in addition to ports like Utqiagvik and Kivalina. DEC will revisit this subject in the progress report to evaluate for changes and trends after the end of the current pandemic.

Northwest Passage and Russian Northern Route

Along with direct trans-Arctic shipping routes are the more traditionally considered coastal shipping routes such as the Northwest Passage and the Northern Route in Russia. Both the Northwest Passage and Northern Route have had increased usage in the last decade. With warming trends continuing it is possible that routes through U.S. and Alaska Arctic waters will have increased utilization through the end of the second planning period.[14]

This is a trend that has been recorded among Russian shipping firms which have increased utilization of the Northern Sea Route along the Siberian coast. In recent years the Russian government has funded the construction of several new ice breakers for use with cargo vessels along this route. Such traffic increase has the potential of increasing local air pollution on the US-side of the maritime border in the Bering Sea.[15] At present, data on maritime traffic is included in current 2028 future forecasting models which includes compliance with IMO regulations.

Due to the international nature of these shipping routes, DEC does not have jurisdiction to control fuel sulfur content used in the Russian Federation or non-IMO signatory flag states. DEC may return to this issue in the progress report to review traffic patterns and usage. At that time, the agency can analyze whether further data (monitoring, etc.) is needed to comprehend RH-related policy issues for maritime Class I areas in the zone of influence (Simeonof National Wilderness Area, Bering Sea Wilderness Area).

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[13] The Chinese Foreign Ministry's current statement on the so-called "Polar Silk Road" is largely centered on current UNCLOS treaties on rights of navigation, submarine cable laying, and scientific research. The state also has gained observer status at the Arctic Council, though does not have the right to propose legislation or international agreements in that forum. For more information, see the following statement: "China's Arctic Policy White Paper," State Council Information Office of the People's Republic of China, January 2018, available at: http://www.scio.gov.cn/zfbps/32832/Document/1618243/1618243.htm (Accessed 1/26/2021).

[14] For more information on current Russian Federation Arctic policy see, the following article:" The Arctic: Global Warming and Heated Politics," June Teufel Dreyer, *Foreign Policy Research Institute*, August 17, 2021, available at: https://www.fpri.org/article/2021/08/the-arctic-global-warming-and-heated-politics/ (Accessed 10/28/2021).

[15] For more information on LNG shipments and ice breakers in the Russian Federation, see the following: "Russia to build first LNG-powered icebreakers for Arctic sea route," Gleb Stolyarov, *Reuters*, July 23, 2021, available at: https://www.reuters.com/business/sustainable-business/russia-build-first-lng-powered-icebreakers-arctic-sea-route-2021-07-23/ (Accessed 10/28/2021).

(b) Aviation Sector LTS

Along with the marine sector, many communities rely on the aviation sector to provide goods and services for residents. With the state's location astride major air routes and trends showing increased passenger and cargo air flights until the COVID-19 pandemic in 2020, it is necessary for DEC to maintain this sector in the LTS and monitor potential growth. Both passenger and cargo aviation are tied to global economic forces and should be seen as a reflection of these trends. Mobile source emission control strategies for aviation sources are generally outside the authority of DEC. The LTS for the state is largely trend monitoring and communication with EPA during triennial NEI years.

Passenger Aviation

Passenger aviation in Alaska in the next ten years will largely be a reflection of the recovery of tourism and cruise vessel traffic after the end of the COVID-19 pandemic, as well as the popularity of Alaska as a travel destination. In addition, recent announcements of low-emissions fuel for carrier airlines could reduce visibility impacts on Class I areas near the major international airports. However, such measures are dependent on the economic viability of purchasing fuel which will likely cost more than current JP-2 burned by commercial aircraft utilizing airports in the state. Such reductions could be measurable on triennial NEIs before the end of the planning period.

Beyond inter-state passenger travel, current intra-state travel utilizing both heavy and light passenger aircraft will likely reflect ongoing trends as well. DEC may track these trends during this implementation period to ensure the State's LTS reflects figures after the end of the pandemic.

Cargo Aviation

Unlike passenger flights, cargo aviation has remained largely unaffected during the last year of pandemic travel restrictions beyond local flight crew quarantine measures and temporary international trade reductions. Mirroring international maritime trade, air cargo volumes rebounded by the end of 2020 and are set to continue their long-term growth patterns.[16] It is unlikely that Anchorage-Ted Stevens International Airport will show air cargo reductions through the end of the planning period. This is a reflection of its air cargo hub status for trade between North America and East Asia and the continued higher volumes of cargo aircraft throughout 2020 during pandemic travel restrictions. While passenger numbers remained low, air cargo volumes increased by over nine percent during 2020.[17]

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[16] For more information about global air cargo trends, see the following report: "World Air Cargo Forecast, 2020-2039," *Boeing Corporation*, 2020, available at: http://www.boeing.com/resources/boeingdotcom/market/assets/downloads/2020_WACF_PDF_Download.pdf (Accessed 1/27/2021).

[17] "Air Cargo Construction is Booming, Thanks to Amazon," Keith Schneider, *New York Times*, January 12, 2021, available at: https://www.nytimes.com/2021/01/12/business/air-cargo-airports-amazon.html (Accessed 1/27/2021).

Over the next decade, continued growth or similar levels of traffic at Anchorage-Ted Stevens could potentially impact visibility at either the Denali or Tuxedni Class I area. Much the same as for passenger aviation and maritime activity, DEC lacks the ability to regulate these aviation activities as mobile sources are primarily controlled at the federal level. Unlike passenger flights, there has been no public discussion of using low-emission fuels to replace JP-2 in cargo flights using Anchorage as a hub or flying onto airports in East Asia.

(c) Railroad Sector

For the two railways operating in Alaska at present, it is unlikely that major changes will occur to increase emissions or cause significant visibility issues. At present, the only Class I area where rail traffic could potentially impact visibility monitors is Denali National Park, where the Alaska Railroad (AKRR) runs north-south between Anchorage and the FNSB. The rail line was more active prior to 2016 when coal shipments were sent south from the Usibelli Coal Mine to Seward for export to markets in East Asia and South America. Coal shipments ended in 2016 and have not been reinitiated given ongoing market conditions and declining demand for coal for energy production.[18] As a result, cargo related emissions have decreased during the year while passenger traffic has remained steady during spring and summer tourist seasons.

In addition to decreased cargo shipments, the AKRR has purchased several efficient diesel-fired engines to replace older and less efficient engines. This, combined with decreased traffic along the lines, will likely keep railroad-associated visibility low through the end of the planning period.

4. MEASURES TO MITIGATE IMPACTS OF CONSTRUCTION ACTIVITIES

Under 40 CFR §51.308(f)(2)(iv)(B), states are required to develop measures to mitigate the impacts of construction activities. In developing this LTS, DEC has considered the impact of construction activities on visibility in Alaska's Class I areas. Alaska's Class I areas are remote with little to no significant construction activities. Based on this general knowledge of growth and construction activity in Alaska, and without conducting extensive research on the contribution of emissions from construction activities on visibility, DEC believes that current state and federal regulations already adequately address this emission source. Using the RH-VPA will allow for additional information to be collected in the future, especially during permit reviews, that will help further evaluate construction activities on visibility.

State regulations contained at 18 AAC 50.045(d) require that entities who cause or permit bulk materials to be handled, transported, or stored or who engage in industrial activities or construction projects shall take reasonable precautions to prevent particulate matter from being emitted into the ambient air. This regulation allows the state to take action on fugitive dust emissions from construction activities.

[18] For more information about the shuttered Seward Coal Terminal, see the following article: "No plan for Seward coal terminal three years after last shipment," Elizabeth Earl, *Alaska Journal of Commerce*, May 8, 2019, available at: https://www.alaskajournal.com/2019-05-08/no-plan-seward-coal-terminal-three-years-after-last-shipment (Accessed 1/28/2021).

In addition to state regulation, federal rules establishing emission standards and fuel requirements for diesel non-road equipment significantly reduced emissions of PM, NOx, and SO_x from emission sources in the construction sector over the first planning period that should continue into the next planning period.

Alaska routinely reviews dust management plans for new construction during a new construction permit review. DEC continues to review and comment on draft EISs for mitigation to dust resulting from construction activities and requests that dust mitigation plans be included in DEC air permit applications. In partnership with EPA, a Dust Toolkit was developed for communities to use to reduce road dust; it provides technical assistance and public outreach materials to communities. While actual reductions in emissions are not known, DEC has been receiving fewer complaints from communities on road dust.

5. SOURCE RETIREMENT AND REPLACEMENT SCHEDULES

Under 40 CFR §51.308(f)(2)(iv)(C), states are required to address source retirement and replacement schedules. The construction of new sources to replace older, less well-controlled sources can aid in progress toward achieving visibility goals. Alaska's continued implementation of NSR and PSD requirements with FLM involvement for Class I area impact review will assist in maintaining the least impaired days from further degradation and assure that no Class I area experiences degradation in visibility resulting from expansion or growth of stationary sources in the state. DEC will continue to track source retirement and replacement and include known schedules in periodic revisions to this plan.

6. SMOKE MANAGEMENT PRACTICES FOR AGRICULTURAL AND FORESTRY BURNING

Under 40 CFR §51.308(f)(2)(iv)(D), states are required to address basic smoke management practices for prescribed fire used for agricultural and wildland vegetation management purposes and smoke management programs. Smoke from wildland fires is a major contributor to visibility impairing air pollution in Alaska communities and mandatory federal Class I areas. Alaska's implementation of smoke management techniques through regulation contribute to minimizing impacts from planned burn activities on visibility in Class I areas.

Alaska has longstanding open burning regulations in 18 AAC 50.065 and included open burning requirements in the SIP (Volume II, Section III.F) to reduce and prevent particulate matter emissions from impacting public health. DEC requires approvals for open burning or controlled burning to manage forest land, vegetative cover, fisheries, or wildlife habitat if the cumulative area to be burned exceeds 40 acres yearly. DEC also requires approvals for open burns for firefighter training exercises. In addition to this ongoing regulation, DEC developed and implemented the Alaska Enhanced Smoke Management Plan (ESMP) and included this plan as part of the LTS in the first RH SIP and has updated the ESMP for this SIP. Open burn approvals require that entities conducting planned burns follow the provisions in the ESMP.

DEC works cooperatively with the Alaska Wildland Fire Coordinating Group (AWFCG) to address air quality impacts from wildland fire through the ESMP. The AWFCG was formed in 1994 and provides a forum that fosters cooperation, coordination, and communication for wildland fire and for planning and implementing interagency fire management statewide. The AWFCG membership includes state, federal, and Native land management agencies/owners that have fire management responsibilities for the lands they manage/own.

One of the objectives of the AWFCG is to provide a forum for anticipating smoke intrusions into sensitive areas, including communities and Class I areas; resolving on-going smoke management issues; and improving smoke management techniques. Another objective is to ensure that prescribed fire, used as a tool to enhance wildlife habitat and to reduce overall fire risk and/or future smoke emissions, is considered by DEC when promulgating policy, procedures, and regulations. Without the use of prescribed fire on the landscape, the state could see large, catastrophic fires whose smoke would create larger impacts on Alaskans and Class I areas than the smoke of controlled burns. The AWFCG Smoke Management/Air Quality Committee addresses the AWFCG smoke management objectives and assists DEC with the development and revision of the ESMP for Prescribed Fire and propagation of policies, procedures and regulations related to smoke management.

The ESMP helps fulfill Alaska's responsibilities for protection of air quality and human health under federal and state law and reflects the CAA requirement to improve regional haze in Alaska's Class I areas. The ESMP outlines the process, practices, and procedures to manage smoke from prescribed and other open burning and identifies issues that need to be addressed by DEC and land management agencies or private landowners/corporations to help ensure that prescribed fire (e.g. controlled burn) activities minimize smoke and air quality problems. The ESMP provides accurate and reliable guidance and direction not only to and from the fire authorities who use prescribed fire as a resource management tool, but also to the private landowners and/or corporations who conduct agricultural or land-clearing burns. The ESMP describes and clarifies the relationship between fire authorities and DEC. These agencies must work together effectively to combine planned burning, resource management and development with smoke, public health, and Class I area visibility goals.

Alaska's ESMP was last adopted by the AWFCG in June 2015 and allows for annual evaluation by the AWFCG and interested parties but commits to revisions at least every five years in accordance with EPA's Interim Policy on Wildland and Prescribed Fires. The ESMP, updated as of December 1, 2021, is included in Appendix III.K.13.H.

Enhanced Smoke Management Program Assessment

Evaluation of the existing ESMP relies on accurate data to determine if improvements are needed. In this review, DEC determined that the data quality needs improvement and permits and controlled burning need better coordination. Routine program review needs to be continual, and identified improvements need to be made by DEC to regularly update the ESMP to be able to address EPA exceptional event regulations[19] and guidance[20]. This guidance includes adding a routine program assessment and also includes agricultural related burning. These updates are included in the revised ESMP, updated as of December 1, 2021.

During this assessment, DEC identified the following improvements to be included in the ESMP or in the emissions inventory assessment.

- *The current program only addresses the prescribed fire permits issued by DEC.*

DEC is working with DNR to include agricultural fires and controlled burning that are less than 40 acres and permitted through DNR's large scale burn permit program. DEC may elect to change the fire acreage for DEC approvals to a lower number in the future if it is found to be necessary to meet the needs of the ESMP and SIP.

- *Data Quality*

Data quality for all fires needs to be upgraded to include actual fire acreage, verified cause and vegetation.

- *The SMP does not address agricultural burning.*

This is an amended section of the ESMP. DEC has been working with DNR in the past three years to include agricultural fires in our emission inventory, but these fires need to be included in the interagency coordination for weather and fire emissions.

- *The current reporting system with AICC or DEC does not validate vegetation type.*

As a result, the default is "grasses" which results in fewer actual emissions. DEC will be working with DNR and the AICC to determine how to make these improvements. Similarly, DEC will review its own prescribed burn reports to make sure reports include accurate information.

- *Agency coordination for weather conditions before controlled or prescribed burns is lacking; this coordination is meant to minimize emissions.*

If fires are under 40 acres, other agencies do not always include the DEC meteorologist in the forecast discussions, which could result in larger emissions or expanded fires. To resolve this, DEC is working with DNR and other agencies through the AWFCG to address the issue.

[19] FR Vol 81, No. 191 / October 3, 2016

[20] Prescribed Fire on Wildland that May Influence Ozone and Particulate Matter Concentrations (August 2019), https://www.epa.gov/air-quality-analysis/exceptional-events-guidance-prescribed-fire-wildland-may-influence-ozone-and

- *Emissions calculation system that supports the fire inventory is outdated.*

DEC is looking at options for difference systems to calculate the emissions from all fires. AICC changed how they document all fires on an annual basis as a result of the dispatched system changes and how the dispatches are logged into their database system.

7. ANTICIPATED NET EFFECT ON VISIBILITY OVER THE PERIOD OF THE LONG-TERM STRATEGY

The anticipated net effect on visibility from emission reductions by point, area, and mobile sources during the period of the LTS is estimated in Section III.K.13.I. The reasonable progress demonstration, based on monitoring, emission inventory, and modeling projections, indicates that measures included in the LTS provide for an improvement in visibility on the 20% MID consistent with the uniform rate of progress target in 2028.

The results of the emission inventories in Section III.K.13.E show many anthropogenic emission sources are declining significantly in Alaska through 2028. Overall visibility benefits of these reductions are somewhat offset, however, by emissions from natural sources such as wildfire, dust, volcanoes, oceanic sea salt, DMS, and other uncontrollable sources. These uncontrollable sources include international sources in Canada, Asia, and Europe; global transport of emissions; and offshore shipping in the Pacific Ocean. It is possible that, with accelerating climate change-related impacts, wildfire and dust related impairment could offset gains made through mobile and marine sources related improvements.

There are numerous on-the-books regulations such as state and federal mobile source rules, the marine emission control area, smoke management, and other elements contained in the LTS that address $PM_{2.5}$ over the next five to ten years that are expected to provide additional improvements in visibility by 2028, the presence of natural and other uncontrollable source impacts will continue to be a challenge, especially to the Tuxedni and Simeonof Class I areas as demonstrated in Section III.K.13.I Reasonable Progress Goals.

As part of the requirement to submit five-year progress reports on this plan, DEC will include in the five-year update any additional visibility improvements realized due to updated or new information related to the demonstration of reasonable progress in Section III.K.13.I of this plan.

8. EMISSIONS LIMITATIONS AND SCHEDULES FOR COMPLIANCE

Promulgated state and federal regulations under the CAA have unique emission limits and compliance schedules specified for affected sources. These limitations and schedules are identified in the specific rules. DEC's four-factor analysis described in Section III. K.13.F identified requiring GVEA North Pole Power Plant's EUs 1 and 2 to switch from No. 2 fuel oil to No. 1 fuel oil. Beyond this source, no additional measures were found necessary to implement during this second regional planning period. As a result, the only emission limitations or schedules of compliance included in this plan are as follows: on or before January 1, 2024, GVEA shall submit a Title I permit application to DEC that includes a RH requirement to limit the sulfur content of fuel combusted in EUs 1 and 2 to fuel oil with a maximum sulfur content of 0.1 percent by weight (1,000 ppmw, No. 1 fuel oil) to be effective no later than January 1, 2025. It is anticipated that further evaluation of control programs for future SIP updates may identify additional emission controls that could be implemented. Emission limitations and compliance schedules will be included as needed during the periodic plan updates.

III.K.13.I REASONABLE PROGRESS GOALS

1. OVERVIEW

Title 40 CFR §51.308(f)(3) requires that states must establish goals (expressed in deciviews) for reasonable progress towards achieving natural visibility conditions for each mandatory Class I area located within the State. The RPGs must provide for an improvement in visibility for the MID over the period of the implementation plan and ensure no degradation in visibility for the clearest days over the same period. These RPGs reflect the visibility conditions that are projected to be achieved by the end of the applicable implementation period as a result of a state's own and other states' long-term strategies. Although an RPG is not an enforceable requirement of the RH Rule, it can be a useful metric for evaluating progress. States are given the flexibility to establish different RPGs for each Class I area.

Under 40 CFR §51.308(f)(3)(ii)(A), a state is required to analyze and determine the consistent rate of progress over time needed to attain natural visibility conditions on the 20 percent MID by the year 2064. This glidepath is referred to in this document as the uniform rate of progress (URP) line. The URP is the slope of this line. The state must then compare its RPGs for the 20 percent MID to the URP for each implementation period. In the first RH SIP, DEC established its RPGs for each of its Class I areas for the first implementation period (2018). In this second RH SIP, DEC is providing updates on its RPGs for the state Class I areas for the second implementation period (2028). The 2028 URP does not mandate a reduction target. States have the option to select RPGs with greater, equivalent, or lesser visibility improvements than established by the URP. If a state selects a visibility goal that results in visibility improvements less than needed to meet the URP, it must provide a robust explanation for why additional visibility improvement approaches have not been considered and how this meets emissions reduction targets through the end of the planning period.[1]

This chapter will identify ways to ensure that each of the Class I areas maintains progress towards natural conditions in 2064 while utilizing reasonable approaches that will not place undue burdens onto sources or groups of sources covered in previous chapters.

2. UNIFORM RATE OF PROGRESS

URP is the rate of improvement in visibility that would need to be maintained during each implementation period in order for the 20% MID to reach natural conditions by 2064, given a starting point of the 2000 through 2004 baseline MID visibility condition. Elements of the URP glidepath include:

- "Baseline conditions" represent visibility conditions for the 2000 to 2004 baseline period as the starting point for the URP glidepath, "Current conditions" represent the most recent

[1] For more information on these requirements, see 51.308(f)(3)(ii): "the State must demonstrate, based on the analysis required by paragraph (f)(2)(i) of this section (the 4- factors), that there are no additional emission reduction measures for anthropogenic sources or groups of sources in the State that may reasonably be anticipated to contribute to visibility impairment in the Class I area that would be reasonable to include in the long-term strategy."

5-year monitoring period for which most recent quality assured visibility monitoring data are available (e.g., 2014 through 2018),
- “Natural conditions” is the URP glidepath end-point in 2064
- RPGs (interim) represent “reasonable progress” towards achieving natural conditions.

Baseline, current, and default natural conditions are described in detail in Section III.K.13.D.

The EPA calculated default natural visibility conditions for all Class I areas but allowed states to develop more refined calculations. States can optionally propose an adjustment of the 2064 URP endpoint to account for international anthropogenic impacts, if the adjustment has been developed using scientifically valid data and methods. The URP can be adjusted by adding an estimate of the visibility impact of international anthropogenic sources to the value of the natural visibility conditions to get an adjusted 2064 endpoint. Glidepaths based on the EPA’s default natural conditions are termed ‘unadjusted glidepaths’ in this SIP. The EPA also estimated RPGs for Alaska using a CMAQ photochemical grid model for the base year 2016 and future year 2028 and developed alternative glidepaths that account for international anthropogenic contributions.

Alaska has interest in accounting for visibility impacts on the State from highly variable natural sources and international emissions. In addition to EPA’s CMAQ modeling and EPA’s H-CMAQ international contribution estimates, Alaska used GEOS-Chem modeling conducted by the University of Alaska Fairbanks (UAF) to provide alternative estimates of the contributions of international anthropogenic emissions to visibility. Detail on UAF’s GEOS-Chem modeling is provided in Appendix III.K.13.I. Both EPA’s H-CMAQ and UAF’s GEOS-Chem used a “Zero-Out” modeling approach to quantify contributions from international sources outside of state control. For Alaska regulators, this form of modeling is useful due to trans-boundary pollution transfer and atmospheric transport which can carry visibility-impairing pollution from distant sources.

The RH Rule also requires states to determine the baseline (2000 through 2004) visibility condition for the 20% clearest days and requires that the LTS and RPG ensure no degradation in visibility for the clearest days since the baseline period.

3. REASONABLE PROGRESS GOALS FOR EACH CLASS I AREA

The RPGs for Alaska are based on the EPA’s CMAQ modeling. The visibility projections follow the procedures in section 5 of the SIP Modeling Guidance. Based on the recommendation in the modeling guidance, the observed base period visibility data is linked to the base modeling year. This is the 5-year ambient data base period centered about the base modeling year. In this case, for a base modeling year of 2016, the ambient IMPROVE data is from the 2014-2018 period. However, the data for the TUXE1 monitor is only available for 2014 so only one year was used in the projection. Table III.K.13.I-1 shows the baseline and future year deciview values on the 20% clearest days and 20% MID at each Class I area for the future year 2028. DEC has determined to treat the KPBO1 and TUXE1 sites as different sites and not as a continuation. Data for the KPBO1 monitor is available from 2015 through the end of the current visibility period in 2018. It will be possible for the state to establish a formalized baseline and glideslope for clearest and MID at KPBO1 by the next progress report.

The EPA's CMAQ modeling includes a 2028 zero-out U.S. anthropogenic emissions CMAQ modeling scenario. The zero-out U.S. anthropogenic emission simulations exclude any anthropogenic emission sources located in the U.S. or territories to provide visibility conditions caused by international anthropogenic emissions and natural sources that are beyond the control of states preparing the RH SIP. At Simeonof, according to EPA's CMAQ modeling, reducing local emissions may not benefit visibility improvement as indicated by the 2028 projected MID being higher when all U.S. anthropogenic emissions are eliminated (13.6 dv versus 14.1 dv; see Figure 3-9-2 in EPA Technical Memo, June 3,2020, in Appendix III.K.13.I and Figure III.K.13.I-2 below).

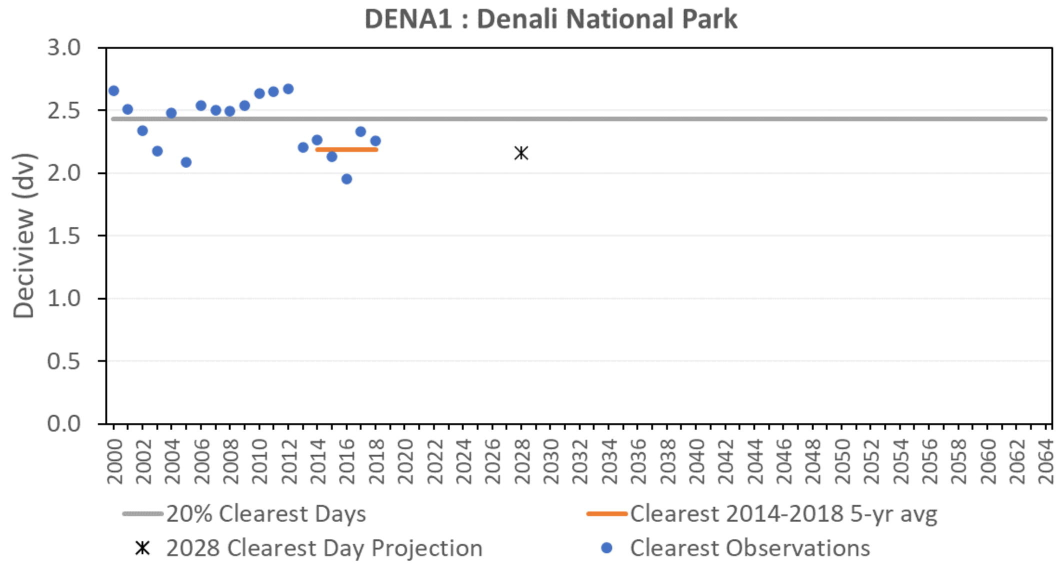
Table III.K.13.I-1. Projected 2028 future year visibility (deciview) on the 20% clearest days and 20% MID at each IMPROVE site representing Class I areas in Alaska.

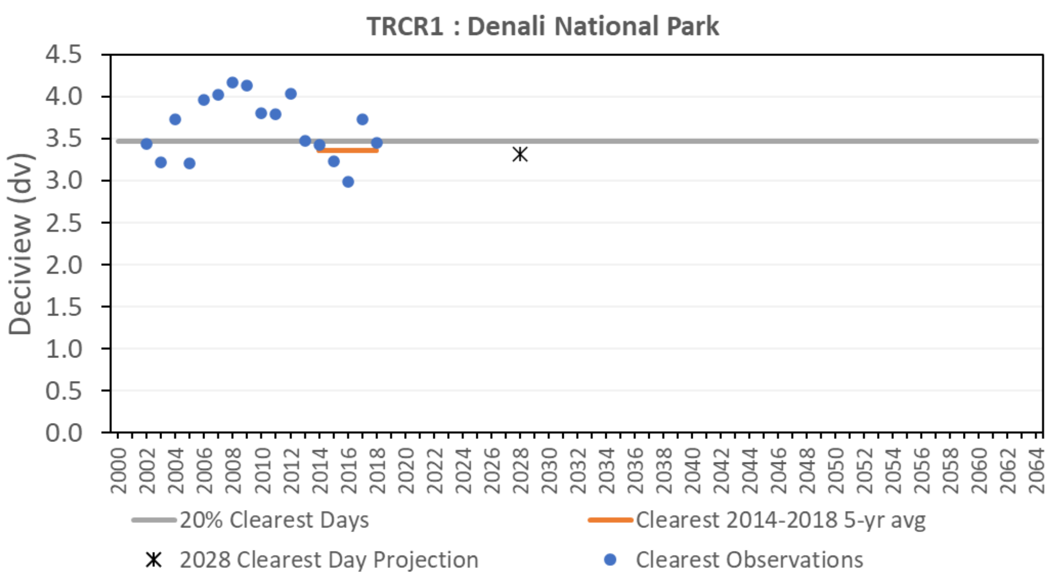
Class I Area	IMPROVE site	Future Year (2028) 20% Clearest Days (dv)	Future Year (2028) 20% MID (dv)	Zero-US Future Year (2028) 20% MID (dv)
Denali NP	DENA1	2.16	6.53	6.41
Denali NP	TRCR1	3.31	8.78	8.50
Tuxedni NWR	TUXE1	3.79	10.66	10.01
Simeonof WA	SIME1	7.56	13.57	14.05

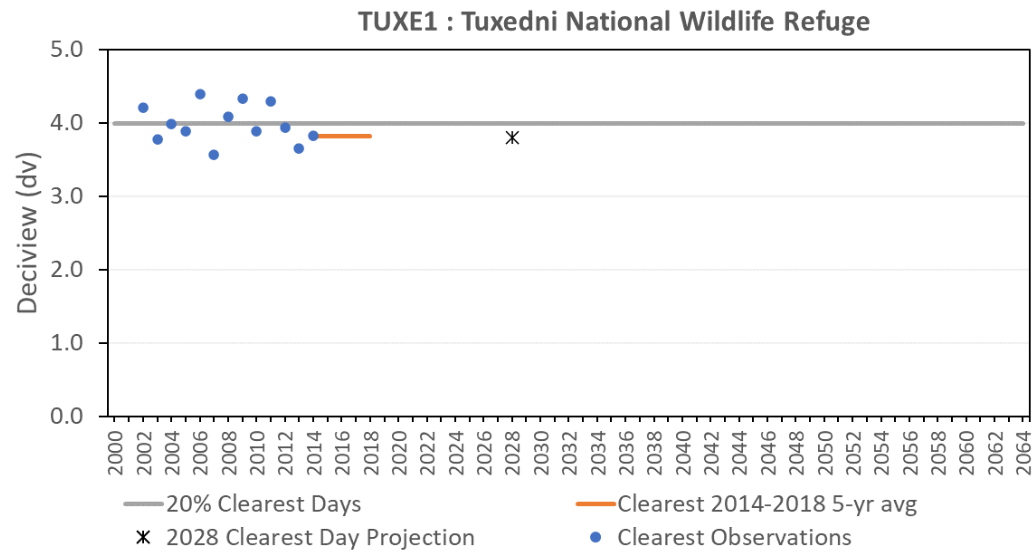
4. COMPARING THE RPGS TO THE URP

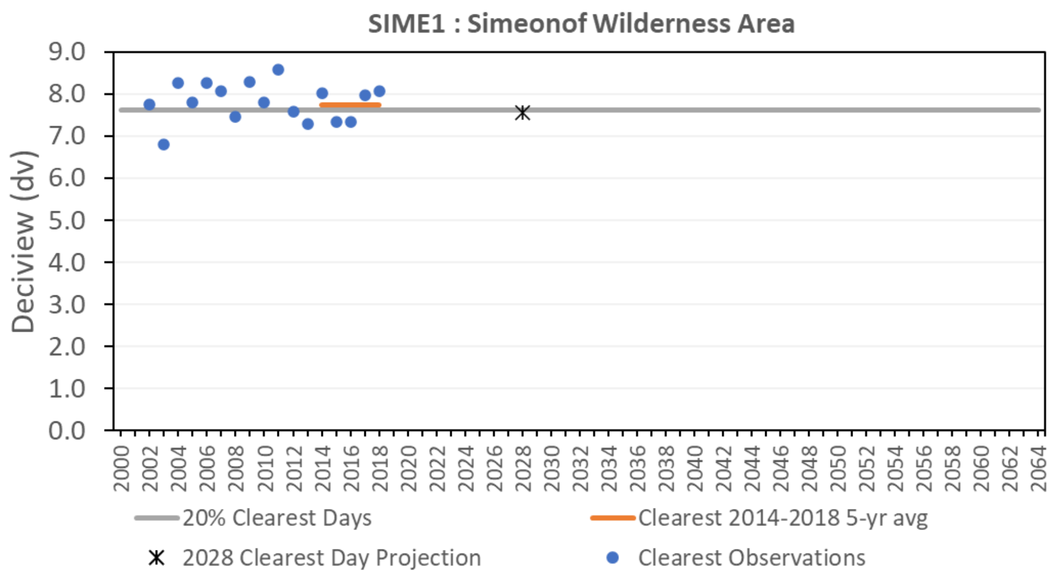
The 2028 RPG for the 20% clearest days is to be compared to the 2000-2004 baseline period visibility condition for the 20% clearest days and must ensure that no visibility degradation from the baseline period is projected. For all Class I areas in Alaska, visibility on the 20% clearest days is projected to be below the baseline visibility condition satisfying the RH Rule requirement of no degradation in visibility for the clearest days since the baseline period. This finding is in agreement with the EPA Alaska CMAQ modeling TSD which used the ambient IMPROVE data from the 2014-2017 period. Glidepaths are shown for each of the Class I areas in Figure III.K.13.I-1.

Figure III.K.13.I-1. 2028 visibility projections for the clearest days compared to the 2000-2004 baseline (grey line) at each Class I area in Alaska.









The 2028 RPG for the MID is to be compared to the 2028 glidepath values that are adjusted to account for international contributions. The international contributions estimated by the EPA H-CMAQ and UAF GEOS-Chem provide a range of adjustment to the 2064 endpoint. The H-CMAQ estimate of international anthropogenic emissions contribution only includes sulfate while the GEOS-Chem estimates also include nitrate and primary PM components. Table III.K.13.I-2 shows the 2028 glidepath values (in dv) at each Class I area, including the 2000-2004 baseline deciview values. Both "adjusted" and "unadjusted" glidepath values for 2028 are also provided. There are two adjusted glidepath values for 2028; one is based on the EPA H-CMAQ modeling and another is based on the UAF GEOS-Chem modeling. Both adjusted glidepaths are less steep (almost flat) than the unadjusted glidepath signifying importance of sources outside of the state control to visibility progress in Alaska Class I areas. Glidepaths are shown for each of the Class I areas in Figure III.K.13.I-2.

The future year 2028 deciview projections are compared to the adjusted visibility "glidepath" at each Class I areas:

Denali NP (DENA1): The 2028 projection (6.5 dv) is below the GEOS-Chem adjusted glidepath (6.9 dv) and is right on the H-CMAQ adjusted glidepath (6.5 dv).

Denali NP (TRCR1): The 2028 projection (8.8 dv) is below the GEOS-Chem adjusted glidepath (9.0 dv) but slightly above the H-CMAQ adjusted glidepath (8.5 dv).

Tuxedni NWR (TUXE1): The 2028 projection (10.7 dv) is slightly above the GEOS-Chem adjusted glidepath (10.4 dv) and H-CMAQ adjusted glidepath (10.3 dv).

Simeonof NWA (SIME1): The 2028 projection (13.6 dv) is slightly above the H-CMAQ adjusted glidepath (13.4 dv) and the GEOS-Chem adjusted glidepath (13.0 dv).

Table III.K.13.I-2. 2000-2004 baseline visibility, 2028 projected visibility (based model period 2014-2018), and 2028 glidepath values (dv) for the MID.

Class I Area	IMPROVE site	Observed 2000-2004 Baseline	Projected 2028	Projected 2028 zero-US	2028 Unadjusted Glidepath	2028 H-CMAQ Adjusted Glidepath	2028 GEOS-Chem Adjusted Glidepath
Denali NP	DENA1	7.08	6.53	6.41	6.14	6.46	6.92
Denali NP	TRCR1	9.11	8.78	8.50	8.01	8.48	9.02
Tuxedni NWR	TUXE1	10.47	10.66	10.01	9.07	10.25	10.37
Simeonof WA	SIME1	13.67	13.57	14.05	11.60	13.35	13.04

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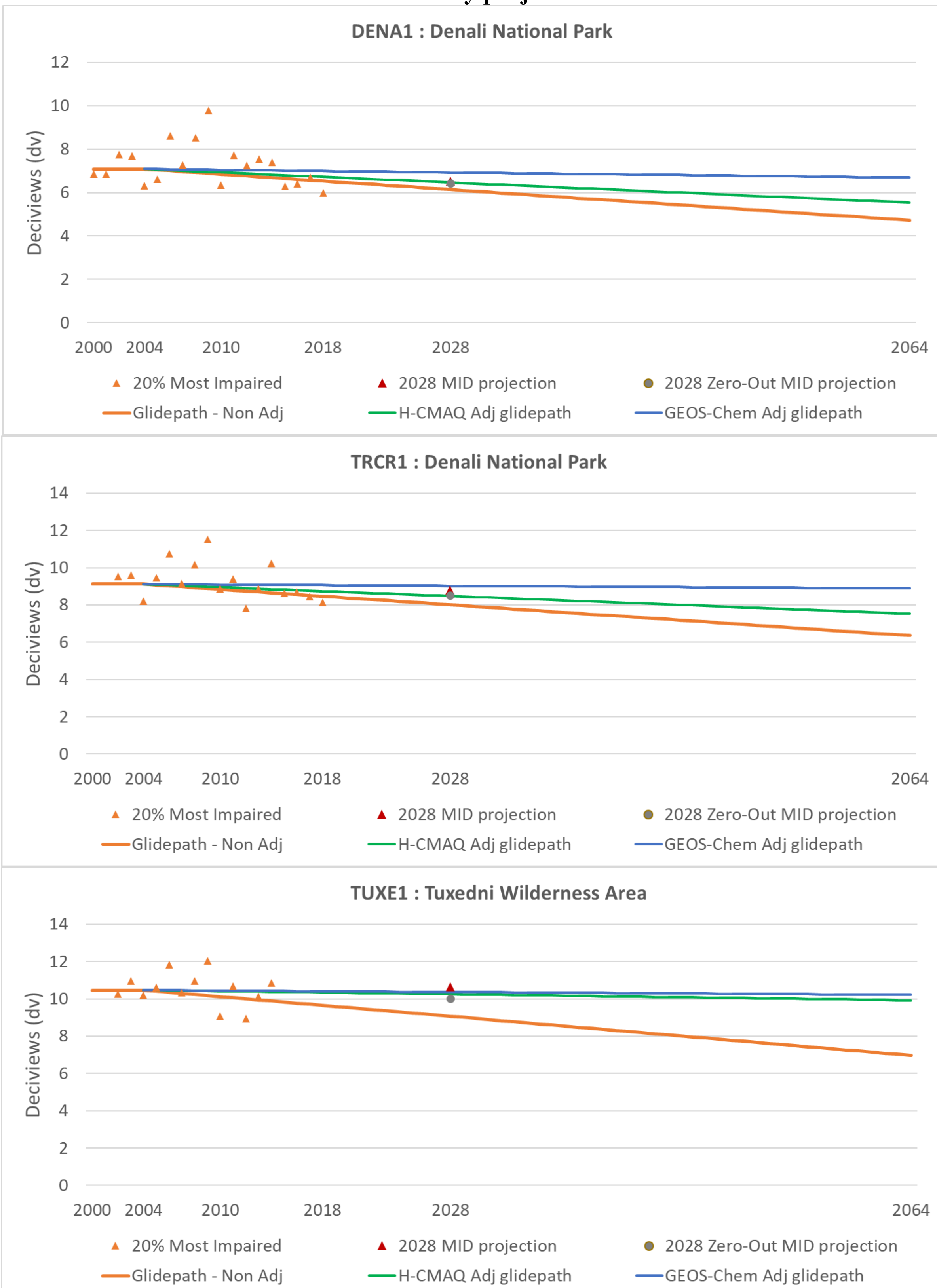
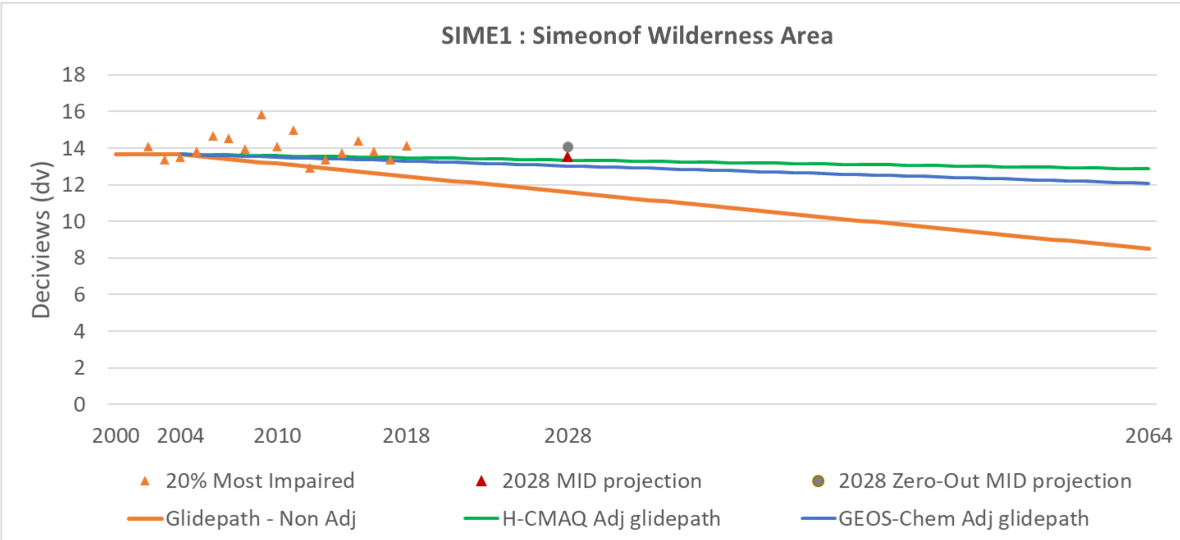
Figure III.K.13.I-2. Unadjusted and adjusted URP Glidepaths at each Class I area in Alaska and 2028 visibility projections for the MID.





Even when all U.S. anthropogenic emissions are eliminated, Alaska Class I areas see minimal visibility benefit. According to EPA's CMAQ modeling, Class I areas experience visibility disbenefit at SIME1 as indicated by the 2028 projected MID being higher. The visibility disbenefit is driven by different chemistry from lower SO_2 and NO_x emissions. The adjusted glidepath for TUXE1 and SIME1 are almost flat which signifies the importance of sources outside of the state control to visibility progress in Alaska Class I areas. Both glidepaths and the 2028 projections suggest that EPA's URP glidepath approach would not capture any efforts and success in reducing local emissions in Alaska.

EPA's URP glidepath approach was developed for use with Class I areas in the lower 48 states and has several issues when applied to Alaska as indicated above. Most importantly, it is the opinion of DEC that the IMPROVE MID approach is likely a flawed visibility impairment metric for Alaska since it potentially has a large component of natural $(NH_4)_2SO_4$ from volcanos and DMS. EPA's CMAQ modeling also did not include these important sources. Therefore, Alaska is also addressing the IMPROVE MID approach by screening out IMPROVE days with measured high $(NH_4)_2SO_4$ to account for volcano emission impacts in a similar way to how fire and dust contributions are screened out using carbon and crustal measurements as proxies. The adjusted URP glidepaths and RPGs were developed using the alternative MID with sulfur screening. The RPG on the 20% MID (taking into account what is believed to be natural-caused sulfate) is below the URP (taking into account international anthropogenic contributions) value for 2028. The sulfate-adjusted glidepaths and RPGs are presented in Appendix III.K.13.I.

Both the EPA and DEC sulfate-adjusted glidepaths show that the SIME1 monitoring station is above the adjusted glideslope (taking into account international anthropogenic contributions) in the last ten years indicating that the monitoring location has shown some level of visibility degradation over this period. It is the position of DEC that this degradation is likely a result of local marine emissions generated by commercial vessels utilizing international shipping routes which run south of the Simeonof Class I area. The only changes that could be implemented that would have any impact on visibility at the SIME1 monitoring station would be targeted at the maritime industry. As much of the visibility impairment is caused by emissions from foreign-flagged vessels utilizing international shipping routes to transit the Pacific Ocean, there is nothing that DEC can do as a state agency. Any impact on this industry would come via communications with, and policy implementation by the EPA through other governmental agencies such as the Department of State due to the treaty aspect of IMO agreements. As the IMO regulations have been in place since January 2020, the state can analyze 2020 and newer IMPROVE data and revisit the issue during the progress report due in 2025. State regulators can communicate visibility progress to the EPA, though the possibility of any form of treaty or otherwise international agreement changes to meet Alaska requests are limited. Beyond this, given the small size and limited footprint of local anthropogenic installations, there is nothing that the state can do further to improve visibility at SIME1.

5. CONCLUSION

This RPG and URP comparison for each Class I area indicates the emission reduction measures necessary to make reasonable progress for the planning period are covered by this SIP revision. The derived RPGs reflect control measures included in the long-term strategy and state and federal programs already in place as described in Section III.K.13.H. DEC determined that the rate of visibility improvement by the end of the second planning period, 2028, is reasonable. For all Class I areas in Alaska, the RPG on the 20% clearest days is below the baseline visibility condition, satisfying the RH Rule requirement of no degradation in visibility for the clearest days. The RPG on the 20% MID is below the URP (taking into account international anthropogenic contributions) value for 2028 at Denali National Park, but slightly above the URP at Simeonof Wilderness Area and Tuxedni National Wildlife Refuge. However, as indicated by the EPA's CMAQ results, even when all U.S. anthropogenic emissions are eliminated these Class I areas see little visibility benefit at TUXE1 and even experience visibility disbenefit at SIME1. Both CMAQ and GEOS-Chem modeling suggest significant contributions from the international anthropogenic emissions. The adjusted glidepaths are almost flat so would not signify any efforts and success in reducing local emissions in Alaska. The disbenefit in the 2028 modeling, excluding all Alaska emissions, as seen at Simenof is due to the sources that are contributing not being local and is therefore not an issue with the modeling.

Setting RPGs and maintaining a reasonable progress following the EPA's glidepath approach is a challenge for Alaska. Volcanic emissions potentially constitute a significant fraction of sulfate at TUXE1 and SIME1 (see Section III.K.13.G WEP Analysis). The inclusion of DMS and volcanic emissions in the visibility degradation as well as international contributions in the glidepaths causes a plateauing of the visibility progress needed at these two sites. There is nothing that DEC can do to impact or control either category of these emissions. Given the likely presence of significant natural sulfur emissions that are highly variable and relatively small local anthropogenic emissions in the area, the concept of glidepath may not be appropriate for Simeonof Wilderness Area and Tuxedni National Wildlife Refuge. While sulfate screening within the 95th percentile threshold helps remove extreme volcano events, bringing 2028 projections closer to the unadjusted glidepath, it cannot effectively account for all contributions of volcano sulfate impacts from persistent degassing activities. Alaska will continue working with EPA to further identify and quantify the contribution of these natural sources of visibility impairment. Some other key considerations in setting and maintaining RPGs are noted below:

- Simeonof Wilderness Area (SIME1): Meeting the RPG for the Simeonof Class I area will largely fall outside of the ability of state regulators, as there are few stationary sources with limited size located near the Class I area that can be controlled. There are no targeted reductions for sources under DEC jurisdiction which would result in the meeting of the RPG. Most anthropogenic pollution that affects visibility at Simeonof has been generated by international marine shipping utilizing major shipping routes located nearby. DEC will monitor visibility improvements over the second implementation period to observe whether the recent IMO low-sulfur marine fuel regulations promulgated January 2020 result in visibility improvements to meet state goals.

  Should IMO low-sulfur marine fuel regulations not result in the needed reductions to meet yearly progress goals between 2018 and 2028, DEC will revisit these goals during the progress report in 2025.

- Tuxedni National Wildlife Refuge (TUXE1 and KPBO1): The largest category of anthropogenically-generated impairment came from the oil and gas sector. DEC's proposed concept of a RH-VPA (see Section III.K.13.H.2.B) and increased permit program reporting and application requirements could assist in monitoring all new projects and ensure no significant degradation of visibility at the TUXE1 or KPBO1 monitoring sites. Together with the IMO low-sulfur marine fuel regulations, it is expected that visibility improvements at this Class I area will meet the RPG.

  DEC has determined to treat the new KPBO1 and TUXE1 sites as different sites and not as a continuation. At present, the state and EPA lack the necessary four years of data to accurately construct a visibility baseline or glideslope for the KPBO1 monitoring site. There is also an insufficient number of years at KPBO1 to apply the statistical technique to estimate the 20% MID. This will be rectified in the progress report, when enough data will be made available for state regulators to effectively calculate a new URP and glideslope for the KPBO1 monitor. It is likely that the progress goals will be changed at that time to meet the adjusted URP for the monitoring location.

- Denali National Park (DENA1 and TRCR1): DEC will work within its air quality division, and specifically its permitting program, to monitor all new projects and ensure no significant degradation of visibility at DENA1 and TRCR1. While this does not directly produce emissions reductions, it is a mechanism to ensure continued monitoring of new projects and tracking of potential visibility impacts from industry efforts. In addition, the TRCR1 monitoring site does register a small amount of visibility impairment which could be the result of marine emissions from Cook Inlet and more distantly from the Gulf of Alaska. DEC expects some visibility improvement at TRCR1 as a result of IMO low-sulfur marine fuel regulations. DENA1 site may see some benefits from emission reductions to address $PM_{2.5}$ attainment in the Fairbanks North Star Borough (FNSB) nonattainment area.

- Bering Sea National Wildlife Refuge: Due to the absence of monitoring data for this Class I area, DEC has neither a baseline nor a glideslope or yearly data by which to set the RPG.

III.K.13.J PROGRESS REPORT

Title 40 CFR §51.308(f)(5) requires states to submit a progress report to EPA every five years that evaluates progress towards the RPGs. The last progress report was submitted in the first implementation period in 2015. The RH SIP due in 2021 will also serve as a progress report addressing the period since submission of the progress report for the first implementation period. At a minimum, the progress reports must contain the elements in 40 CFR 51.308(g)(1) through (5) for each Class I area as summarized below:

(1) Implementation Status of the Current SIP Measures
(2) Emissions Reductions Due to Ongoing Air Pollution Programs
(3) Visibility conditions and changes
(4) Analysis tracking changes in emissions since the most recent RH SIP revisions
(5) Assessment of any significant changes in anthropogenic emissions on progress

1. IMPLEMENTATION STATUS OF THE CURRENT SIP MEASURES

40 CFR §51.308(g)(1) requires "a description of the status of implementation of all measures included in the implementation plan for achieving reasonable progress goals for Class I areas both within and outside the state." Several existing air pollution programs contribute to visibility improvements in the state's Class I areas; some are state programs and others are federal requirements. Section III.K.13.H Long-Term Strategy for Regional Haze provides a description of air control measures to reduce emission within the state. Some of these measures are summarized below:

- All facilities within the state which have BART requirements from the first implementation period will continue to have these requirements in place until final emissions unit retirement has been registered with the state. As a result, BART remains a functional part of the state's long-term strategy as it applies to specific stationary sources;

- The PSD/NSR rules protect visibility in Class I areas from new industrial sources and major changes to existing sources;

- Implementation of programs to meet $PM_{2.5}$ NAAQS as a part of the "Serious" nonattainment designation for 24-hour $PM_{2.5}$ NAAQS in Fairbanks;

- Alaska open-burning regulations; and

- International Marine Organization low-sulfur marine diesel regulation and the North America Emissions Control Area.

Uncontrollable emissions sources contribute to the atmospheric mix of visibility-impairing pollutants as well as those produced by anthropogenic sources in Alaska; all are detected but not differentiated by the IMPROVE monitoring data. The fact that uncontrollable natural and anthropogenic sources outside of the United States affect visibility is not neglected in the analysis presented in this RH SIP.

2. EMISSIONS REDUCTIONS DUE TO ONGOING AIR POLLUTION PROGRAMS

40 CFR §51.308(g)(2) requires "a summary of the emissions reductions achieved throughout the state through implementation of the measures described in (g)(1)". Anthropogenic emissions in Alaska have been decreasing since 2014, but it is not certain if the reductions are due to the RH SIP progress goals. Annual emissions from point sources (2014 and 2017 data include nonpoint data) submitted to EPA in the yearly and triennial NEI demonstrate that the measures are contributing to overall emission reductions (Table III.K.13.J-1). Some of the emission reductions may be due to the economic recession which began in 2016 and population migration loss.[1] However, some reductions are likely due to reduced operations at facilities and use of low sulfur-content fuel. DEC continues to track source or emission unit retirements and changes at point sources through its permit program. Emission reductions from these changes have not been calculated on an annual basis.

Table III.K.13.J-1. Annual Alaska national inventory emissions (2014 to 2019).

Year	CO	NO_x	VOC	SO_2	PM_{10}	$PM_{2.5}$
2014*	30,000	61,272	4,222	5,354	2,966	2,288
2015	27,633	61,489	6,095	4,392	2,907	1,755
2016	7319	38,013	1714	1,565	1,374	292
2017*	12,814	54,135	3,842	3,794	2,494	821
2018	6,543	36,020	1,743	1,642	947	241
2019	6,953	37.122	1,633	1,825	1,003	245

* Triennial Emission Inventory years which tend to be higher than other years due to the reporting of small sources and nonpoint sources.

A. Electrical Grid

Among the largest changes to the anthropogenic emissions footprint within the state includes the refit of George Sullivan Plant 2 in Anchorage, which is one of the largest electrical generators in the state. It has new natural gas-fired generators which generate electricity more efficiently and have up-to-date mechanical emissions controls installed. The Beluga River Power Plant, owned and operated by Chugach Electric, has been maintained in stand-by mode over the last five years to provide additional power generation capacity for the electrical grid in Southcentral Alaska. The Eklutna Generating Station has been brought online to provide power generation capacity for the Matanuska Electric Association. It uses natural gas-fired turbines which have updated mechanical

[1] February 2021 Alaska Economic Trends, Alaska Department of Workforce and Economic Development. https://labor.alaska.gov/trends/feb21.pdf

controls installed. Its activation further reduces grid reliance on older power generators to provide excess capacity during periods of increased demand.

B. Oil and Gas Industry

Given market factors and field maturation in the Prudhoe Bay region, oil extraction has plateaued below a half-million barrels per day and was significantly curtailed during the first months of 2020 due to market conditions caused in part by COVID-19 pandemic. For more information about this industry and potential future growth, see Section III.K.13.H.

C. Low-Sulfur Fuel Use and Maritime Industry Adoption

In the intervening years since the promulgation of the first RH SIP, regulations concerning the sale and burning of ULSD by stationary and mobile sources have come into effect. Maritime sources have similar regulations as per the ECA. This has resulted in a reduction of sector sulfur dioxide in areas where ECA sulfur requirements apply.

3. ASSESSMENT OF CLASS I AREAS

40 CFR §51.308(g)(3) requires "a summary of for each Class I area within the state, the state must assess the following visibility conditions and changes, with values for most impaired, least impaired and/or clearest days as applicable expressed in terms of five-year averages of these annual values." This section requires the report to include deciview values for three separate time periods: "current visibility conditions," "baseline visibility conditions (2000-2004)," and "the past 5 years." Current visibility conditions" includes the most recent quality assured public data available at the time the state submits its 5-year progress report which is 2014-2018 in this RH SIP. The year associated with the "past 5 years" is the year 5 years previous to the year used for "current visibility conditions." (i.e., 2009-2013).

Visibility baseline and current conditions are reported in Section III.K.13.D: Assessment of Ambient Data for Class I Areas. The section describes assessment of baseline (2000-2004), past 5 years (2009-2013), and current conditions (2014-2018) for most impaired and clearest days as summarized in Table III.K.13.J-2 and Table III.K.13.J-3 below. Comparison between the current and past 5 years' visibility conditions demonstrates visibility improvement for most impaired and clearest days at all Alaska IMPROVE sites. Note that the last year of TUXE1 IMPROVE data was 2014; therefore, years 2010-2014 comprise the current period for the TUXE1 site in this RH SIP.

Table III.K.13.J-2. Summary of baseline, past 5 years, and current visibility conditions (dv) on the most impaired days.

Class I Area	IMPROVE ID	Baseline (2000-2004)	Past 5 years (2009-2013)	Current (2014-2018)	Deciview Change between Current and Past 5 years	Improvement: YES/NO?
Denali National Park	TRCR1	9.1	9.3	8.8	-0.5	YES
	DENA1	7.1	7.7	6.6	-1.2	YES
Tuxedni Wilderness Area	TUXE1	10.5	10.6*	10.0*	-0.6	YES
	KPBO1**	n/a	n/a	n/a	n/a	n/a
Simeonof Wilderness Area	SIME1	13.7	14.3	13.9	-0.4	YES

*Since TUXE1 ceased operation after 2014, 3-year average is used instead. Current Period for TUXE1 IMPROVE site is 2012-2014 and Past Period is 2009-2011.
** First full year of KPBO1 IMPROVE site operation was 2016

Table III.K.13.J-3. Summary of baseline, past 5 years, and current visibility conditions (dv) on the clearest days.

Class I Area	IMPROVE ID	Baseline (2000-2004)	Past 5 years (2009-2013)	Current (2014-2018)	Deciview Change between Current and Past 5 years	Improvement: YES/NO?
Denali National Park	TRCR1	3.5	3.8	3.4	-0.5	YES
	DENA1	2.4	2.5	2.2	-0.4	YES
Tuxedni Wilderness Area	TUXE1	4.0	4.2	3.8	-0.4	YES
	KPBO1	n/a	n/a	6.0	n/a	n/a
Simeonof Wilderness Area	SIME1	7.6	7.9	7.7	-0.2	YES

4. ANALYSIS OF CHANGE (2013-2018) - STATE SOURCES AND ACTIVITIES

40 CFR §51.308(g)(4) requires analysis tracking of the change over the period since the 2009 and 2014 RH SIP revisions, emissions of pollutants contributing to visibility impairment from all sources and activities within the state, and emissions changes identified by type of source or activity.

Analysis of changes to state mobile and stationary sources and other activities is based on state triennial NEI reporting. Three complete inventories are used to analyze changes to the state emissions profile during the last decade: 2011, 2014, and 2017. The 2017 inventory is the last complete inventory available for emissions analysis at present[2]. Emissions are broken out by source sector as defined in the NEI.

A. Analysis of State Emissions Trends: 2011, 2014, 2017

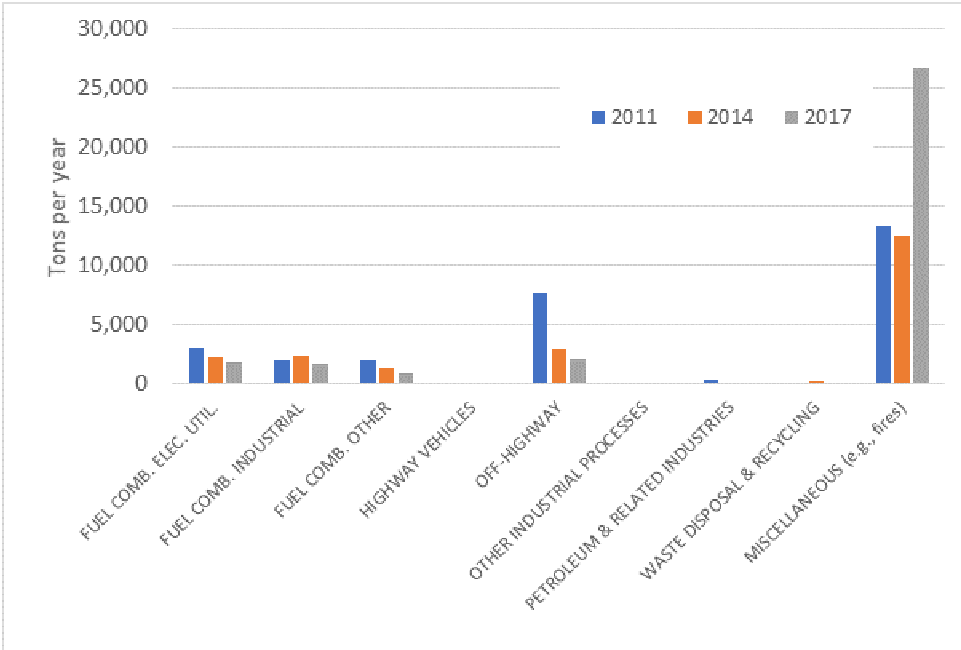
Emission trends are shown for SO_2 and $PM_{2.5}$ since the largest contributors to visibility at Alaska IMPROVE monitors are sulfate and OMC. As evidenced in Figure III.K.13.J-1 and Figure III.K.13.J-2, the largest single category for both pollutants reported to EPA in the state triennial NEI all three years is the miscellaneous category which encompasses both prescribed fires and wildfire activity within the state. All other categories were small by comparison. Off-highway (including commercial marine vessels) contributes to SO_2 emissions as a second largest category, and emissions from this sector have declined significantly in 2017 from 2011. Other sources of visibility impairment include the oil and gas industry, which are categorized as fuel-combustion industrial. Other industrial processes in the NEI also show downward emission trends of SO_2 and $PM_{2.5}$.

Because the miscellaneous fire category covers both prescribed fires and wildfires, only a limited window of emissions is controllable by any form of state regulations. More information about ongoing prescribed fires and human-caused fire trends are presented below.

[2] Alaska's residential wood combustion emissions appear to have errors in the 2017 NEI. For the trend analysis purpose, the EPA's 2016 residential wood combustion emissions are used for 2017.

Figure III.K.13.J-1. Emissions trends of SO_2: 2011, 2014, and 2017 NEI.

Including Miscellaneous Category



Excluding Miscellaneous Category

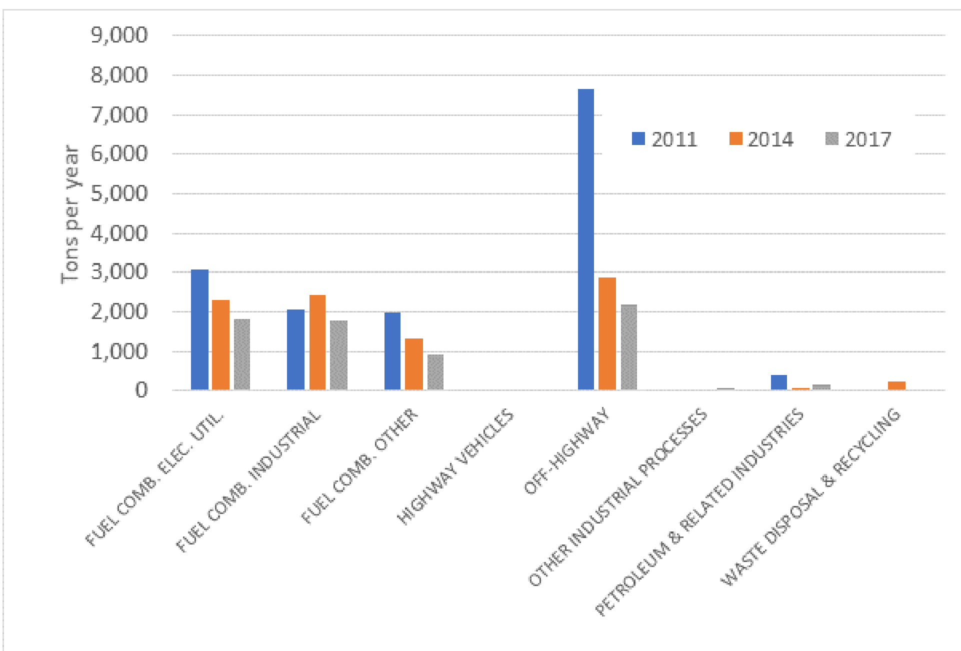
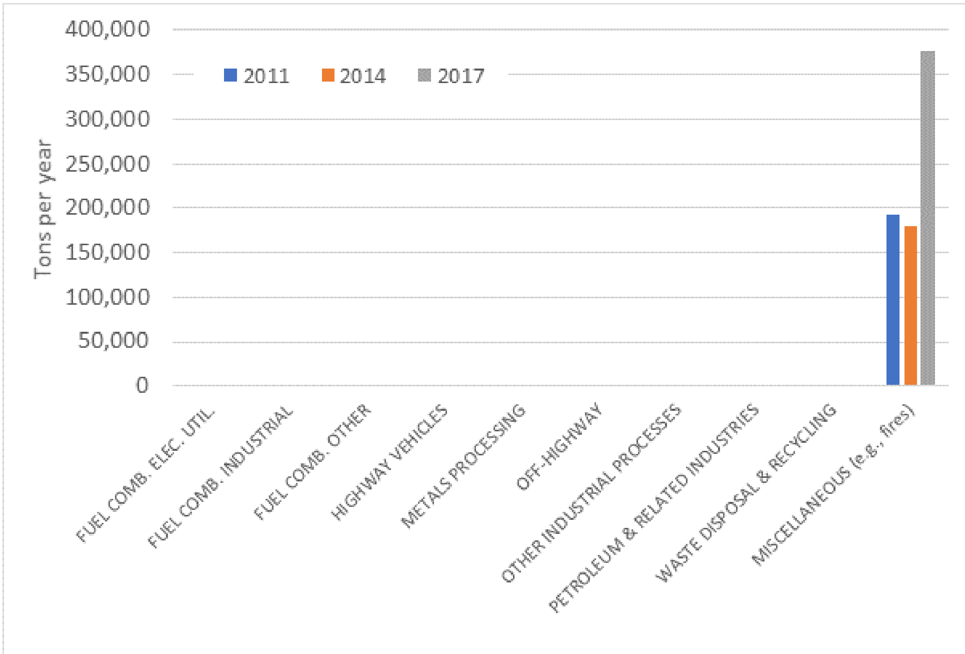
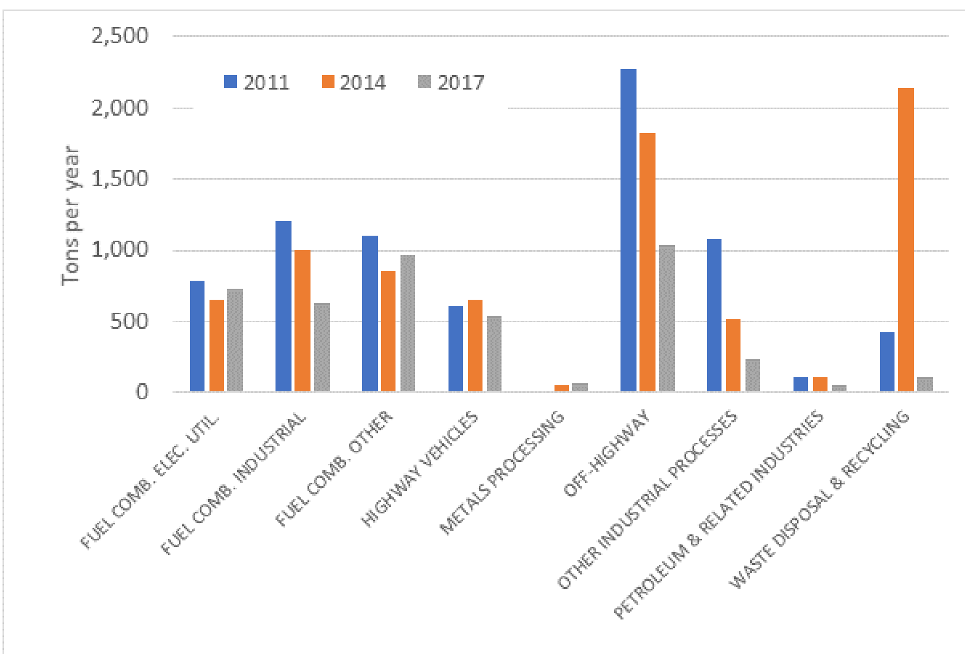


Figure III.K.13.J-2. Emissions trends of $PM_{2.5}$: 2011, 2014, and 2017 NEI.

Including Miscellaneous Category



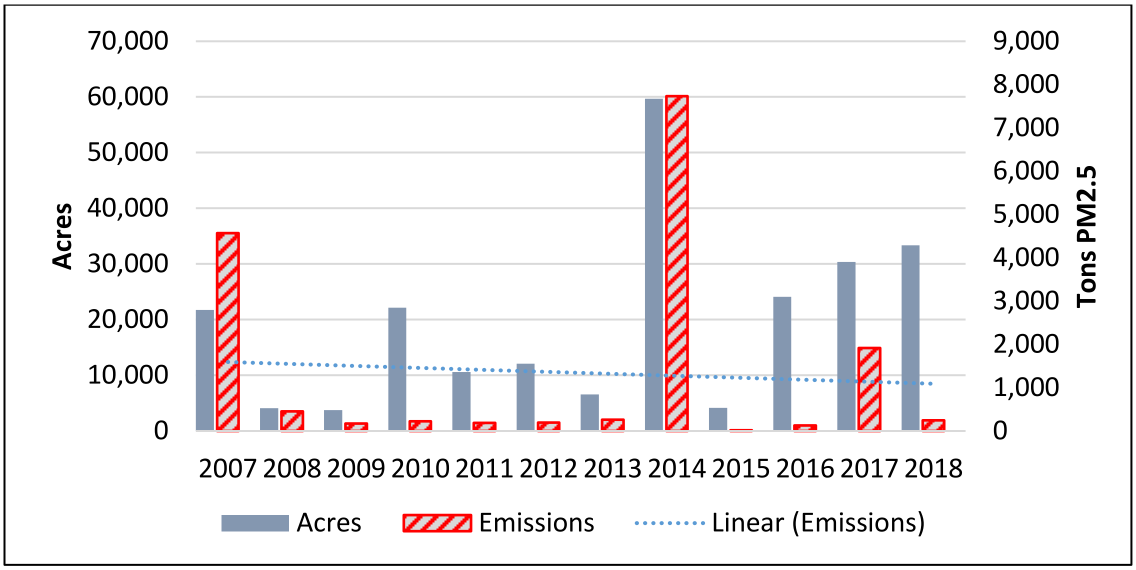
Excluding Miscellaneous Category



B. Prescribed Fires

The number of prescribed fires permitted by DEC with the Open Burn Permit approval is consistent from year to year, and generally they average approximately 20 permits annually. The acreage burned by prescribed fires is steadily growing, and in 2017, one prescribed fire was over 29,000 acres (Figure III.K.13.J-3). There are other categories of fires that are permitted by the Alaska Department of Natural Resources (DNR) under large scale burn permits. These have generally not been tracked over the years but will be included in the 2020 NEI and in the next progress report. DNR issues permits for land clearing, agricultural burning, and other purposes where DEC does not issue permits (fires less than 40 acres in size). Since DEC issues permits for prescribed fires over 40 acres in size within a calendar year, it is not clear how the emissions will change.

Figure III.K.13.J-3. Prescribed fires acres and emissions.



i. Human-Caused Fires

The number of human-caused fires has decreased since 2000, and in the last five years, this trend has continued (Figure III.K.13.J-4). The acreage burned resulting from human caused fires has increased slightly (Figure III.K.13.J-5). The acreage increases are likely due to climatic changes where we have warmer summers and less rainfall. This is also mirrored in the wildfire trends.

In reviewing the data provided by AICC, there are some inconsistencies and completeness problems where some fires under investigation are never resolved and data is missing.

Figure III.K.13.J-4.

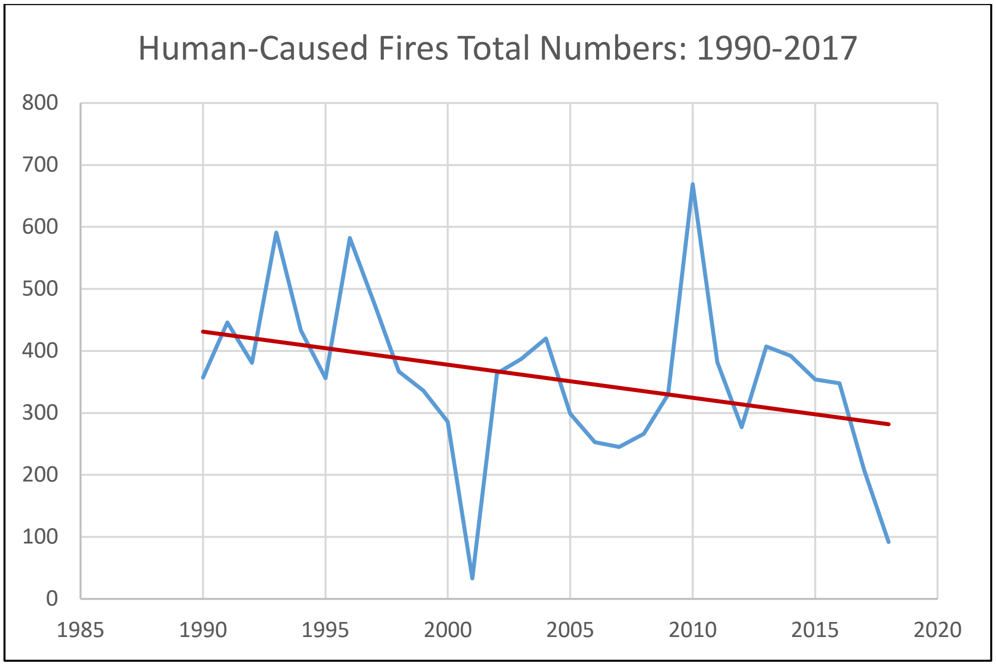
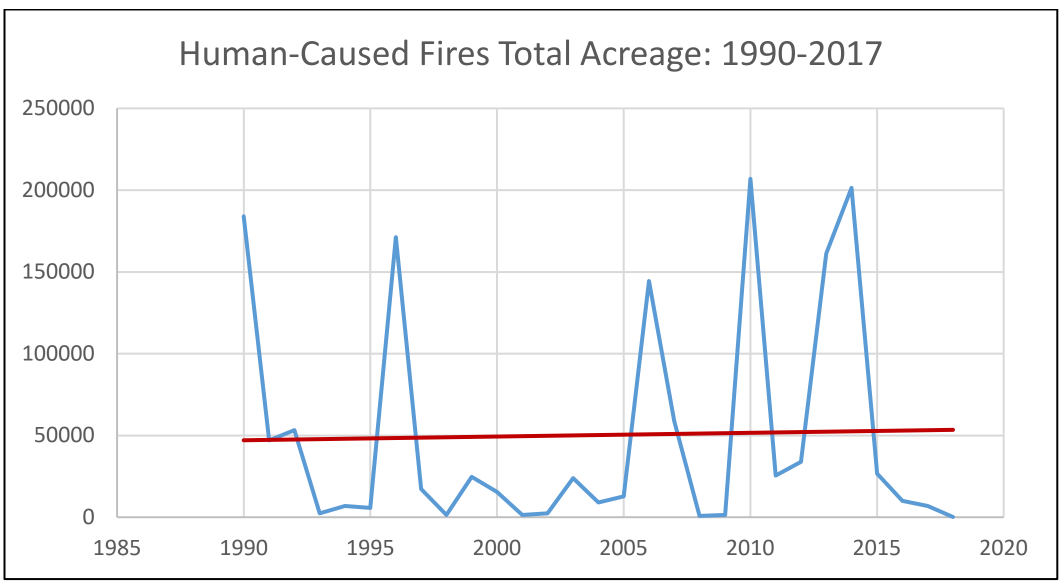


Figure III.K.13.J-5.



5. ASSESSMENT OF ANY SIGNIFICANT CHANGES IN ANTHROPOGENIC EMISSIONS

40 CFR §51.308(g)(5) requires assessment of any significant changes in anthropogenic emissions within or outside the state that have occurred since the period addressed in the most recent plan required under paragraph (f) of this section, including whether or not these changes in anthropogenic emissions were anticipated in that most recent plan and whether they have limited or impeded progress in reducing pollutant emissions and improving visibility.

In the five years since promulgation of the last progress report in 2015, progress on meeting permitting stipulations and requirements under the BART and Healy Power Plant Consent Decree appear to meet state obligations. At present, there have been no FLM requests to analyze any stationary sources under RAVI stipulations in the 1999 RH Rule. All BART stipulations continue to remain in place on sources subject to BART controls. At present, only the Healy Power Plant has BART stipulations in effect which were brought under the Consent Decree between GVEA and the EPA. Permitting stipulations for emissions controls and best practices appear to be working as intended.

The largest changes that will take place between the writing of this RH SIP and the next progress report will be at the Healy Power Plant and Fort Wainwright CHPP. The Fort Wainwright privatized CHPP is in the process of identifying a suitable replacement for its four coal-fired boilers that have been in use since 1953. The Fort Wainwright EIS identified several alternatives to the current generators, including new coal-fired boilers and distributed natural gas boilers to provide heating and power for the base. Facility managers will have completed the EIS process and either begun construction of replacement CHPP or fully retrofitted the existing CHPP with sulfur controls by the time of the next progress report.

The Healy Power Plant, owned and operated by GVEA, is bound under the terms of the Consent Decree with the EPA regarding emissions controls. GVEA will need to either install SCR controls on Unit 2 or shut it down, with a decision mandated to occur by December 31, 2022. Final shut-down or control installation is scheduled for December 31, 2024. Both deadlines occur prior to the promulgation of the next progress report. Visibility impact of either option will not be readily available, though will be measurable, at the time of the next RH SIP in 2028.

6. ASSESSMENT OF THE CURRENT SIP SUFFICIENCY TO MEET REASONABLE PROGRESS GOALS

The RH SIP in place appears to sufficiently meet the state progress goals at present with ongoing visibility improvement at all IMPROVE monitors. Stationary sources have installed requisite emissions control technology as requested under permitting stipulations and as part of ongoing modernization efforts at stationary sources. The best example of this has been the refit of the George Sullivan Plant, where a formerly BART eligible emissions unit was shut down and a new unit with up-to-date controls were installed. Healy Power Plant has installed SNCR controls onto Unit 1, which meets its obligations under the Consent Decree with the EPA. This does fall outside of the scope of the Alaska RH SIP, as it is an agreement between GVEA and the EPA and does not involve DEC participation.

At present, though, DEC lacks the modeling tools to quantify how all the control stipulations in the RH SIP are contributing to visibility improvement. In addition, the State of Alaska has been in an ongoing economic recession for much of the last decade due to economic challenges and competitiveness of the state oil and gas industry. This has resulted in a reduction in emissions within the state from several categories of emissions, including transportation and electrical generation. The population of the state has gone down by nearly twenty-thousand people in the last half-decade. While DEC cannot fully identify the reasons for visibility improvement at present, the agency views the measures taken in this plan as adequate to maintain visibility progress moving into the second planning period.

The RH Rule amendments changed the schedule for the five-year reports from states to the EPA. For this second planning period only, the five-year report is required by 40 CFR §51.308(g) to be submitted by July 31, 2025. The five-year report will be examined by the EPA, but the EPA will not formally approve or disapprove it. In the future, the RH SIP process will not be required for the five-year report, but FLM consultation and public comments will still be required.

III.K.13.K STATE, TRIBE, AND FEDERAL LAND MANAGER CONSULTATION

1. INTRODUCTION

In accordance with the RH Rule, in developing the RH SIP and in future revisions to the RH SIP, DEC coordinates and consults with federal land managers (FLMs), tribes, and other states. DEC also provides opportunities for public participation and review of the SIP prior to its adoption and submittal to EPA. Requirements related to these consultation and outreach activities along with DEC's efforts to meet the requirements for the initial RH SIP are discussed in greater detail in the following sub-sections.

2. FEDERAL LAND MANAGERS CONSULTATION

40 CFR §51.308(i) of the RH Rule requires coordination between states and the FLMs. During the development of this plan, the FLMs were consulted in accordance with the provisions of 51.308(i)(2).

DEC has provided several opportunities for coordination and consultation with FLMs during the writing of this plan. This included the ability to review technical documentation and analyses developed by DEC contractors (Ramboll) and the WRAP. In the two years preceding submittal, DEC has hosted six formal consultations with FLMs. These included two meetings in July 2020 with individual agencies to discuss marine emissions and impacts on non-Class I Areas and a meeting with NPS to discuss the status of the Healy Power Plant.

The State of Alaska has provided an opportunity for FLM consultation, at least 120 days prior to holding any public hearing on the SIP with the general public. An agreement reached between DEC and FLMs allowed for a shorter 60-day window for SIP review and comment submission, rather than the full 120-day review period. This was based on DEC's ongoing engagement with all interested FLMs and federal agencies on SIP development since December 2019. This sixteen-month window of engagement with FLMs included eight official meetings between DEC staff and FLMs. This early engagement allowed FLMs, as well as the EPA, to provide substantive comments on DEC's approach and strategy for the Second Planning Period throughout the SIP writing process. This early engagement allowed DEC and FLMs to agree on a condensed window for comments and engagement on the pre-public notice version of the draft SIP.

This SIP was submitted to the FLMs in draft form on May 27, 2021, for review and comment. Comments were received from the NPS and FWS by July 27, 2021, when the window for FLM comments was closed; additionally, separate initial comments were received from EPA as part of the SIP-PIP process between the agency and states. As required by 40 CFR Section 51.308(i)(3), the FLM comments and State responses are included in Appendix III.K.13.K to this plan.

40 CFR Sections 51.308(f)-(h) establish requirements and timeframes for states to submit periodic RH SIP revisions and progress reports that evaluate progress toward the reasonable progress goal for each Class I area to EPA. As required by 40 CFR Section 51.308(i)(4), DEC

will continue to coordinate and consult with the FLMs during the development of these future progress reports and plan revisions, as well as during the implementation of programs having the potential to contribute to visibility impairment in mandatory Class I areas. This consultation process shall provide on-going and timely opportunities to address the status of the control programs identified in this SIP, the development of future assessments of sources and impacts, and the development of additional control programs. In particular, DEC commits to the following consultation requirements:

- DEC will provide the FLMs an opportunity to review and comment on RH SIP revisions, the five-year progress reports, and other developing programs that may contribute to Class I visibility impairment.

- DEC will afford the FLMs an opportunity for consultation at least 120 days prior to holding any public hearing on an RH SIP revision. The FLM consultation must include the opportunity to discuss their assessment of visibility impairment in each federal Class I area and to provide recommendations on the reasonable progress goals and on the development and implementation of the visibility control strategies. DEC will include a summary of how it addressed the FLM comments in the revised RH SIP.

3. TRIBAL CONSULTATION

For its SIP planning, DEC has kept in contact with participants in the Alaska Tribal Air Workgroup and will continue to remain in contact with those tribes which are near Alaska's Class I areas. Presentations and workshops will be offered for interested tribal environmental officers or other persons interested in the state regional haze planning process. DEC has conducted one public presentation on the planning process on December 16, 2020, during the Alaska Tribal Conference for Environmental Managers (ATCEM). It was held remotely due to COVID-19 and involved a 45-minute presentation along with fifteen minutes for questions and comments. Documentation of DEC's coordination and consultation with tribes will be maintained and included in Appendix III.K.13.K. EPA bears a trust responsibility to the federally recognized tribal governments in Alaska. As a result, Alaskan tribes also have an opportunity for consultation with EPA on this plan through the federal approval process.

4. INTER-STATE CONSULTATION

40 CFR §51.308(f)(2)(ii) requires states to consult with those other states that have emissions that are reasonably anticipated to contribute to visibility impairment in the same Class I area or areas, in order to develop coordinated emission management strategies for making reasonable progress. DEC has not identified any other state that is impacting Alaska's Class I areas, and Alaska has not been identified as a contributor to impacts in other states' Class I areas. Therefore, the subparagraphs A, B, and C of 40 CFR 51.308(f)(2)(ii) do not apply to Alaska.

However, in accordance with 40 CFR 51.308(f)(2)(ii), DEC commits to continue consultation with states which may reasonably be anticipated to cause or contribute to visibility impairment in federal Class I areas located within Alaska. DEC will also continue consultation with any state for which Alaska's emissions may reasonable be anticipated to cause or contribute to visibility impairment in that state's federal Class I areas.

With regards to the established or updated goal for reasonable progress, should disagreement arise between another state or group of states, DEC will describe the actions taken to resolve the disagreement in future RH SIP revisions for EPA's consideration. With regards to assessing or updating long-term strategies, DEC commits to coordinate its emission management strategies with any affected states and will continue to include in its future RH SIP revisions all measures necessary to obtain its share of emissions reductions for meeting progress goals should they be required.

5. REGIONAL PLANNING COORDINATION

To meet the requirements of 40 CFR §51.308(f)(2)(ii) and (iii), DEC commits to continued participation in the WRAP and its regional haze committees and commits to coordinate future revisions with other WRAP member states in addressing regional haze. As part of this commitment, DEC will include the following in future RH SIP revisions.

- Demonstration of on-going WRAP participation and commitment for continue participation in addressing regional haze.

- Description of the regional planning process, including the list of member states, goals, objectives, management, decision making structure, established product deadlines, and schedule for adopting RH SIP revisions implementing WRAP's recommendations.

- Showing of inter-state visibility impairment in federal Class I areas based on available inventory, monitoring, or modeling information.

- As applicable, address fully the recommendations of WRAP, including Alaska's apportionment of emission reduction obligations as agreed upon through WRAP and the resulting control measures required.

A summary of WRAP-sponsored work groups DEC participated in is provided in Appendix III.K.13.K. Additional information on WRAP regional haze activities and meetings is available on the WRAP regional haze website: https://www.wrapair2.org/reghaze.aspx.

6. PUBLIC PARTICIPATION AND REVIEW PROCESS

Section 110(a) of the CAA requires that a state provide reasonable notice and public hearings of SIP revisions prior to their adoption and submission to EPA. In addition to the open public meetings of the WRAP process, the state administrative process for adoption of regulation ensures that the public has adequate opportunity to comment on this RH SIP. During the development of this SIP, DEC has received comments on the planning process from an interested stakeholder non-governmental organization (NGO) and conducted a web presentation in June 2020 to present basic information on haze strategy for the Second Planning Period. This plan was provided to the public for review on March 30, 2022, to allow interested members of the public and NGOs to provide comments on the plan and its stipulations. Details on the comment period, comments received, and responses will be provided in Appendix III.K.13.K (comments and responses will be added to the final appendix document after the comment period closes). There is another opportunity for public comment during the EPA approval process on the state's submitted plan.